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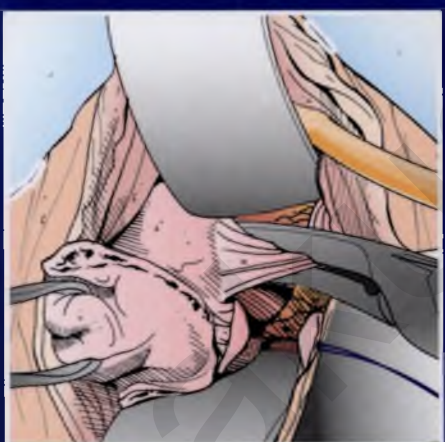
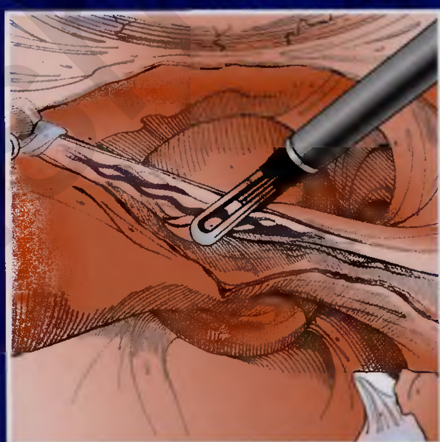
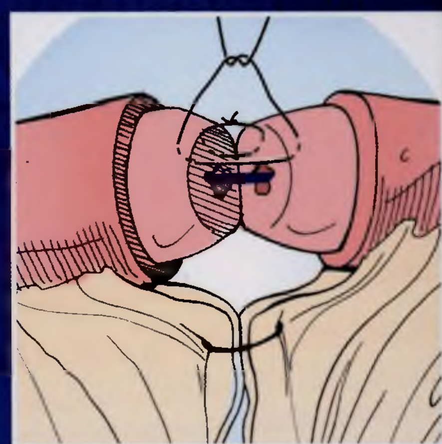
Te Linde's Atlas of GYNECOLOGIC SURGERY







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Wolters Kluwer Health | Lippincott Williams & Wilkins

Te Linde's Atlas of Gynecologic Surgery

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To Cindy, Ashlee, Jonathon, and Mallory—for their unwavering love and support.
Ricardo Azziz

To my family—Michelle, Jackson, Chloe, and Haley—for your love, patience, inspiration, and support.
Robert E. Bristow

To the women who have brought meaning and joy to my life, including my patients, my colleagues, my mother, Peggy, daughters, Victoria and Adreanna, and most importantly, my wife, Valerie.
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PREFACE

Gynecology has always been a surgical specialty, yet the breadth and complexity of gynecologic surgery continues to expand. The complex three-dimensional nature of pelvic anatomy and distinctive opportunity for multiple surgical approaches challenge the surgeon who is seeking to master the full breadth of the specialty. Add novel techniques and technologies of recent years, and the challenge grows. Faced with this challenge, both the gynecologist-in-training and those already in practice can benefit from readily accessible visual tools that assist them in achieving mastery of their field. This is the goal of *Te Linde's Atlas of Gynecologic Surgery.*

Achieving quality and patient-centered care requires a surgeon to be flexible in utilizing the surgical technique and approach that will best meet the patient's needs. Of course, no surgical technique should be offered until there is adequate evidence of both safety and efficacy, as a patient cannot make an informed choice in the absence of such data. All of the techniques described in this text have ample evidence of safety and efficacy, although this evidence is not presented. The reader is referred to the seminal text *Te Linde's Operative Gynecology*, which this atlas complements, for a more extensive discussion of the development, considerations, pros and cons, and risks and benefits of these procedures.

Instead, in this atlas we have aimed to provide a clear and detailed description of the steps involved in performing the procedures. To assist the readers in their comprehension, the prose is accompanied by meticulously accurate drawings. These illustrations are rendered in an accessible style with color to maximize the surgeons' understanding. Many chapters also have narrated videos to provide further context for the reader.

Whether this text is used to complement the descriptions and discussions presented in *Te Linde's Operative Gynecology*, or used as an initial introduction to a new surgical technique, or as a method to prepare prior to carrying out a procedure not commonly performed, we hope that this surgical atlas will become an invaluable tool for all surgeons treating women.

ACKNOWLEDGMENTS

No project of this kind can be solely attributed to the authors, or even the practitioners who kindly contributed to its writing. Rather, these feats are the result of the efforts of many. And this text is no different.

Firstly, we should acknowledge the work of our colleagues who contributed to text, including Dr. Roxana Geoffrion, Dr. Melinda Henne, Dr. Darren Lazare, Dr. Jonathon Solnik, and Dr. Frank Tu. We are also indebted to Jennifer Smith, whose considerable artistic skill allowed us to illustrate that which is hard to see with the naked eye. And to Chris Merillo, at Biomedia Communications, for ensuring excellent videos and voice-overs to complement the text and Jennifer's drawings.

Secondly, we must acknowledge the many editorial staff members who made an effort to assist within the vagaries and ever-present changes of today's publishing world. Beginning with Sonya Seigafuse, Nicole Walz, and Mark Flanders, and continuing with Rebecca Gaertner, Senior Acquisitions Editor, Wolters Kluwer Health—Lippincott Williams & Wilkins, and Ashley Fischer, who we had the pleasure of seeing develop from Editorial Assistant to Product Manager for Medical Practice during the rather lengthy production of this multifaceted project. We are also indebted to the efforts of Louise Bierig, Developmental Editor, who worked diligently to ensure the project kept moving forward. From an editorial point of view, this complex project certainly took a village!

Thirdly, we would like to acknowledge the patience and support of our own office staff, who facilitated the innumerable revisions and helped to coordinate the myriad disparate pieces of the whole, including Marlies Wagner, Sue Barber, and Tariq Leslie assisting Dr. Cundiff, and Lois Dollar, Jim Morrow, and Laura Sherrouse assisting Dr. Azziz.

Fourthly, we all recognize that our expertise as surgeons arises from the patient and dedicated efforts of our many surgical mentors and teachers, including Drs. John A. Rock, Alfred E. Bent, W. Allen Addison, Rick Bump, and Rick Montz. And no less, we are eternally grateful for the trust of those many patients who allowed us to care for them, providing us with a rich experience that we now share with the reader, as our patients are truly the drive, passion, and purpose behind this text.

And we rightfully should recognize the unwavering support and encouragement of our families, without whose care and support during the production of this text its reality would have been an impossibility.

Finally, we would like to acknowledge you, the reader, for caring enough about your patients to expand your understanding and hone your skills, and for being willing to lead in the surgical care of women, now and in the future.

Goeffrey W. Cundiff
Ricardo Azziz
Robert E. Bristow

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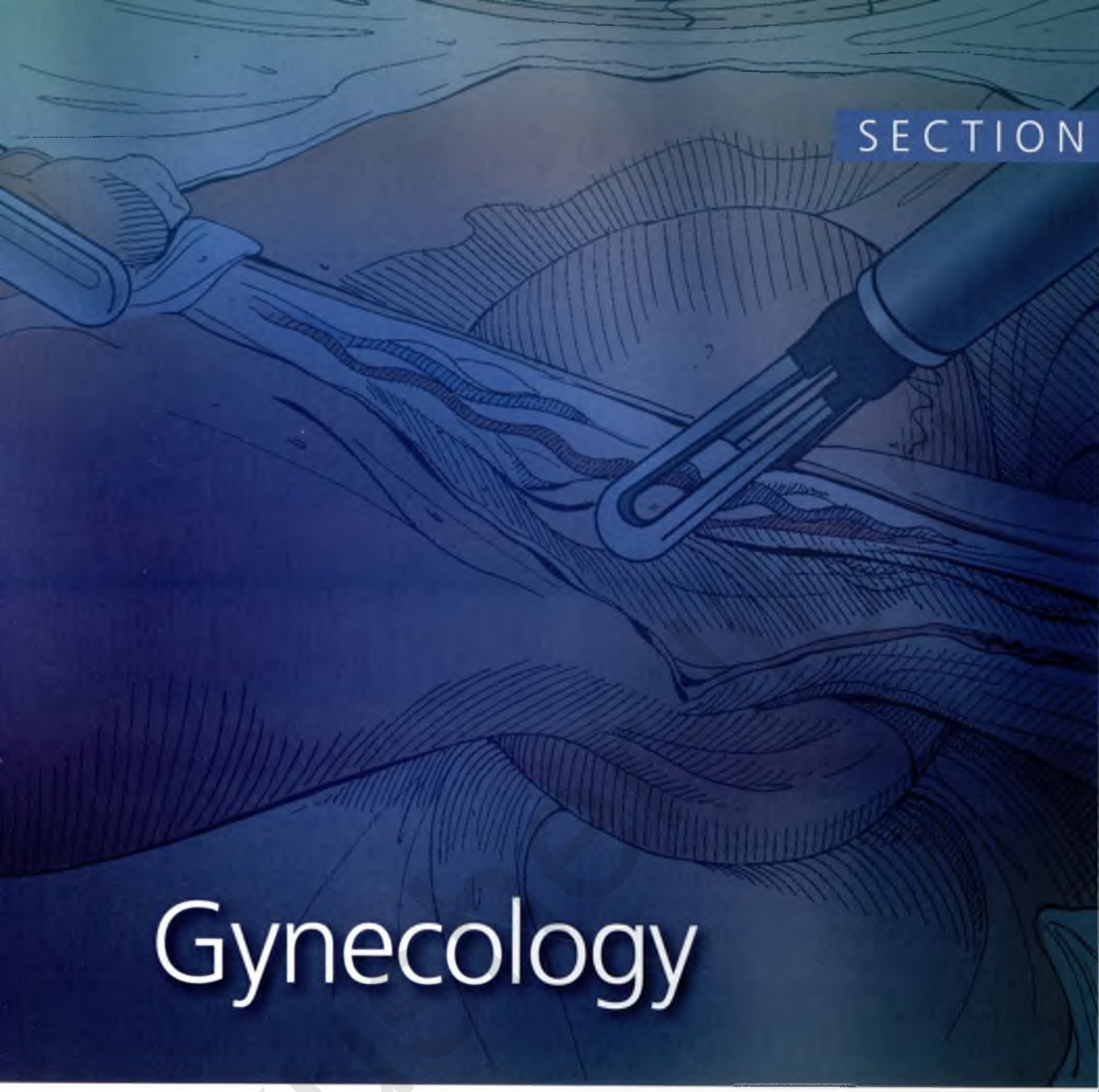

SECTION I

Gynecology

CHAPTER 1

Uterine Ablation Techniques

Frank Tu

INTRODUCTION

There is a long history of attempts to deliver energy to the endometrial lining in order to reduce abnormal menstrual bleeding—dating back to as early as the 1890s. More recently, hysteroscopic resection or hysteroscopic ablation has proven to be of significant value in ensuring the destruction of the endometrium and amelioration of menorrhagia and related symptoms. However, due to concerns about serious complications from fluid overload with conventional hysteroscopic endometrial resection for abnormal uterine bleeding, several global endometrial ablation (GEA) devices were introduced around the beginning of the new millennium. These GEA techniques use radiofrequency, thermal energy, or microwave energy to destroy the endometrium, in order to reduce the amount of cyclical bleeding or, in some cases, even achieve complete amenorrhea.

GEA is indicated for the treatment of dysfunctional uterine bleeding. This can include comorbid leiomyoma for certain devices, but typically a hysteroscopic myomectomy might be a better treatment for a known submucosal leiomyoma. There are several contraindications to consider; these include ongoing pregnancy or desire for future pregnancy, cancer or premalignant change, untreated pelvic inflammatory disease, hydrosalpinx, history of classical cesarean section, or transmural myomectomy. A woman with a cesarean section scar measuring less than 8 to 10 mm on ultrasound should be considered a relative contraindication for GEA or might consider having the procedure done under ultrasound guidance to minimize the risk of perforation. Women with intra-uterine devices (IUDs) in place and, for selected procedures, the presence of intramural leiomyomas and endometrial polyps may benefit from additional pre-ablation procedures.

Benefits of GEA have been supported by multiple head-to-head comparative trials against traditional transcervical endometrial resection, with patient satisfaction ranging from 89% to 98% and amenorrhea rates ranging from 14% to 55%. Patient satisfaction is generally quite high with all the procedures, although it is important to note that one survey has suggested that women are willing to tolerate up to a 50% failure rate with conservative management strategies in order to avoid hysterectomy. Despite the high overall satisfaction with virtually all devices, bipolar ablation has been shown in two head-to-head trials to deliver superior objective results compared to thermal balloon and hydrothermablation, respectively. This may be in part due to differences in how patients are pretreated for these procedures.

The particular attractiveness of GEA over endometrial resection is also evident in the number of cases that increasingly are done in the office or under local anesthetic. That being said, there is still a selective role for endometrial resection in the hands of experienced hysteroscopic surgeons, particularly in patients desiring conservative therapy after failure of initial GEA. Patients do need to be counseled about risks, including the rare risk in women with a prior history of tubal ligation of "postablation tubal pain syndrome," central hematometra, endometritis with rare reports of sepsis, uterine perforation, and injury to adjacent pelvic organs. Minor side effects include temporary abdominal cramping in around 10% to 15% of patients treated and a few weeks of vaginal discharge in most patients.

Effective means of contraception are needed if permanent sterilization has not already been assured, as future gestational complications such as uterine dehiscence, intrauterine growth restriction, and preterm delivery have been described in unexpected pregnancies following GEA. Unfortunately, GEA in a subset of women impairs cancer screening due to obliteration of the endometrial cavity, which can obscure the abnormal bleeding that is a hallmark of endometrial cancer.

PREOPERATIVE CONSIDERATIONS

The initial workup of menorrhagia should follow generally accepted clinical practice and includes: (a) excluding pregnancy, (b) completing a pelvic exam and pelvic ultrasonography, (c) obtaining confirmation of a recent negative PAP smear, (d) performing an endometrial biopsy to rule out cervical or endometrial malignancy and pre-malignant changes to the uterus, and (e) potentially performing a hysteroscopy to confirm the appropriateness of the size of the uterus and the absence of intracavitary lesions that might limit the effectiveness of GEA techniques. All methods, except for the Novasure® bipolar electrode array, recommend performing the procedure during the early follicular phase or following a month of hormonal (e.g., progestogen) pretreatment to thin the endometrial lining. Although many patients are comfortable having this done in the ambulatory setting using one of several available analgesic strategies, the clinician must select the best setting based on the examination and his/her assessment of the patient's tolerance level (**Box 1.1**).

To address the issue of a submucosal leiomyoma, or to prevent future pregnancies, some clinicians perform concomitant procedures such as hysteroscopic myomectomy, or tubal sterilization, or IUD placement at the same time as GEA. The Her Option® cryoablation system and MEA® have indications for intracavitary leiomyoma up to 2 and 3 cm, respectively. Published postmarketing experience from Kaiser Permanente suggests that the use of office-based Hydrothermablator® (HTA) can still be effective in the presence of either Type 0 or Type I myomas, although the reported failure rate of 23% at a mean follow-up of ~2.5 years post-procedure was markedly higher than their 3.7% failure rate in myoma-free patients. Similar efficacy has been reported for off-label use of Thermachoice® and Novasure®. There is concern that an immediate prior myomectomy may weaken the uterine tissue and increase the risk of perforation or iatrogenic injury to abdominal organs. Placement of the tubal sterilization implant Essure® must be done after Novasure® ablation due to

BOX 1.1

Suggestions for in-office analgesic protocols for GEA procedures

Consider using a combination of the following agents to achieve multimodal pain management. Many practices use all of these in conjunction to achieve optimal comfort. Patient selection is crucial.

1. Anti-inflammatory: administer 600 to 800 mg of oral ibuprofen every 6 hours beginning in evening prior to procedure, followed by in-office intramuscular injection of ketorolac 30 mg (at least 6 hours after previous NSAID dose)
2. Muscle relaxant/anxiolytic: oral diazepam 2 to 5 mg 60 minutes prior to procedure
3. Cervical ripening agent: misoprostol 200 μg at bedtime night prior to procedure—not recommended if doing HTA in office due to concern for spill
4. Opioid analgesic: 5 to 10 mg of oral hydrocodone or oxycodone, or belladonna and opium rectal suppositories 16.2/30 or 16.2/60, 60 minutes prior to procedure
5. In-office paracervical block with local anesthetic: must wait 5 to 10 minutes to achieve effect
6. Patients should consider arranging for transportation to and from procedure if any sedative agents are administered in the perioperative period

the metal content of the implants. While an IUD can be placed after GEA, it may be difficult to remove subsequently due to the resulting fibrosis.

SURGICAL TECHNIQUE

1. **GEA techniques:** Patients are placed in slight Trendelenburg position in stirrups and the perineum prepped and draped in the usual fashion. Typically, some sort of IV sedation is given or else office protocols for preoperative pain control are used. The bladder is emptied with a catheter if appropriate. Preoperative antibiotics are usually unnecessary, although patients should be counseled that endometritis can occur rarely after these procedures. A paracervical block is given at 4 and 8 o'clock if indicated and uterus is sounded to confirm appropriateness for each given device. A speculum is placed and the cervix grasped with a tenaculum.

   a. **Her Option® (Cooper Surgical):** The only cryoprobe therapy approach among the five methods reviewed achieves biological effect on the endometrium by cooling the 3.5-cm tip of an intrauterine probe to −80°C during two freeze cycles of 4 and 6 minutes each, to treat each side of the uterine cavity (**Figure 1.1**). The procedure is done under ultrasound guidance and usually does not require preoperative cervical dilation as the probe measures 5.5 mm in diameter (and 22 cm in length). Women with uterine cavity lengths between 4 and 10 cm (by sounding) and a uterine volume of 300 ml or less are considered appropriate candidates for treatment with this device.

   The active probe is connected to a gas compressor. On activation, a hermetically sealed gas mixture flows into the distal tip of the probe, which permits cooling and heating of the probe. The disposable probe is first tested in the air and confirmed to be able to reach −50°C in a test freeze. Air is first cleared from the probe channel with a small volume (1–2 ml) of saline and the probe is then inserted under ultrasound guidance toward the right or left fundus. A saline-filled 30-ml syringe is attached to the injection port on the probe, and 5 to 10 ml injected into the cavity to optimize contact of

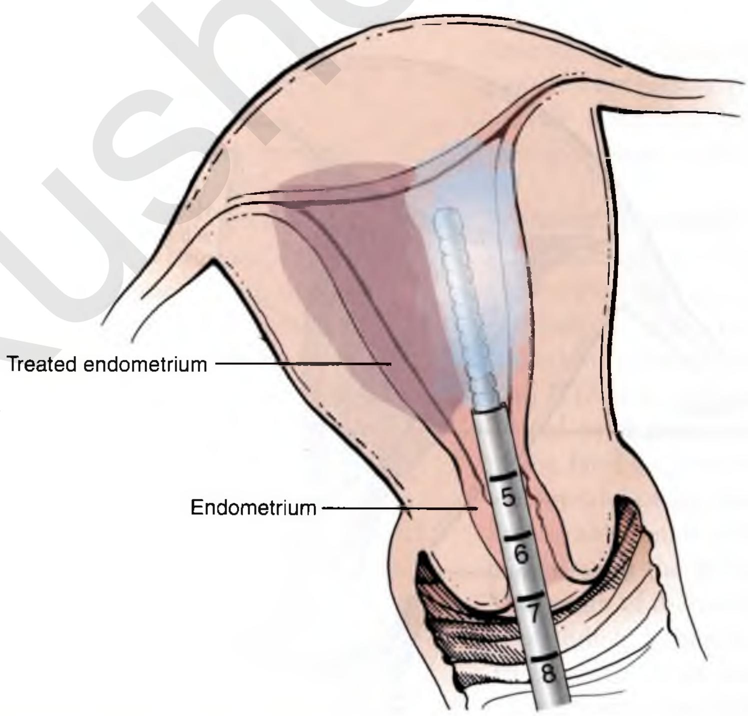

FIGURE 1.1 Her Option® (Cooper Surgical): The only cryoprobe therapy approach to endometrial ablation, it achieves its biological effect on the endometrium by cooling the 3.5-cm tip of an intrauterine probe to −80°C during two freeze cycles of 4 and 6 minutes each, treating each side of the uterine cavity. The procedure is done under ultrasound guidance.

the probe against the endometrial tissue and enhance sonographic visualization.

The surgeon begins the freeze cycle by depressing the button on the probe. The formation of the "cryozone" (a discrete dark area detected by ultrasonography at the perimeter of the echolucent cryoprobe) is monitored by ultrasound during the first 4-minute therapy cycle, which should be stopped and the heat button engaged if it reaches closer than 5 mm from the uterine serosal surface. Five to 10 ml of saline is injected into the cavity through the probe after the heat cycle is completed before the probe is withdrawn into the endocervical canal. The probe is then positioned against the opposite cornua and a freeze cycle of up to 6 minutes initiated, again using saline as needed to unseat the probe.

b. Thermachoice® (Ortho Women's Health): Thermachoice® features a heating element inside a silastic balloon that conforms to the shape of the uterine cavity. The Thermachoice III® has a flexible silastic balloon to optimize fit. The balloon is first checked for leaks out of the package by performing a filling test before placement with a D5W-filled 30-ml luer lock syringe attached to the injection port. Next the balloon is inserted into the endometrial cavity and filled with enough D5W (up to 30 ml) to achieve a stable intrauterine pressure of between 160 and 180 mmHg (**Figure 1.2**). The heating element is then activated to 87°C for 8 minutes to treat the endometrial cavity. The system will automatically shut off if the intrauterine pressures reach >210 mmHg or <45 mmHg (such as with sudden loss of balloon integrity or uterine perforation) during a heating cycle; or balloon temperatures exceed >95°C for more than 2 seconds or <75°C for 15 seconds. Original approval by the FDA was for uterine sizes between 4 and 12 cm with normal cavity contour.

c. Hydrothermablator® (HTA, Boston Scientific): In many ways, a similar concept to the Thermachoice® family of products, the HTA differs in that it achieves biological effect by directly exposing heated saline (at 90°C) to the endometrial cavity. Over the course of 10 minutes, this similarly destroys the endometrium. The cervical canal is dilated to 8 mm prior to inserting a clear 7.8-mm polycarbonate probe (**Figure 1.3**). The procedure is performed

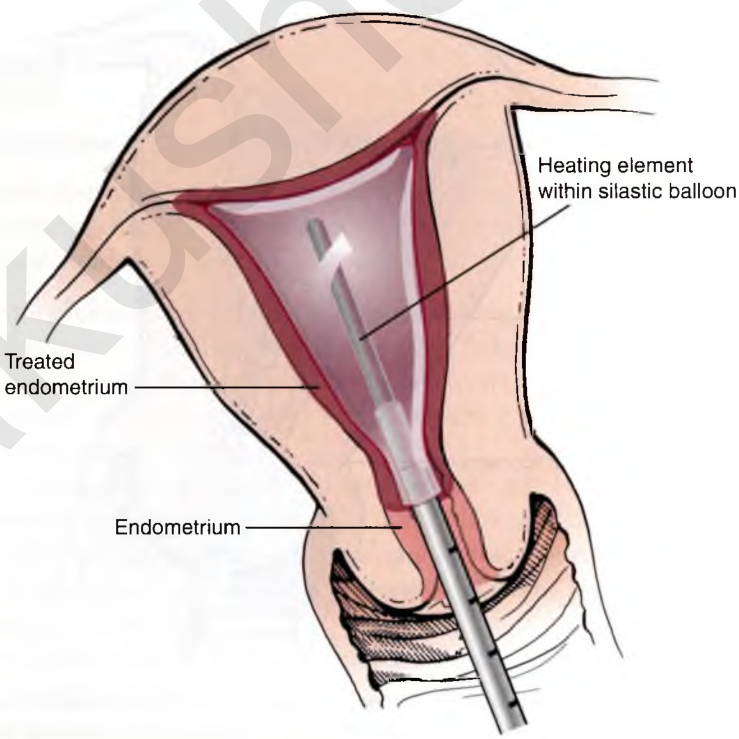

FIGURE 1.2 Thermachoice® (Ortho Women's Health): Thermachoice® features a heating element that is activated to 87°C for 8 minutes inside a silastic balloon that conforms to the shape of the uterine cavity.

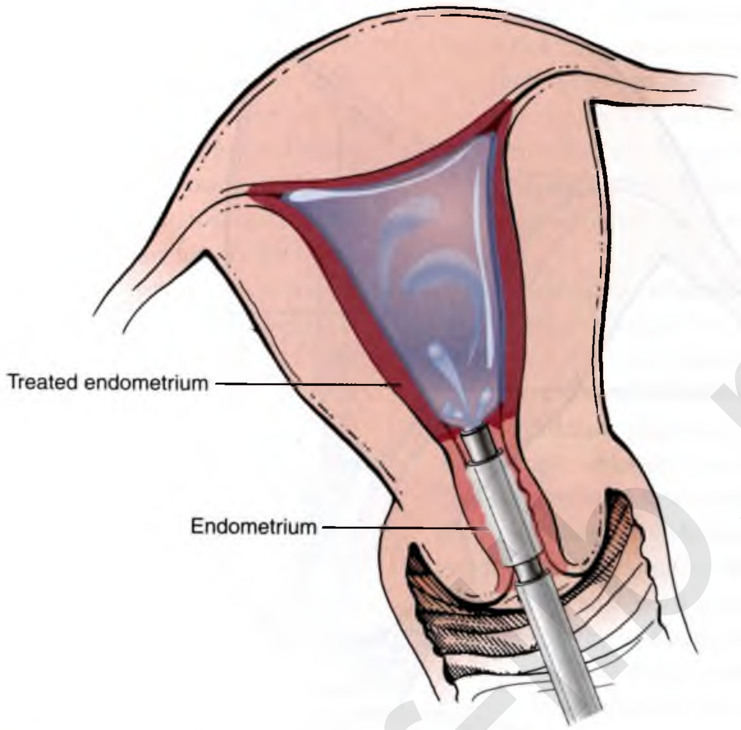

FIGURE 1.3 Hydrothermablator® (HTA, Boston Scientific): The HTA differs from other methods of uterine ablation in that it achieves biological effect by directly exposing heated saline (at 90°C) to the endometrial cavity, over the course of 10 minutes. The procedure is performed under continuous visual guidance by a 3-mm hysteroscope inserted directly through the polycarbonate working channel.

under continuous visual guidance by a 3-mm hysteroscope inserted directly through the polycarbonate working channel.

A priming cycle of 2 minutes is first performed at infusion rates of 300 mL/min. If this initial safety check is confirmed (i.e., no evidence of leakage into the abdominal cavity) by the system software, a heating cycle brings the temperature gradually up to 80°C at which time the treatment cycle begins at the same flow rate. Subsequently, a cool-down phase to 45°C completes the treatment cycle.

Concerns regarding the procedure, including the risk of hot fluid spilling retrograde into the peritoneal cavity, are avoided by following standard GEA contraindications, such as avoiding use in women with prior classical cesarean section or transmural myomectomy, and because the system keeps infusion pressures below the opening (coaptation) pressure of the fallopian tubes (~55 mmHg). To further minimize accidental burns, the onboard software initiates an automatic cooling phase if the cycle is interrupted for any reason. Insulated tubing, a tenaculum stabilizer, and a ribbed cervical component attached to the polycarbonate sheath provide additional safeguard against external thermal injuries to the cervix, vagina, or legs.

d. Novasure® (Hologic): The disposable Novasure® system features a 7.2-mm wide retractable bipolar electrode array that is inserted into the endometrial cavity to desiccate the endometrium using radiofrequency (RF) current. As with HTA, the cervical canal needs to be first dilated to 8 mm. The concrete dimensions of the fan-like array require that the internal endometrial cavity dimensions be determined before ablation to allow proper output programming of the RF generator (**Figure 1.4**). The length of the cavity needs to be estimated by sounding, hysteroscopy, or ultrasonography. The gun-like array assembly is first inserted transcervically and the array is extended to fit between the cornu. The entire array is then gently rocked back and forth, and from side to side, to optimally seat it within the cavity. The width and length dimensions must then

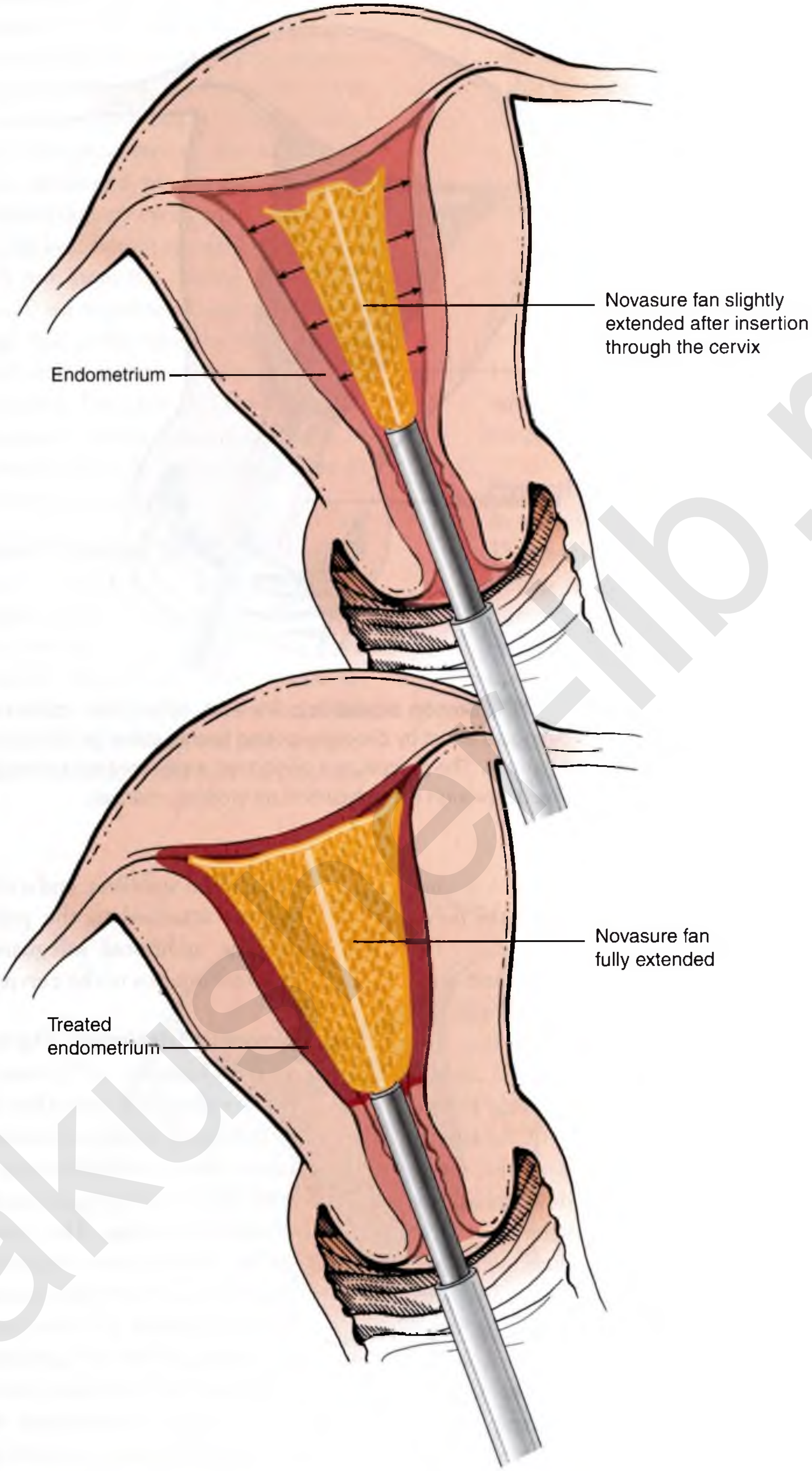

FIGURE 1.4 Novasure® (Hologic): The disposable Novasure® system features a 7.2-mm wide retractable bipolar electrode array that is inserted retracted into the endometrial cavity. It is then extended fully to desiccate the endometrium using radiofrequency (RF) current. The concrete dimensions of the fan-like array require that the internal endometrial cavity dimensions be determined before ablation to allow proper output programming of the RF generator.

be input manually into the RF generator. Only cavities between 4.0 and 6.5 cm in length and >2.5 cm in width are approved for treatment with the Novasure® system; treatment of cavities >4.5 cm in width may not be effective.

Next, a cavity integrity test is performed using carbon dioxide infusion. If the intrauterine pressure can be maintained for 4 seconds, a treatment cycle can be initiated. The cause for a failed cavity integrity test needs to be determined and resolved in order to safely move to initiation of the treatment phase. Occasionally, with a large multiparous lax cervix, a tenaculum may need to be used to close the cervical canal around the array and avoid leakage of CO_2 transcervically, which otherwise prevents the system from being activated.

When activated, the system continuously measures the electrical impedance of the target tissue; the impedance rises as the tissue is desiccated. Once tissue impedance reaches 50 ohms, or treatment reaches 2 minutes, the cycle is terminated. Novasure® is the fastest of the GEA methods. Furthermore, Novasure®'s effectiveness in its original FDA trial was documented without requiring pretreatment thinning of the uterine lining.

e. **Microwave Endometrial Ablation (MEA®, Microsulis Americas Inc.):** In a variant of the RF bipolar treatment array (i.e., Novasure®), MEA® applies microwave energy at 9.2 Hz to the uterine cavity using a transcervical wand to deliver temperatures of 75°C to 85°C to an endometrial/myometrial depth of 5 to 6 mm (**Figure 1.5**). A preoperative ultrasound is suggested by the manufacturer to confirm a uniform uterine wall thickness of ≥10 mm. In addition, an endometrial curettage immediately prior to the procedure should be avoided to minimize the risk of inadvertent perforation or transmural injury. MEA® is also not recommended following a prior endometrial ablation attempt, if the uterine cavity is <6 cm, or if the patient has had a prior classical cesarean section or other transmural uterine surgery, such as myomectomy.

The cervix is dilated to 8.5 mm, and the wand inserted and advanced until the tip reaches the uterine fundus. The wand is then moved back and forth from cornua to cornua until the real-time temperature reaches 70°C. The wand is then withdrawn slightly into the lower corpus and treatment continued with back and forth movements. Treatment times vary but typically are 3 to 5 minutes in a normal-sized uterus. The MEA® is approved for use in larger uterine cavity lengths compared with the other GEA methods (up to 14 cm). The original FDA trial also permitted submucosal myomas to be treated by this technology if they did not protrude more than 3 cm into the cavity.

2. **Hysteroscopic endometrial resection and ablation:** Although first-line surgical management of abnormal uterine bleeding in the United States has tilted heavily toward the GEA approaches, some clinicians continue to use the traditional resectoscopic ablations, and the availability of bipolar resectoscopes does simplify the technique while also providing an enhanced safety profile over the monopolar instruments. Historically, ND:YAG laser fibers have also been used. For conservative management after unsuccessful GEA, resectoscopic ablation allows direct visual treatment of areas of endometrium that remain viable.

At least two bipolar systems, which permit the use of isotonic distension medium, are available made by Richard Wolf Medical Instruments Corporation (Vernon Hill, IL) and Gynecare (Somerville, NJ). Both of these come with both a wire loop as well as a rollerball tip electrode. Because each of these has idiosyncratic power settings tied to a dedicated generator, we will describe the technique specifically for the Gynecare Versapoint® system that the author uses; however it is imperative that users be familiar with the instructions for their specific setup. The Versapoint® vaporizing electrode measures 4 mm wide and 4 mm in diameter, while the wire loop electrode has a diameter of 2.5 mm. Either of these components attaches to the working element and sits within the 9-mm hysteroscopic sheath, which generally necessitates dilation of the cervix (**Figure 1.6**). The goal is to use the electrode to desiccate the endometrium to the basalis while avoiding damage to the myometrium. Hysterscopically guided endometrial resection and ablation can be used as either primary treatment or for the treatment of a patient who has previously undergone a failed, usually GEA, ablation procedure.

For previously untreated endometrium, many surgeons use hormonal suppression (GnRH analogue, progestins) for 1 to 2 months to thin the lining preoperatively. The area is treated circumferentially with the electrode introduced near the ostia and then pulled back while the electrode is activated for brief segments, in overlapping

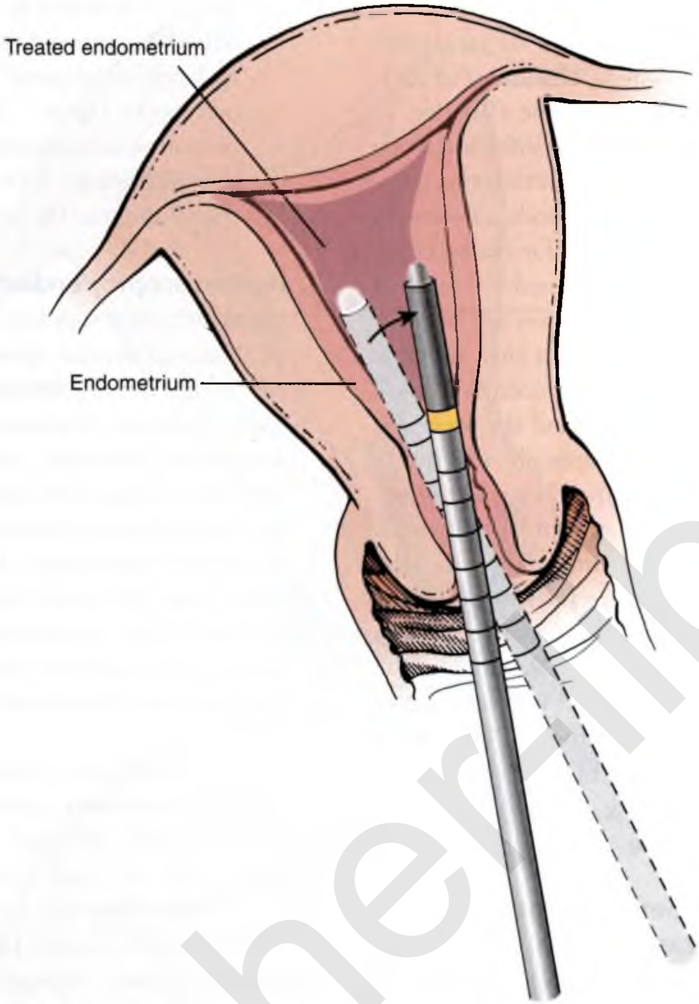

FIGURE 1.5 Microwave Endometrial Ablation (MEA®, Microsulis Americas Inc.): In a variant of the RF bipolar treatment array, the MEA applies microwave energy at 9.2 Hz to the uterine cavity using a transcervical wand to deliver temperatures of 75°C to 85°C to an endometrial/myometrial depth of 5 to 6 mm.

rows until the entire cone of each cornua has been successfully vaporized or desiccated (**Figure 1.7**). The endometrium of the cornua is thinnest and most awkward to treat, so use of the vaporizing electrode, a ball electrode, or a straightened-out wire loop permits gentle treatment of this area. The anterior uterine wall is treated next, because desiccation can generate obscuring bubbles. These bubbles can be removed from the cavity by occasionally pushing the scope up against the fundus, permitting evacuation through the hysteroscopic outflow. Subsequently, the posterior wall is vaporized/desiccated, again using the same technique of pulling the electrode toward the os as it is being activated.

Use of either electrode is appropriate in these circumstances, although the advantage of using the wire loop is that strips of tissue are available for pathological evaluation; the latter also does require that periodically the tissue be removed to avoid obstructing the visualization of the cavity. The visual goal is blanching and ablation of the endometrium down to the basalis, which appears as whiteness in the treated area of the endometrial cavity indicative of the myometrium. Some surgeons also suggest leaving a rim of untreated endometrium above the os to minimize the development of hematometria. Alternately, a small series of published cases suggest good patient satisfaction with only desiccation of one wall of the uterus, which may further minimize the risk of hematometria.

If the patient is undergoing a secondary ablation, the visualization obviously can be markedly impaired by scar and fibrosis, and the specific goals of ablation may be limited to the visually viable areas of endometrium. An additional benefit of the hysteroscopic approach is

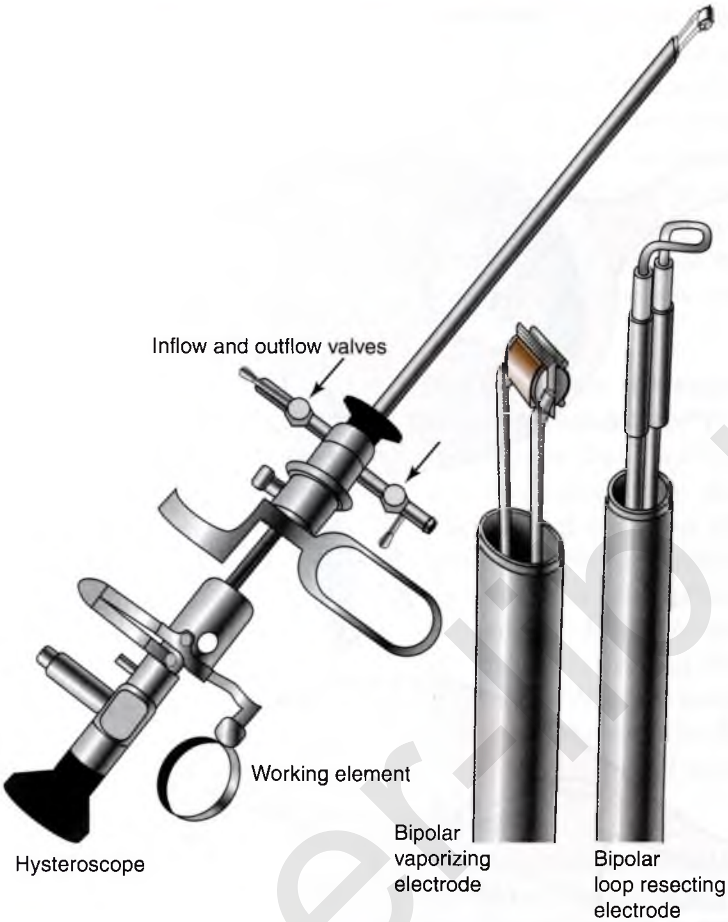

FIGURE 1.6 Versapoint® Resectoscopic System (Gynecare, Inc.): The Versapoint® vaporizing electrode measures 4 mm wide and 4 mm in diameter, while the wire loop electrode has a diameter of 2.5 mm. Either of these components attaches to the working element and sits within the 9-mm hysteroscopic sheath, which generally necessitates dilation of the cervix.

that when intrauterine pathology is encountered, a polypectomy or myomectomy may be performed.

The risks of hysteroscopic ablation involve infection, bleeding, perforation (at least 1%), fluid overload, and postop hematometria (see **Complications** box on page 14). As with any operative hysteroscopic procedure, recommended goals for monitored fluid deficit should be respected, with 2,500 ml of isotonic fluid being the absolute cutoff for a procedure, and potentially less for patients with cardiopulmonary compromise. Surgeons are encouraged to rapidly move to complete the hysteroscopic case at 1,500 ml deficits. Active fluid monitoring systems are readily available to ensure precise calculation of these deficits. To minimize the chance of perforation, some surgeons use combined ultrasound or laparoscopic guidance. A suspected perforation while an electrode is being used actively should be investigated (usually laparoscopically) with careful evaluation of the intestine and other pelvic organs at the site of perforation, and subsequent treatment dictated by findings. While gas embolism is an extraordinarily rare event, it can create severe cardiopulmonary collapse. Emergent recognition and coordination with the anesthesia team and a vascular surgeon to evacuate the gas bubble may avoid serious consequences including death. Proposed steps to reduce this risk include limiting the degree of Trendelenberg tilt (head down relative to pelvis), and limiting the number of times the hysteroscope is pulled in and out of the cervix.

POSTOPERATIVE CONSIDERATIONS

For most patients, GEA can be performed in the day surgery setting as an outpatient and in selected cases in the ambulatory clinic setting. Observation in the postprocedure state usually for an hour or so is appropriate to ensure adequate pain control.

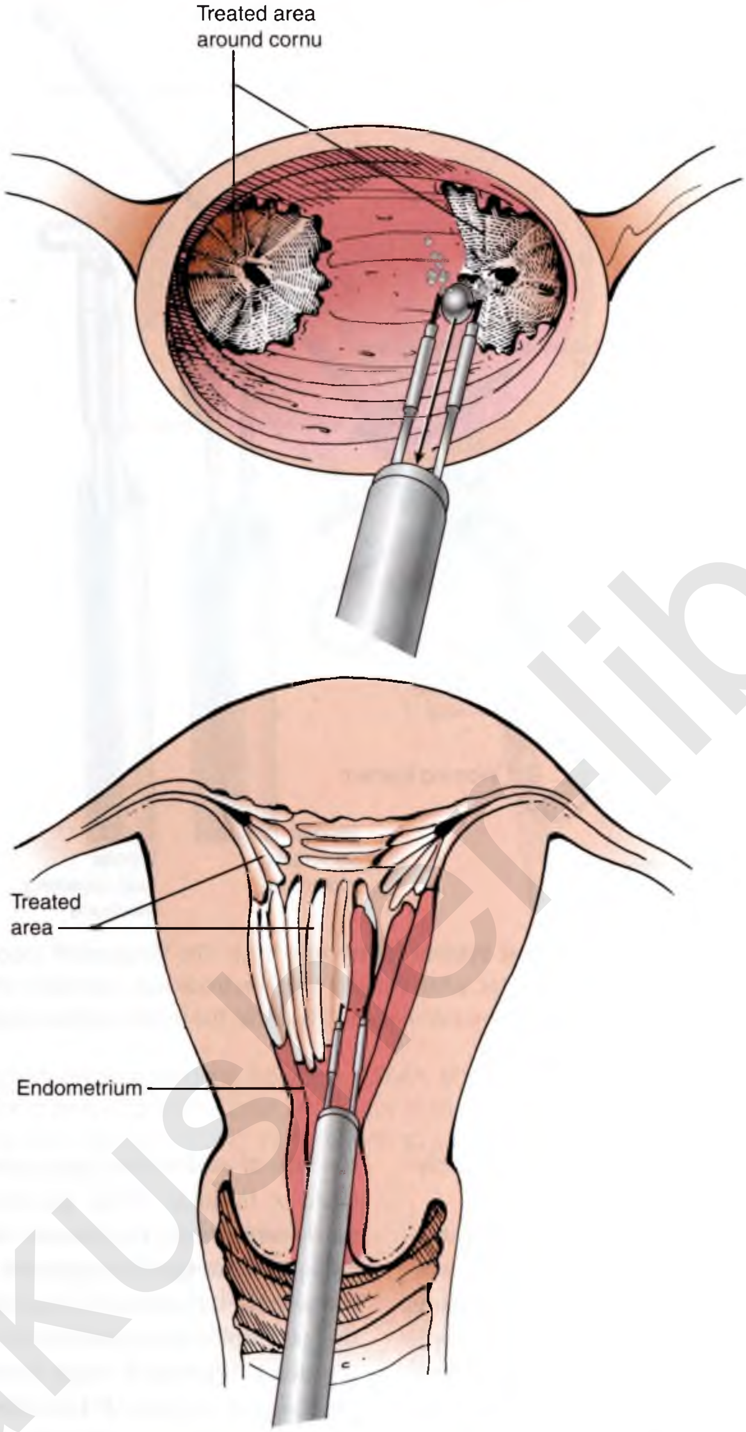

FIGURE 1.7 Versapoint® Resectoscopic System (Gynecare, Inc.) in use: The area is treated circumferentially with the electrode introduced near the ostia and then pulled back while the electrode is activated for brief segments, in overlapping rows until the entire cone of each cornua has been successfully vaporized or desiccated. The endometrium of the cornua is thinnest and most awkward to treat, so use of the vaporizing electrode, a ball electrode, or a straightened-out wire loop permits gentle treatment of this area.

Postoperative pain management is usually managed adequately with nonsteroidal anti-inflammatory drugs. A regular schedule of oral medication helps to minimize postoperative pain needs, by providing baseline analgesia. Oral narcotics can then be used on an "as needed" basis for pain spikes. No activity restrictions beyond the patient's personal comfort level are usually needed. Patients should be instructed to avoid coitus for at least 1 week after the procedure and ideally should be examined in the office evaluation before resuming sexual intercourse.

Operative Note

PROCEDURE: UTERINE ABLATION TECHNIQUES

The patient was taken to the operating room, where her identity was confirmed. After the establishment of adequate anesthesia, patient was placed in the dorsal lithotomy position, and a combined abdominal and vaginal prep and sterile drape were performed. Arms were padded and tucked in military position, the hip and ankles placed in neutral position, and knees flexed to 90°C to minimize nerve compression. The operative team completed a "time-out" when universal precautions where reviewed, including patient identification and site of surgery. Team questions were answered. A straight catheter was inserted to drain the bladder. A vaginal speculum was placed and the anterior lip of the cervix grasped with a single-tooth tenaculum. Uterine sound confirmed appropriate size of the cavity. Preprocedure hysteroscopy using saline infusion confirmed appropriate cavity appearance without masses or structural anomalies and both cornua were visualized.

Technique specific procedure notes are denoted below:

1. **Endometrial cryoablation (Her Option®):** The disposable probe was tested and confirmed to be able to reach −50°C in a test freeze. The probe was cleared of air and then inserted under ultrasound guidance toward the right fundus. The balloon was filled with 5 ml of saline to optimize contact of the probe against the endometrial tissue. The freeze cycle was initiated and the formation of a cryozone monitored by transabdominal ultrasound for the initial 4-minute therapy cycle. The zone stayed 5 mm from the uterine serosal surface at all times. The probe was then positioned against the opposite cornua and the second 6-minute freeze cycle initiated, again without excessive penetration of the cryozone into the myometrium by ultrasound guidance.

   Or

2. **Thermal balloon ablation (Thermachoice®):** A vaginal speculum was placed and the anterior lip of the cervix grasped with a single-tooth tenaculum. The balloon probe was filled and confirmed to be intact. The probe was then inserted into the endometrial cavity and filled with enough D5W to achieve a stable intrauterine pressure of between 160 and 180 mmHg. The heating element was activated to 87°C for 8 minutes to treat the endometrial cavity. No pressure or temperature warnings were noted. After cooldown the fluid was removed from the balloon and the probe was removed.

   Or

3. **Hysteroscopic thermal endometrial ablation (Hydrothermablator®):** The system was checked to ensure no leaks and the fluid management system was calibrated to the patient's bed position. The cervical canal was dilated to 8 mm and the probe then inserted under visual guidance. A priming cycle was first performed at infusion rates of 300 ml/min. After the safety check was executed, the treatment cycle at 80°C was completed over 10 minutes. After the cooldown phase to 45°C, the probe was removed. The fluid tubing was kept away from the patient at all times.

   Or

4. **Radiofrequency bipolar array endometrial ablation (Novasure®):** The cervical canal was dilated to 8 mm. The length of the cavity was determined to be appropriate by sounding. The array was inserted into the uterine cavity up against the fundus, and then seated and locked open in full extension by rocking it gently back and forth against all four cardinal surfaces of the uterine cavity. The resulting width (3.5 cm) and length (6 cm) dimensions were programmed into the RF generator. After the cavity integrity was confirmed with CO_2 infusion, a 90-second treatment cycle was performed. The array was then retracted and the probe removed from the patient.

   Or

5. **Microwave endometrial ablation (MEA®):** The cervix was dilated to 8.5 mm, and repeat hysteroscopy confirmed the absence of a perforation. The fluid was then evacuated from the uterine cavity. The preprocedure temperature profile evaluation was reassuring. The MEA applicator was inserted up to the uterine fundus. The device was then activated and the wand moved back and forth from cornua to cornua until the real-time temperature displayed on the control unit reached 70°C. The wand was then withdrawn slightly into the lower corpus and treatment continued with back and forth movements until the black band was visible at the external cervical os.

Or

6. Hysteroscopic global endometrial resection: The cervix was dilated to 9 mm. The Versapoint bipolar resectoscope was inserted with saline infusion, using a fluid management system. The rollerball with settings of 170 W vapor cut 1 was used to treat the ostia in overlapping radial rows until the entire cone of each cornua was vaporized. Next the fundal endometrium was vaporized in overlapping rows. The hysteroscope was removed and a wire loop attached. Using the wire loop, the anterior and then posterior endometrial lining was excised using desiccation, again on the 170 W vapor cut 1 mode. For all surfaces, we vaporized/excised down to the visibly white basalis layer. The hysteroscope was then withdrawn. All strips of endometrial tissue were then systematically evacuated with a suction curette. Repeat hysteroscopy confirmed no perforation and an empty cavity. The final fluid deficit was within limits (800 ml).

All instruments were removed. The tenaculum site was inspected and noted to be hemostatic. The patient was woken up and transferred to recovery in good condition. No complications were observed.

COMPLICATIONS

- Uterine perforation—*Infrequent (less than 5%)*
- Fluid or electrolyte imbalance (see Table 27.1)—*Infrequent (less than 5%)*
- Hemorrhage and major vessel perforation—*Rare (less than 1%)*
- Postoperative infection (endometritis, myometritis, adenexitis)—*Rare (less than 1%)*

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CHAPTER 2

Total Abdominal Hysterectomy

Robert E. Bristow

INTRODUCTION

Approximately 600,000 hysterectomies are performed annually in the United States, and more than one-third of women have had a hysterectomy by age 60 years. The most common diagnoses among women undergoing hysterectomy are uterine leiomyomata (41%), endometriosis (18%), uterine prolapse (15%), and cancer or hyperplasia (12%). Other indications for hysterectomy include adenomyosis, pelvic inflammatory disease, chronic pelvic pain, and pregnancy-related conditions.

The uterus can be removed by a variety of different approaches including the abdominal route (laparotomy), transvaginally, or using minimally invasive surgical techniques. Selection of the operative approach is based on many factors including the physical properties and topography of the uterus and pelvis, the indication for surgery, patient body habitus and medical comorbidities, and the presence or absence of adnexal pathology. Abdominal hysterectomy allows the greatest ability to manipulate distorted pelvic anatomy or perform extensive adhesiolysis safely, and over 60% of hysterectomies performed in the United States are still performed via the abdominal approach. Although abdominal hysterectomy is typically associated with shorter operating times than minimally invasive surgical approaches, it is also associated with a higher level of incisional pain, greater risk of postoperative febrile morbidity and wound infection, longer hospital stay, and a more protracted recovery time.

Hysterectomy may include removal of the uterine corpus and cervix, termed *total hysterectomy*, or may include only the uterine corpus, called *supracervical hysterectomy*. The term *subtotal hysterectomy* refers to the supracervical type but is not the preferred terminology. There has been a recent increase in the popularity of supracervical hysterectomy despite multiple randomized trials indicating no benefit over total hysterectomy in sexual function, bladder function, or pelvic floor support. In the absence of adnexal pathology, the decision to perform prophylactic removal of the ovaries and fallopian tubes should be addressed individually and will depend on patient preference, menopausal status, and the risk of subsequent ovarian cancer or other adnexal pathology that might require surgical intervention.

PREOPERATIVE CONSIDERATIONS

In preparation for abdominal hysterectomy all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate major surgery or place the patient at elevated risk for postoperative complications. Routine laboratory testing should include a complete blood count, serum electrolytes, a pregnancy test in reproductive-age women, age-appropriate health screening studies, and an electrocardiogram for women aged 50 years and older. Specifically, all patients undergoing abdominal hysterectomy for a benign indication should have current Pap smear screening, and endometrial biopsy should be performed prior to hysterectomy for abnormal uterine bleeding to rule out an unexpected endometrial hyperplasia or cancer diagnosis. Preoperative imaging is not required; however, a transvaginal pelvic ultrasound is useful to assess uterine topography and anatomy and determine whether concurrent adnexal pathology is present.

Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) can be utilized according to the surgeon's preference. Prophylactic antibiotics (Cephazolin 1 g, Cefotetan 1 g to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and/or subcutaneous heparin) should be initiated prior to surgery. Surgical equipment for abdominal hysterectomy includes a standard pelvic surgery tray. Additional equipment may include a self-retaining retractor with or without a fixed arm attaching the retractor ring to the operating table, an electrosurgical unit (ESU or "Bovie"), and a vessel-sealing device. Following is a brief description of the surgical procedure used (see also video: *Total Abdominal Hysterectomy*).

SURGICAL TECHNIQUE

General or regional anesthesia may be used for abdominal hysterectomy. The patient may be positioned in the dorsal low-lithotomy (perineolithotomy) position using Allen® Universal Stirrups (Allen Medical Systems, Cleveland, OH) or supine on the operating table. The low-lithotomy position is preferable, as it permits intraoperative bimanual examination to accurately assess distorted pelvic anatomy and allows access to the perineum for colpotomy and cystoscopy. Abdominal entry and exposure can be achieved through either a transverse or vertical incision, depending on clinical factors or the anticipated scope of the operation. The low transverse Pfannenstiel incision is usually adequate for most cases of abdominal hysterectomy for benign indications; however, if wide exposure is needed, the transverse Cherney or Maylard incisions may be more appropriate. The vertical midline incision offers the greatest flexibility and can be extended above the umbilicus if necessary. A self-retaining retractor will optimize exposure and reduce surgeon fatigue but is not a requirement.

Once the abdomen has been opened, a thorough exploration of abdominal structures is conducted before directing attention to the pelvis. Adhesions are divided and normal anatomy restored prior to packing the bowel out of the pelvis. The uterus is elevated out of the pelvis and manipulated by two large Kelly clamps placed across the broad ligament adjacent to the uterine fundus encompassing the round ligament, fallopian tube, and utero-ovarian ligament on each side. The broad ligament is incised cephalad to the round ligament, and the peritoneal incision extended toward the pelvic brim parallel to the infundibulopelvic ligament. The external iliac artery is an important landmark and is identified on the medial surface of the psoas muscle. The external iliac artery should be traced proximally to the bifurcation of the common iliac artery. The hypogastric (internal iliac) artery can then be located and followed as it courses deep along the lateral pelvic wall. The uterine arteries originate from the hypogastric artery within the cardinal ligament. The round ligament is identified and a ligature of 1-0 delayed absorbable suture placed midway between the uterus and pelvic sidewall, which is held long for traction (**Figure 2.1**). A large hemo-clip (or suture ligature) is placed medially (uterine side) to control back-bleeding and the round ligament is divided. An incision is created in the anterior leaf of the broad ligament and continued medially across the vesicouterine peritoneal reflection or fold at the junction of the lower uterine segment and cervix (**Figure 2.2**).

The pararectal space is developed by carefully dissecting, with a finger or large Kelly clamp, between the hypogastric artery (laterally) and the medial leaf of the broad ligament peritoneum. The ureter is attached to the medial leaf of the broad ligament peritoneum and is most easily located at the pelvic brim in the region of the bifurcation of the common iliac artery. The ureter should be clearly visualized as it courses through the pararectal space toward the cardinal ligament. The ureter can also be palpated along its course by placing the surgeon's thumb and index finger on opposite sides of the medial leaf of the broad ligament peritoneum, straddling the infundibulopelvic ligament, and drawing the fingers upward. As the fingers cross the ureter, a characteristic "snap" is felt. Visual confirmation of the ureter's position is the preferred technique, however.

If one or both adnexae are to be left in situ, the uterus is placed on traction anteriorly and medially and a window created in the avascular space of Graves (between the ureter and the infundibulopelvic ligament) in the medial leaf of the broad ligament peritoneum. Two large, curved clamps (e.g., Kelly and Heaney) are placed across the utero-ovarian ligament/fallopian tube complex (the round ligament is not included) and the pedicle divided and suture ligated. The adnexae may then be allowed to drop into the posterior pelvis or packed into the paracolic gutters out of the surgical field, with care taken not to injure the infundibulopelvic ligament, for the remainder of the hysterectomy.

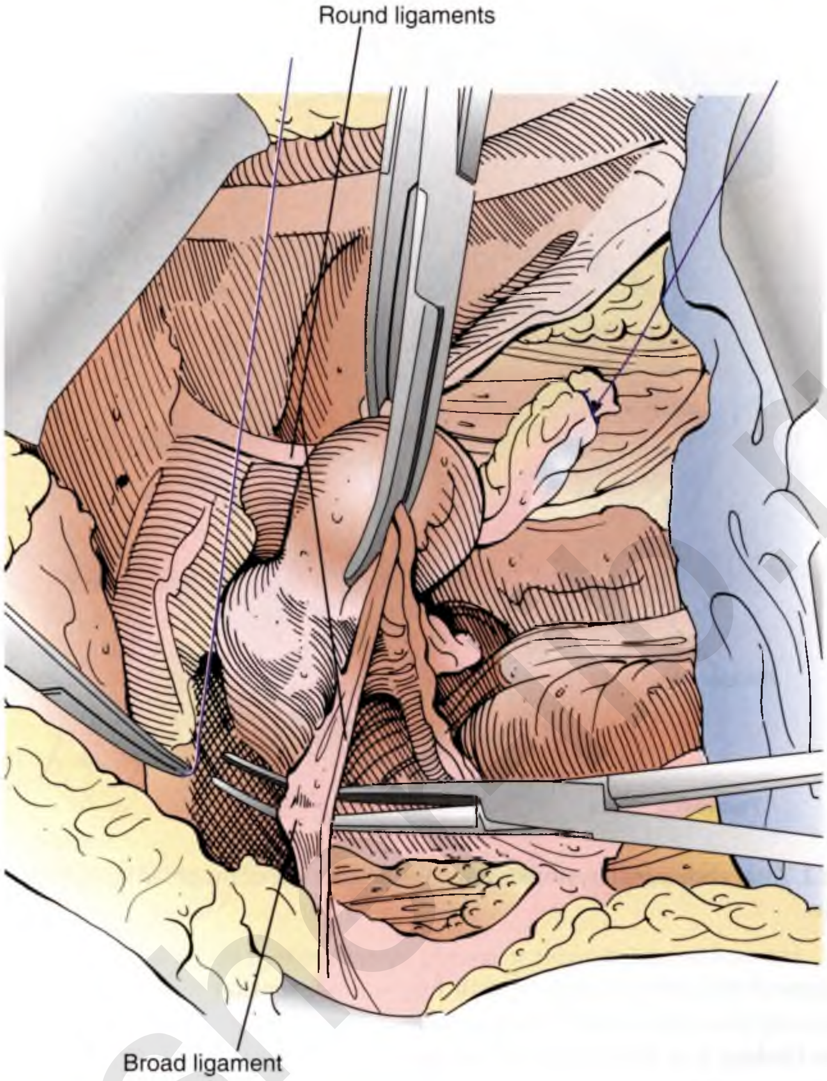

FIGURE 2.1 Total abdominal hysterectomy: Ligation and division of the round ligament.

At the conclusion of the case, the adnexal pedicle can be sutured to the round ligament stump on each side to avoid adherence to the vaginal cuff and resulting dyspareunia. If the adnexae are re-approximated to the round ligament stumps, the peritoneal defect lateral to the infundibulopelvic ligament should be closed with a running, nonlocking stitch of 3-0 delayed absorbable suture to prevent an internal small bowel herniation and entrapment.

If one or both adnexae are to be removed, a window is created in the avascular space of Graves and the infundibulopelvic ligament dissected up to the level of the pelvic brim. It is important to completely visualize the ureter as it crosses the common iliac artery at the pelvic brim, as this is a common area of ureteral injury during hysterectomy with salpingo-oophorectomy. If necessary, the ureter is dissected from its attachments to the medial leaf of the broad ligament peritoneum to allow sufficient space (at least 1 to 2 cm) to safely place clamps between it and the infundibulopelvic ligament. The infundibulopelvic ligament is doubly clamped, divided, and suture ligated with 1-0 delayed absorbable suture (**Figure 2.3**). To optimize exposure for hysterectomy, the adnexae are moved out of the field of vision by tying the sutures of the distal ends of the divided infundibulopelvic ligaments to the clamps holding the uterus. Alternatively, the adnexae can be detached from the uterus entirely and submitted as separate specimens. The infundibulopelvic ligament can also be divided with a vessel-sealing device.

Prior to approaching the uterine vessels, it is preferable to mobilize the bladder so that unanticipated bleeding from the uterine vasculature or cardinal ligament can be safely controlled with clamps without concern over bladder injury. With cephalad traction on the uterus, the lower border of the previously incised

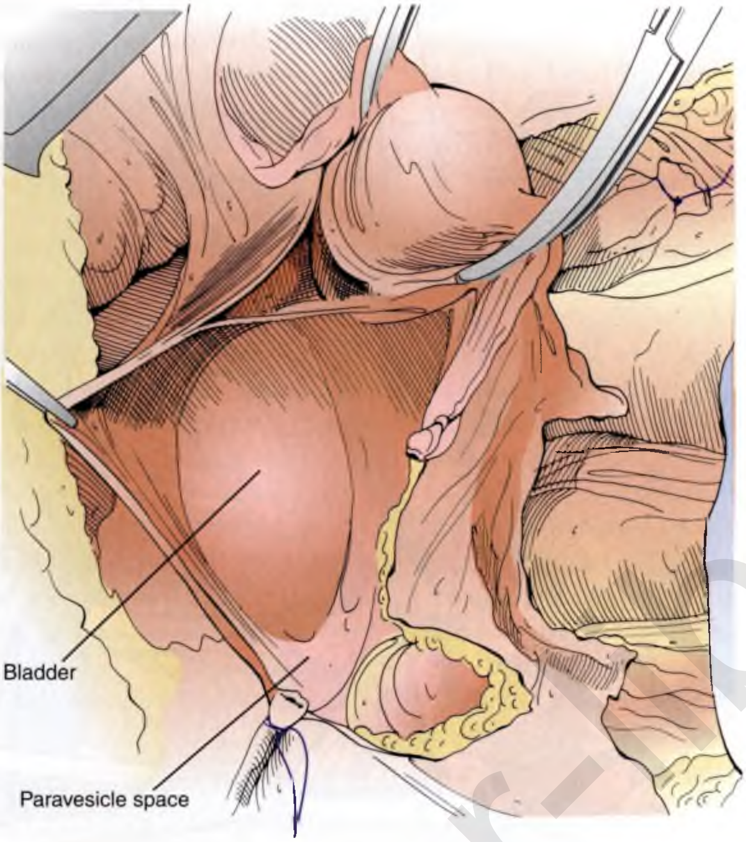

FIGURE 2.2 Total abdominal hysterectomy: The anterior leaf of the broad ligament is opened, exposing the bladder.

vesicouterine peritoneal reflection is grasped with forceps or Allis clamps and placed on caudad traction. The plane between the bladder and cervix is identified and the loose areolar tissue sharply dissected with the ESU or scissors to develop the vesicocervical space. Dissection should be concentrated over the cervix and avoid drifting laterally into the bladder pillars, where troublesome bleeding may be encountered. The bladder pillars also transmit the ureters from the cardinal ligament to the bladder base. The bladder is usually easily separated from the cervix. However, at the level of the cervicovaginal junction the bladder is attached to the cervix by the transverse vesicocervical ligament, which demarcates the vesicocervical space from the vesicovaginal space. The dissection is continued through the vesicocervical ligament by using the ESU to superficially incise the tissue 2 to 3 mm above the visible edge of the bladder in a curvilinear fashion, with gentle downward counter-traction on the bladder with smooth forceps. The bladder should be mobilized at least 1 cm below the cervicovaginal junction (**Figure 2.4**). While some surgeons prefer to bluntly mobilize the bladder with a spongestick, this maneuver can result in unnecessary trauma to the bladder and is not recommended.

Attention is then directed toward dividing the uterine vessels and cardinal ligaments. Clamp placement across the uterine vessels and cardinal ligament is a common area of ureteral injury during abdominal hysterectomy. The medial leaf of the broad ligament peritoneum is incised posteriorly and medially toward the uterosacral ligament, releasing the ureter laterally. Excess peritoneum and areolar tissue is carefully dissected from around the uterine vessels, but overzealous efforts to "skeletonize" the uterine vessels should be avoided. The uterine vessels are secured with a heavy curved clamp (Heaney, Zeppelin, or Masterson) placed perpendicular to the long axis of the uterus at the level of the uterine isthmus (internal cervical os). At the level of the uterine isthmus, the clamp will be 1.0 to 1.5 cm above the ureter as it traverses the cardinal ligament. The tip of the clamp is placed against the uterus to ensure the uterine vessels are completely encompassed. The clamp should be placed across the pedicle as close to a 90° angle as possible, rather than the diagonal, to minimize the amount of tissue incorporated in the pedicle. A second clamp (straight Kocher) is placed just above the Heaney clamp at a 45° angle to control back-bleeding from the uterine

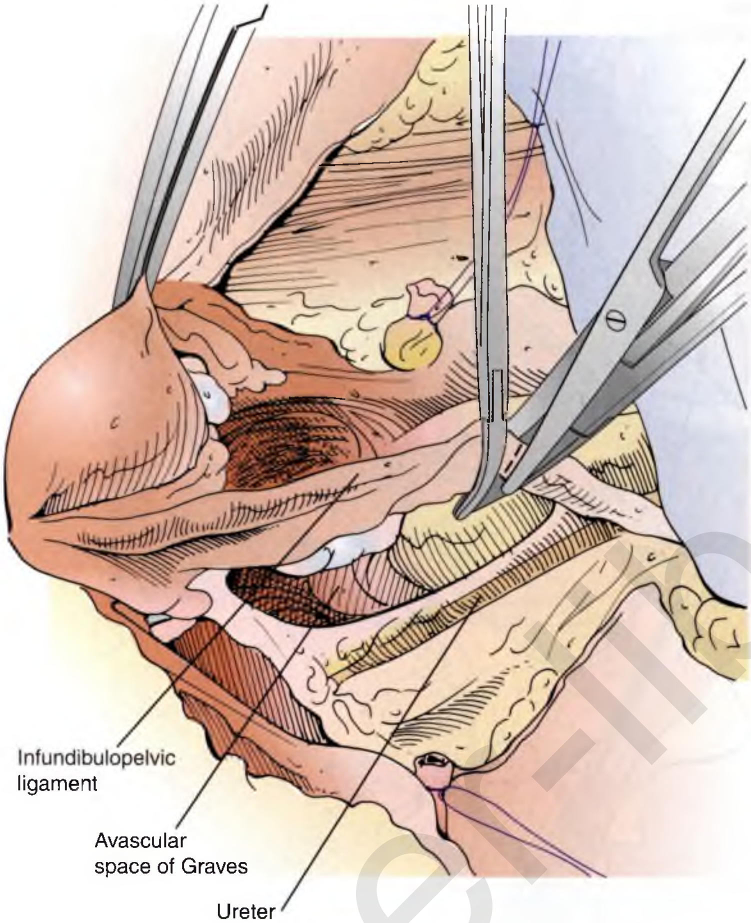

FIGURE 2.3 Total abdominal hysterectomy: Division of infundibulopelvic ligament.

side (**Figure 2.5**). The uterine vessels are divided and ligated with a 1-0 delayed absorbable suture. The needle should be placed precisely at the lower border of the tip of the clamp; the suture is tied down as the clamp is released. Some surgeons prefer to place a second suture in a transfixion stitch distal to initial ligature; however, this is usually unnecessary. The pedicle of the uterine-side back-clamp is secured with a 1-0 suture ligature in a Heaney transfixion stitch and the clamp removed to clear the operative field. To reduce back-bleeding from the specimen during the cardinal ligament dissection, the contralateral uterine vessel pedicle should be clamped, divided, and ligated at this time.

The uterus should be maintained on upward traction using the long Kelly clamps holding the fundus throughout the case, as this will provide the best exposure to the focal point of the operative field. Each cardinal ligament is taken down with a series of pedicles. A heavy straight clamp (e.g., Heaney, Zeppelin, and Masterson) is placed right next to the cervix, almost parallel to the long axis of the uterus, and the pedicle divided (**Figure 2.6**) and ligated with a 1-0 delayed absorbable suture placed in the same fashion as for the uterine pedicle. Usually, two or three “bites” are required to completely divide the cardinal ligament down to the level of the cervicovaginal junction. In this series of steps, the tip of the clamp is placed so as to slide off the lateral portion of the cervix as the clamp is closed, and the jaw of the clamp juxtaposed to the cut edge of the previous pedicle to ensure that all cardinal ligament tissue is incorporated in one of the suture ligatures. Each subsequent “bite” is placed medial to the previous pedicle to ensure that the ureter remains lateral to the point of active dissection. The same sequence of steps is repeated on the contralateral side.

The posterior cul de sac should be inspected to determine the position of the rectum relative to the posterior cervix and vaginal wall. If the rectum is adherent in this area and exposure to the posterior proximal vagina is inadequate, the rectovaginal space should be developed and the rectum sharply dissected free.

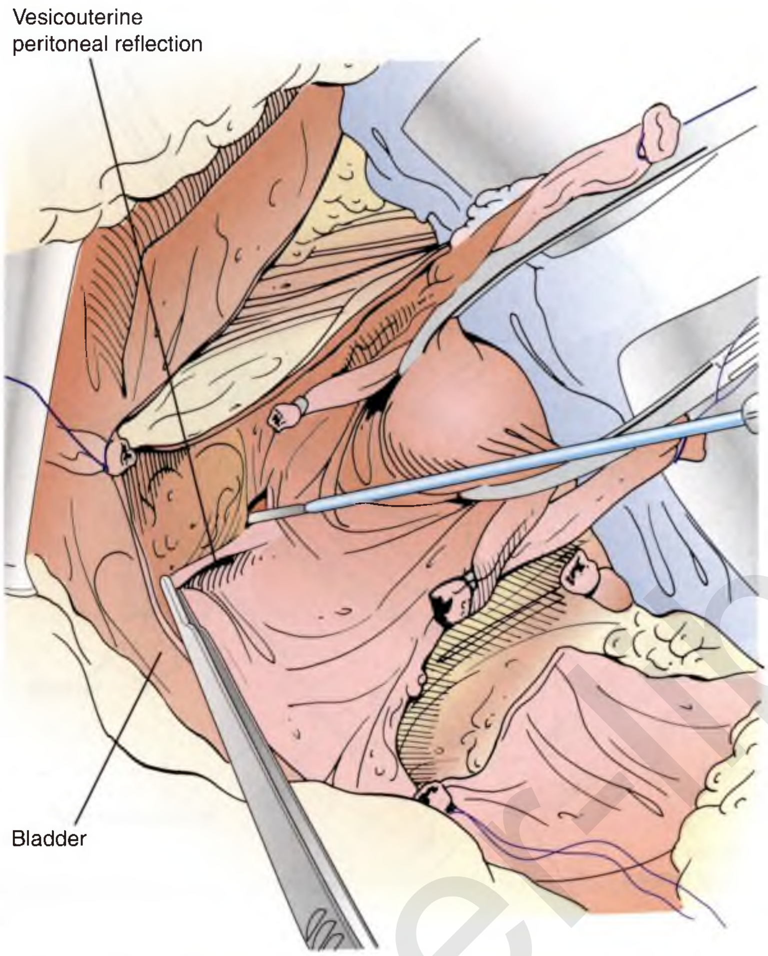

FIGURE 2.4 Total abdominal hysterectomy: Dissection of the bladder from the anterior lower uterine segment and cervix.

A variety of techniques can be used to transect the uterus and cervix from the proximal vagina, depending on the clinical situation and anatomy. The easiest and most straightforward technique consists of placing heavy curved clamps (e.g., Heaney, Zeppelin, and Masterson) from each side below the cervix across the cervicovaginal junction, at right angles to the long axis of the uterus, and dividing the cervix from the upper vagina with heavy curved scissors (**Figure 2.7**). To avoid injury to the bladder, the bladder must be mobilized at least 1 cm below the cervicovaginal junction to allow safe placement of these clamps and permit sufficient space for suture ligating the pedicles without incorporating the bladder. These clamps incorporate the lower cardinal ligaments, the lateral vagina, and the uterosacral ligaments. The vagina is closed with a Heaney transfixion stitch of 1-0 delayed absorbable suture at each angle and a series of figure-of-eight stitches working toward the midline to complete the closure (**Figure 2.8**). Each suture is held long and used to provide upward traction on the vaginal cuff prior to placement of the next stitch. This technique is well suited for the patient with a short cervix and clearly demarcated cul de sac. For patients with a cervix that protrudes more than 1 to 2 cm into the vagina, this technique requires resection of a portion of the upper vagina (to have sufficient room to place clamps beneath) and results in unnecessary shortening of the vagina.

The technique of retrograde hysterectomy is an excellent alternative in the case of an elongated cervix or obliterated cul de sac. In this method, an anterior colpotomy is created 0.5 to 1.0 cm below the cervicovaginal junction using the ESU. An empty spongestick placed transvaginally and elevated against the anterior cervicovaginal junction delineates the anatomy and provides a convenient starting point for the colpotomy. The cervicovaginal junction is circumferentially incised by placing a series of curved Heaney clamps, with each pedicle being clamped, divided, and secured with a Heaney transfixion stitch of 1-0 delayed absorbable suture in sequence (i.e., each

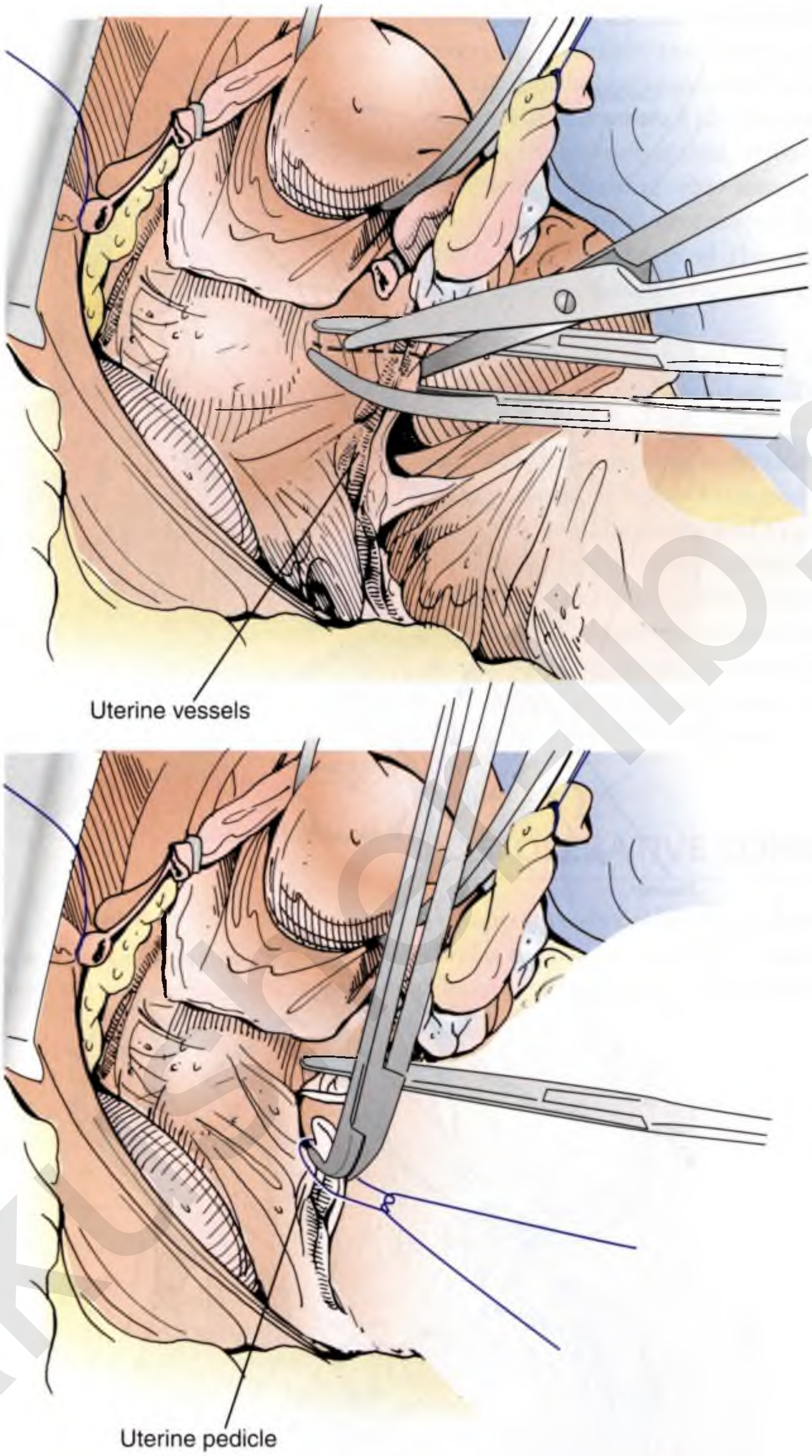

FIGURE 2.5 Total abdominal hysterectomy: Division of uterine vessels. The pedicle is ligated (inset).

pedicle is tied before the next clamp is placed). The ties from each pedicle are held long and used to provide upward traction on the vaginal cuff, optimizing exposure for placement of the next clamp. Grasping the cervix with a straight Kocher clamp and applying upward traction will also improve exposure. The final two clamps are placed across the posterior proximal vagina and the specimen excised. A simple method for closing the vaginal cuff consists of placing a horizontal mattress stitch of 1-0 delayed absorbable suture on either side of the vaginal cuff, working from posterior to anterior, below the tip of the

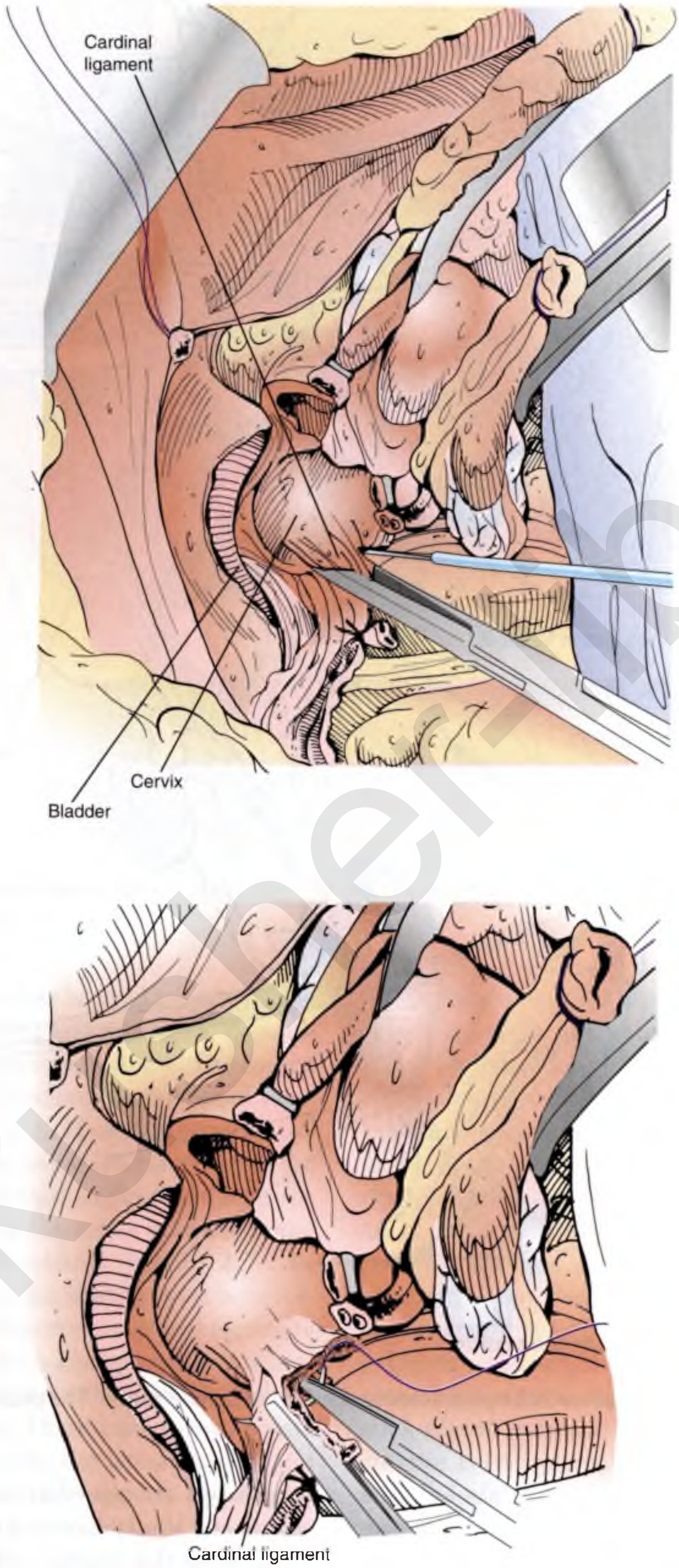

FIGURE 2.6 Total abdominal hysterectomy: Transection of the cardinal ligament. The pedicle is ligated (inset).

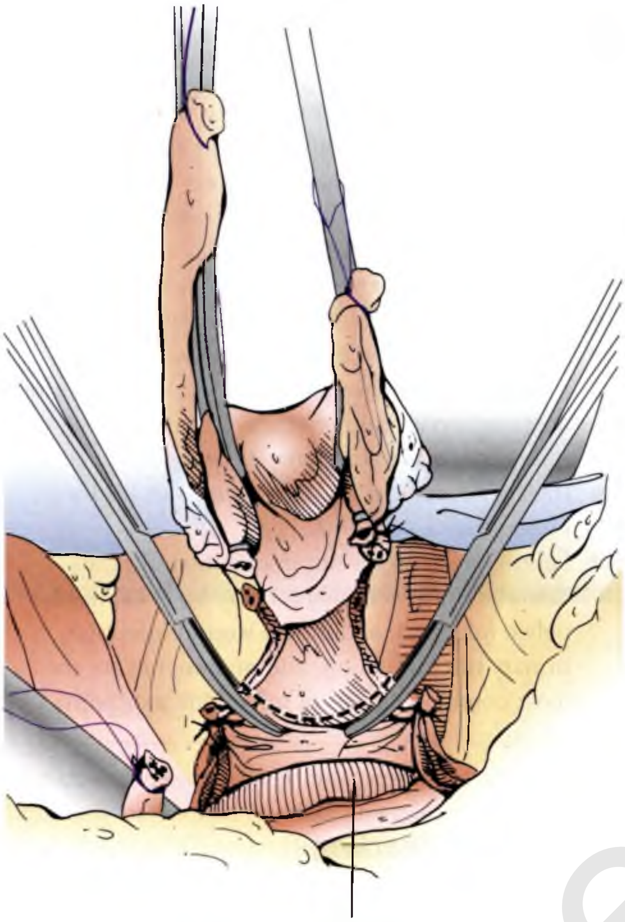

FIGURE 2.7 Total abdominal hysterectomy: Transection of the uterus and cervix from the proximal vagina.

clamp, through the medial anterior vaginal wall, then reversing direction and placing the needle through the anterior lateral vaginal wall and exiting the posterior lateral vaginal wall just beneath the "heal" of the clamp. The suture is tied as the clamp is released, effectively securing the lower cardinal ligament, lateral vagina, and uterosacral ligament in a single stitch. The remainder of the vaginal cuff is closed with several figure-of-eight stitches of 1-0 delayed absorbable suture.

The pelvis is irrigated and all dissection areas inspected to ensure hemostasis. The course and safety of the ureters should be verified. If there is any concern over a possible ureteral or bladder injury, cystoscopic examination with intravenous methylene blue or indigo carmine should be performed to assess the integrity of the urinary tract. If the hysterectomy has been complicated by distorted pelvic anatomy associated with large uterine leiomyomata (especially broad ligament or lower uterine segment), severe endometriosis, or malignancy, cystoscopic examination of the lower urinary tract should also be considered.

POSTOPERATIVE CONSIDERATIONS

Postoperative care following abdominal hysterectomy is similar to that for any other major abdominal surgery. The overall incidence of morbidity is approximately

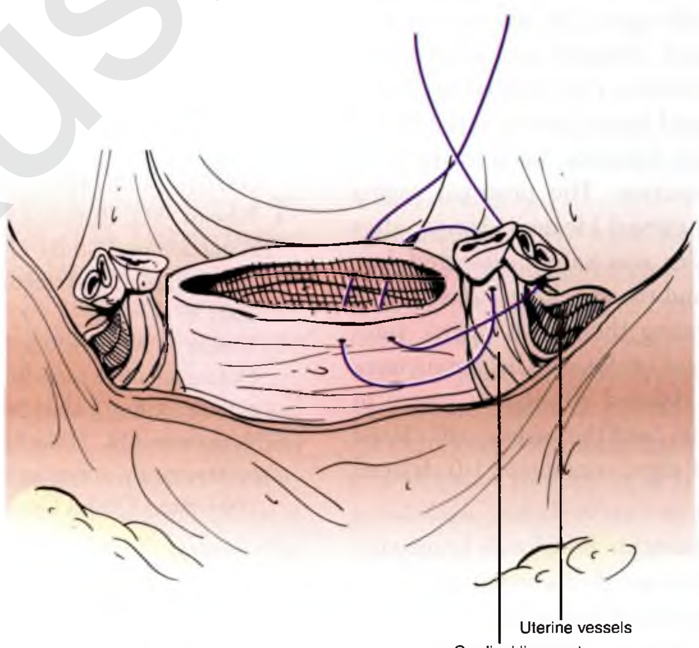

FIGURE 2.8 Total abdominal hysterectomy: Closure of the vaginal cuff.

17%, with most instances related to febrile morbidity or infectious complications (e.g., pelvic abscess, vaginal cuff cellulitis, urinary tract infection, and pneumonia). The risk of urinary tract injury is <1%, but can vary by surgical indication and complexity of procedure. An indwelling catheter is continued overnight and removed on the first postoperative day unless there is has been a bladder or ureteral repair. Diet can usually be advanced rapidly according to patient tolerance and clinical examination. Criteria for discharge include afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, satisfactory bowel and bladder function, and evidence of appropriate wound healing. Postoperative activity should be individualized; however, vaginal intercourse should be restricted for 6 to 8 weeks and a pelvic examination should be performed to confirm integrity of the vaginal cuff.

Operative Note

PROCEDURE: TOTAL ABDOMINAL HYSTERECTOMY

The uterus was grasped and elevated and the round ligaments suture ligated and divided. The pelvic peritoneal sidewalls were incised parallel to the external iliac vessels and the pararectal spaces developed with visualization of the ureters. The infundibulopelvic ligaments were isolated, doubly clamped, divided, and ligated with 1-0 delayed absorbable suture. The vesicouterine peritoneal reflection was incised and the bladder reflected off of the anterior lower uterine segment, cervix, and proximal vagina. The uterine vascular pedicles were skeletonized, clamped, and ligated with 1-0 delayed absorbable sutures. The cardinal ligaments were clamped, divided, and ligated with a series of 1-0 delayed absorbable suture ligatures down to the level of the cervicovaginal junction. The proximal vagina was cross-clamped with curved Heaney clamps, after ensuring that the bladder was safely dissected free from the upper vagina, and the specimen excised. The vaginal angles, incorporating the lateral vagina, inferior cardinal ligaments, and uterosacral ligaments were suture ligated with 1-0 delayed absorbable suture in Heaney transfixion stitches, and the vaginal cuff closed with a series of figure-of-eight stitches of 1-0 delayed absorbable suture.

COMPLICATIONS

- The most common sites of ureteral injury during abdominal hysterectomy are (a) the pelvic brim in proximity to the ovarian vessels (division of infundibulopelvic ligament), (b) the parametrium (division of uterine vascular and cardinal ligament pedicles), and (c) the bladder base (transection of cervix from proximal vagina).
- The most common cause of bladder injury is inadequate mobilization of the bladder from the anterior cervix and proximal vagina, resulting in injury to the bladder dome or base when placing the cervicovaginal junction clamps or suturing closed the vaginal cuff.
- Febrile morbidity is not uncommon after abdominal hysterectomy and may be unexplained; pelvic infection, abdominal wound infection, urinary tract infection, and pneumonia are the most common causes of infectious morbidity.

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CHAPTER 3

Total Vaginal Hysterectomy

Roxana Geoffrion

INTRODUCTION

After cesarean section, hysterectomy is the second most commonly performed surgical procedure in the United States (US) and Canada. Despite the availability of conservative alternatives, hysterectomy rates and indications have not changed significantly over the past few years. A hysterectomy rate of approximately 5 per 1,000 US patients has stayed the same since 1995. In Canada, rates vary from province to province, with the highest rates (around 5 per 1,000) in Prince Edward Island and the lowest rates (around 2 per 1,000) in Nunavut.

Uterine fibroids provide the most common indication for hysterectomy, followed by menstrual disturbances, prolapse, and endometriosis. Other benign indications include dysmenorrhea and adenomyosis, cervical dysplasia, endometrial hyperplasia, and pelvic inflammatory disease. Vaginal hysterectomy only accounts for approximately 20% of all hysterectomies in the US, as laparotomy is by far the most common route for hysterectomy. This is different from some European countries where one out of two hysterectomies is performed transvaginally.

The vaginal route is associated with decreased postoperative febrile morbidity, a shorter duration of hospital stay, and a speedier patient return to normal activities when compared to the abdominal route for hysterectomy. Intraoperative complications arise with similar or lesser frequency during vaginal when compared to abdominal hysterectomies via laparotomy or laparoscopy. Whenever possible, vaginal hysterectomy should be the preferred route. Bilateral salpingo-oophorectomy is also feasible vaginally in most cases and should not be considered a contraindication to performing a hysterectomy via the vaginal route.

PREOPERATIVE CONSIDERATIONS

Patients should be counseled regarding alternatives to hysterectomy, such as uterine artery embolization for fibroids, hormonal treatments or endometrial ablation for menstrual disturbances, vaginal pessaries for prolapse, gonadotropin-releasing hormone (GnRH) analogue or pain management for endometriosis, and progestins for endometrial hyperplasia. Completion of childbearing and the use of a reliable method of contraception until surgery should be confirmed with the patient. A history of cervical cytology should be carefully reviewed and abnormal results should be clarified. Symptomatic pelvic organ prolapse and stress urinary incontinence should be carefully assessed before surgery, so that the merits of concurrent surgical management at the time of hysterectomy can be discussed with the patient. Hysterectomy alone is not adequate surgical treatment of pelvic organ prolapse. If physical examination is inconclusive at determining the size and shape of the uterus or is indicative of additional gynecologic pathology such as an adnexal mass, a pelvic ultrasound should be obtained prior to determination of surgical approach. If menstrual bleeding is irregular or excessive, an endometrial biopsy should be obtained, especially in women over 35. An endometrial biopsy should also be obtained with postmenopausal bleeding.

Typically, a vaginal hysterectomy is feasible if the uterine size does not exceed the size of a 12-week gravid uterus. Consideration should be given to the use of a GnRH analogue preoperatively if the uterine size can be reduced enough to make the vaginal approach feasible. A very narrow (less than 90°) pubic arch can make a vaginal approach challenging. The shape of the uterus should also be assessed. If the uterus is enlarged due to the presence of a pedunculated subserosal fibroid floating above it, a vaginal hysterectomy may be feasible. Conversely, if the fibroids are mainly intramural and give the uterus a cannonball shape or extend too far laterally or into the cervix, a vaginal approach may be extremely challenging. The vaginal surgeon can rely on a variety of techniques for uterine debulking intraoperatively (such as bivalving, coring, and sequential myomectomy); however, these only become available once the uterine artery pedicles have been divided. Consequently, the cardinal ligaments need to be sufficiently low and accessible for clamping vaginally to improve feasibility of vaginal hysterectomy for an enlarged uterus.

Patients should also be counseled regarding salpingectomy and oophorectomy at the time of vaginal hysterectomy. There is some evidence to suggest salpingectomy may decrease the lifetime incidence of ovarian cancer as some of these cancers may originate in the Fallopian tubes. Currently, one out of two US women undergoing hysterectomy for benign disease also receives prophylactic oophorectomy. Prophylactic bilateral oophorectomy seems to be harmful prior to age 55, as there is an 8.6% excess mortality by age 80. There is decreasing benefit of ovarian conservation until the age of 75, when excess mortality for oophorectomy is less than 1%.

A complete physical examination should be performed preoperatively and blood work, a chest X-ray and electrocardiogram, as well as other investigations should be ordered depending on patient-specific health concerns. The patient should be assessed for preoperative anemia, especially if the reason for hysterectomy is abnormal uterine bleeding. If anemia is present, iron supplements or GnRH analogue are helpful to correct anemia prior to surgery. In cases of severe anemia, preoperative blood transfusion should be considered. If intraoperative blood loss is expected to be significant, such as in the case of large fibroids, cross-matched packed red blood cells should be available for intraoperative transfusion. In any case, a preoperative Type and Screen is prudent. Drugs and supplements that increase the risk of surgical bleeding should be discontinued prior to surgery. Patients taking oral contraceptives for abnormal uterine bleeding may not be able to discontinue them prior to surgery. In these patients, there is a moderate risk of venous thromboembolism based on this risk factor alone, so careful prophylaxis against deep vein thrombosis should be administered. Preoperative bowel preparation is not necessary for vaginal hysterectomy.

Prophylactic antibiotics should be administered prior to incision. A first-generation cephalosporin should be the first choice, but clindamycin, erythromycin, or metronidazole are also acceptable choices for those allergic to penicillin or cephalosporins. An assessment of risk for deep venous thromboembolism is indicated, and given the lithotomy position and length of case, some prophylactic measure, whether pharmaceutical or mechanical, is usually appropriate. We use sequential compression devices applied prior to surgery and maintained intraoperatively and postoperatively until the patient is fully ambulatory. Consideration should be given to simultaneous postoperative anticoagulation with heparin or low molecular weight heparin in patients at moderate risk for deep vein thrombosis. Heparin or low molecular weight heparin should be given to patients at high risk for deep vein thrombosis. Following is a brief description of the surgical procedure used (see also video: *Total Vaginal Hysterectomy*).

SURGICAL TECHNIQUE

In preparation for vaginal hysterectomy, the patient is placed in comfortable dorsal lithotomy position, with the edge of her hips just over the edge of the operating table. Hip hyperflexion and excessive external rotation are avoided to prevent injury to the femoral and sciatic nerves. The patient's lower legs are elevated to allow enough space for surgeon and assistants to operate comfortably. A metallic shelf or Mayo tray can be used to hold instruments close to the surgical field, as space is lacking for the scrub nurse to pass required instruments back and forth easily (as during abdominal cases). The patient's skin is prepared with a scrub solution from lower abdomen to upper medial thighs bilaterally; an internal vaginal scrub is also required. Surgical lights are directed onto the surgical field although a head lamp may be utilized for optimal visualization.

A pelvic examination under anesthesia is performed to assess the size and shape of the uterus and any pelvic pathology including pelvic organ prolapse. The bladder is emptied. Some surgeons prefer to leave a Foley catheter in place for intraoperative bladder drainage, while others prefer to perform the surgery with a full bladder, which facilitates recognition of inadvertent cystotomy.

A weighted speculum or a Jackson retractor is placed in the posterior vagina and lateral vaginal retractors such as curved Deavers are used to facilitate exposure.

The cervix is visualized and grasped with a Lahey thyroid clamp. Alternatively, two tenaculums, one on the anterior and one on the posterior cervical lip, can be used for downward traction on the cervix. The cervical clamp as well as Deaver retractors can be moved around during the operation to provide optimum exposure. The proper use of these instruments for traction and countertraction is essential for the correct performance of the operation. Pulling the cervix upward and out assists in identification of the uterosacral ligaments at the back of the uterus. Their three-dimensional orientation is 45° downward, posteriorly and lateral to the cervix. Downward traction on the cervix also protects the ureters during placement of clamps on the pedicles.

Next, the cervicovaginal junction is infiltrated with saline or a vasoconstrictive agent circumferentially. (**Figure 3.1**) This facilitates dissection in the proper plane and also acts as an internal tourniquet, decreasing blood loss. The cervicovaginal junction is then incised with scalpel or cautery circumferentially (**Figure 3.2**). As much as possible, the cutting instrument at the cervicovaginal junction should be held perpendicular to the cut tissues. A U- or V-shaped incision is made at the back, with the apex of the incision extending into the posterior vaginal fornix behind the junction of the two uterosacral ligaments. If this incision is made too distal on the posterior cervix, unnecessary bleeding will be encountered as the surgeon struggles to find the right plane for the posterior colpotomy.

A traction retractor is then placed in the midline anteriorly to retract the bladder upward; countertraction is provided by pulling downward on the anterior cervix. The anterior colpotomy is started by finding the right plane between the cervix and bladder. Dissection in this plane can be performed with Metzenbaum scissors held at 45° against the anterior cervix and with Debakie forceps holding the anterior vaginal mucosa up. Gentle finger dissection can be used to identify the proper plane. Dissection in the wrong plane and especially too deep within the cervix causes

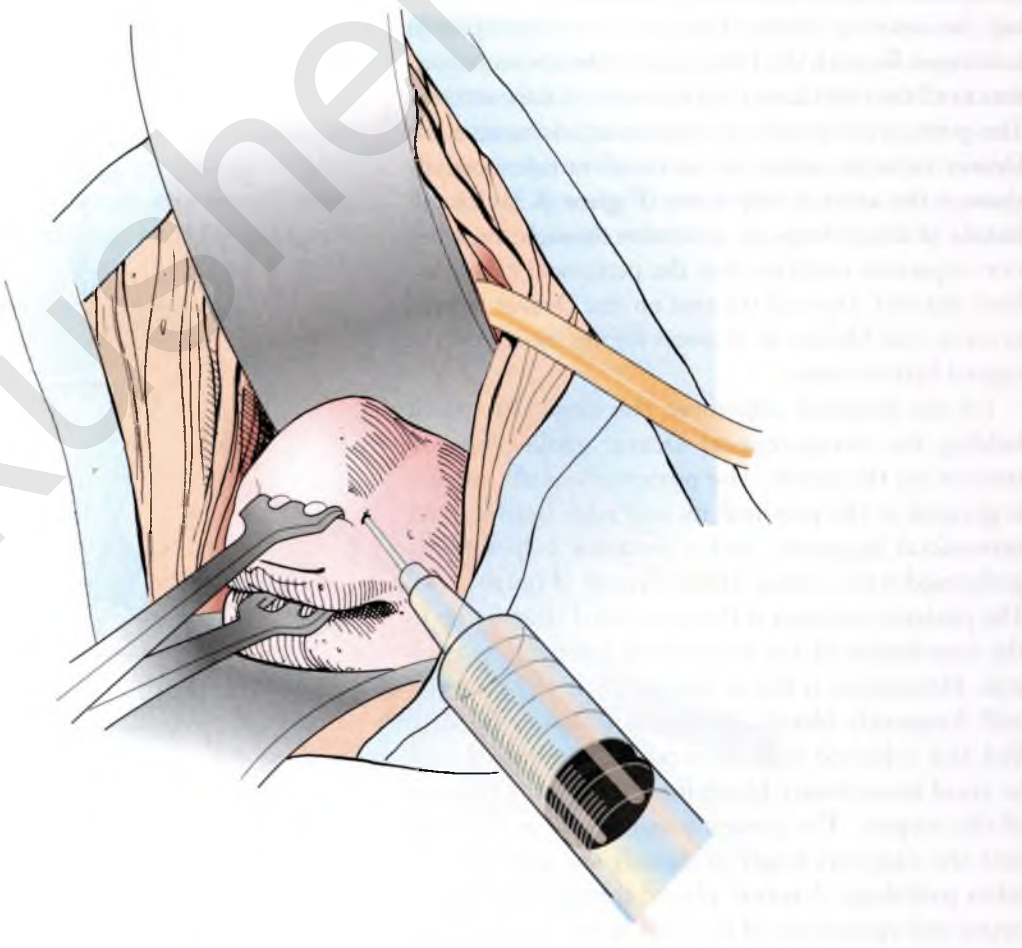

FIGURE 3.1 Infiltration of local anesthetic at the cervicovaginal junction.

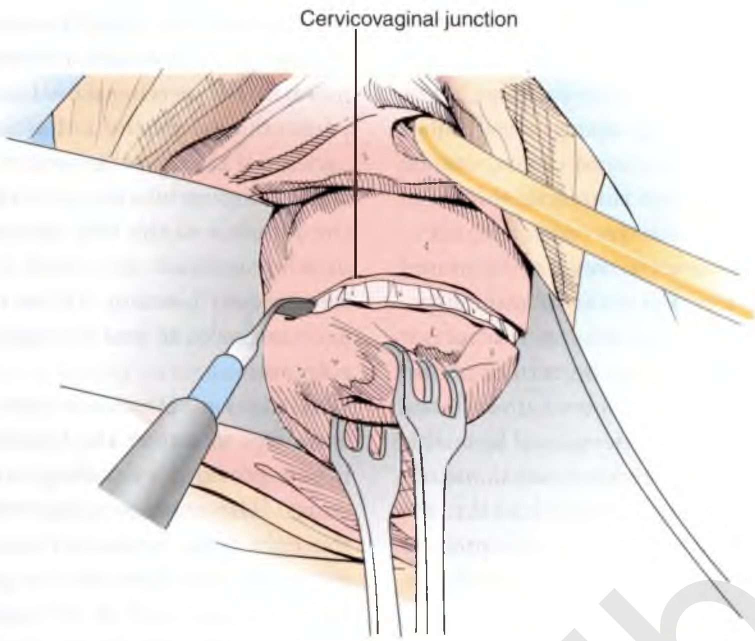

FIGURE 3.2 Circumferential incision of the cervicovaginal junction.

brisk bleeding. As the dissection progresses superiorly, the bladder is lifted anteriorly by advancing and retracting the anterior Deaver retractor. The dissection is continued beneath the Deaver with Metzenbaum scissors until the filmy layer of peritoneum is encountered. The peritoneum is then cut open to accommodate the Deaver retractor, which is advanced intraperitoneally through the anterior colpotomy (**Figure 3.3**). Visualization of bowel loops or omentum through the anterior colpotomy confirms that the peritoneal cavity has been entered. Upward traction on the Deaver is used to retract the bladder at all times during the rest of the vaginal hysterectomy.

For the posterior colpotomy, the surgical assistant holding the intraperitoneal Deaver applies upward traction on the cervix. The posterior vaginal mucosa is grasped at the proximal incised edge between the uterosacral ligaments, and a posterior colpotomy is performed with curved Mayo scissors (**Figure 3.4**). The posterior incision is then extended laterally up to the attachment of the uterosacral ligament on each side. Hemostasis is key at this point, as the posterior cuff frequently bleeds. Hemostasis should be verified and achieved with cautery or a running suture to avoid unnecessary blood loss throughout the rest of the surgery. The posterior cul-de-sac is explored with the surgeon's finger to identify any adhesions or other pathology. A suture placed through the peritoneum and epithelium of the cuff helps to define the cul-de-sac.

On occasion, if the anterior colpotomy proves to be challenging, posterior colpotomy is performed first. If the uterus is small, the surgeon can insert the index and middle fingers of the nondominant hand through

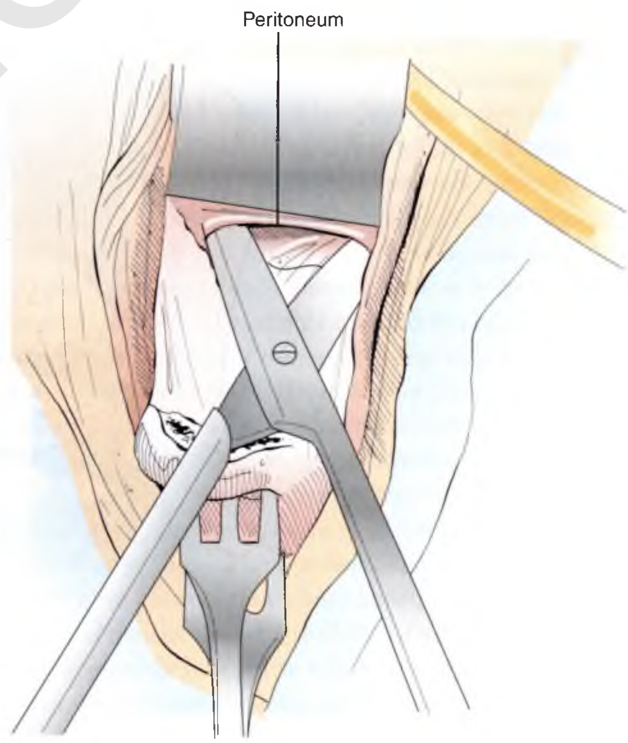

FIGURE 3.3 Anterior colpotomy achieved through traction on anterior retractor and sharp dissection.

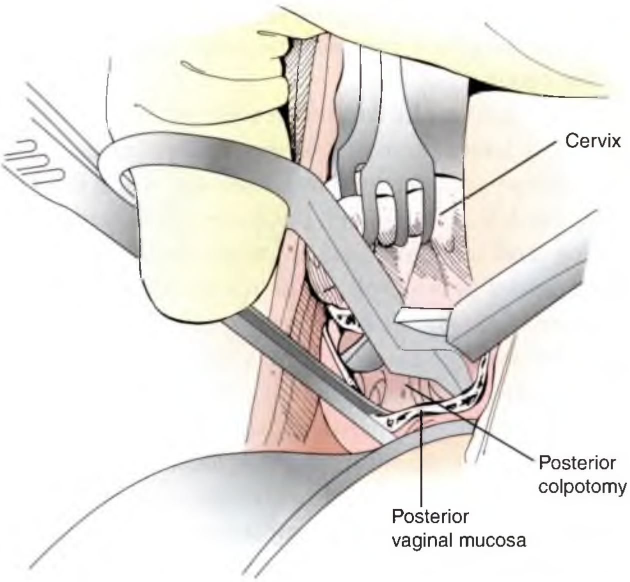

FIGURE 3.4 Posterior colpotomy achieved through sharp entry into the cul-de-sac.

the posterior colpotomy and around the uterus over the top of the broad ligament. The anterior bladder reflection is then palpated intraperitoneally and the border between the bladder and the anterior aspect of the uterus is identified. The dominant hand is then used to dissect at this border with scissors and penetrate the anterior peritoneum.

The uterus is removed through sequential clamping, cutting, and suture-ligating pedicles bilaterally from the uterosacral ligaments to the utero-ovarian ligaments. The role of the assistant in providing optimal retraction and visualization cannot be over stated. The anterior retractor holds the bladder anteriorly, as previously noted. The uterosacral ligaments are again palpated and their three-dimensional orientation identified and a posterior (weighted or Jackson) speculum is placed over the vaginal cuff into the cul-de-sac. A lateral retractor is placed to retract the lateral vaginal wall on the side where the first uterosacral pedicle is to be clamped.

The uterus is initially held upward and away from the side where the uterosacral ligament is being clamped. Downward traction is essential to protecting the ureter, which is on average 1.4 cm lateral to the uterine artery. As the first curved clamp is applied onto the uterosacral ligament, the posterior tip should minimally overlap the posterior cervix, then the anterior tip is brought against the anterior cervix, also minimally overlapping the cervix, then the handle is directed superiorly to bring both tips together as the clamp is closed (**Figure 3.5**). Clamp tips should slide off the body of the cervix. Some surgeons use the fingers of the nondominant hand to guide the clamp tips against the cervix, while palpating to ensure that no intra-abdominal structures are being incorporated into the pedicle. Every effort should be made to catch the edge of the peritoneum both anteriorly and posteriorly, as this insures that the clamp is fully isolating the broad ligament through which the uterine artery passes. The surgeon holding the cervical clamp should

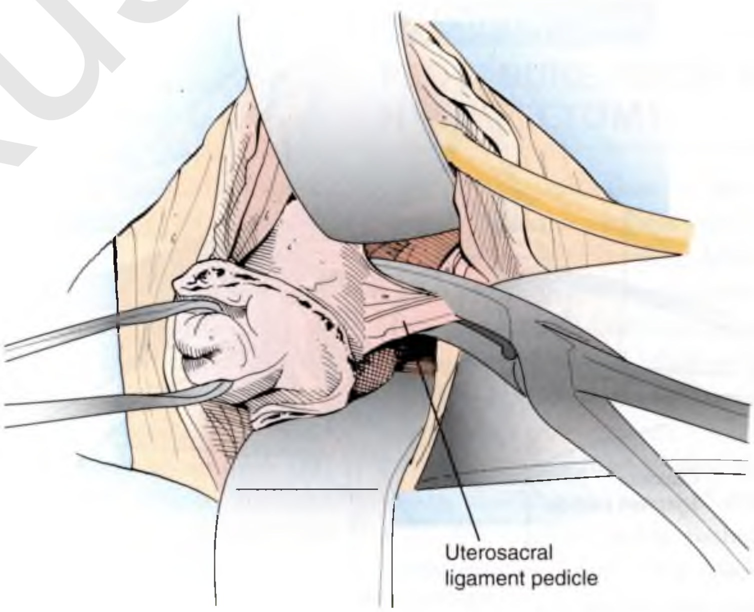

FIGURE 3.5 Uterosacral ligament pedicle.

swing it downwards as the uterosacral clamp is being applied; this is to allow visualization of the anterior tip of the clamp and to ensure that the bladder has not been incorporated. Clamps should be closed to the last notch to avoid losing the pedicles. The uterosacral pedicles are then cut with curved Mayo scissors or scalpel down to the tip of the clamp against the cervix. Transfixion sutures are used to tie the uterosacral pedicles, which are thick and relatively avascular. A 2-0 or larger delayed absorbable suture is appropriate. We use 2-0 polyglactin 910 because its multifilament nature makes it easy to tie. Once the uterosacral ligament has been suture-ligated, the suture should be clamped and held, and the same process applied to the contralateral uterosacral ligament. New surgeons should strive to develop ambidexterity in placing clamps as it provides a significant advantage to use the ipsilateral hand when the hysterectomy is challenging.

Successive clamps are placed on the cardinal ligaments, each followed by cutting and suture-ligating the pedicles (**Figure 3.6**). The bottom jaw of each clamp is placed behind the cervix into the posterior cul-de-sac and may be guided by the surgeon's nondominant index finger to avoid clipping intraperitoneal organs. The tip of the anterior jaw then slides off the anterior aspect of the cervix as the clamp is closed. Generous bites on the cardinal ligaments should be avoided, given the ureters run approximately 1 cm superior to the uterine vessels within these ligaments. Each clamp is placed as close to the uterus as possible and stays medial to the previously tied pedicle. In tying down sutures, the most efficient use of limited space is to push down the knot with the surgeon's contralateral index finger posterior to the cervix.

After ligating the uterine vessels bilaterally, if the uterus is large, there are several options to decrease the uterine volume, thereby increasing space for further pedicle placement. Bivalving, intramyometrial coring, and sequential myomectomy are all options to allow easier delivery of the uterus through the vault. Further clamps are placed sequentially on the broad ligament, and pedicles are cut and suture-ligated up to the utero-ovarian ligaments. The uterine fundus is then carefully palpated to rule out any adhesions of intestine or omentum at this location. A curved Rogers clamp is then used to clamp the utero-ovarian, round and Fallopian tube simultaneously. This can be accomplished in either the up–down or the down–up approach, but the tips should be visualized during closure to prevent inadvertent inclusion of bowel. Some surgeons doubly clamp the utero-ovarian artery, but we find this overcautious and compromising of limited space. Both sides may be clamped before cutting the pedicles (**Figure 3.7**). The uterus is then completely divided and delivered to the surgical scrub nurse.

The thick pedicles at the top can be free-tied first to bunch the pedicle. Both pedicles are then suture-ligated usually using a fore-and-aft stitch. The suture ends are held carefully for assessment of hemostasis. If visualization is hampered by the presence of protruding

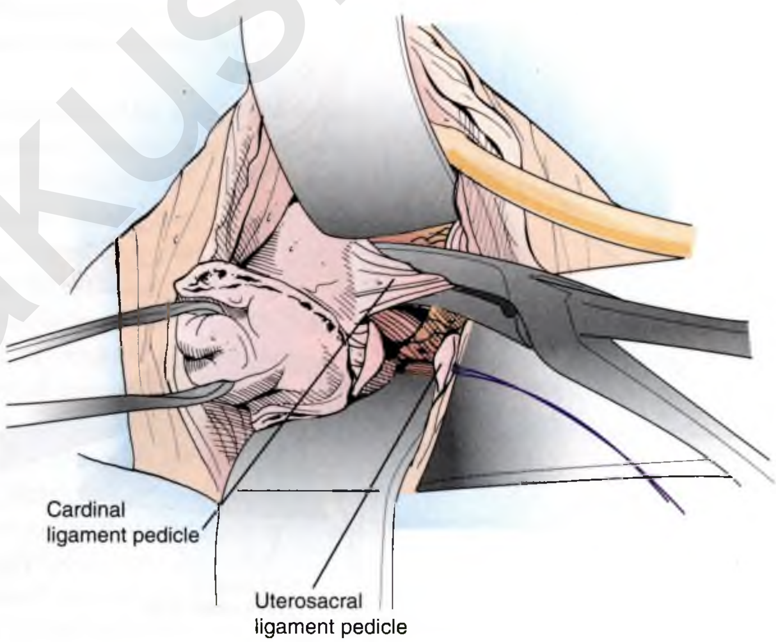

FIGURE 3.6 Cardinal ligament pedicle.

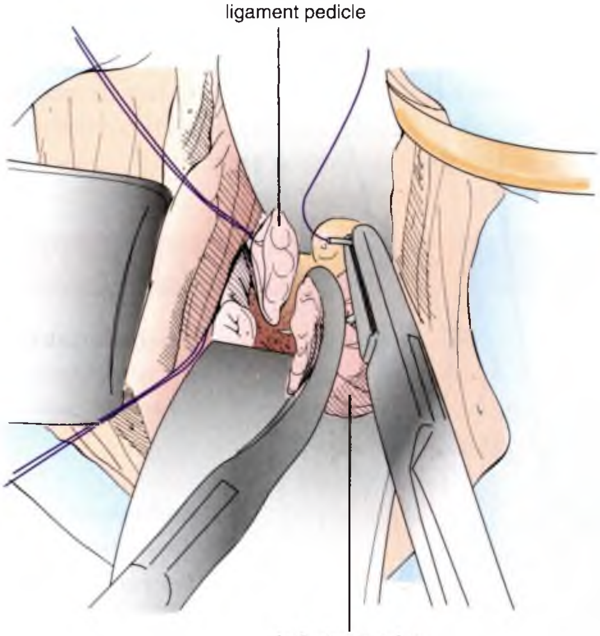

FIGURE 3.7 Uteroovarian pedicle.

small bowel loops, the small bowel is packed away using a moist lap sponge. All pedicles are inspected for hemostasis. All pedicles should run between the uterosacral ligament pedicle and utero-ovarian pedicle, so gentle traction of the utero-ovarian pedicle toward the contralateral side with simultaneous traction on the uterosacral pedicle provides easy visualization of all pedicles on that side. If bleeding vessels are encountered, cautery or sutures can be used for control. Alternatively, shallow figure-of-eight sutures can be used with caution, as the ureters are always in close proximity laterally.

Once hemostasis is confirmed, the adnexal areas are palpated for any unrecognized pathology or adhesions and visualized with gentle traction on the tuboovarian pedicles. If concurrent salpingectomy or adnexectomy is not planned, then the utero-ovarian pedicle can be cut and the vaginal vault closed.

The apical support of the vaginal vault is provided by the attachments of the uterosacral ligaments and cardinal ligaments to the cervix. Removing the cervix, therefore, compromises the normal apical support of the vaginal vault, unless the vaginal vault is reattached to these ligaments. Some surgeons accomplish this by doing a concurrent McCall culdoplasty, although if this approach is pursued, cystoscopy should be performed to ensure patency of the ureters, given a reported 6% rate of obstruction. A simpler approach is to take the suture arms of the uterosacral pedicle back through the vaginal vault ipsilaterally using a free needle. One arm is brought through the vaginal vault anterior to the pedicle, while the other is brought through the vaginal vault posterior to the pedicle (**Figure 3.8**). These sutures are then tied and held to improve visualization while closing the intervening cuff. If hemostasis is adequate, the vaginal vault can be closed with a simple running suture. A running locking absorbable suture may be preferred if there is bleeding noted at the cuff. Vaginal packing is inadequate to prevent cuff bleeding, and is therefore not necessary unless vaginal repairs are done simultaneously. A Foley catheter needs to drain the urinary bladder and is inserted at the end of the procedure if an indwelling catheter has not been used.

POSTOPERATIVE CONSIDERATIONS

After isolated vaginal hysterectomy, the patient usually stays in hospital overnight. The Foley catheter is removed the next morning. Sequential compression devices are maintained until the patient is fully ambulatory. Diet should be as tolerated, with early feeding preferable and left to the patient's discretion. Postoperative pain is usually manageable with oral Tylenol and anti-inflammatory medication used alternatively every 2 hours. Narcotics are used only if required by the patient. The patient should abstain from sexual intercourse and tampon use for 6 weeks postoperatively. Heavy physical activities should be avoided during this healing period.

Operative Note

PROCEDURE: TOTAL VAGINAL HYSTERECTOMY

The patient was taken to the operating room; her identity and the surgical plan were confirmed during a preoperative briefing. After the establishment of adequate anesthesia, pneumatic compression devices were placed and antibiotic prophylaxis initiated. She was placed in a dorsal lithotomy position, and the vaginal field was prepped and draped. The operative team completed a time out.

A pelvic examination was conducted under anesthesia, checking the size and shape of the uterus, and any accompanying pelvic pathology. A size 14 Foley catheter was placed in the bladder for bladder drainage. A Jackson retractor was placed in the vagina and the cervix was grasped with a Lahey thyroid clamp. The

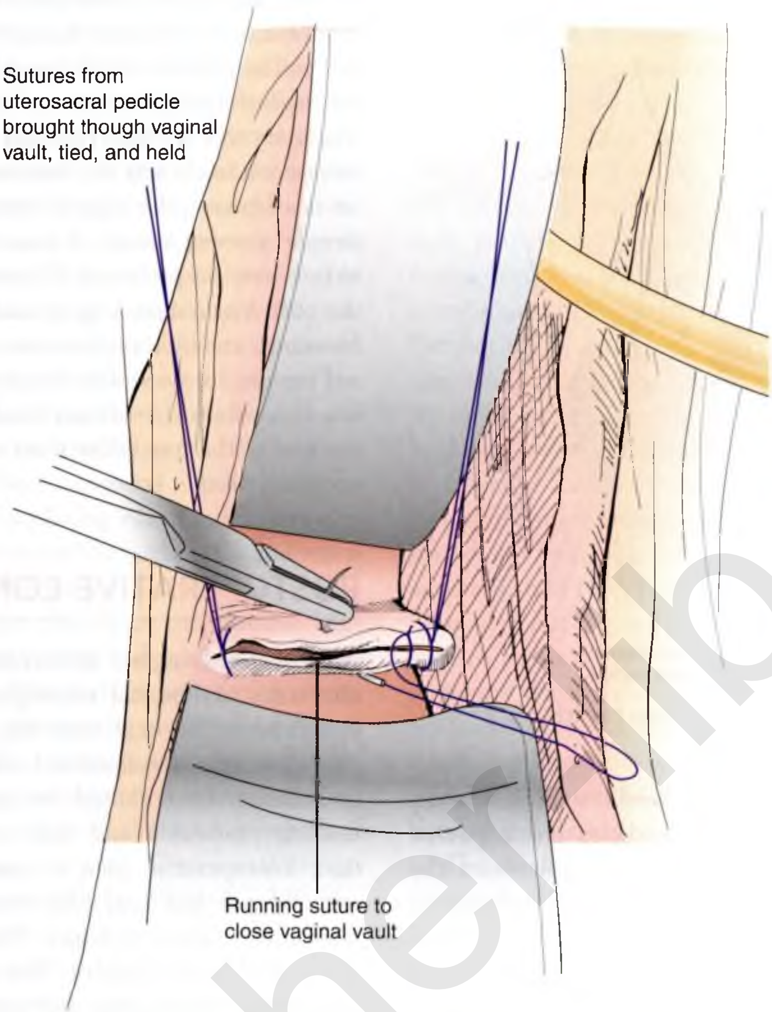

FIGURE 3.8 Cuff closure with reattachment of the uterosacral ligament to the vaginal cuff.

cervicovaginal junction and uterosacral ligaments were identified. The cervicovaginal junction was infiltrated with 1% lidocaine with epinephrine, and circumferentially incised. The vesicovaginal space was developed and an anterior colpotomy was performed. A Deaver retractor was placed into the peritoneal cavity anteriorly to retract the bladder. Bowel loops were visualized, confirming intraperitoneal location.

Posterior colpotomy was then performed. A stitch of 2-0 polyglactin 910 was placed through the peritoneum and vaginal epithelium in the midline and held. Hemostasis of the posterior vaginal cuff was achieved using electrocautery. The Jackson retractor was replaced over the posterior vaginal cuff. Palpation of the cul-de-sac, the intraperitoneal uterosacral ligaments, and the uterine fundus was carried out through the posterior colpotomy.

The uterosacral ligaments were clamped, cut, and suture-ligated using 2-0 polyglactin 910. The stitches on the uterosacral ligaments were clamped and held. The cardinal ligaments were clamped, cut and suture-ligated sequentially using 2-0 polyglactin 910. The right utero-ovarian ligament, round ligament, and fallopian tube were clamped; those on the left were then clamped. Both pedicles were then cut, free-tied and suture-ligated under direct visualization of adjacent bowel loops and bladder. The uterus was delivered to the scrub nurse, placed in formalin, and delivered to the Pathology Department for detailed evaluation.

The adnexal areas were palpated, then directly visualized using gentle traction on the utero-ovarian pedicles. All pedicles were then inspected for hemostasis, which was found to be adequate. The vaginal vault was then closed. First, a free needle was used to bring one arm of the held uterosacral stitch through the anterior vaginal cuff and the other through the posterior vaginal cuff, bilaterally. Both stitches were held and the intervening cuff was closed using a simple running 2-0 polyglactin

910 suture. At the end of the procedure, hemostasis was satisfactory. The patient was then cleaned, repositioned, extubated, and transported back to Recovery Room in stable condition. Sponge and instrument counts were correct. Estimated blood loss for this procedure was... There were no obvious complications.

COMPLICATIONS

Intraoperative	Postoperative
Conversion to laparotomy—4%	Combined—pulmonary complications, return to OR, wound dehiscence, hematoma—2%
Major hemorrhage (req. transfusion)—3%	
Bladder injury—1%	

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CHAPTER 4

Total Laparoscopic Hysterectomy

Robert E. Bristow

INTRODUCTION

Reich and colleagues reported the first case of laparoscopically assisted vaginal hysterectomy in 1989. Since that time, the use of laparoscopy to perform hysterectomy has increased concordant with the evolution of surgical techniques and instrumentation. There are several subdivisions of "laparoscopic hysterectomy" that are defined according to the extent of laparoscopic surgery used to accomplish surgical removal of the uterus. Vaginal hysterectomy (VH) assisted by laparoscopy includes laparoscopic lysis of adhesions or excision of endometriosis prior to vaginal hysterectomy. Laparoscopically assisted vaginal hysterectomy (LAVH) includes laparoscopic dissection down to but not including transection of the uterine arteries, with the remainder of the dissection being done via the vaginal approach. Laparoscopic hysterectomy (LH) extends the use of laparoscopy from LAVH to include transection of the uterine arteries, while colpotomy and division of the cardinal ligaments is performed vaginally. Total laparoscopic hysterectomy (TLH) consists of complete laparoscopic excision of the uterus with laparoscopic closure of the vaginal cuff.

The main advantage of laparoscopy for hysterectomy is to convert those cases that would otherwise have to be performed via an abdominal approach to a minimally invasive procedure. The indications for laparoscopic hysterectomy are the same as those for abdominal hysterectomy. Most minimally invasive hysterectomies performed in the United States are either LAVH or LH, although the frequency of TLH is increasing. This chapter describes one variation of the surgical approach to TLH.

PREOPERATIVE CONSIDERATIONS

A number of laparoscopic instruments have been developed to afford the laparoscopic surgeon the same or similar functionality to that of open surgery. Several different instruments can be used for vessel occlusion, including monopolar and bipolar grasping forceps, Harmonic® scalpel (Ethicon Endo Surgery, Cincinnati, OH), stapling/cutting devices, vessel-sealing/cutting devices (Ligasure™, Covidien, Mansfield, MA; Enseal®, Ethicon Endo Surgery, Cincinnati, OH), and tools for extracorporeal suturing.

In preparation for TLH, all patients should undergo a comprehensive history and physical examination, focusing on those areas that may indicate a reduced capacity to tolerate major surgery or the steep Trendelenburg position necessary for pelviscopy. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, and electrocardiogram for women aged 50 years and older. Preoperative imaging of the pelvis (ultrasonography and computed tomography) may be indicated to evaluate the extent of uterine pathology and associated anatomical changes for surgical planning purposes.

Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) may facilitate pelvic exposure by making the small bowel and colon easier to manipulate. Prophylactic antibiotics (Cephazolin 1 g, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. Following is a brief description of the surgical procedure used (see also video: *Total Laparoscopic Hysterectomy*).

SURGICAL TECHNIQUE

General anesthesia is required. The patient should be positioned in low dorsal lithotomy position using Allen-type stirrups (Allen Medical Systems, Cleveland, OH) with arms tucked. Care is taken to avoid hyperextension at the elbows or external rotation of the arms. The abdomen is prepped and a Foley catheter placed. Examination under anesthesia should pay particular attention to uterine size and topography. Any one of a variety of uterine manipulators can be used; however, using an instrument with a colpotomy ring or cup (e.g., V-Care®, Conmed Endosurgery, Utica, NY; RUMI® with KOH Colpotomizer, CooperSurgical, Trumbull, CT) will greatly facilitate incision of the proximal vagina. Alternatively, a laparoscopic tenaculum or transvaginal placement of a colon anastomosis-sizing instrument can be used to elevate the uterus during laparoscopic dissection.

The number and size of trocars used for TLH can vary according to surgeon preference, but in general, TLH requires a midline 12-mm port placed through or in close proximity to the umbilicus, and bilateral 5-mm ports placed lateral to the lateral margin of the rectus abdominis muscles. As dictated by uterine size and pathology, a third 5-mm or second 12-mm port can be placed either midline in the lower abdomen or in the left or right upper quadrant equidistant between the umbilical and lateral ports (**Figure 4.1**). Laparoscopic suturing of the vaginal cuff usually requires a second 12-mm port through which the suture and needle can be introduced and extracted. Either a 10- or 5-mm laparoscope can be utilized through the umbilical port. The 5-mm scope has the advantage of being able to be temporarily relocated from the umbilical port to the lateral abdominal ports for improved visualization during the pelvic sidewall dissection in the presence of a large myomatous uterus or broad ligament leiomyoma. Alternatively, a 30° laparoscope can be used instead of the 0° laparoscope for this purpose. The patient is placed in steep Trendelenburg position to facilitate displacement of the bowel out of the pelvis. Adhesions are taken down and normal anatomy is restored.

The lateral leaf of the broad ligament is opened between the round ligament and infundibulopelvic ligament, and the retroperitoneal space is developed bluntly. The round ligament is cauterized and divided, and the lateral portion of the anterior leaf of the broad ligament is divided, incising the vesicouterine

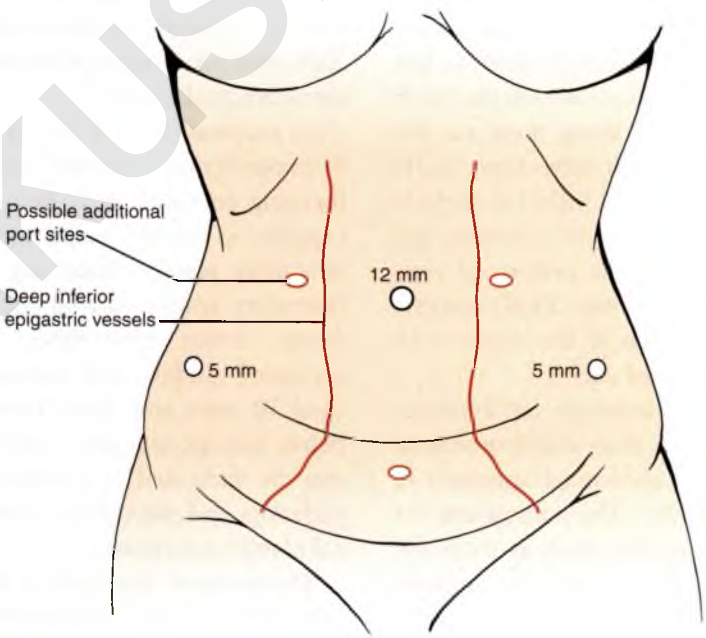

FIGURE 4.1 Total laparoscopic hysterectomy: Port placement sites.

peritoneal reflection toward the uterine midline. Attention is directed to the posterior lateral pelvis, and the pararectal space is developed. The ureter should be identified on the inner surface of the medial leaf of the broad ligament or should be visualized transperitoneally. The ureter is usually easier to locate at the level of the pelvic brim rather than deep within the pararectal space (**Figure 4.2**).

To facilitate hysterectomy, management of the adnexa should be addressed at this juncture. In the event of adnexal pathology or planned salpingo-oophorectomy, removal of one or both adnexa is indicated. The infundibulopelvic ligament is grasped gently and placed on contralateral traction. A window is created in the medial leaf of the broad ligament below the ovarian vessels and ventral to the ureter, maintaining direct visualization of the ureter. This incision can be extended to the uterine isthmus. The infundibulopelvic ligament is coagulated and divided using a combination of bipolar and monopolar cautery or a vessel sealing-cutting device (**Figure 4.3**). If preservation of the adnexa is planned, the fallopian tube and utero-ovarian ligament should be coagulated close to the uterine fundus and detached. The medial leaf of the broad ligament can be incised down to a level just ventral to the pelvic ureter to allow the adnexa to drop out of the field of dissection or be placed in the paracolic gutters to improve visualization. The procedure is repeated on the contralateral side.

The bilateral incisions of the vesicouterine peritoneal reflection are united in the midline, and the bladder peritoneum is placed on ventral and caudal traction (**Figure 4.4**). Cephalad displacement of the uterine manipulator with colpotomy ring enhances visualization of bladder. Development of the bilateral para-vesicle spaces may also facilitate identification of the bladder and the proper plane of dissection (vesicovaginal space). Sharp dissection is used to carefully mobilize the bladder off the anterior lower uterine segment, cervix, and proximal vagina down to a level approximately 1 cm below the cervicovaginal junction (**Figure 4.5**).

The uterine vessels are skeletonized by removing excess fatty or areolar tissue. Exposure may be improved by incising the medial leaf of the broad ligament down to the level of the uterosacral ligament while keeping the ureter under direct vision and retracting it laterally. The uterine vessels are coagulated and divided using a combination of bipolar and monopolar cautery or a vessel sealing-cutting device at the level of the uterine isthmus (**Figure 4.6**). The cardinal ligaments are divided in a similar fashion down to the level of the cervicovaginal junction (**Figure 4.7**). Use of a uterine manipulator with a colpotomy ring usually makes it unnecessary to detach the utero-sacral ligaments from their attachments to the proximal vagina. If necessary, however, the utero-sacral ligaments can be divided at this point and incorporated into the vaginal cuff closure.

The colpotomy incision and extraction of the uterus can be accomplished in a variety of ways. This step is simplified by use of a uterine manipulator with colpotomy ring. These devices usually have a device component that occludes the distal vagina to maintain the pneumoperitoneum during colpotomy. In such

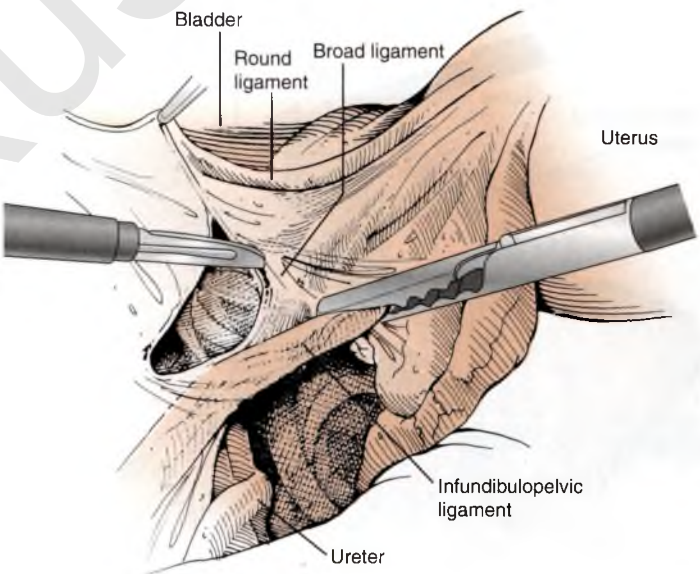

FIGURE 4.2 Total laparoscopic hysterectomy: The broad ligament is opened, and the ureter is clearly identified.

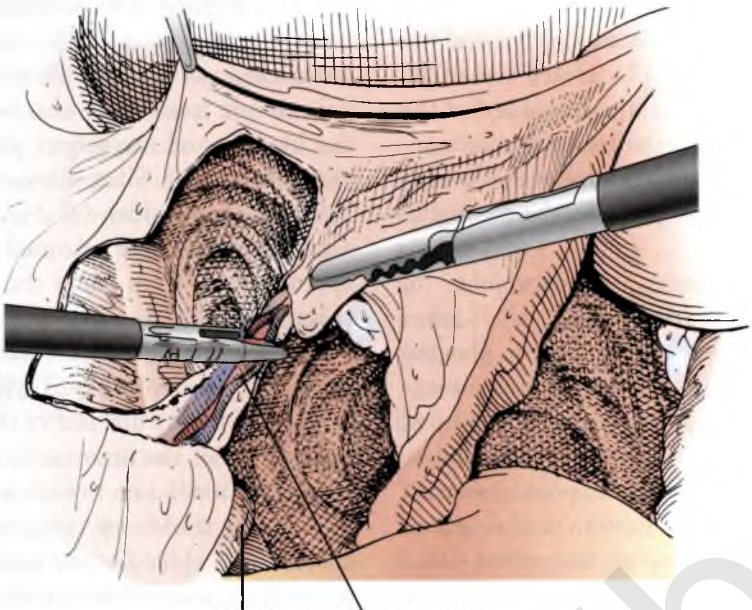

FIGURE 4.3 Total laparoscopic hysterectomy: The infundibulopelvic ligament is skeletonized, and the ovarian vessels are coagulated and divided.

cases, the colpotomy incision can be initiated wherever it is most convenient based on exposure, either anteriorly, posteriorly, or laterally on the colpotomy ring at the cervicovaginal junction (**Figure 4.8**). The vaginal incision is created using monopolar cautery and continued circumferentially around the cervicovaginal junction. Additional bipolar cautery may be required at the lateral vaginal angle to secure a descending vaginal branch of the uterine artery. In the absence of a vaginal occlusive device, the anterior colpotomy incision is created first, as subsequent anterior displacement of the uterus will facilitate creation of the posterior colpotomy while simultaneously occluding the anterior vaginal incision and preserving the pneumoperitoneum. Following the circumscribing colpotomy, the uterus can be delivered transvaginally, and a moist laparotomy pack

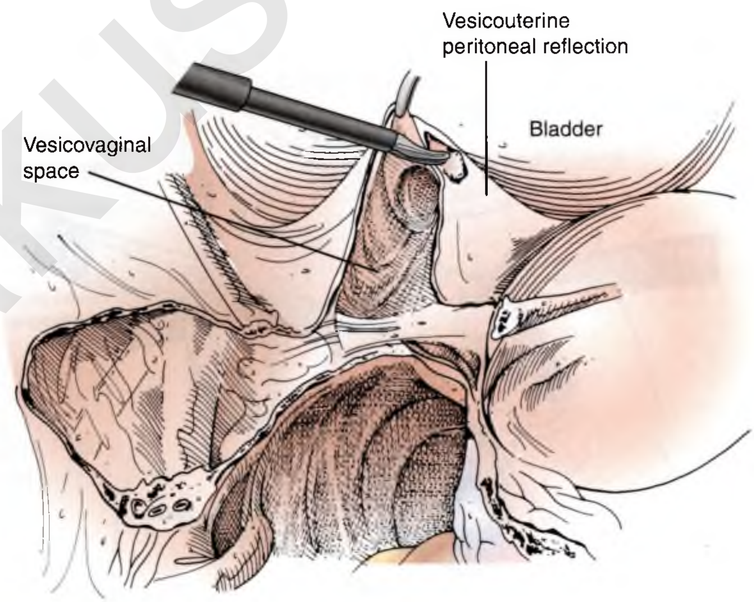

FIGURE 4.4 Total laparoscopic hysterectomy: The vesicouterine peritoneal reflection is placed on traction and incised.

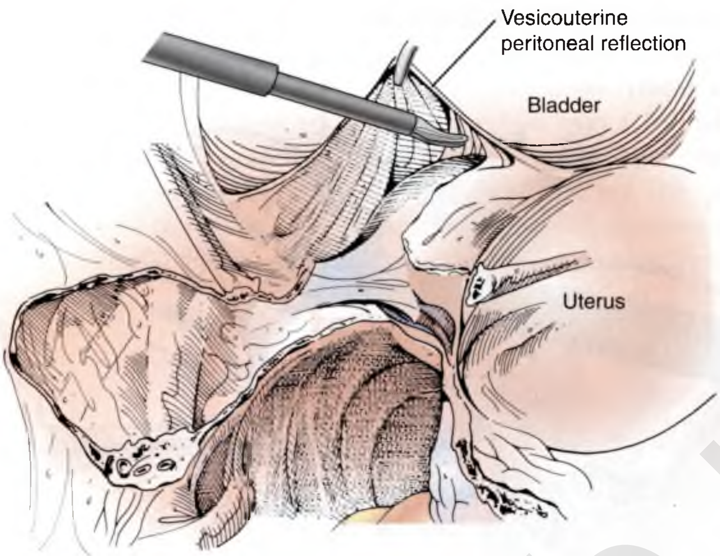

FIGURE 4.5 Total laparoscopic hysterectomy: The vesicovaginal space is developed with sharp dissection, and the bladder is mobilized from the anterior proximal vagina. The colpotomy ring delineates the cervicovaginal junction.

can be placed in the vagina to preserve the pneumoperitoneum during vaginal cuff closure. Alternatively, the uterus can be left in the mid-vagina to prevent loss of the pneumoperitoneum during closure and delivered once the vaginal cuff is closed.

The vaginal cuff is closed laparoscopically using a running, locking stitch or series of figure-of-eight stitches of 0 or 2-0 absorbable suture in the same fashion as for abdominal hysterectomy. Alternatively, the vaginal cuff can be closed via the vaginal approach, although technically this would be classified as a LH. All laparoscopic ports 10 mm in diameter or larger should be closed with interrupted or figure-of-eight stitches of 1-0 delayed absorbable suture under direct vision or using an extended needle driving device (e.g., Carter-Thompson Closure System®, Cooper Surgical, Trumbull, CT).

POSTOPERATIVE CONSIDERATIONS

The incidence of major complications with TLH is 2.2%. Postoperative care is generally straightforward. Routine thromboembolic prophylaxis is usually unnecessary, provided the patient is fully ambulatory, and the procedure

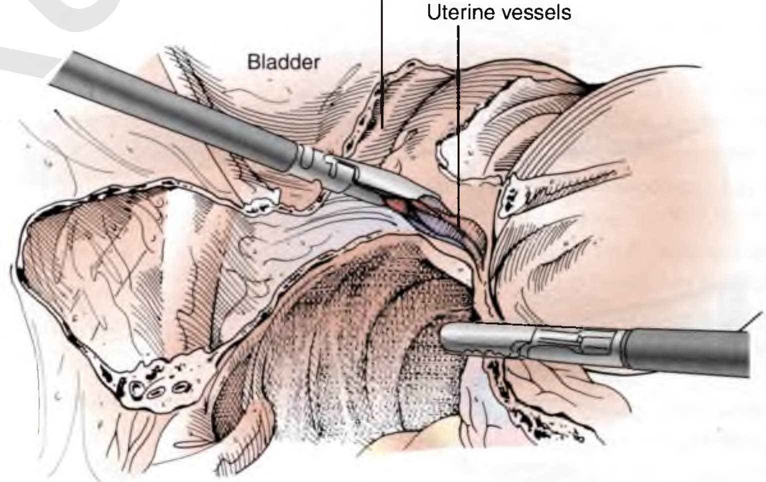

FIGURE 4.6 Total laparoscopic hysterectomy: The uterine vessels are coagulated and divided at the level of the uterine isthmus.

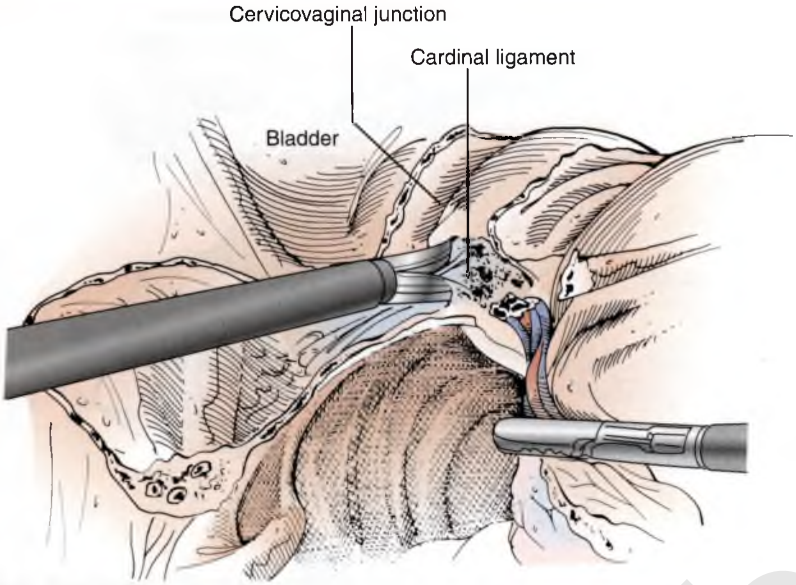

FIGURE 4.7 Total laparoscopic hysterectomy: The cardinal ligament is coagulated and divided down to the level of the cervicovaginal junction.

time was not prolonged. Diet can be advanced rapidly the day of surgery, once the patient has recovered from the effects of anesthesia, and will allow for same-day or next-day discharge in the majority of cases. Routine laboratory evaluation is unnecessary unless there has been significant blood loss or requirement for intravenous fluid replacement. A Foley catheter for bladder drainage may be left in place overnight for patient comfort or convenience, but this is not mandatory, and the catheter may be removed immediately postoperatively unless there has been a bladder injury or extensive dissection. Criteria for discharge include: afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, and satisfactory bladder function. The laparoscopic incision sites should remain covered with a sterile dressing for 24 to 48 hours. Protection of the vaginal incision is the same as for hysterectomy performed by any approach, and intercourse should be avoided for a period of at least 6 to 8 weeks postoperatively. As with any type of laparoscopic surgery

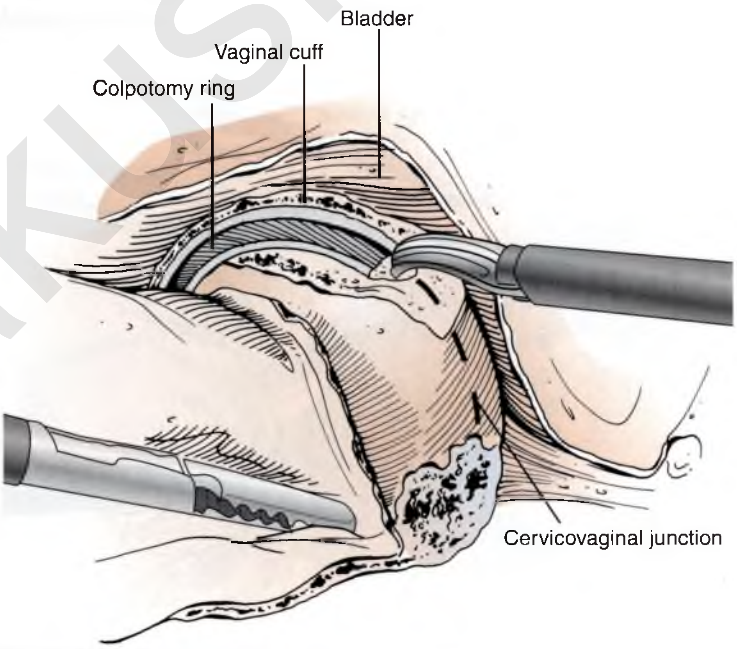

FIGURE 4.8 Total laparoscopic hysterectomy: The colpotomy is created and the proximal vagina incised circumferentially, using the colpotomy ring as a guide.

utilizing energy sources, an infrequent but important cause of postoperative morbidity is an unrecognized thermal injury to the small or large bowel, which can result in delayed (48 to 72 hours) bowel perforation and peritonitis. For this reason, patients presenting with delayed return of bowel function with abdominal distension, disproportionate abdominal pain, fever, and leukocytosis should be carefully evaluated and observed for signs of clinical deterioration.

Operative Note

PROCEDURE: TOTAL LAPAROSCOPIC HYSTERECTOMY

Examination under anesthesia was performed and the uterine cavity was sounded to (describe findings). A uterine manipulator with colpotomy ring was placed using standard technique. A 12-mm incision was created in the umbilicus, and the verres needle was introduced, followed by insufflations of 2.5 L of CO_2 gas. The 12-mm laparoscopic trocar and trocar sheath were introduced into the abdominal cavity, followed by the laparoscope. The abdomen and pelvis were inspected with the following findings: (describe findings). Additional 5-mm incisions were created in the right and left lower quadrants, lateral to the inferior epigastric vessels, and 5-mm laparoscopic trocars were introduced under direct visualization.

The round ligaments were grasped, and the broad ligament peritoneum was elevated and incised. The retroperitoneal space was dissected and the pararectal space developed, with visualization of the ureter. A window was created in the avascular space of Graves in the medial leaf of the broad ligament and the infundibulopelvic ligament was skeletonized, coagulated using bipolar cautery, and divided with monopolar cautery (or a vessel-sealing device). The same procedures were repeated on the contralateral side.

The vesicouterine peritoneal reflection was incised and the bladder sharply dissected off the anterior lower uterine segment, cervix, and proximal vagina. The uterine vessels were then coagulated with bipolar cautery and divided using monopolar cautery (or coagulated and divided using a vessel-sealing device). The cardinal ligament was taken down in a similar fashion to the cervicovaginal junction. The same procedures were repeated on the contralateral side.

A colpotomy was created using monopolar cautery, and the cervicovaginal junction was circumferentially incised. The uterus, tubes, and ovaries were extracted transvaginally and intact. The vaginal cuff was closed with 2-0 delayed absorbable suture in a series of figure-of-eight stitches, with excellent reapproximation of tissue and hemostasis. The 12-mm laparoscopic trocar was withdrawn and the incision closed with a 1-0 delayed absorbable suture in a figure-of-eight stitch using the Carter-Thompson Closure System. The pneumoperitoneum was decompressed and the remaining laparoscopic trocars were removed. Skin incisions were closed using standard technique.

COMPLICATIONS

- Development of the retroperitoneal spaces, with visualization of the ureters, and adequate mobilization of the bladder from the proximal vagina are important for minimizing the risk of urinary tract injury (1% to 2%).
- In the event of hemorrhage from the uterine or ovarian vascular pedicles, avoid the indiscriminate use of thermal energy or blindly placing sutures or hemo-clips. Achieve adequate visualization (suction/irrigation), identify critical anatomy (e.g., ureter and bladder), and precisely secure the source of bleeding.
- Unrecognized thermal injury to the small or large intestine can present as delayed bowel perforation with delayed return of bowel function, abdominal distension, disproportionate abdominal pain, fever, and leukocytosis.

Suggested Reading

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CHAPTER 5

Laparoscopic Supracervical Hysterectomy

Frank Tu

INTRODUCTION

Hysterectomy is performed for a wide variety of female health indications, including symptomatic uterine fibroids, uncontrolled uterine bleeding, persistent pelvic pain, and malignancy. In the United States, most hysterectomies continue to be performed by an abdominal approach. However, laparoscopic approaches to hysterectomy need to be understood better, due to their improved recovery, reduced infection risk, and faster recovery relative to abdominal hysterectomy.

The technique of laparoscopic hysterectomy has the same surgical risks as abdominal or vaginal approaches (see **Complications** box on page 50). The use of electrosurgery is more common when performing laparoscopy, so the surgeon should strive to keep the active elements of all energy devices in clear view at all times during the procedure to minimize the risk of an iatrogenic injury. The reduced ability to retract tissue during laparoscopy also may be a source of increased complications and prolonged operating time, and surgeons should be aware of the number of tissue and uterine retractors available in the modern operating room. The decision to remove the cervix or adnexa at the time of surgery must be individualized. However, with modern cervical screening methodology, only a minority of women will need invasive cervical evaluation and far fewer a subsequent removal of the cervix after a laparoscopic supracervical hysterectomy is performed. Performance of a laparoscopic supracervical hysterectomy may require that the surgeon be familiar with the use of the laparoscopic morcellator.

PREOPERATIVE CONSIDERATIONS

Initial workup of a uterine disorder such as symptomatic uterine leiomyoma or menorrhagia should follow normal practice, including a history, physical exam, laboratory studies, and appropriate imaging. A preoperative endometrial biopsy, when appropriate, may also reduce the risk of morcellating a malignant uterus. However, even with a rapidly enlarging uterus, the risk of an undetected sarcoma is estimated at less than 0.1%. Documentation of an up-to-date normal pap smear, and a clear understanding of the patient's history of cervical pathology, is essential. Careful patient selection is very important in completing a laparoscopic hysterectomy in a timely, safe fashion. Roughly 80% of hysterectomies done are for uteri 12 weeks in size or less, and should not present problems for most surgeons otherwise comfortable with operative laparoscopic surgery. However, if uterine size is a concern, the most important issue is to determine how accessible the uterine pedicles are to the laparoscopic surgeon. A bimanual exam can determine whether the lower uterine segment is free, and usually the presence of subserosal leiomyoma does not influence the likelihood of surgical success.

General contraindications to undergoing laparoscopy (cardiopulmonary compromise, history of severe pelvic infections, etc.) and relative contraindications (morbid obesity or multiple prior laparotomies, especially those involving bowel surgery) need to be considered before choosing the appropriate route of surgery, but the vast majority of patients will be able to take advantage of the smaller incisions and faster outpatient recovery of laparoscopic surgery. Preoperative bowel preparation in selected patients, based on the preferences of the surgeon or colorectal consultant, may be of value in high-risk patients where extensive bowel dissection is anticipated. A single preoperative dose of a third-generation cephalosporin as first-line prophylaxis is recommended; alternatively, penicillin-allergic patients can be given macrolide and aminoglycoside combinations. Use of thromboembolic prevention measures such as sequential compression devices, or low-dose molecular weight heparin should be applied based on individual risk profiles. Following is a brief description of the surgical procedure used (see also video: *Laparoscopic Supracervical Hysterectomy*).

SURGICAL TECHNIQUE

a. **Patient placement:** With the patient in the dorsal lithotomy position on the operating room table, care should be taken to ensure that the knees, hips, and ankles are in neutral positions, with the hips slightly flexed, and the knees bent at 90°. This will minimize the risk of nerve injury, while also allowing full instrument mobility, particularly when rotated low over the lower abdomen. We prefer to pad and tuck the arms at the patient's sides to reduce risk of ulnar nerve injury.

b. **Port and instrument placement:** Three to four laparoscopic ports are placed to allow full use of endoscope, graspers, vessel sealers, and a morcellator. Two lower lateral quadrant ports should be placed, taking care to avoid the epigastric vessels and the ilioinguinal and iliohypogastric nerves. If a suprapubic port is chosen, the bladder can be retrofilled to identify its boundary, or else a point 2 to 3 cm above the symphysis pubis is selected. At least one 10 cm or larger port is usually needed for specimen retrieval. We routinely use a uterine manipulator such as a ZUMI™ (Cooper Surgical, Trumball, CT), and define the vaginal fornices using forniceal delineation rings. Sponge sticks inserted into the fornix are also a practical alternative when trying to dissect the bladder off the cervix. The bladder is generally decompressed with a Foley during the entire case. Gas insufflation tubing attached to one of the ports allows continuous inflow of CO_2 during the case to maintain a pneumoperitoneum between 12 and 15 mmHg.

A midline endoscopic camera (5 to 10 mm) is used to guide the procedure, but can be moved to offer alternate views, particularly of the ureters' courses. Choice of the initial entry port needs to take into account prior surgical scars, but a midline infraumbilical or left upper quadrant (LUQ or Palmer's point) entry is the most commonly used. An orogastric tube should be used to decompress the stomach if the LUQ approach is used. Particularly with larger uteri, where the fundus approaches 16-week size or greater, a higher camera placement, usually 3 to 4 cm above the umbilicus, may afford a better view. The lower quadrant ports can be moved a similar distance superiorly, but should still be able to reach the lower pelvis. There are little differences when choosing an open entry technique versus a closed approach, using insufflation needle preinsufflation followed by trocar insertion, in reducing the risk of entry-associated bowel or vascular injury. Surgeons should use what they have the most experience with and as dictated by the clinical circumstance. In general, we insufflate through a insufflation needle placed through the umbilicus when it is accessible, even if the camera port will be placed higher, to take advantage of the easier entry into the peritoneal cavity due to the fusion of the abdominal fascia at this point.

c. **Retraction and initial inspection:** We begin the procedure by using atraumatic graspers to bring the mesentery of the small bowel, the ileocecal valve, and the rectosigmoid reflection of the large bowel to above the sacral promontory, thus exposing the pelvic cavity. If obstructing adhesions need to be released, these should be done carefully. Careful inspection of the entire pelvic cavity and pelvic diaphragm should be performed. Examining the peritoneum at close proximity to uncover occult disease should be done first, as positive findings may dictate converting the case immediately. The ureters' courses should be identified next, and for complex cases, preemptive ureteral stenting may facilitate identification and dissection from dense periureteral scar tissue if necessary.

d. **Uterine dissection:** The round ligaments are identified, and the uterus is retracted contralaterally from the operating side. The round ligaments can be desiccated and divided with either a vessel-sealing device (monopolar, bipolar, ultrasonic), or they can be tied off and transected sharply—most surgeons prefer to use the more efficient energy-based methods. The broad ligament is then opened up anteriorly and posteriorly with blunt and sharp dissection parallel to the infundibulopelvic vessels as far as needed. At this point the utero-ovarian ligaments (if the ovaries are to be preserved; **Figure 5.1**) or the infundibulopelvic ligaments (if the ovaries are to be removed) are transected (see also Chapter 8).

Once the utero-ovarian or infundibulopelvic vessels are controlled, the anterior leaf peritoneum is opened up to begin the bladder flap, which is then undermined above the cervicouterine junction (**Figure 5.2**). This plane may be harder to define in patients with a prior cesarean section, and starting the dissection laterally and using pressure from a forniceal retractor placed vaginally will expose this plane best (**Figure 5.3**). Dissection then exposes Denonvilliers vaginal fascia; for laparoscopic supracervical hysterectomy this fascial plane does not need to be dissected more than 1 to 2 cm below the level of the uterosacral ligaments and away from the bladder. If proceeding with a laparoscopic total hysterectomy, the dissection of bladder should be continued caudad, away from the vaginal tissue and until the forniceal delineator pushed cephalad (and which can also be the surgeon's or assistant's fingers placed transvaginally if necessary) is visible. The technique is then repeated on the contralateral side, beginning with the transection of the round ligaments, opening of the broad ligament, isolation of the ovarian pedicle, and completion of the bladder flap dissection.

e. **Ligation of the uterine vessels:** Now, with both uterine vessels exposed, the surrounding broad ligament tissue is skeletonized off these vessels using either electrosurgical desiccation or blunt and sharp dissection, in order to allow the ureter to pull away further laterally. The uterine pedicle is exposed to the level of the uterosacral ligament insertion, just above the vaginal fornix and is readily visualized when a retractor is pushed cephalad transvaginally (**Figure 5.4**). The uterine vessels can be ligated at the level of the fornix either with electrosurgical clamps, or for surgeons with experience in suturing laparoscopically, a Heaney stitch placed medial to the vessels adjacent to the cervix. Multiple bites, moving medially away from the ureter, may be necessary. The key to safe dissection in this area is to maintain tension on the vaginal fornices, which not only permits optimal visualization of the vessels but also somewhat retracts the ureter laterally. Similarly, the contralateral uterine pedicle is desiccated, ligated, and divided. The uterus should now turn a dusky color.

f. **Removal of the uterus:** At this point, if a total hysterectomy is desired, the vaginal fornices are

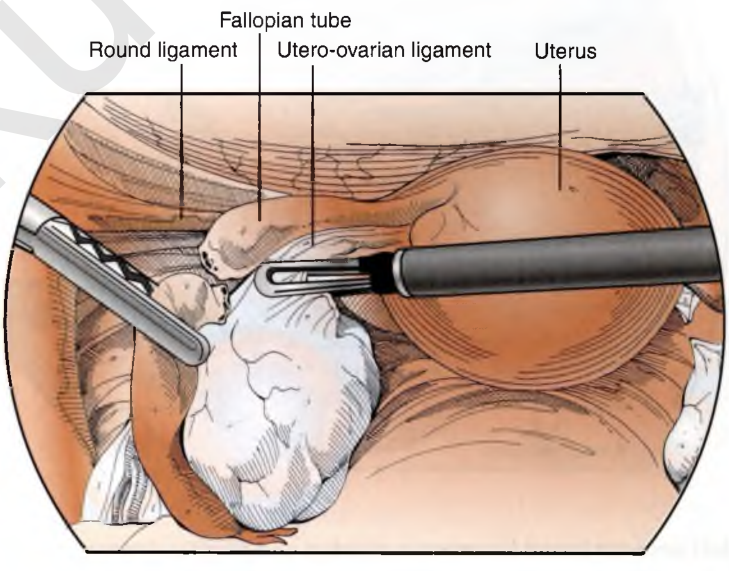

FIGURE 5.1 Transection of the left utero-ovarian ligament with bipolar desiccating forceps.

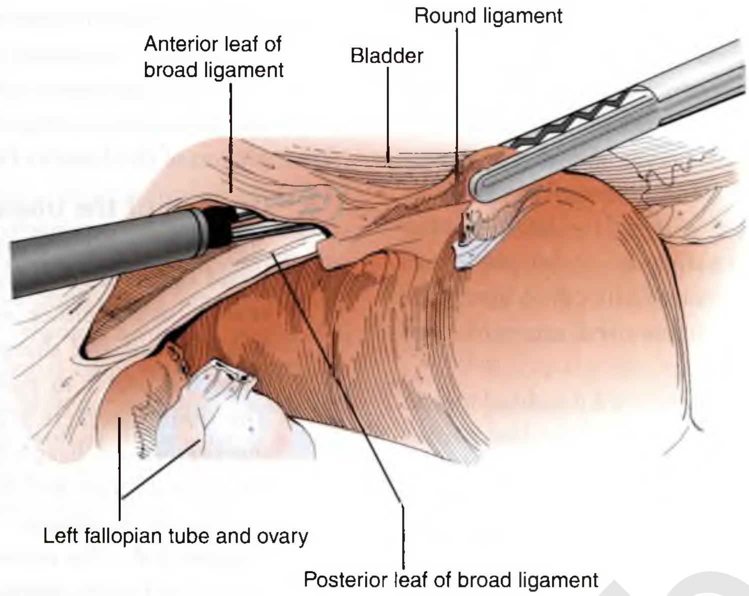

FIGURE 5.2 With uterine fornices being defined with a vaginal retractor, the vesicouterine peritoneal fold is developed and divided to free the bladder away from the uterus.

entered directly over the contour of a forniceal delineator, using an electrosurgical hook or an ultrasonic shear. A laparoscopic scalpel or scissors may also be used, but with somewhat more bleeding. The uterus can then be removed transvaginally and the cuff closed either laparoscopically or transvaginally. Care should be made to minimize the amount of thermal damage done to the cuff as this is a speculated risk for cuff dehiscence subsequently. If the ovaries are to be removed, many surgeons suggest extracting them separately and laparoscopically, using a specimen bag, to avoid the accidental seeding of an occult ovarian malignancy into the pelvis.

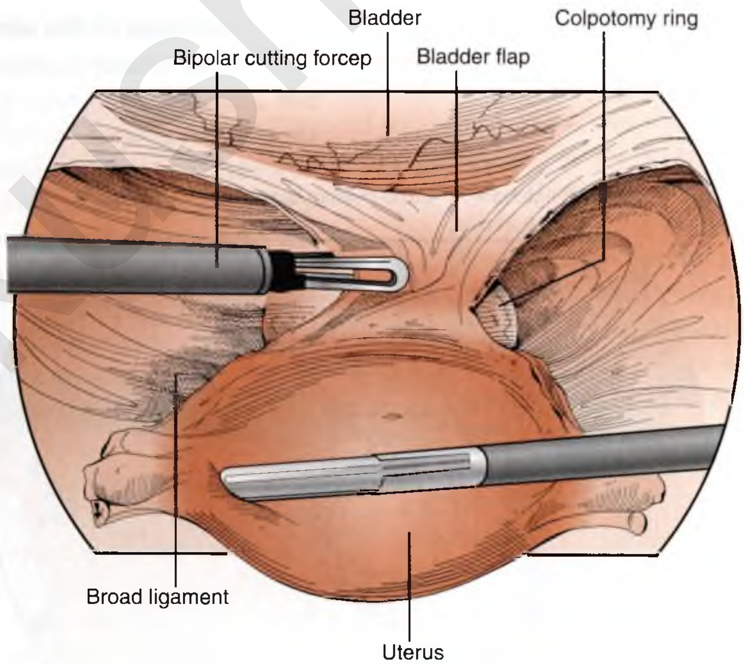

FIGURE 5.3 The left anterior broad ligament is divided and bluntly dissected down to the level of the bladder: Starting at the level of the round ligament in cases of previous scar allows identification of the proper plane of dissection.

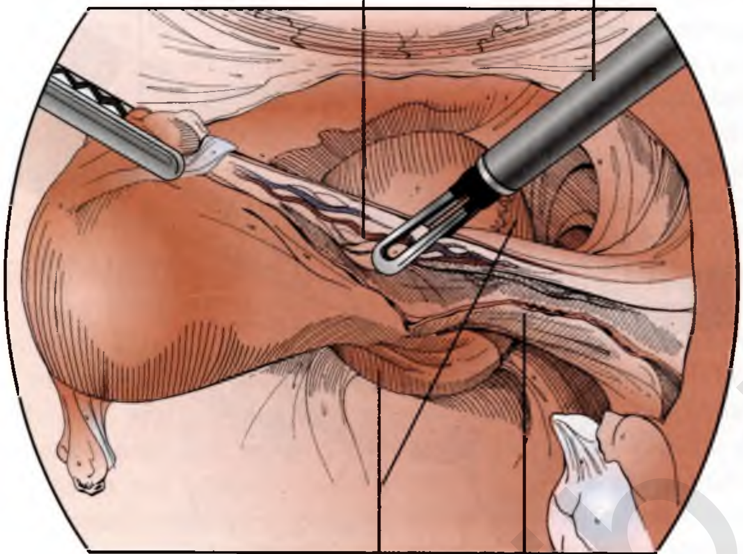

FIGURE 5.4 Right uterine vessels being ligated with bipolar desiccating forceps.

For supracervical hysterectomy, the cervix is transected away from the uterine corpus, taking care to first remove any uterine manipulator that may be in place to avoid damage to the instrument (**Figure 5.5**). The decision regarding whether to use a minilaparotomy incision versus a tissue morcellator to remove the uterus must be individualized. A reasonable rule of

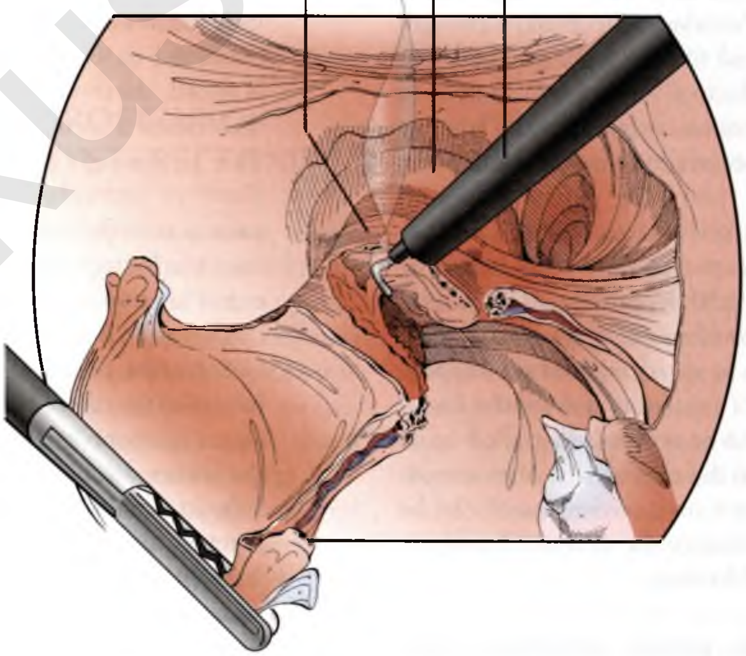

FIGURE 5.5 Uterus being transected from cervical stump using monopolar desiccation.

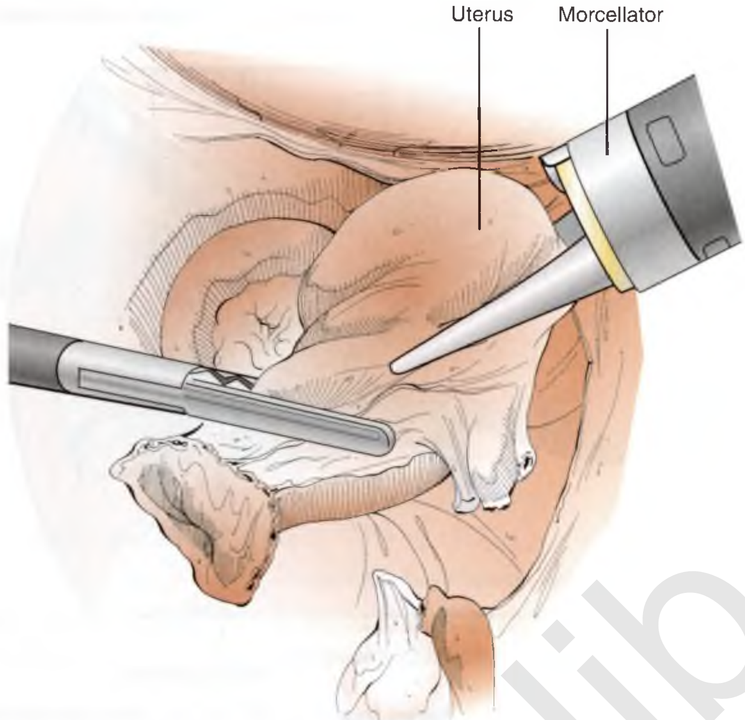

FIGURE 5.6 Uterus is extracted via electromechanical morcellation.

thumb to consider is that a morcellation of a uterus >700 g or >18 week in size may take 30 to 60 minutes, depending on the surgeon skill. In these cases, enlarging the suprapubic to a 5-cm Pfannenstiel incision may be warranted as an effective and efficient alternative.

For the usual smaller, more manageable uteri, morcellation may be appropriate **(Figure 5.6)**. An electromechanical morcellator is introduced through a 10 mm or larger port, and a single tooth tenaculum is used to introduce the uterine corpus into the rotating blades of the morcellator (usually selected to speeds ~1,000 rpm). The assisting surgeon helps guide the orientation of the specimen into the extraction port so that the tissue can be fed continuously and repeatedly into the morcellator as one would unroll a ball of yarn. Care should be taken to avoid inadvertent slippage of the morcellator posteriorly toward the bowel or for the bowel to be accidentally pulled up on the uterus toward the morcellator. After uterine removal, the cervix and cervical canal can be desiccated to minimize the chance of postprocedural cyclical bleeding.

g. **Postprocedural pelvic inspection and abdominal closure:** Once the uterus and, if desired, the cervix and ovaries are removed, any residual fragments sheared off the uterus should be retrieved to avoid the postoperative risk of parasitizing myomas, or worse, infection and sepsis, mobilizing the intestines to search for hidden fragments along the pelvic gutters. The pelvis is then carefully inspected under low-pressure conditions (around 6 mmHg of intraabdominal pressure), and the pedicles are examined to confirm hemostasis. If bleeding is noted, these vessels should be isolated and desiccated. Thorough irrigation of the cavity is then performed. The surgeon may choose to place an anti-adhesive barrier or imbricating sutures over the cervical stump. In a total laparoscopic hysterectomy, the cuff may be closed either laparoscopically (extracorporeal or intracorporeal knot-tying technique) or vaginally. It is important to take 1 cm bites of the cuff to minimize the risk of cuff dehiscence. The uterosacral ligaments are generally incorporated into the corner stitches to provide preventative vault support, and we generally use figure-of-eight stitches rather than running the cuff closed, while other surgeons have used running barbed suture to further simplify closure. Cystoscopy to detect occult iatrogenic urogenital injury may be performed at the surgeon's discretion based on the patient's history and the course of the procedure. When the procedure is complete, the fascia of any port larger than 10 mm is generally closed. The incisions are reapproximated following standard techniques, after as much as possible of the pneumoperitoneum has been evacuated.

POSTOPERATIVE CONSIDERATIONS

Most patients undergoing a laparoscopic hysterectomy, particularly a supracervical hysterectomy, require only an overnight stay, and in some centers patients are discharged home the same day. Prolonged bladder drainage in not generally necessary for patients with normal bladder function, but some may benefit from overnight drainage. Postoperative pain management is usually adequately managed with nonsteroidal anti-inflammatory drugs and occasional oral narcotics. If necessary a patient-controlled analgesia pump may be useful for overnight pain control. Diet can usually be advanced as tolerated and ambulation encouraged the first day. Patients should be instructed to avoid vigorous activity for the first 4 weeks after the procedure, although many will return to work sooner. Avoiding intercourse for at least 1 month after surgery is recommended, and possibly may be longer for patients at risk for impaired healing (i.e., diabetics, obese) to minimize the risk of cuff dehiscence if a total hysterectomy has been performed.

Operative Note

PROCEDURE: LAPAROSCOPIC SUPRACERVICAL HYSTERECTOMY

The patient was taken to the operating room, where her identity was confirmed. After the establishment of adequate anesthesia, pneumatic sequential compression devices were placed in the lower extremities and antibiotic prophylaxis initiated. Patient was placed in the dorsal lithotomy position, and a combined abdominal and vaginal prep and sterile drape was performed. Arms were padded and tucked in military position, and the hip and ankles placed in neutral position and knees flexed to 90° to minimize nerve compression. The operative team completed a "time out" when universal precautions where reviewed, including patient identification, site of surgery, and need for prophylactic antibiotics. Team questions were answered. A Foley catheter was placed to drain the bladder. A forniceal delineator was placed transvaginally around the cervix and a uterine manipulator was inserted into the uterus after the cervix was dilated to the appropriate size.

All port sites were infiltrated with bupivacaine. A 5-mm incision was made in the infraumbilical skin and the subcutaneous tissue bluntly dissected down to the fascia with a Kelly clamp. A blunt insufflation needle was then inserted gently into the abdominal cavity and low entry pressures confirmed. Three liters of CO_2 gas was then insufflated to achieve pneumoperitoneum, and continuous insufflation was continued with a preset maximum of 15 mmHg. A 5-mm atraumatic, radially dilating trocar was then inserted into the abdominal cavity through the infraumbilical incision and safe entry confirmed by visualization through the laparoscope. Additional 5-mm RLQ and LLQ trocars were placed through incisions 1 cm medial and superior to the anterior superior iliac spine (ASIS). An 11-mm port was placed 3 cm above the symphysis pubis. The patient was then placed in Trendelenburg position. Bipolar desiccating forceps (at 35 W) were used during the case for vessel sealing. Tissue dissection was performed with a combination of blunt dissection, sharp scissor dissection, and monopolar nonmodulated current desiccation at 30 W.

The small and large bowels were retracted above the sacral promontory to expose the posterior cul-de-sac. The upper abdomen and the appendix were visualized to confirm absence of incidental pathology. The uterus was mobilized gently to confirm that the uterine vessels would be accessible and that the anterior cul-de-sac and bladder reflection could be seen. The course of both ureters was identified from the pelvic brim and traced down to the uterocervical junction.

The round ligaments were desiccated and divided allowing entry into the broad ligament, which was bluntly dissected open. The utero-ovarian ligaments were identified to be away from the ureters on both sides, and were then desiccated and divided. The ovaries were left in place. The anterior bladder flap was then mobilized sharply away from the round ligaments to the peritoneal reflection, using the vaginal forniceal delineator as a landmark. The bladder flap was carefully dissected free from the underlying cervix until the plane of Denonvilliers fascia was exposed. Small bleeders were desiccated and divided as needed. The uterine vessels were skeletonized sharply on both sides at the level of the uterosacral ligament insertion. A bipolar clamp was then used to desiccate both uterine pedicles at this site. The uterus blanched reflecting loss of blood flow.

A monopolar hook electrode was then used to amputate the uterine corpus at 50 W of cutting current. Small bleeders were desiccated subsequently from the cervical stump, and a bipolar clamp was inserted into the cervical canal to ablate any residual endometrial tissue. The uterine corpus was then fed into an electromechanical morcellator inserted through the midline suprapubic port and removed from the patient in multiple passes. The morcellator blade was monitored carefully at all times during operation to avoid incidental injury to other pelvic structures. Fragments of morcellated uterus were carefully searched for in the pelvis and in the pericolic gutters, and any fragments encountered were removed to minimize the risk of parasitic myomas and/or sepsis.

The pelvis was deflated to 6 mmHg of intra-abdominal pressure and all pedicles inspected for hemostasis. Thorough irrigation of the pelvis was performed with normal saline and evacuated. The pneumoperitoneum was released and as much CO_2 as possible was evacuated. The fascia of all 10 mm or larger ports was closed with braided absorbable suture and the skin incisions closed with subcuticular stitches. All instruments were removed from the vagina and the Foley catheter left in overnight. The patient was extubated and transferred to recovery in good condition. No complications were observed.

COMPLICATIONS

- Bowel, bladder, ureteral injury–*Infrequent (less than 5%)*
- Pelvic infection–*Infrequent (less than 5%)*
- Major vascular injury–*Rare (less than 1%)*
- Hemorrhage requiring transfusion–*Rare (less than 1%)*
- Vaginal cuff dehiscence–*Rare (less than 1%)*

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CHAPTER 6

Laparoscopic Salpingostomy

Darren M. Lazare

INTRODUCTION

Ectopic pregnancy remains a potentially fatal condition affecting 2% of reported pregnancies and accounting for 9% of all maternal deaths. Etiologic factors relate to distal occlusive tubal disease, resulting either from inflammatory processes, such as endometriosis and pelvic inflammatory disease, or arising from tubal scarring related to previous tubal surgery or prior ectopic pregnancy. The result is a physical barrier to fluid and follicular transport within the tube that can cause hydrosalpinx, infertility, pelvic pain, and ectopic pregnancy.

There have been dramatic improvements in the management of ectopic pregnancy within the last few decades. Ultrasonography has simplified the diagnosis and has allowed earlier diagnosis that often avoids tubal rupture and resulting hemoperitoneum. Equally important is the development of medical treatment regimens that utilize methotrexate. In spite of these advances, there remain circumstances where surgical management is required. Methotrexate is inappropriate for ectopic pregnancies in certain tubal locations or gestations. Surgical treatment is also necessary for up to 10% of patients unsuccessfully treated by methotrexate.

Within the context of surgical management of ectopic pregnancy in hemodynamically stable patients, a laparoscopic approach is superior to laparotomy. Advantages include lesser blood loss, decreased analgesic requirements, shorter duration of hospital stay, quicker return to normal activity, improved cosmesis, and fewer postoperative intra-abdominal adhesions. Outcomes and subsequent pregnancy rates are equivalent to laparotomy. In a review of laparoscopy versus laparotomy in the management of ectopic pregnancy, the rates of subsequent intrauterine pregnancies were 61.0% and 61.4%, and the rates of ectopic pregnancy were 15.5% and 15.4%, respectively. There is conflicting data in the literature regarding persistent ectopic pregnancy in patients managed laparoscopically.

Laparoscopic management can be directed at removing the tube with the gestation, salpingectomy, or removing the gestation and preserving the tube, salpingostomy. Fallopian tube preservation when future fertility is desired remains the primary consideration when performing a salpingostomy. The available evidence does not show different postsurgical pregnancy rates for salpingostomy compared to salpingectomy, although there is a theoretical advantage to maintaining both tubes when possible. There is also no evidence that salpingostomy has a higher rate of persistent ectopic pregnancy or other postsurgical complications, which makes it a viable surgical option for patients requiring surgical management who are seeking preserved fertility.

PREOPERATIVE CONSIDERATIONS

Salpingostomy in the setting of ectopic pregnancy is most often performed as an emergency rather than elective case. As such, preoperative bowel preparation is not possible and also not indicated. There is limited evidence that perioperative antibiotic prophylaxis is valuable in settings with a high surgical site infection rate. A first-generation cephalosporin is an appropriate choice, and either clindamycin or metronidazole is also an acceptable choice for those allergic to penicillin or cephalosporins. The use of prophylaxis against deep venous thromboembolism should be based on an assessment of risk and should include as risk factors the dorsal lithotomy position and anticipated length of the case as well as patient-specific risks. The patient should be positioned in dorsal lithotomy position with legs in stirrups. General anesthesia is appropriate. A Foley catheter should be placed during the surgery to drain the bladder and may be removed postoperatively once the patient is able to ambulate independently.

SURGICAL TECHNIQUE

A uterine manipulator facilitates manipulation of the uterus to maximize optimal access to the adnexa laparoscopically. Surgery, therefore, typically begins with the vaginal placement of a uterine manipulator (**Figure 6.1**).

Upon entry into the peritoneal cavity, the patient is placed in moderate Trendelenburg position to facilitate displacement of the small bowel above the pelvic brim. Careful inspection of the insufflation needle insertion site, upper abdomen, and pelvis may then be performed. The fallopian tube; round and utero-ovarian ligaments; and structures of the pelvic sidewall including the ureter, iliac artery, and vein may then be identified. Adequate visualization is often the key determinant to successful laparoscopic surgery. The principle of triangulation also applies whereby the surgeon's instruments are located at apices that are contralateral to the pathological fallopian tube. We suggest bilateral lower quadrant and an umbilical port for the laparoscope. A suprapubic port or lower quadrant port ipsilateral to the lesion may be added if further retraction by the surgical assistant is required (**Figure 6.2**).

Initial efforts are directed to assessing bleeding and optimizing the surgical field. An atraumatic grasper such as a laparoscopic Babcock or bowel grasper and suction-irrigator through the lower quadrant ports helps to assess and evacuate the hemoperitoneum. Once the fallopian tube is adequately visualized, it may be gently elevated so as to demonstrate the portion of the tube containing the ectopic pregnancy or hydrosalpinx.

As a means of preventative hemostasis, some surgeons advocate the use of dilute vasopressin solution injected into the mesosalpinx. A typical recipe involves combining 20 IU of vasopressin with 20 to 100 ml of normal saline. A spinal needle inserted directly through the skin or insufflation needle may be used to infiltrate 10 to 20 ml of solution into the avascular peritoneum of the mesosalpinx.

A 1- to 2-cm incision is made over the distended portion of the fallopian tube along the antimesenteric border using monopolar scissors or needle-point cautery (**Figure 6.3**). Appropriate electrocautery settings are cutting or blended current at 20 to 70 W. Upon entering the tubal lumen, the suction irrigator may be used with pressurized irrigation to dislodge the ectopic pregnancy (**Figure 6.4**). Often, an intraluminal

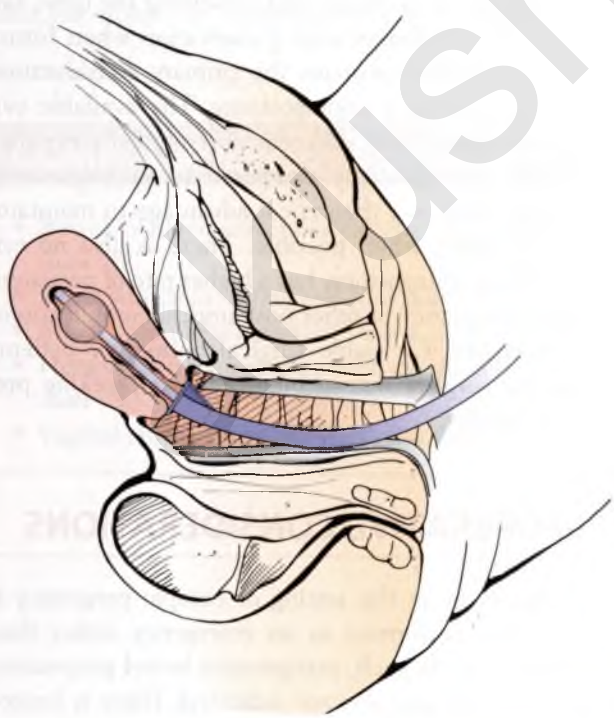

FIGURE 6.1 Placement of a uterine manipulator.

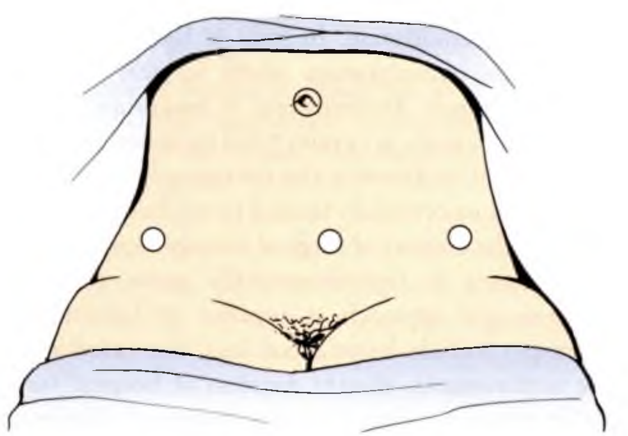

FIGURE 6.2 Laparoscopic port placement.

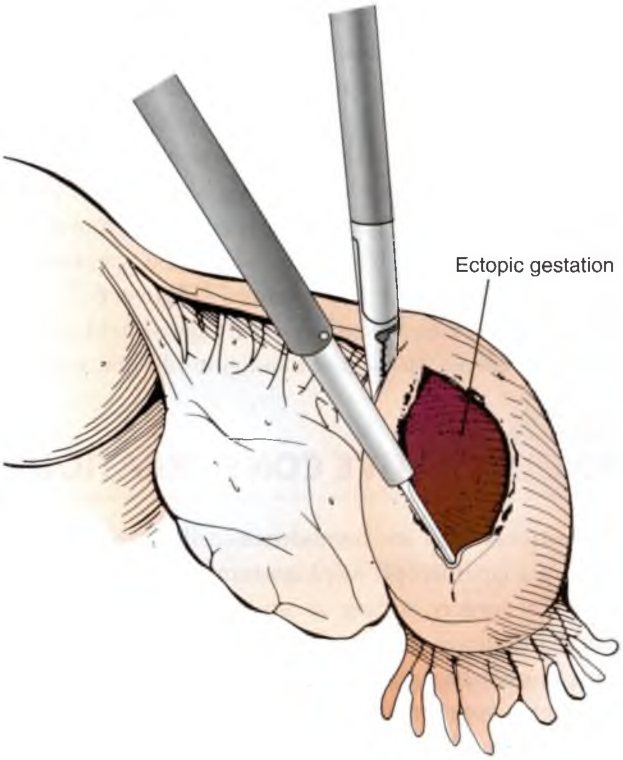

FIGURE 6.3 Incising the tube along the antimesenteric portion of the distended tube.

ectopic pregnancy can be successfully evacuated using hydrodissection in this fashion. In contrast, extraluminal pregnancies invade the tubal muscularis and are more challenging to excise with hydrodissection. The extraluminal pregnancies occur more commonly in the isthmic portion of the tube. Surgical manipulation of the tube in this situation will likely result in hemorrhage and significant scarring of the tube. A salpingectomy may be preferable under these circumstances.

Hemostasis at the edges of the tubal incision may be achieved by judicious application of needle-point cautery (**Figure 6.5**). Irrigation helps to confirm that bleeding has been controlled. Primary closure of the fallopian tube incision offers no advantage and leads to adhesion formation. Consequently, the salpingectomy incision is left open to heal by secondary intention once hemostasis has been achieved.

Once the tubal site is hemostatic, the surgeon must remove the specimen. Small specimens may be removed through a 10-mm trocar, while larger specimens can be removed through a colpotomy. Regardless of which site is used, a specimen removal bag helps to insure that the entire specimen is removed.

Creation of a colpotomy is facilitated by removal of the uterine manipulator and placement of a sponge stick in the posterior fornix. Dipping the sponge in

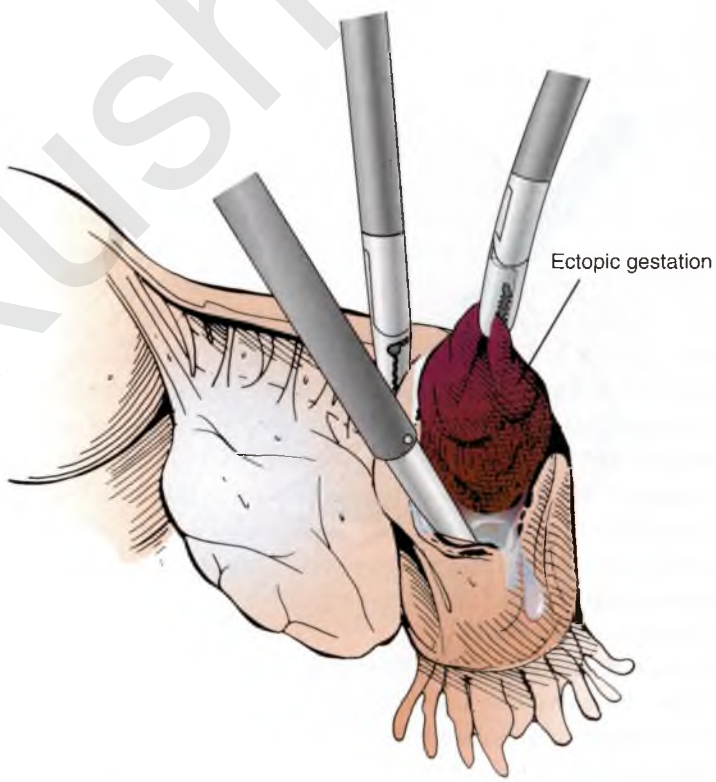

FIGURE 6.4 Hydrodissection is used to dislodge the intraluminal ectopic gestation.

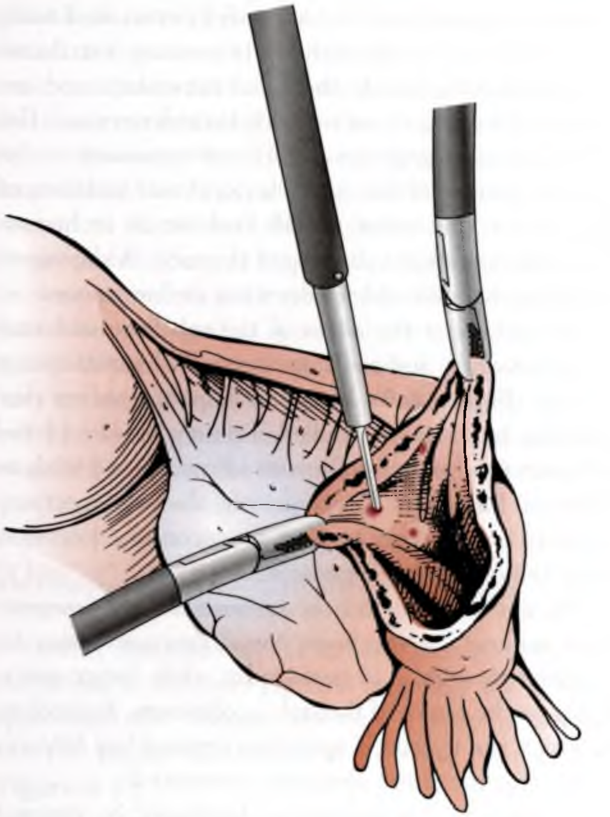

FIGURE 6.5 Hemostasis is achieved with needle-point cautery.

methylene blue dye facilitates visualization of sponge during creation of the colpotomy. The cul-de-sac should be evacuated to provide good visualization of the sponge stick pushing into the laparoscopic field inferior to the posterior cervix. A 1-cm transverse incision is made into the posterior fornix using a monopolar probe (**Figure 6.6**). This allows the specimen removal bag to be advanced into the field, where the specimen is dropped into the bag and removed (**Figure 6.7**). The colpotomy is then closed from the vaginal field using a 2-0 polygalactin 910 suture in a figure-of-eight suture.

POSTOPERATIVE CONSIDERATIONS

For patients who are hemodynamically stable prior to surgery, a laparoscopic salpingostomy can be performed in a day-surgery setting as an outpatient. Prolonged bladder drainage is generally not necessary for patients with normal bladder function, although an indwelling catheter is appropriate until the patient is able to ambulate independently. Nonsteroidal anti-inflammatory medication is usually adequate postoperative analgesia.

Persistent ectopic pregnancy is observed in 8.3% of patients treated by laparoscopic salpingostomy, so it is important to draw a serum β-hCG a week after surgery. A single intramuscular dose of methotrexate is usually successful in treating persistent ectopic pregnancy if the β-hCG level remains elevated. Patients are generally

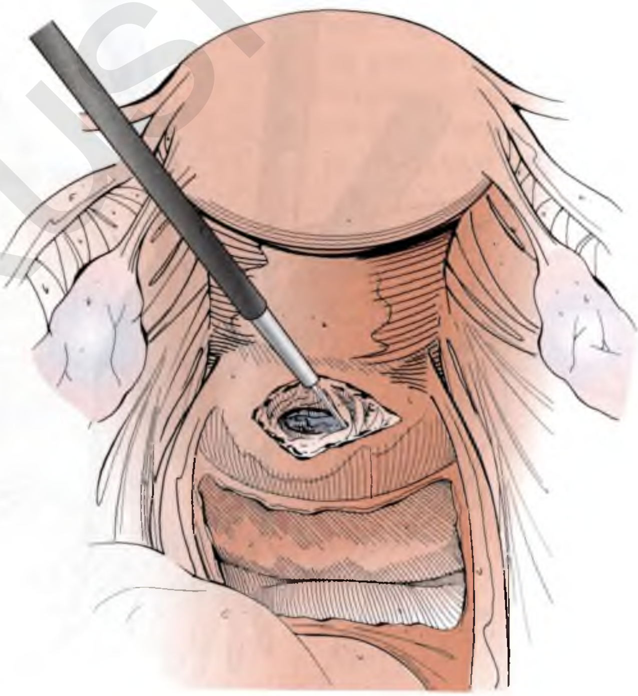

FIGURE 6.6 Creation of a colpotomy.

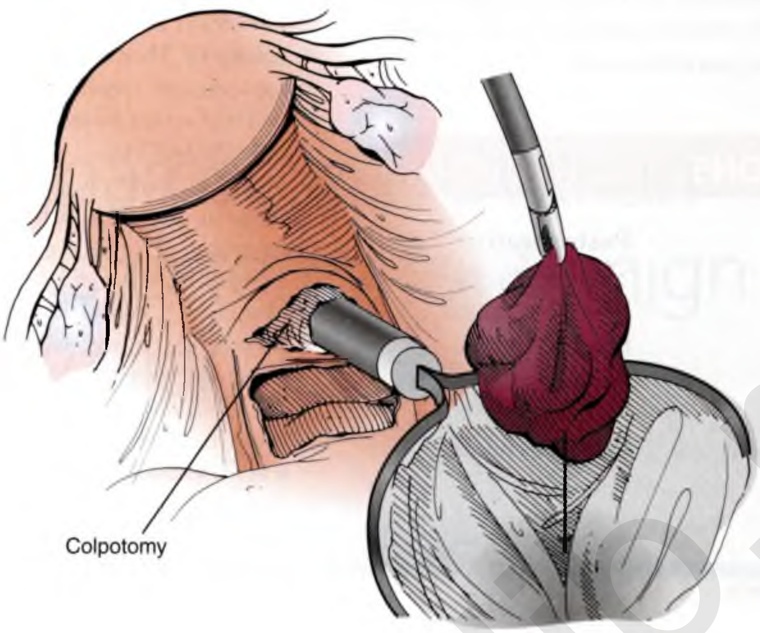

FIGURE 6.7 Removal of specimen using a specimen-removal bag via the colpotomy.

advised to avoid conceiving for three cycles following an ectopic pregnancy (see **Complications** box on page 56).

Operative Note

PROCEDURE: LAPAROSCOPIC SALPINGOSTOMY

The patient was taken to the operating room, where her identity was confirmed and the planned procedure reviewed during a preoperative briefing. After the establishment of adequate general anesthesia, the patient was placed in a dorsal lithotomy position, and the abdominal and vaginal fields were prepped and draped. Antibiotic prophylaxis was given intravenously. The operative team completed a time-out.

Xylocaine 1% with epinephrine was injected into the umbilicus. A scalpel was used to perform a 5-mm umbilical incision and the insufflation needle with CO_2 gas running was inserted into the abdominal cavity. Initial insertion pressure fell to below 10 mmHg upon entry of the needle into intra-abdominal space, confirming the intraperitoneal location. Insufflation was performed until the intra-abdominal pressure reached 20 mmHg. The insufflation needle was removed and a 5-mm trocar was placed through the umbilical incision. The 5-mm laparoscope was then inserted. Inspection of the initial trocar insertion site demonstrated an atraumatic entry. The upper abdomen was inspected; the liver edge, gallbladder, and stomach margin appeared normal.

Under direct visual guidance, 5-mm ports were placed in the right and left lower quadrant and left paraumbilical area. The abdomen was de-insufflated to 15 mmHg and the patient was placed in moderate Trendelenburg position. Using a blunt probe and suction irrigator, the small bowel was moved above the pelvic brim. Hemoperitoneum was evacuated using the suction irrigator.

Inspection of the left adnexa, uterus, bladder peritoneum and cul-de-sac revealed normal anatomy. The right fallopian tube was identified from the uterine cornua to fimbria, and an ectopic pregnancy was noted in the ampullary portion of the tube. A Babcock grasper was introduced through the right lower quadrant port and the right tube was elevated. Using a bowel grasper through the left lower quadrant port to stabilize the tube, monopolar scissors were used to create a 1-cm incision on the antimesenteric portion of the tube over the distended ectopic site. The suction irrigator with pressurized irrigation was then used to dislodge the pregnancy and the tissue was placed in the cul-de-sac. Needle-point cautery was then used to achieve hemostasis. Irrigation of the tube demonstrated tubal patency and confirmed hemostasis. The products of conception were removed under direct visual guidance through the left lower quadrant port.

The trocars were removed under direct visual guidance and hemostasis was observed. The pneumoperitoneum was released, and the operating room table was leveled. The 5-mm incisions were closed with thin adhesive strips. Sponge and instrument counts were correct after removing vaginal instruments.

The patient was returned to a supine position and then transferred to the recovery room in stable condition. She tolerated the procedure well.

COMPLICATIONS

Intraoperative	Postoperative
Salpingectomy	Shoulder-tip pain
Oophorectomy	Wound infection
Laparotomy	Persistent trophoblastic tissue (4–8/100)
Injury to pelvic viscera:	Incisional hernia
• Enterotomy	
• Cystotomy	
• Uterus	
Injury to blood vessels	
Ureteral injury	

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CHAPTER 7

Laparoscopic Ovarian Cystectomy for Benign Ovarian Tumors

M. Jonathon Solnik

INTRODUCTION

The decision to proceed with surgical exploration in a patient with a pelvic mass should be based on presenting symptomatology or the potential for a reproductive cancer. Ovarian cysts represent one of the most common findings encountered on pelvic examination and ultrasonography, and the combination of historical intake and physical suggestion is often sufficient to the physician and patient with a sound working diagnosis. Not infrequently, however, do we rely on ultrasound features to confirm the diagnosis and provide appropriate counseling with regard to the risk of a pelvic malignancy. Such characteristics include size >10 cm, bilaterality, complex sonographic appearance with solid component (especially if Doppler flow is present within solid areas), mural nodules, or ascites. Protocols with more detailed and quantifiable descriptors such as morphology indices (MIs) have been validated, and more specific imaging modalities such as magnetic resonance imaging (MRI) have been proposed as better predictors of malignancy than transvaginal ultrasound. Notwithstanding, the Agency for Healthcare Research and Quality (AHRQ) reported on the various testing parameters surrounding different means of measuring risk of cancer and concluded that no individual test was superior to the other.

Patients may be categorized based on native risk factors, the presence of pain and whether the ovarian cyst was documented incidentally. It may be more appropriate to triage a symptomatic patient or one with features suggestive of a malignancy to surgery, but there is a definite role for expectantly managing patients who have been diagnosed with an ovarian incidentaloma. Large cancer-screening studies such as the Prostate, Lung, Colorectal and Ovarian (PLCO) cancer-screening trial confirmed our inability to adequately screen populations for ovarian cancer without incurring more harm onto patients with no real disease. For the purposes of this chapter, we are assuming surgical management of a benign process for which ovarian cystectomy is planned.

PREOPERATIVE CONSIDERATIONS

For surgical planning, we find it useful to have a good understanding of what potential surgical obstacles exist for any given patient. For example, if a patient has significant dysmenorrhea and is found to have a homogeneously complex ovarian cyst, she is more likely to need extensive surgical resection for advanced-stage endometriosis. This may require a longer operating room booking time, preoperative consultation with a surgeon if rectal involvement is suspected, and perhaps psychological preparedness on behalf of the surgeon. Alternatively, if the patient is young, asymptomatic and has a complex mass suggestive of a mature cystic teratoma (**Figure 7.1**), the approach to her surgery may be different. Being able to provide a younger woman, whose ultimate goal may be to preserve fertility, with an accurate diagnosis and treatment plan to either remove the cyst or ovary itself is critical during the preoperative period.

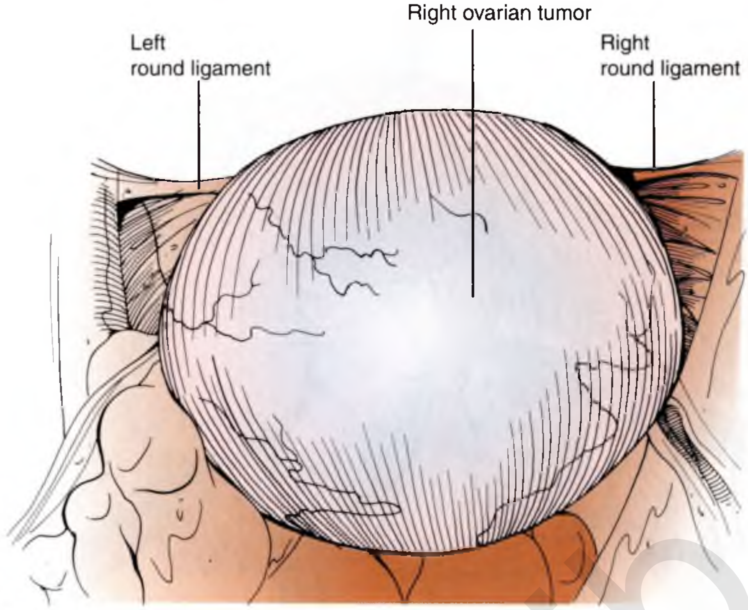
FIGURE 7.1 Transvaginal ultrasound of a complex adnexal mass consistent with a mature cystic teratoma: Note the normal-appearing ovarian stroma with antral follicles toward the left of the image with an echogenic focus to the right, consistent with nondependent fluid, most likely representing sebaceous material.

If there is any concern of a possible malignancy, preoperative referral to and evaluation by a gynecologic oncologist is highly recommended since the original plan of an ovarian cystectomy may subsequently become a staging procedure whereby preserving reproductive function may or may not be an option. Involving the oncologist early in the process will ensure a more rapid response if malignancy is suspected or encountered at surgery. As indicated above, notwithstanding the technologies we currently have in place, the ability to correctly predict cancer risk is imperfect, and an occult malignancy may be uncovered during surgery. How the gynecologist approaches these varying scenarios changes based on the environment where he or she works, along with the ready availability of an oncologist. If at the time of initial surgical inspection, there is a suggestion of malignancy, obtaining pelvic washings and terminating the procedure may be warranted without addressing the mass if it appears unruptured. This will allow for expedited referral and reoperation by the appropriate surgeon. If, however, the process appears to be disseminated, then biopsy of suspicious lesions should also be performed. In the ideal setting, when an intraoperative oncology consult is available and preferably has been planned, and the patient appropriately counseled and consented, then staging could be performed concomitantly.

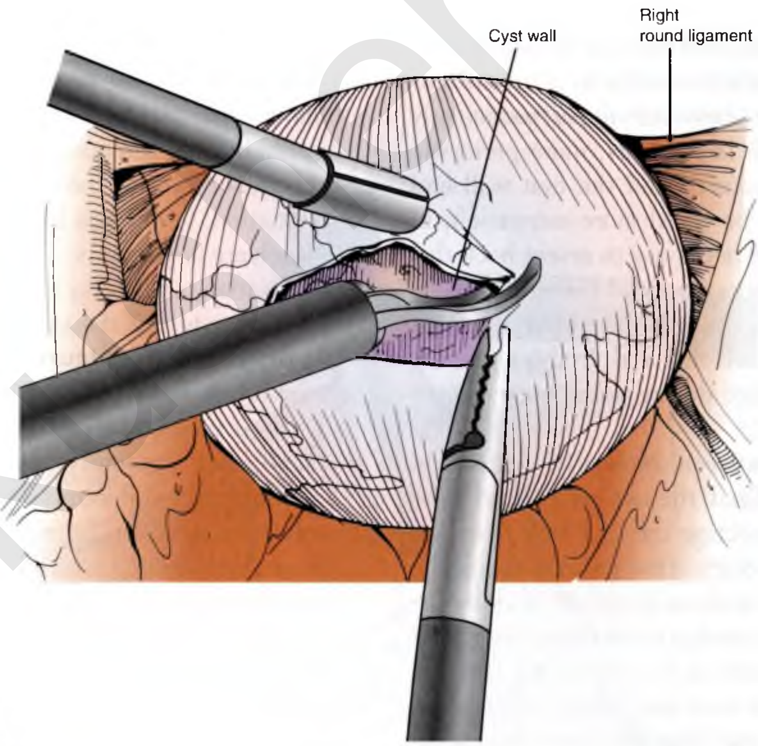
SURGICAL TECHNIQUE

1. **Port and instrument placement:** Initial port placement depends on the location and size of the mass, similar to when treating a patient with an endometrioma (see Chapter 10). If possible, use of open-access technique will facilitate retrieval of larger cysts due to the larger fascial defect created, especially if cyst rupture is not desired.
2. **Initial pelvic assessment:** Upon entry into the peritoneal cavity, the first step should be to obtain pelvic washings with at least 200 ml of normal saline. This should be done in order to best evaluate for a priori microscopic, extra-ovarian seeding should the mass represent a cancer. After the remaining ports are placed, comprehensive evaluation of the abdomen and pelvis should then ensue. Assuming a benign process, the focus should then turn to the cyst itself.
3. **Restoration of normal anatomic landmarks:** The next step should then be to restore normal anatomy if distorted by adhesions, all the while identifying the course of both ureters and the sigmoid colon, rectum, and larger vessels. Most ovarian or tubal adhesions may be dissected bluntly, but if more dense, then sharp dissection with minimal energy application may be required (see Chapter 24). Once freed from its attachments, the ovarian cystectomy can then be performed.
4. **Ovarian cystectomy:** In general, once the ovarian cyst is freed from surrounding adhesions (**Figure 7.2**) in smaller cysts, an ovarian epithelial (cortical) incision should be directed along the longitudinal axis of the ovary to avoid extension toward larger vessels (**Figure 7.2b**). We typically recommend use of cold scissors to incise the ovarian epithelium since it minimizes injury to functional reproductive tissue and allows clear access to the correct surgical planes. In contrast to removal of an endometrioma (see Chapter 30), the enucleation of a benign ovarian cystectomy is relatively more simple. Alternatively, if the cyst is larger, and the amount of thinned out and fibrotic ovarian epithelium overlying the cyst is significant, it may be preferable to incise the cyst circumferentially at the interface between the normal ovarian cortex and the fibrotic epithelium, thereby minimizing the amount of fibrotic material left attached to the remaining ovary (**Figure 7.2c**).

   In most cases, the epithelium overlying the cyst can be incised superficially using cold scissors, needle-tip cautery, or laser at what appears to be the area where the ovarian cyst protrudes from the ovary and the overlying ovarian cortex is evident. Once the ovarian cortex alone is incised superficially at this site, the underlying cyst wall will be readily visualized beneath. In this situation, the cyst

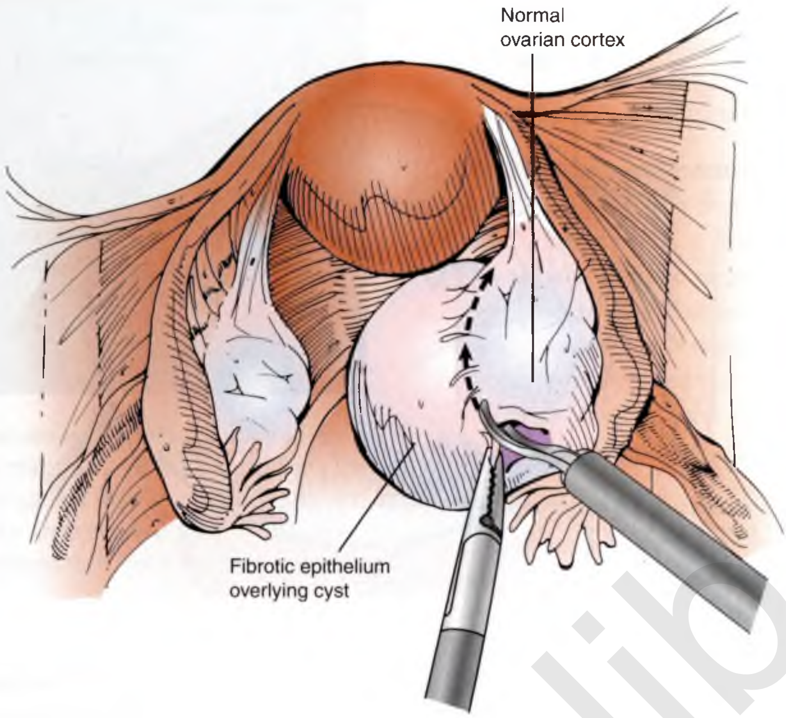


A



B

FIGURE 7.2 Large right-sided ovarian cyst: (A). The normal ovarian epithelium is stretched as the underlying neoplasm enlarges. **(B).** In smaller cysts, a longitudinal incision is made over the distal side of the cyst, readying it for enucleation. **(C).** If the cyst is larger, and the amount of thinned out and fibrotic ovarian epithelium overlying the cyst is significant, it may be preferable to incise the cyst circumferentially at the interface between the normal ovarian cortex and the fibrotic epithelium, thereby minimizing the amount of fibrotic material left attached to the remaining ovary. *(Continued)*



C

FIGURE 7.2 *(Continued)*

wall should be grasped, and the cyst dissected away from the overlying ovarian cortex in a careful circumferential fashion. Less commonly, particularly in those women with larger cysts, more pericystic fibrosis may have occurred and the cyst wall and ovarian capsule may be fused more extensively, in which case it may be necessary to resect back this layer using cold scissors (to avoid fusing the layers by cauterization) until two distinct layers (ovarian cortex and cyst wall) are observed. In this situation, the risk of cyst rupture during resection increases significantly.

Once the plane between the ovarian cortex and the cyst wall is visualized, the two layers need to be separated gently, dissecting the cyst wall from the surrounding normal ovary. This process should be done in a careful and organized manner, working circumferentially, in an attempt to minimize the risk of cyst rupture, particularly in the setting of a complex cyst or a mature cystic teratoma. Finally (see below), if the cyst ruptures, the plane between the ovarian cortex and the cyst wall is often readily evident at the site of original incision transection (**Figure 7.3**).

Once the plane between the ovarian cortex and the cyst wall is identified, one technique to free the cyst wall from the ovary is to advance atraumatic graspers into the undissected plane, opening and withdrawing them. Aqua-dissection with a suction/irrigation device may also facilitate this dissection, since pressurized liquid will only travel along easily identifiable planes. Although a smaller epithelial incision may be more desirable to reduce the risk of injuring the ovarian cortex and adhesion formation, it will also limit the surgeon's ability to enucleate larger cysts.

Ovarian cystectomy should be a relatively bloodless procedure if the correct planes are identified at the beginning (**Figure 7.4**). Surface capillaries may bleed, but typically stop without intervention, whereas vessels within the cortex of the ovary may bleed more vigorously and may require energy to control loss and minimize surface clots, which may influence adhesion formation. Hilar vessels do not penetrate ovarian cyst walls, and so it is a common misconception that dissection of cysts approximating this portion of the ovary poses added risk of bleeding. If the correct planes are developed and followed, excess bleeding will not occur.

5. **Managing ovary cyst rupture and spillage:** The risk of intraoperative spillage of cystic contents, more common when addressing an adnexal mass laparoscopically, should always be considered. This risk seems to increase with the size of the mass, although size alone should not prevent a skilled surgeon from approaching a cyst laparoscopically. Aside

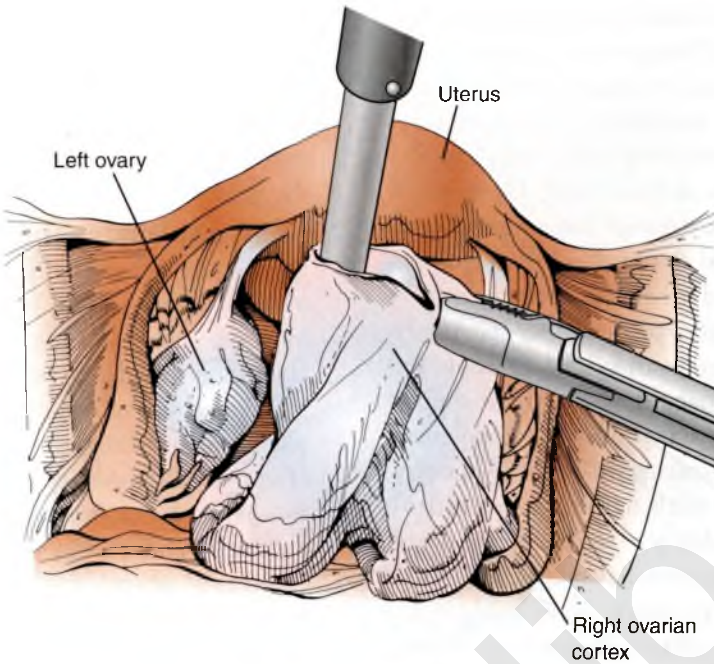


FIGURE 7.3 If cyst rupture occurs, contained drainage with a suction probe placed from anterior to posterior into the rupture site should be performed: The surgical planes between the ovarian cortex and underlying cyst wall can now be more readily identified.

from the risk of upstaging a patient with a confined ovarian malignancy, there are other reasons that exposure to cyst contents may increase morbidity, although none have been consistently proven. These include the development of pseudomyxoma peritonei in patients with mucinous cystadenomas, most often

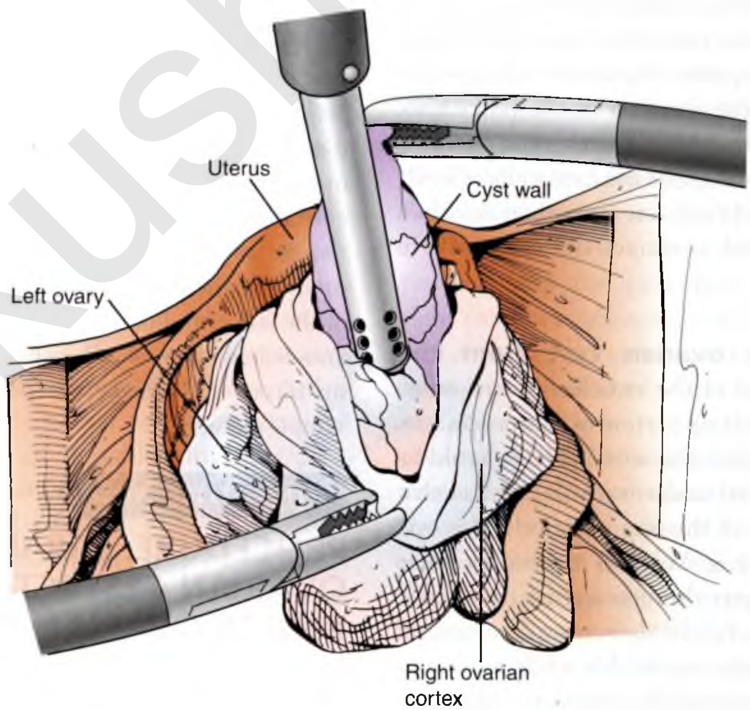


FIGURE 7.4 Using a toothed grasped to manipulate the cyst wall, traction and countertraction techniques are used to enucleate the cyst wall: Following the correct surgical planes, identified early in the dissection, will minimize bleeding.

encountered in patients having experienced preoperative cyst leakage, and foreign body reaction or inflammatory adhesiogenesis in patients with ruptured or leaking mature cystic teratomas.

Regardless of what the cyst represents, enucleation is facilitated with an intact cyst. However, if the cyst is simple and extremely large, intentional rupture with contained drainage allow for easier retrieval once resected from the ovarian cortex. Some surgeons describe placing the secondary trocars directly into the ovarian cyst to allow for a larger portal for drainage. However care should be taken to avoid the trocar slip sliding upon entry and inadvertently perforating viscera. Less entry force is typically used with newer, bladeless trocars, also limiting the ability to penetrate the ovary upon entry. Larger gauge needles may also be used if attached to suction to slowly drain larger cysts with somewhat less spillage. Regardless of how this is accomplished, if there is a fluid component to the cyst, the contents should be collected separately for cytology if indicated.

If unplanned cyst rupture does occur, copious irrigation and removal of all visible contents, including careful inspection of the pericolic gutters, should be performed. Keeping the aperture of the cyst as anterior as possible, preventing extension of the opening and placing the suction probe into the cyst and draining the fluid component should all be considered. If possible, placement of a retrieval bag around the ovary may limit the degree of exposure to cyst content for the duration of the procedure, and can even be done while enucleating the cyst itself. If at the time of rupture the cyst wall is clearly identified at the rupture site, traumatic/toothed graspers may be used to retract the cyst itself to avoid slippage.

6. **Removal of the ovarian cyst from the abdomen:** Retrieval of the enucleated cyst often poses the most frustrating portion of this procedure. If large and unruptured, the retrieval bag should be introduced and placed underneath the cyst so that by simple elevation of the bag anteriorly, the cyst is scooped into the bag. We find it most useful to then deliver such cysts through open laparoscopic technique since the fascial defect is often greater than 2 cm and is easily extendable while maintaining the ability to conceal the incision. The cyst, if unruptured, can then be intentionally ruptured with a scalpel and a suction probe placed over the incision used to contain the drainage. Morcellating complex or solid components can then take place without the risk of added peritoneal exposure, and can be done with larger, hand-held instruments. Alternatively, a colpotomy incision may be created with passage of a retrieval bag and delivery through the vagina.
7. **Final inspection and closing steps:** Once the cyst has been delivered, reinspection of the ovarian defect should take place to ensure a hemostatic cortex. Intermittent bursts of bipolar energy can be used to stop discrete areas of bleeding, but we recommend minimal energy application to preserve maximum ovarian function. Once the surgical site is hemostatic and all irrigation used has been suctioned from the upper abdomen and pelvis, adhesion barriers such as Interceed® absorbable adhesion barrier (Ethicon Inc., Sommerville, NJ) can be wrapped around the ovary to minimize the development of periovarian adhesions (**Figure 7.5**), although in most cases no anti-adhesive is necessary. That said, adherence to microsurgical principles, with careful tissue handling, minimal suture placement and tissue cautery/desiccation/strangulation, careful hemostasis, and appropriate and continuous irrigation, remains the primary modality for reducing risk of postoperative adhesion formation.

POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see **Complications** box on page 64). Laparoscopic management of benign ovarian pathology should be considered an outpatient procedure, and few patients require anything other than typical postsurgical follow-up. Subsequent imaging should be left to the discretion of the surgeon, but if the cyst was felt to be completely enucleated, then we do not typically perform a follow-up ultrasound unless the patients present with new symptomatology.

Operative Note

PROCEDURE: LAPAROSCOPIC OVARIAN CYSTECTOMY FOR BENIGN OVARIAN TUMORS

The patient was taken to the operating room after proper informed consent was obtained. She was placed in dorsal supine position and underwent successful induction of general endotracheal anesthesia. Her legs

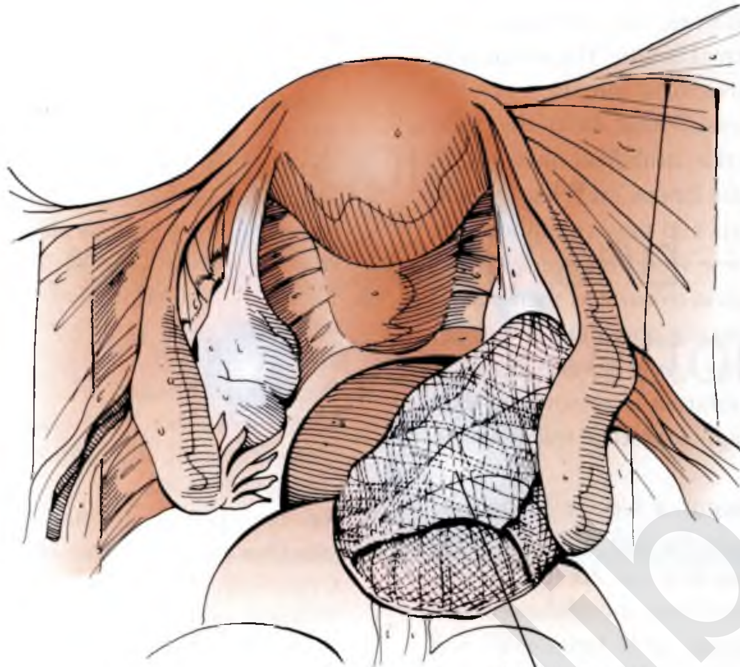


FIGURE 7.5 Placement of adhesion barriers should be considered, but adherence to microsurgical techniques may be all that is needed to minimize postoperative adnexal adhesion formation.

were placed in Yellofin stirrups and her arms tucked appropriately to her side. She was prepped and draped in sterile fashion and time-out was then performed. Attention was first turned to the pelvis where a Foley catheter was placed in the urinary bladder, followed by placement of a side-opening bivalved speculum into the vagina. A single-tooth tenaculum was placed along the anterior lip of the cervix to then allow for placement of a uterine manipulator.

We then turned our attention to the abdomen where, after orogastric suction was applied, we initially attempted to obtain peritoneal access through a left upper quadrant entry; however, due to the obese habitus of the patient it was difficult to confirm entry. After a insufflation needle was placed, negative aspiration was performed, but opening pressures remained 7 to 8 mmHg. I was not comfortable with these pressures, at which point we attempted access through the umbilicus, and in a similar fashion opening pressures remained moderately high. Direct entry with a 5-mm optical trocar was then performed in the left upper quadrant, and this was done successfully.

Once the peritoneal cavity was entered, pneumoperitoneum was created with carbon dioxide to 15 mmHg, and inspection of the pelvis and abdomen was performed. It was noted that initially the trocar had gone through a small window in the omentum, but no evidence of other insertional injuries were noted. We could also see that there were no underlying injuries to the bowel or blood vessels. Ancillary trocars were then placed, first with 11-mm bladeless trocar in the umbilicus proper, followed by three other 5-mm bladeless trocars (two in the lower quadrant, lateral to the epigastric inferior gastric vessels, and one between the pubic symphysis and umbilicus). All had balloon-stay devices to keep them within the peritoneal cavity given her high body mass index.

The patient was then placed in Trendelenburg position and the procedure then continued. The right ovary was elevated and clearly appeared to contain a dermoid. Pelvic washings were obtained using approximately 200 ml of normal saline. Using monopolar scissors, the ovarian epithelium was incised along the long axis of the ovary to allow for eventual enucleation. Using traction–countertraction techniques with the suction irrigator device, multiple cystic structures were ultimately enucleated, and a small amount of bleeding was noted; however, it was minimal as we maintained proper surgical planes. Incidental rupture of one of the cysts did occur; however, spillage was contained. Cystic content exposure was minimized by placing EndoCatch bags to retrieve individual or clusters of cystic lesions to keep them within the pelvis during enucleation. The left ovary was found to be normal on visual examination and preoperative ultrasound. Despite her habitus, her end-tidal CO_2 was maintained within normal limits. We eventually lowered insufflation pressures to 12 mmHg.

Once all lesions were enucleated from the right ovary, we then extended the umbilical incision to facilitate retrieval of the four EndoCatch bags which had been placed in the pelvis and now contained cyst fragments and contents. These were retrieved without incident. At this point a Hasson trocar was then placed into the umbilicus to maintain pneumoperitoneum. We then irrigated the pelvis using several liters of room-temperature isotonic solution to remove any cystic content that had potentially leaked or was released during the procedure.

At this point, a small amount of bipolar energy was used to achieve hemostasis on the left ovarian cortex, where a small amount of bleeding was noted. After all irrigation had been suctioned from the abdomen and pelvis, we wrapped each ovary with Interceed® and allowed them to fall back into the cul-de-sac. The umbilical fascial defect was reapproximated with two interrupted 0-Vicryl sutures using a fascial closure device. The lateral quadrant trocar sites were also removed under direct visualization to assure hemostasis. Pneumoperitoneum was released, and CO_2 was evacuated to the extent possible; the remaining trocars were then removed. All skin incisions were reapproximated with 5-0 Monocryl in interrupted fashion for later removal. The uterine manipulator and Foley catheter were then removed. The patient tolerated the procedure well, and was taken to recovery in stable condition.

COMPLICATIONS

- De novo pelvic adhesion formation and adhesion reformation—*Frequent (greater than 10%* de novo *adhesion formation, and as high as 90% adhesion reformation if severe re-existing adhesions)*
- Spill of unsuspected ovarian cancer—*Infrequent (less than 5%)*
- Postoperative infection (myometritis, adnexitis)—*Infrequent (less than 5%)*
- Hemorrhage and major vessel perforation—*Rare (less than 1%)*

Suggested Reading

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CHAPTER 8

Laparoscopic Oophorectomy and Salpingo-oophorectomy

Frank Tu

INTRODUCTION

Removal of one or both ovaries, with or without the adjacent fallopian tube, has evolved in recent years beyond the management of acute conditions such as ovarian malignancy or torsed adnexa to encompass prophylactic surgery for women seeking to reduce their future risk of breast and ovarian cancer. Consequently, laparoscopic approaches to adnexal removal in isolation, or in conjunction with hysterectomy need to be well understood by most gynecologic surgeons. In addition to the above-listed indications, women with persistent lateralized abdominal or pelvic pain will often request removal of one or both ovaries, although limited evidence exists to confirm a long-term decrease in pain symptoms, even when a persistent mass, such as an endometrioma, or recurrent painful functional ovarian cysts are present. This is primarily due to current limitations in preoperatively diagnosing the root cause of chronic abdominal-pelvic pain. Similarly, removal of both ovaries to achieve permanent hypoestrogenism as a treatment for endometriosis in young women with multiple prior surgeries remains controversial, as some postmenopausal women continue to develop recurrent disease.

The technique of laparoscopic oophorectomy or salpingo-oophorectomy when done safely poses minimal surgical risks (see **Complications** box on page 72). The opening of the pelvic side wall in order to distance the ureter from the infundibulopelvic (IP) ligament prior to ligation should largely eliminate the risk of ureteral injury. If the entire ovarian cortex is not removed at the time of oophorectomy, particularly in patients with endometriosis, functionally active ovarian remnants may subsequently cause symptoms including pain, and can be challenging to remove. Complete removal of both ovaries, of course, induces surgical menopause with all attendant issues, including potential bone loss, hot flashes, and increased cardiovascular morbidity, some of which may be mitigated by the use of hormone replacement therapy. The decision to remove both ovaries must be individualized by patient, but computer models suggest that women under the age of 65 likely benefit more from ovarian preservation then bilateral oophorectomy, primarily due to reduced cardiovascular disease. Alternatively, women testing positive for BRCA1 or BRCA2 mutations have a 15% to 40% lifetime risk of developing ovarian cancer. In these patients prophylactic salpingo-oophorectomy reduced the risk of ovarian cancer by 80% (95% confidence interval, 42% to 93%) in one prospective study.

PREOPERATIVE CONSIDERATIONS

An initial workup of a pelvic mass generally will include a history, physical exam, and pelvic ultrasound. Certain findings (**Table 8.1**) are more frequently associated with an increased risk of malignancy. Unfortunately, recent studies still indicate that current markers are inadequate to predict the risk of an ovarian malignancy, and generally between 20 and 30 surgeries for benign disease are performed for every one ovarian cancer that is identified, if routine screening of asymptomatic

Table 8.1

Ultrasonographic Features Suggestive of Ovarian Malignancy

Features	Score
Sassone et al. (1991)	
Inner wall structure	1: Smooth
	2: Irregularities ≤3 mm
	3: Papillarities >3 mm
	4: Not applicable, mostly solid
Wall thickness	1: Thin ≤3 mm
	2: Thick >3 mm
	3: Not applicable, mostly solid
Septa	1: No septa
	2: Thin ≤3 mm
	3: Thick >3 mm
Echogenicity	1: Sonolucent
	2: Low echogenicity
	3: Low echogenicity with echogenic core
	4: Mixed echogenicity
	5: High echogenicity
Based on abnormal score defined as ≥9, test characteristics for this index are as follows: sensitivity 100%, specificity 83%, positive predictive value 37%, and negative predictive value 100%.	
DePriest et al. (1994)	
Volume	0: $<10\ cm^3$
	1: $10–50\ cm^3$
	2: $>50–200\ cm^3$
	3: $>200–500\ cm^3$
	4: $>500\ cm^3$
Cyst wall structure smooth	0: <3 mm thickness
	1: Smooth >3 mm thickness
	2: Papillary projection <3 mm
	3: Papillary projection ≥3 mm
	4: Predominantly solid
Septa structure	0: No septal
	1: Thin septal <3 mm
	2: Thick septal 3 mm to 1 cm
	3: Solid area ≥1 cm
	4: Predominantly solid
Based on abnormal score defined as ≥5, test characteristics for this index are as follows: sensitivity 89%, specificity 73%, positive predictive value 46%, and negative predictive value 96%.	

postmenopausal women is performed. Certain laboratory tests may suggest particular malignancies (elevated CA-125 is associated with an epithelial ovarian malignancy in postmenopausal women; elevated lactic dehydrogenase, α-fetoprotein, and human chorionic gonadotropin levels are associated with the presence of germ cell tumors in younger women; elevated levels of inhibin, estrogen, or testosterone are associated with sex-cord tumors at any age—see Chapter 18 for more details).

Those patients with higher risk features may benefit from a discussion of their surgical plan with a gynecologic oncologist; who should consider simultaneous staging at the time of oophorectomy. In addition, selected individuals who are found to have a malignancy at the time of their initial laparoscopic surgery may be able to undergo the staging laparoscopically. In younger patients, the decision to perform an ovarian cystectomy versus an oophorectomy should consider the relative risk of occult malignancy, as spill of a confined ovarian malignancy will affect subsequent staging and potentially the use of adjuvant chemotherapy. When anticipated, the risk of chemical peritonitis following intraoperative rupture of a mature teratoma should be discussed with patients as well, although with aggressive irrigation at the time of spill the outcome of this is usually favorable.

Very large masses (>15 cm) may dissuade many surgeons from proceeding with an endoscopic approach to the ovarian mass; however, suction aspirator systems that allow decompression of a large cyst while minimizing the risk of spillage may be sufficient to allow mobilization of the mass and exposure of the adnexal pedicles. Similarly, general contraindications (cardiopulmonary compromise, history of severe pelvic infections, etc.) and relative contraindications (morbid obesity, multiple prior laparotomies, especially with bowel surgery, or pregnancy) to undergoing laparoscopy need to be considered before choosing the route of surgery. However, the vast majority of patients will be able to take advantage of the smaller incisions and more rapid recovery from laparoscopic surgery. The use of a preoperative bowel prep in select patients, based on the preferences of local colorectal surgeons, may be applicable in high-risk patients, where bowel adhesions and/or dissection is anticipated. Premenopausal patients undergoing removal of their sole remaining ovary, or both ovaries, need to be counseled regarding the onset of acute menopausal symptoms and the potential need for hormonal replacement.

SURGICAL TECHNIQUE

1. **Port and instrument placement:** Patients should be placed in the dorsal lithotomy position for pelvic laparoscopy. Three to four laparoscopic ports are placed to allow use of an endoscope, graspers, vessel sealers, and specimen retrieval bag. Two lateral quadrant ports should be placed, avoiding the course of the epigastric vessels, and the ilioinguinal and iliohypogastric nerves. If a suprapubic port is chosen, the bladder can be retrofilled to identify its boundary, or else a point 2 cm above the symphysis pubis is selected. The bladder is generally decompressed with a Foley catheter during the entire case. One 10 cm or larger port is needed usually for specimen retrieval. An optional uterine manipulator can be placed transcervically. Gas insufflation tubing connected to one of the ports allows continuous inflow of CO_2 during the case to maintain a pneumoperitoneum between 12 and 15 mmHg.

   A midline endoscopic camera (5 to 10 mm) guides the procedure, but it can be placed through other ports to offer alternate views, particularly of the ureter's course. Choice of the initial entry port needs to account for prior surgical scars, but a midline infraumbilical and left upper quadrant (Palmer's point) insertion are the most typical for safe entry. In skilled hands, there are minimal differences in entry-associated bowel or vascular injuries when choosing an open technique versus preinsufflation with a insufflation needle followed by trocar insertion. Surgeons are generally best off using what they have the most experience with and as dictated by the clinical circumstance.

2. **Retraction and initial inspection:** We begin by using atraumatic graspers to bring the mesentery of the small bowel, the ileocecal valve, and the rectosigmoid reflection of the large bowel above the sacral promontory, thus exposing the pelvic cavity. If obstructing adhesions need to be released, these should be done carefully. Inspection of the entire pelvic cavity and pelvic diaphragm at close proximity to the peritoneum for occult metastatic ovarian disease should be done first, as positive findings may dictate converting the case immediately. The ovaries should be inspected next, and the feasibility of removal confirmed. Washings of the pelvic peritoneum can be obtained using an irrigator and held until a frozen section, if performed, is complete. The ureters' courses should be identified. For complex cases, preemptive ureteral stenting may facilitate identification of the ureter and, if necessary, facilitate its subsequent dissection from dense scar tissue.

3. **Dissection and specimen removal:** A contralaterally introduced grasper brings the ovary toward the midline and slightly caudad, placing tension on the IP ligament (**Figure 8.1**). If the ureter can be readily visualized posterior and distant from the IP ligament, side-wall dissection is generally not

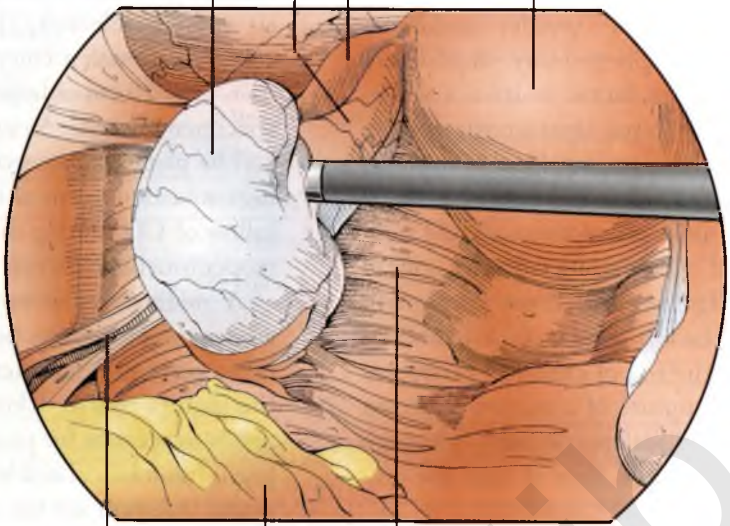

FIGURE 8.1 The left ovary retracted laterally in preparation for oophorectomy.

mandated. Otherwise the broad ligament can be opened up lateral to the IP ligament using an ipsilaterally placed scissors or electrosurgical dissector. The space between the IP ligament and the ureter can then be readily identified and dissected open. The fully exposed IP can be ligated either using desiccating current through a bipolar forceps (**Figure 8.2**), or for advanced surgeons, using conventional suture ligation techniques, using a free tie followed by a fixation suture on the pedicle side and specimen side, respectively. After transection of the IP, the cut pedicles should be inspected for bleeding.

The ovary is again retracted medially and the broad ligament dissection is extended sharply (using sharp scissors or energy-based cutting devices) along the lateral aspects of the ovary until the round ligament is reached, taking care to visualize and avoid the adjacent ureter. If a salpingo-oophorectomy is to be performed, the tube is first desiccated cauterized at its insertion to the uterus and then transected (**Figure 8.3**). The lateral peritoneal incision freeing the ovary is made lateral and parallel to the fallopian tube. At this time the utero-ovarian ligament can be bluntly exposed, ligated, and transected using either current or two ligation sutures (**Figure 8.4**).

Preservation of the adjacent fallopian tube is an option for women who continue to plan childbearing and in whom there is low suspicion for malignancy. In this event, lateral dissection of the ovary is carried out by transecting the tubo-ovarian peritoneum longitudinally along the top of the ovary, taking care to avoid the underlying vessels.

4. **Removal of the ovary from the abdomen:** With the ovary freed, a specimen bag is introduced into the pelvic cavity through the 10 cm or larger port, and the specimen is guided into the bag in its entirety (**Figure 8.5**), and the bag is closed. Note that with larger masses (8 cm or greater), preemptive decompression of the ovarian mass, if fluid filled, is an option. However, this should be done by a surgeon familiar with using a secure cyst aspirator system. The aspiration points are typically first harnessed with an open pre-tied Roeder knot, which is cinched closed below the defect after the fluid has been evacuated. The opening of the bag containing the specimen is pulled extraperitoneally, opened outside the skin, and further dissection or aspiration of the cyst is performed if necessary to reduce the specimen size to lesser than the diameter of the port incision. Eventually, the bag(s) is completely removed. If both ovaries are to be removed, the contralateral adnexa are approached in an identical fashion.

5. **Final inspection and closing steps:** The pelvis is then carefully inspected under low pressure

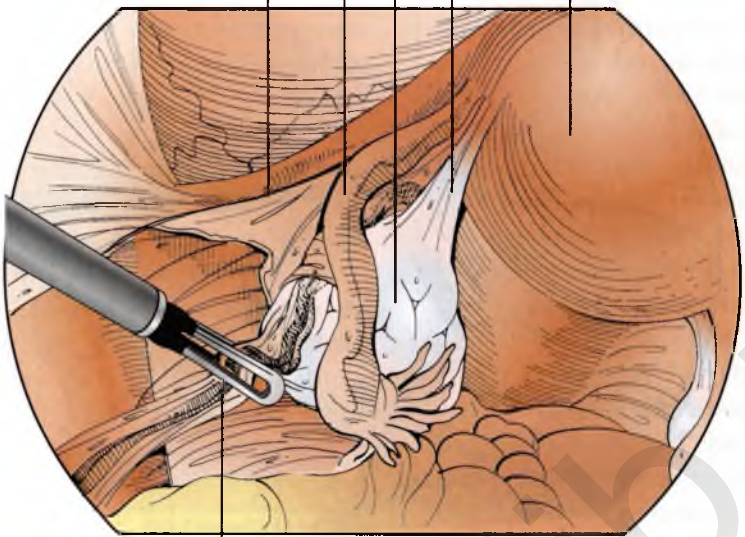

FIGURE 8.2 The ovarian vessels are being ligated for a left salpingo-oophorectomy with bipolar desiccating forceps.

(around 6 mmHg), and the pedicles are confirmed to be hemostatic, or ligated again if bleeding is noted. Based on frozen section results and preoperative discussion with the patient, further staging, at this time or later, may be necessary. When the procedure is complete, the fascia of any ports larger than 10 mm are closed, and the skin is reapproximated following standard techniques.

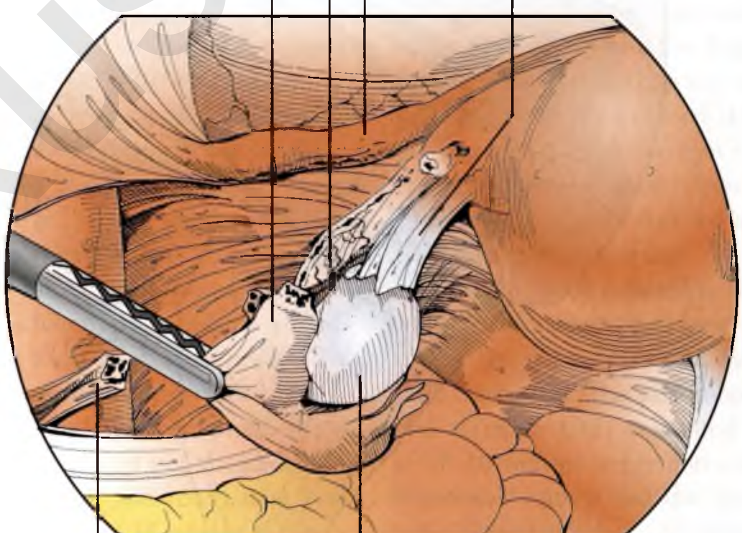

FIGURE 8.3 The fallopian tube transected at the time of left salpingo-oophorectomy, exposing utero-ovarian vessels.

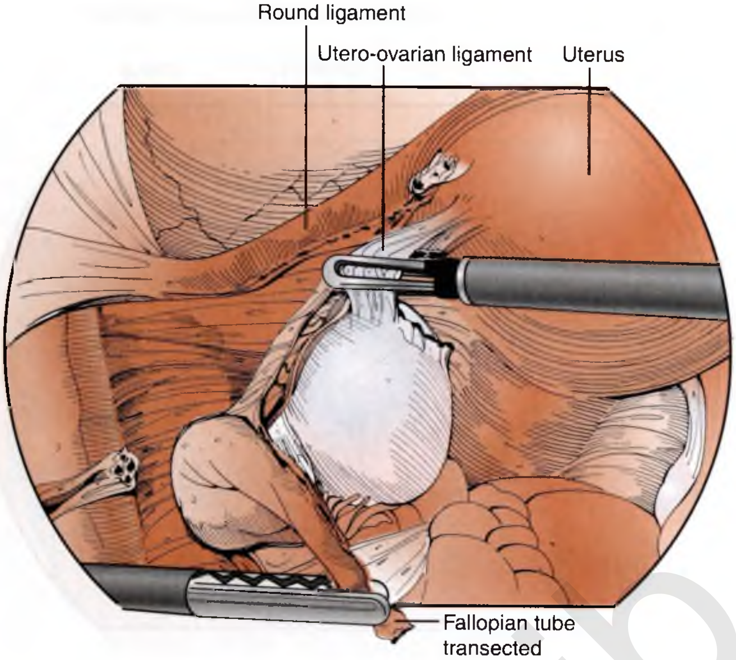

FIGURE 8.4 Transection of utero-ovarian vessels at the time of left salpingo-oophorectomy.

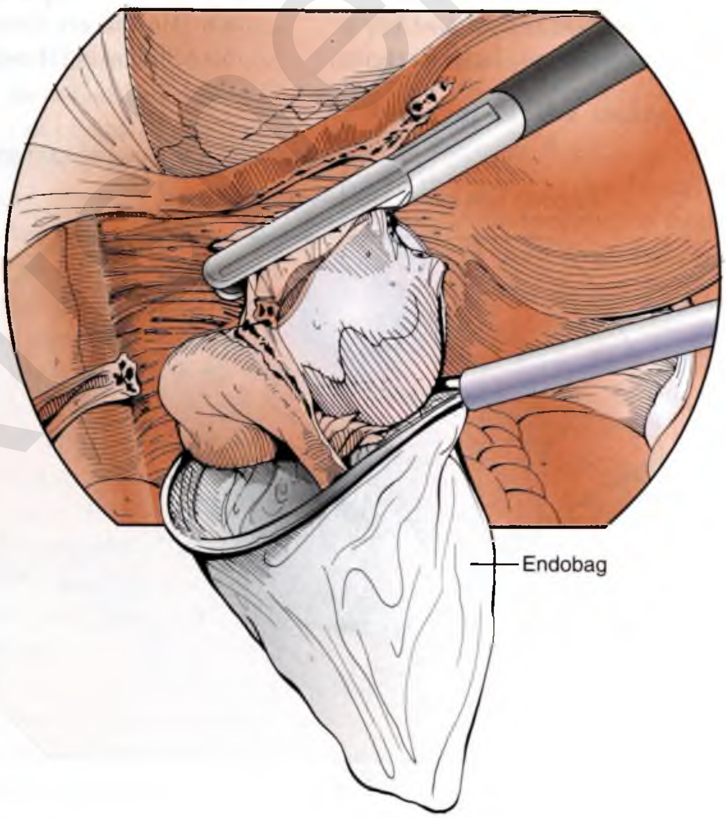

FIGURE 8.5 Extraction of excised left adnexa into specimen bag.

POSTOPERATIVE CONSIDERATIONS

For most patients, laparoscopic salpingo-oophorectomy can be performed as an outpatient in a same-day surgery setting. If it is combined with other procedures, then an overnight stay may be more appropriate. Prolonged bladder drainage is not generally necessary for patients with normal bladder function. Postoperative pain is usually adequately managed with nonsteroidal anti-inflammatory drugs. Oral narcotics can then be used on an "as needed" basis for episodes of increased pain.

Patients should be instructed to avoid vigorous activity for the first week or so after the procedure. Some may return to work within a few days; others may need 1 to 2 weeks off. In premenopausal women who have had all of their ovarian tissue removed, side effects such as hot flashes may present acutely, and use of estrogens, with (if uterus is present) or without progestins, can be highly effective.

Operative Note

PROCEDURE: LAPAROSCOPIC OOPHORECTOMY AND SALPINGO-OOPHORECTOMY

The patient was taken to the operating room, where her identity was confirmed. After the establishment of adequate anesthesia, she was placed in the dorsal lithotomy position, pneumatic sequential compression devices were placed over the lower extremities, a combined abdominal and vaginal prep and drape was performed. Arms were padded and tucked in military position, the hip and ankle joints were placed in neutral position, and the knees were flexed to 90° to minimize nerve compression. The operative team completed a time-out. A Foley catheter was placed in the bladder. A uterine manipulator was inserted into the uterus after the cervix was dilated to the appropriate size.

All port sites were infiltrated with bupivacaine. A 5-mm incision was made in the infraumbilical skin, and the subcutaneous tissue was bluntly dissected down to the fascia with a Kelly clamp. A blunt insufflation needle was then inserted gently into the abdominal cavity through the umbilicus and low entry pressures were confirmed. Three liters of CO_2 gas was then insufflated into the abdomen to achieve a pneumoperitoneum, and insufflation was continued with a preset maximum of 15 mmHg. A 5-mm atraumatic radially dilating trocar was then inserted into the abdominal cavity through this site, and safe entry was confirmed by visualization through the laparoscope. Additional 5-mm RLQ and 11-mm LLQ trocars were placed through incisions 1 cm medial and superior to the anterior superior iliac spine. The patient was then placed in the Trendelenburg position. Bipolar desiccating forceps were used during the case for vessel sealing (35 W), and tissue dissection was done with a combination of blunt dissection, sharp scissor dissection, and monopolar non-modulated current desiccation set at 30 W.

The small and large bowels were retracted above the sacral promontory to expose the posterior cul-de-sac. The upper abdomen and the appendix were visualized to confirm absence of incidental pathology. The uterus was mobilized gently to visualize both anterior and posterior cul-de-sacs. The course of both ureters was identified from the pelvic brim and traced down to the uterocervical junction. Pelvic washings were obtained with a laparoscopic irrigator and then held until the frozen specimen was returned.

The left ovary was identified again as having a persistent ovarian mass. It appeared to be sufficiently mobile to permit removal without excessive risk of rupture. The ovary was then placed on tension to expose the IP ligament. A plane between the ureter and the IP ligament was identified and sharply dissected open. The lateral aspect of the IP ligament was likewise sharply divided from the broad ligament. The exposed IP pedicle was then desiccated and divided using bipolar cutting forceps. Pulling the ovary medially, it and the adjacent fallopian tube were freed by incising the lateral peritoneum. The utero-ovarian ligament and tubouterine insertion were desiccated and divided with bipolar cutting forceps. The freed ovary and tube was then placed into an endoscopic specimen bag inserted through the 11 mm port, and the bag was exteriorized through the skin. A needle was placed through the open end of the bag and the ovarian cyst decompressed, allowing the specimen bag to be removed fully. It was sent for frozen section and returned as a benign tumor. The washings were discarded.

The pelvis was deflated to 6 mmHg and all pedicles inspected for confirmed hemostasis. Thorough irrigation of the pelvis was done with normal saline and all fluid evacuated. The pneumoperitoneum was released and as much CO_2 evacuated as possible. The fascia of all 10 mm or larger ports was closed with braided absorbable suture and the skin incisions closed with subcuticular stitches. All instruments were removed from the vagina and the Foley catheter removed. The patient was extubated and transferred to recovery in good condition.

COMPLICATIONS

- Bowel, bladder, ureteral injury–*Infrequent (less than 5%)*
- Major vascular injury–*Rare (less than 1%)*
- Pelvic infection–*Rare (less than 1%)*
- Dissemination of unsuspected ovarian malignancy–*Rare (less than 1%)*
- Hemorrhage requiring transfusion–*Rare (less than 1%)*
- Ovarian remnant syndrome–*Very rare (less than 0.5%)*
- Premature menopause–*Very rare (less than 0.5%)*

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CHAPTER 9

Marsupialization of Bartholin Gland Cyst

M. Jonathon Solnik

INTRODUCTION

The Bartholin glands are bilateral glands located in the vulva, normally less than 1 cm in diameter, and secrete mucous to provide for vaginal lubrication. The Bartholin ducts, normally lined with transitional epithelium, open into the inner aspect of the introitus. A Bartholin gland may expand and dilate if the gland's duct becomes obstructed, most commonly after traumatic injury, or even after surgical repair of the posterior vaginal compartment; it occurs less commonly after gonococcal infection. Management of women presenting with symptomatic Bartholin gland cyst obstruction typically depends on whether the obstruction of the duct is acute and associated with inflammation and/or abscess, or whether it is chronic and noninfected. Many women are not symptomatic and may not be aware of such a cyst until noted on gynecologic examination.

A noninfected cyst normally ranges in size from 1 to 3 cm, does not cause pain, and may slowly regress and re-expand over time (**Figure 9.1**). Alternatively, if it becomes infected, a Bartholin gland cyst can form an abscess that will rapidly increase in size over several days and is very painful. In order to heal, a Bartholin gland cyst abscess usually must be drained. Acute infection, resulting in a painful, pus-filled gland, should be treated by incision and drainage (I & D) and placement of a Word catheter. Irrigation of the gland with sterile saline and manual disruption of any loculations within with a small curved clamp typically results in symptomatic relief. Use of antibiotic irrigant or post-procedural antibiotics have not been shown to be of additional benefit. Cultures, unless suspected for methicillin-resistant *Staphylococcus aureus*, are not clinically useful. Simple I & D, without the placement of a Word catheter, should be avoided since this does not allow for ongoing drainage, predisposing to recurrence.

Either marsupialization or gland excision, representing more aggressive treatment of a Bartholin gland cyst, are indicated for chronic gland cysts that are symptomatic. Marsupialization should be avoided during the acute phase of infection. Marsupialization, in contrast to gland excision, preserves gland function and may allow for adequate vaginal lubrication after release of the obstruction.

PREOPERATIVE CONSIDERATIONS

Marsupialization is reserved for patients with chronic, symptomatic cysts and avoids complications associated with gland excision, which is more lengthy and morbid. During the preoperative evaluation, a thorough history should be obtained to ascertain risk factors for initial cause, postoperative complications, and potential recurrence. On examination, the size and location of the Bartholin gland should be documented, and the clinician should make certain that the process does indeed involve the Bartholin gland rather than the labia minora or other vaginal glands as the treatment may differ significantly.

Risks of the procedure should be reviewed, including postoperative tenderness, drainage, as well as the need to refrain from coitus for at least 3 to 4 weeks to minimize irritation and trauma. The procedure should

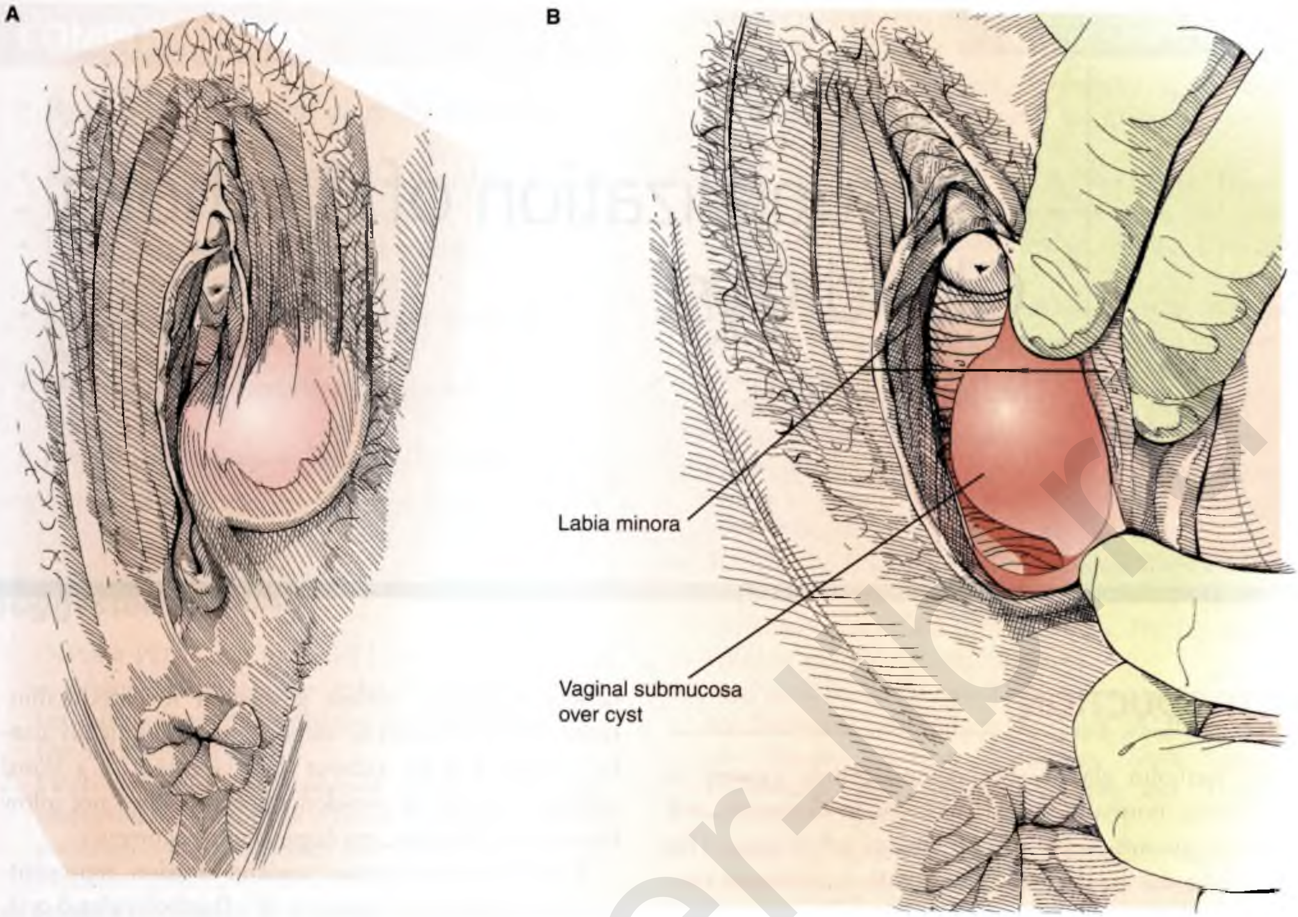

FIGURE 9.1 A left-sided uninfected Bartholin gland cyst (Figure 9.1A) can be seen best with lateral retraction of the labia majora (Figure 9.1B).

take place in an ambulatory surgery setting since adequate anesthesia (local, regional, moderate sedation) and exposure are needed for marsupialization, as opposed to I & D and Word catheter placement, which can easily be performed in the office setting.

SURGICAL TECHNIQUE

Patients are placed in lithotomy position using Allen stirrups, and reexamination should take place once the patient is comfortable. Even if performed under regional or general anesthesia, local infiltration of the surrounding tissues with a long-acting anesthetic may allow for clear planes of dissection and improved postoperative comfort.

An elliptical incision is made overlying the cyst itself, in the anteroposterior direction, inside the hymenal ring (Figure 9.2). It should be of sufficient size (generally 2.5 cm in length and 1.5 cm in width) to minimize the risk that the opening will close with subsequent healing and scar retraction. The cyst wall is identified and dissected away from the surrounding vaginal mucosa, in order to better isolate the cyst and prepare it for suturing to the submucosa. The cyst wall is then grasped with a toothed forceps and entered sharply. Once fluid contents are drained and any intralocular adherences broken manually (**Figure 9.3**), the edges of the cyst wall are sutured to the corresponding vaginal submucosa. Several interrupted sutures of 2-0 delayed absorbable sutures circumferentially around the edges of the opening are recommended and should not be tied under too much tension, which may strangulate the submucosa and result in loosening of the sutures (**Figures 9.4 and 9.5**). In this fashion the gland opening created should remain open without a tendency to close on itself.

POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see **Complications** box on page 77). Routine analgesics and sitz baths (beginning 3 to 4 days post-procedure) should be prescribed. Pelvic rest should be maintained

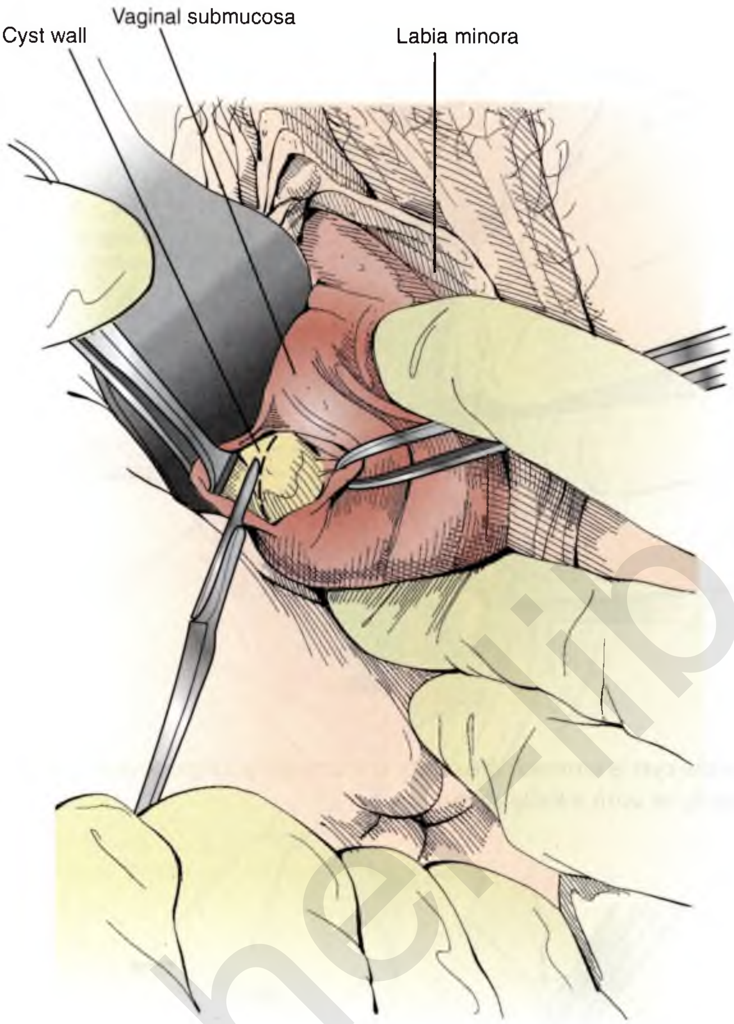

FIGURE 9.2 A scalpel is used to make a 2.5 cm vertical and elliptical incision overlying the cyst itself, concealing the incision medial/cephalad to the hymenal ring.

for at least 3 to 4 weeks to allow for healing and minimize risk of secondary infection. Postoperative fibrosis may occur, resulting in closure of the aperture made during marsupialization and a recurrence of up to 10% to 15%.

Operative Note

PROCEDURE: MARSUPIALIZATION OF BARTHOLIN GLAND CYST

After successful induction of general anesthesia with laryngeal mask airway, the patient was placed in lithotomy position with her legs in Allen-type stirrups. She was prepped and draped, and a time out was performed. An in-and-out catheter was used to drain her bladder.

The external genitalia were thoroughly examined and an enlarged, 4-cm right-sided Bartholin gland cyst was identified. A small amount (1 to 2 ml) of local anesthetic was used to infiltrate the medial border of the labia minora to access the gland proper and conceal the eventual incision. Using a 15-blade scalpel, a 2 cm elliptical incision was made inside the hymenal ring exposing the dilated gland wall. A mosquito clamp was used to dissect the margins of the vaginal mucosa from the underlying cyst wall, which was then entered sharply with the scalpel. A suction device was used to empty fluid contents, and a small hemostat was used to confirm the lack of loculations within the gland itself. Using several interrupted sutures of 2-0 braided, absorbable suture, the edges of the gland wall were sutured to the overlying vaginal mucosa to ensure sufficient opening to allow ongoing drainage to minimize cyst reformation. Minimal bleeding was encountered and no electrosurgery was needed to maintain a dry surgical field. The patient tolerated the procedure well without complications.

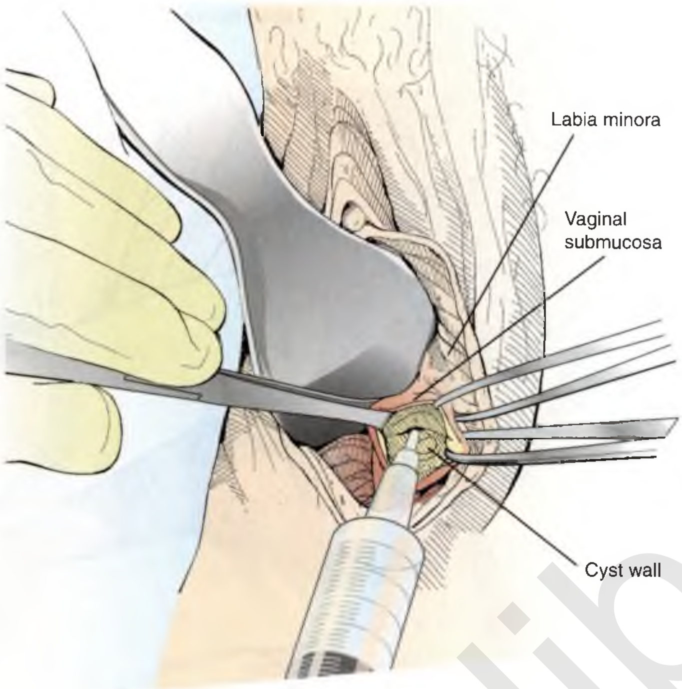

FIGURE 9.3 Once the cyst is entered, the cavity is thoroughly irrigated and intralocular adherences are broken manually or with a Kelly clamp.

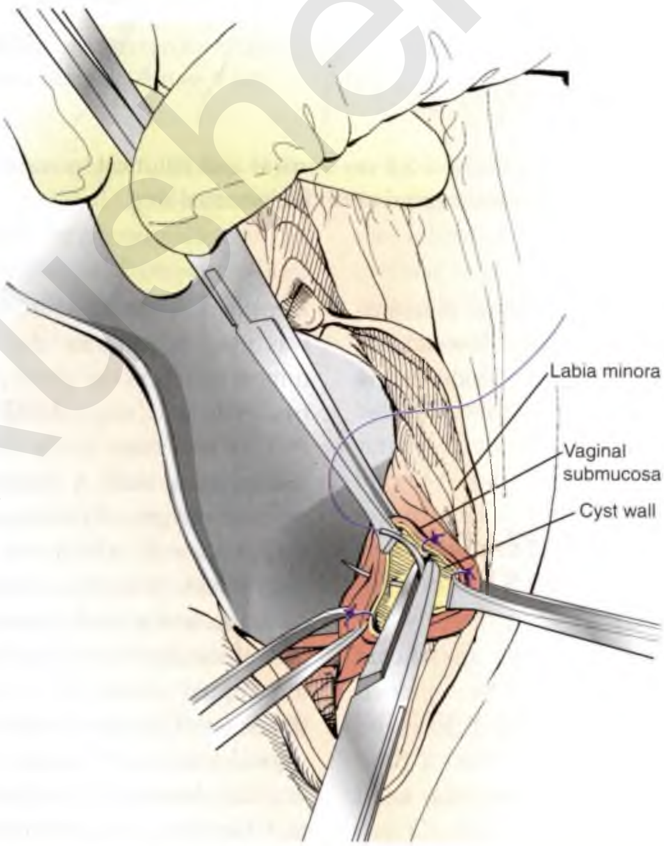

FIGURE 9.4 Once irrigated, the cyst wall is sutured to the vaginal submucosa in a circumferential fashion using absorbable suture.

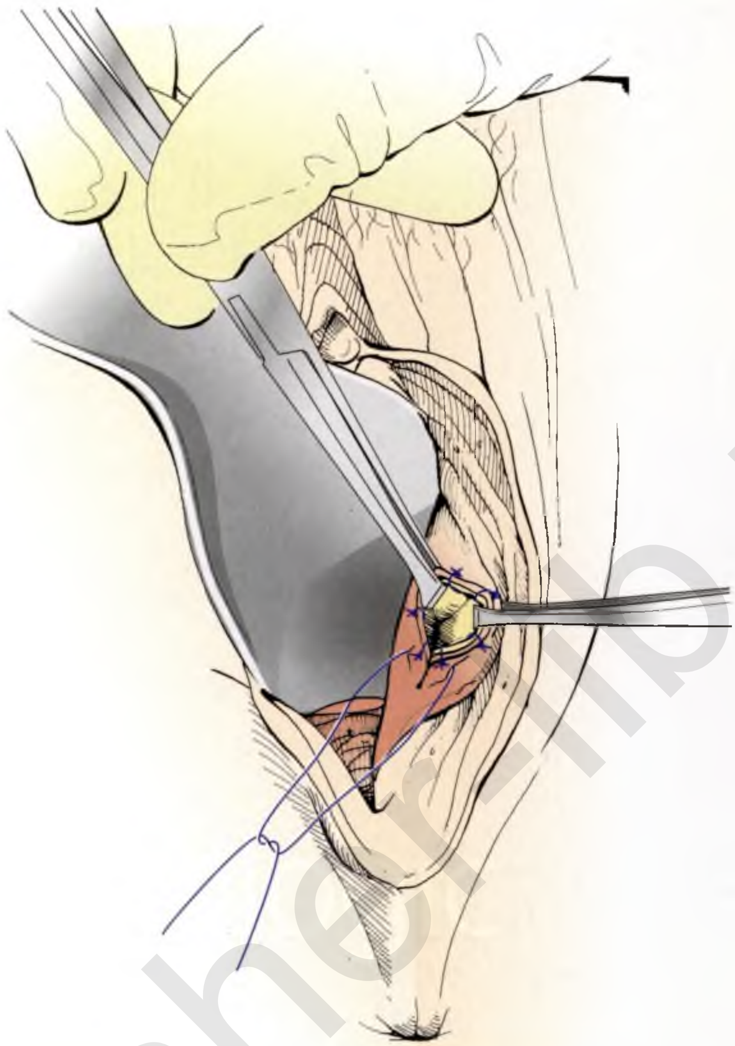

FIGURE 9.5 A completed reapproximation is seen with the final suture being placed.

COMPLICATIONS

- Recurrence—*Frequent (up to 10% to 15%)*
- Postoperative infection—*Infrequent (less than 5%)*
- Hemorrhage or major vessel perforation—*Infrequent (less than 5%)*

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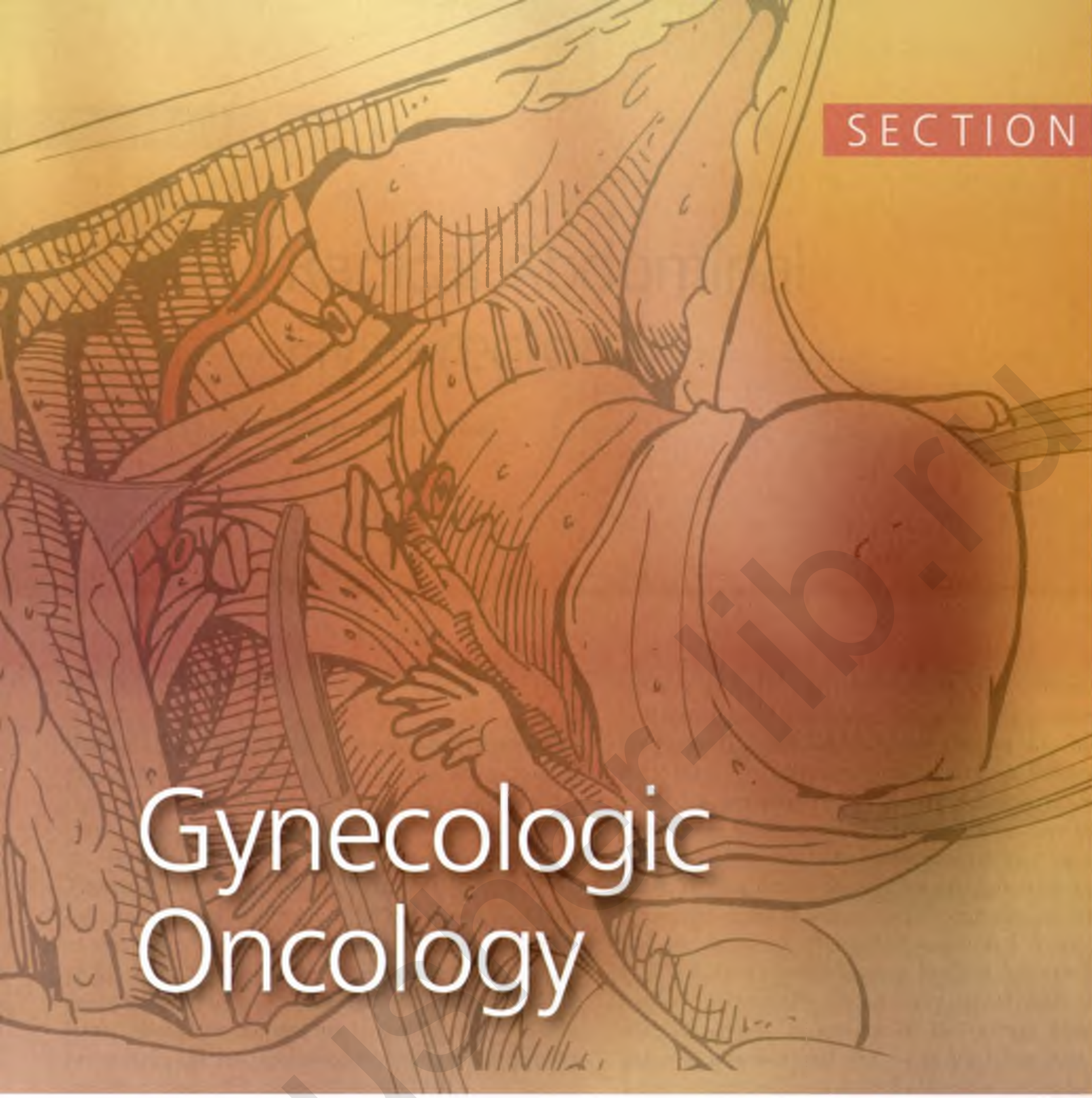

SECTION II

Gynecologic Oncology

CHAPTER 10

Radical Abdominal Hysterectomy

Robert E. Bristow

INTRODUCTION

Radical hysterectomy is distinguished from simple extrafascial hysterectomy by the dissection of the ureters from within the parametria and a wider resection of additional tissue surrounding the cervix, usually for an early-stage cancer of the cervix. The first radical abdominal hysterectomy for cervical cancer was performed in 1895 by John G. Clark at the Johns Hopkins Hospital under the direction of Howard A. Kelly. The vaginal approach to radical hysterectomy was described by Schauta in 1902. Ernst Wertheim contributed modifications to the procedure, and his published experience contributed greatly to the acceptance of radical hysterectomy as a viable treatment for women with early-stage cervical cancer. Later modifications were introduced by Okabayashi. Although recent attention has been directed toward implementation of a more anatomically distinct classification system of radical hysterectomy, including nerve-sparing variants, the Piver-Rutledge classification system, introduced in 1974, is still commonly referenced. In practice, there are three basic variations of radical hysterectomy. The Wertheim hysterectomy is the most commonly performed variant in the United States, has the broadest applicability, and is described in the following section. The two most common variations are the modified radical hysterectomy and the extended radical hysterectomy.

The most common indication for radical hysterectomy is the surgical treatment of early-stage (Stages IA2-IIA) cervical cancer. The efficacy of combined irradiation and low-dose chemotherapy for Stage IB2 disease has made this an uncommon indication for radical surgical treatment. Some centers also perform radical hysterectomy for Stage IIB cancer of the cervix, although this is rare in the United States. Radical hysterectomy may be indicated as completion surgery for patients with locally advanced cervical cancer with centrally persistent disease following definitive combined irradiation and low-dose chemotherapy. Radical hysterectomy is also a treatment option for patients with endometrial cancer extending to the cervix (clinical Stage II disease) and may be required as part of a larger cytoreductive surgical effort for patients with advanced ovarian cancer. The surgical principles of radical hysterectomy are also applicable to the operative management of a number of noncancerous gynecologic conditions including extensive endometriosis and uterine leiomyomata involving the cervix or lower uterine segment. Radical hysterectomy can be performed with or without pelvic lymphadenectomy or adnexectomy.

The typical route of approach to radical hysterectomy is abdominal, laparoscopic, or robotically assisted. Radical vaginal hysterectomy is uncommonly performed in the United States. This chapter addressed the abdominal approach, although the same basic principles apply whichever route is selected and are also applicable to conservative surgical approaches to early-stage cervical cancer for fertility preservation (radical trachelectomy).

PREOPERATIVE CONSIDERATIONS

In preparation for radical hysterectomy, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate major surgery or disease-related characteristics (e.g., parametrial extension) that would contraindicate successful surgical resection. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, and electrocardiogram for women aged 50 years and older. Preoperative imaging of the pelvis and abdomen (computed tomography) is usually indicated to evaluate the extent of cervical pathology and associated extent of adenopathy for surgical planning purposes.

Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) may facilitate pelvic exposure by making the small bowel and colon easier to manipulate but is not required. Prophylactic antibiotics (Cephazolin 1, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. The instrumentation will necessarily vary according to the approach selected. For abdominal hysterectomy, a self-retaining retractor (e.g., Bookwalter, Codman Division, Johnson & Johnson, Piscataway, NJ) with a fixed arm attaching the retractor ring to the operating table is advisable to optimize exposure, maximize patient safety, and reduce surgeon fatigue. A variety of instruments, in addition to the standard surgical armamentarium, can be used at the surgeon's discretion to facilitate the retroperitoneal dissection including vessel-sealing devices, the argon beam coagulator, and surgical stapling devices. Following is a brief description of the surgical procedure used (see also video: *Radical Abdominal Hysterectomy*).

SURGICAL TECHNIQUE

Either general or regional anesthesia is acceptable. The patient should be positioned in low dorsal lithotomy position using Allen-type stirrups. The abdomen is prepped and a Foley catheter placed. Examination under anesthesia should pay particular attention to the size and topography of the cervix, uterus, proximal vagina, parametria, and uterosacral ligaments.

Either a low-transverse incision (Pfannenstiel, Maylard, Cherney) or low vertical midline incision will provide satisfactory exposure for radical hysterectomy, depending on patient body habitus. After abdominal entry and placement of a self-retaining retractor, adhesions are taken down, normal anatomy is restored, and the bowel is packed out of the surgical field.

The uterus is elevated out of the pelvis and manipulated by two large Kelly clamps placed across the broad ligament adjacent to the uterine fundus encompassing the round ligament, fallopian tube, and utero-ovarian ligament on each side. The broad ligament is incised cephalad to the round ligament, and the peritoneal incision extended above the pelvic brim parallel to the infundibulopelvic ligament. The common iliac artery is identified and traced distally to its bifurcation into the external iliac artery and internal iliac (hypogastric) artery, which courses deep along the lateral pelvic wall. The uterine arteries originate from the hypogastric artery within the cardinal ligament. The round ligament is identified and a ligature of 1-0 delayed absorbable suture placed as far laterally toward the pelvic sidewall as possible and held long for traction. A large hemo-clip (or suture ligature) is placed medially (uterine side) to control back-bleeding, and the round ligament is divided. An incision is created in the anterior leaf of the broad ligament and is continued medially across the vesicouterine peritoneal reflection (or fold) at the junction of the lower uterine segment and cervix.

To perform radical hysterectomy safely and efficiently, six of the eight potential pelvic spaces should be developed early in the operation—the paired paravesical spaces, the paired pararectal spaces, the vesicovaginal space, and the rectovaginal space. The pararectal space is developed by carefully dissecting, with a finger or large Kelly clamp, between the hypogastric artery (laterally) and the medial leaf of the broad ligament peritoneum. The ureter is attached to the medial leaf of the broad ligament peritoneum and is most easily located at the pelvic brim in the region of the bifurcation of the common iliac artery. The ureter should be dissected from its adventitial sheath using a right angle clamp and placed within a vessel-loop for traction. The paravesical space is identified by placing upward traction on the round ligament ligature and the lateral surface of the bladder with a Babcock clamp. The obliterated umbilical artery will appear as a thick band of tissue running just lateral to the bladder, and it demarcates the medial border of the paravesical space. The paravesical space is developed with a finger or long Kelly clamp starting along the pelvic sidewall anterior to the cardinal ligament and dissecting anteriorly,

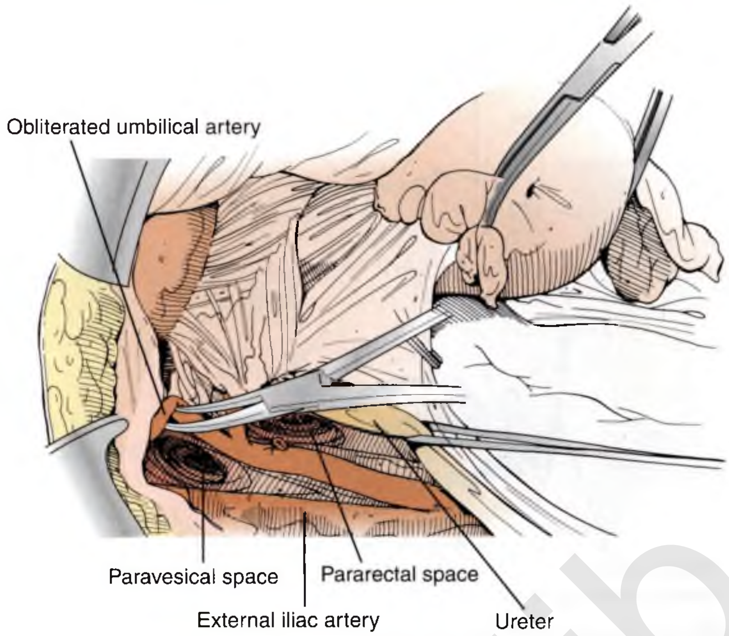

FIGURE 10.1 Radical abdominal hysterectomy: Development of the paravesical and pararectal spaces.

medially, and inferiorly. Both the pararectal and paravesical spaces are developed down to the level of the pelvic floor (**Figure 10.1**).

Depending on clinical indications, adnexectomy and pelvic lymphadenectomy can be performed in conjunction with radical hysterectomy. These techniques are described in Chapters 2 and 12, respectively. If the adnexa are to be preserved, they are detached from the uterus and tucked into the upper abdomen. Otherwise, the infundibulopelvic ligaments are clamped, divided, secured with 1-0 delayed absorbable sutures, and the adnexa are tied to the Kelly clamps holding the uterus.

The pelvic sidewalls are inspected and palpated for evidence of metastatic nodal disease. The pelvic node dissection can be performed before or after the radical hysterectomy. Clinically suspicious lymph nodes should be excised and sent for frozen-section analysis. Some clinicians will abandon the radical hysterectomy if pelvic nodal metastases are documented, rationalizing that radiation therapy will be administered in any case and that completing the hysterectomy will add to the risk of morbidity. It is the author's preference to complete the hysterectomy, provided the metastatic pelvic nodal disease is completely resectable; however, the radicality of the hysterectomy is scaled back to that of a modified radical procedure to reduce the risk of complications associated with combined radical surgery and adjuvant pelvic radiation therapy. The cardinal ligament, or "web" of tissue between the paravesical and pararectal spaces, is palpated to evaluate the local extension of cervical tumor and ensure the absence of disease in the paracervical tissues. Local tumor extension into the paracervical tissues is generally an indication to abandon radical hysterectomy.

The posterior leaf of the broad ligament is placed on medial traction and the ureters are dissected from their attachments to the lateral side of the uterosacral ligaments using a right angle clamp to gently develop the correct plane outside the adventitial sheath. The ureter is completely mobilized from the medial leaf of the broad ligament peritoneum from the level of the pelvic brim down to its entrance into the parametrial tunnel of Wertheim (cardinal ligament). Early mobilization of the bladder will facilitate ureteral dissection through the cardinal and vesicouterine ligaments. The bladder is grasped at the edge of the vesicouterine peritoneal incision and placed on ventral and caudad traction. Working in the midline, the electrosurgical unit is used to develop the vesicocervical space. At the level of the anterior vesicocervical junction, the bladder is attached to the cervix by the vesicocervical ligament, which separates the vesicocervical space from the more caudal vesicovaginal space. The electrosurgical unit is used to divide the vesicocervical ligament and mobilize the bladder off of the proximal vagina. As the bladder is mobilized caudally, the bladder pillars are defined at the anterolateral aspects of the cervix, appearing as a crescent-shaped complex of muscle fibers and fibrovascular connective tissue. The proximal component of the bladder pillar—the vesicouterine ligament—transmits the ureter from the parametrial tunnel of Wertheim to the bladder. The bladder is mobilized to expose the proximal 3 to 4 cm of vagina (**Figure 10.2**).

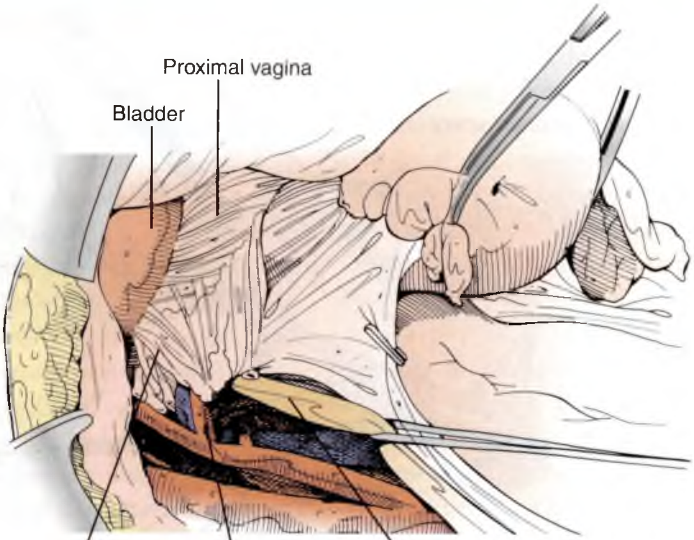

FIGURE 10.2 Radical abdominal hysterectomy: Mobilization of the bladder from the proximal vagina and definition parametria and bladder pillar anatomy.

The uterine artery is identified by tracing the hypogastric artery distally or by locating the obliterated umbilical artery and tracing it proximally. A right angle clamp is used to skeletonize the lateral aspect of the uterine artery, which is then doubly ligated with 1-0 delayed absorbable sutures or clipped and divided at its origin from the hypogastric artery (**Figure 10.3**). The medial suture is left long and used to apply upward traction on the uterine artery as it is dissected from the underlying cardinal ligament and mobilized over the ureter. The ureter is sharply dissected from its attachments within the parametrial tunnel and mobilized laterally, using the vessel-loop for traction. The uterine vein follows a more unpredictable course, and may run above or below the ureter. It is ligated separately and divided as far laterally as possible.

The ureteral tunnel is developed within the vesicouterine ligament (bladder pillars) by introducing a right angle clamp along the superior and medial border of the ureter and gently spreading the tips of the clamp several times (**Figure 10.4**). The ureter should be maintained on gentle backward traction to facilitate dissecting in the correct plane outside the adventitial sheath. The vesicouterine ligament is then divided between fine-tipped clamps (Tonsil or right angle), and the anterior and posterior "leaves" are ligated with 2-0 or 3-0 delayed absorbable sutures and divided. The ureter is completely released from its attachments to the posterior leaf, rolled laterally, and dissected to the ureterovesical junction, leaving both anterior and posterior components of the vesicouterine ligament attached to the hysterectomy specimen.

Once the ureters have been completely mobilized from the pelvic brim to the bladder, attention is directed toward the posterior pelvis and cardinal ligament. The pelvic wall peritoneum of the medial leaf of the broad ligament is incised down to the base of the uterosacral ligament at the level of the rectum. The rectovaginal space is entered by placing the rectosigmoid colon on dorsal traction and incising the peritoneal Douglas cul-de-sac between the uterosacral ligaments. A combination of sharp and blunt dissection is used to develop the correct plane within the thin areolar tissue between the anterior rectal wall and posterior wall of the vagina (**Figure 10.5**). The rectum should be mobilized caudally for a distance of 3 to 4 cm. The uterosacral ligaments are divided between clamps (or using the electrosurgical unit or a vessel sealer-cutting device) close to the rectum, with the line of resection directed toward a point 3 cm below the cervicovaginal junction on the posterior vaginal wall.

The proximal rectal pillar, which is a continuation of the uterosacral ligament, and the anterior portion of the cardinal ligament are clamped as a unit and divided at the level of the pelvic sidewall (**Figure 10.6**). In this way, the posterior portion of the cardinal ligament and the associated autonomic nerves to the bladder and rectum are preserved. It may be necessary to take these structures in a series of successive bites, rather

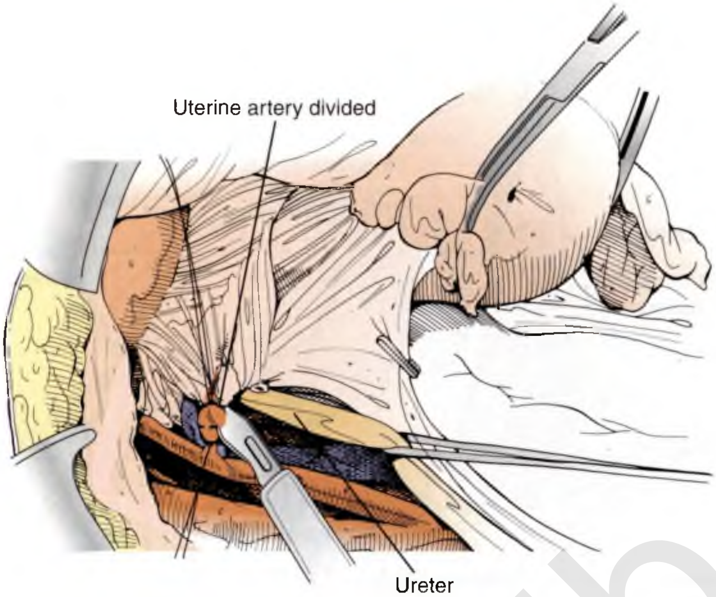

FIGURE 10.3 Radical abdominal hysterectomy: Ligation and division of the uterine artery at its origin from the hypogastric artery.

than a single unit, if the resulting tissue pedicle is larger than 2 cm. A clamp is placed across the paravaginal tissue (paracolpos) such that the heel is juxtaposed to the pelvic wall and the tip of the clamp approximates the lateral vaginal wall 2 to 3 cm below the cervicovaginal junction or lowermost extent of palpable tumor (**Figure 10.7**). An anterior colpotomy is created using the electrosurgical unit or scissors. An "empty" spongestick introduced transvaginally can assist in selecting the appropriate site for colpotomy to ensure a 2- to 3-cm margin of resection. The proximal vagina is circumferentially resected using a series of bites with a heavy clamp (e.g., curved Heaney), each pedicle being sequentially divided and secured with a Heaney transfixion stitch of 1-0 delayed absorbable suture and held long for traction (**Figure 10.8**). The final two bites incorporate the posterior-lateral vaginal wall and meet in the midline, and the specimen is removed. The vaginal cuff is closed with a series of figure-of-eight stitches of 1-0 delayed absorbable sutures.

If pelvic lymphadenectomy was not done prior to the radical hysterectomy, it is completed at this time. If the adnexa have been preserved and there is a low likelihood of adjuvant pelvic radiation, the

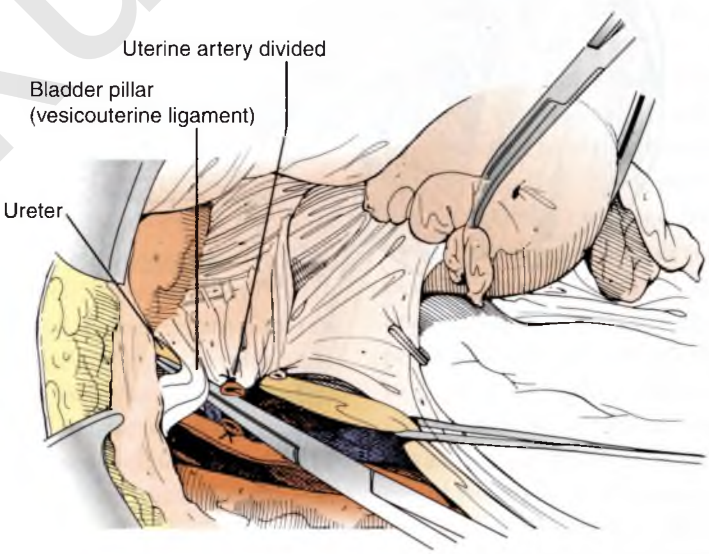

FIGURE 10.4 Radical abdominal hysterectomy: Dissection of the vesicouterine ligament (bladder pillar).

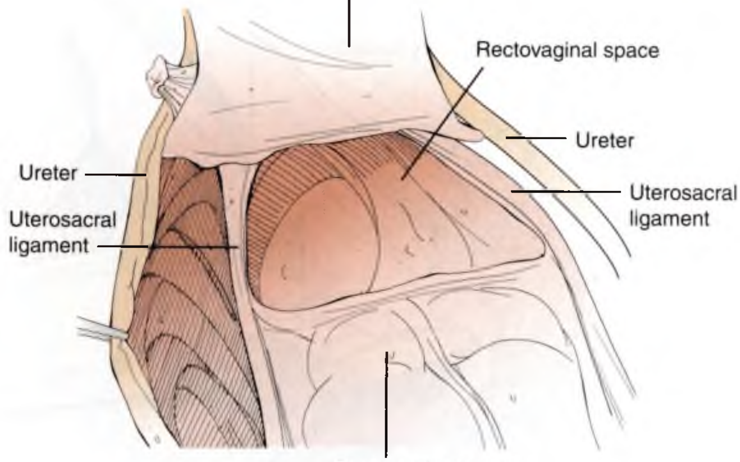

FIGURE 10.5 Radical abdominal hysterectomy: Posterior dissection showing uterosacral ligament and rectovaginal space.

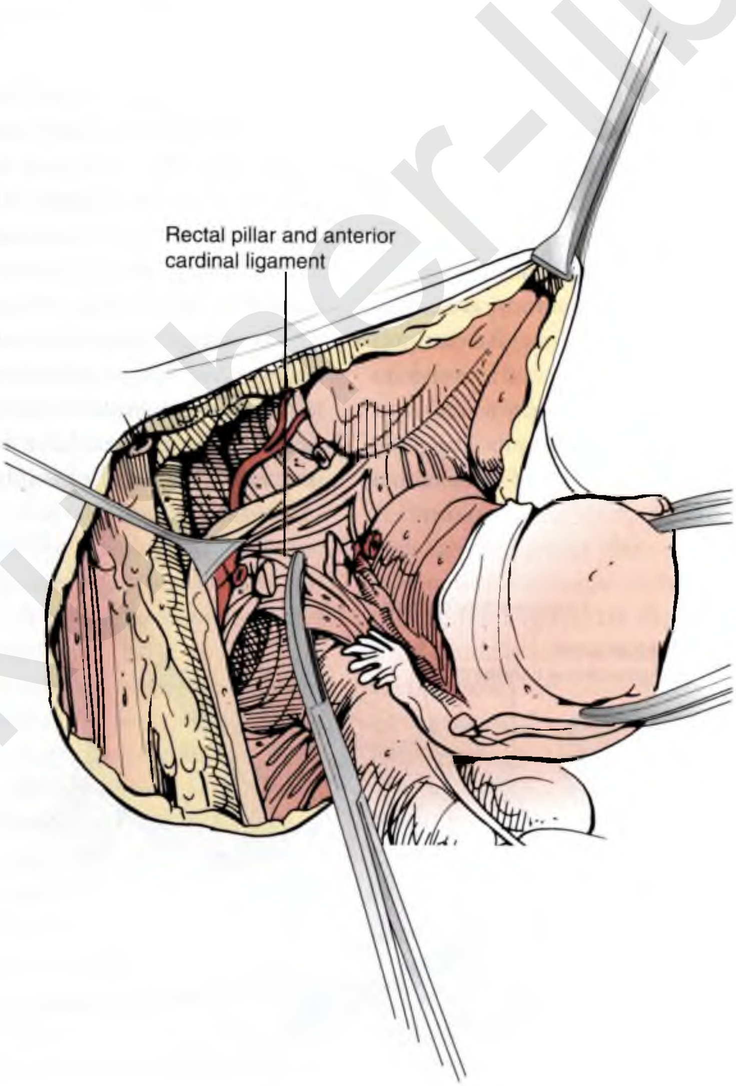

FIGURE 10.6 Radical abdominal hysterectomy: Resection of the rectal pillar and anterior portion of cardinal ligament as a unit.

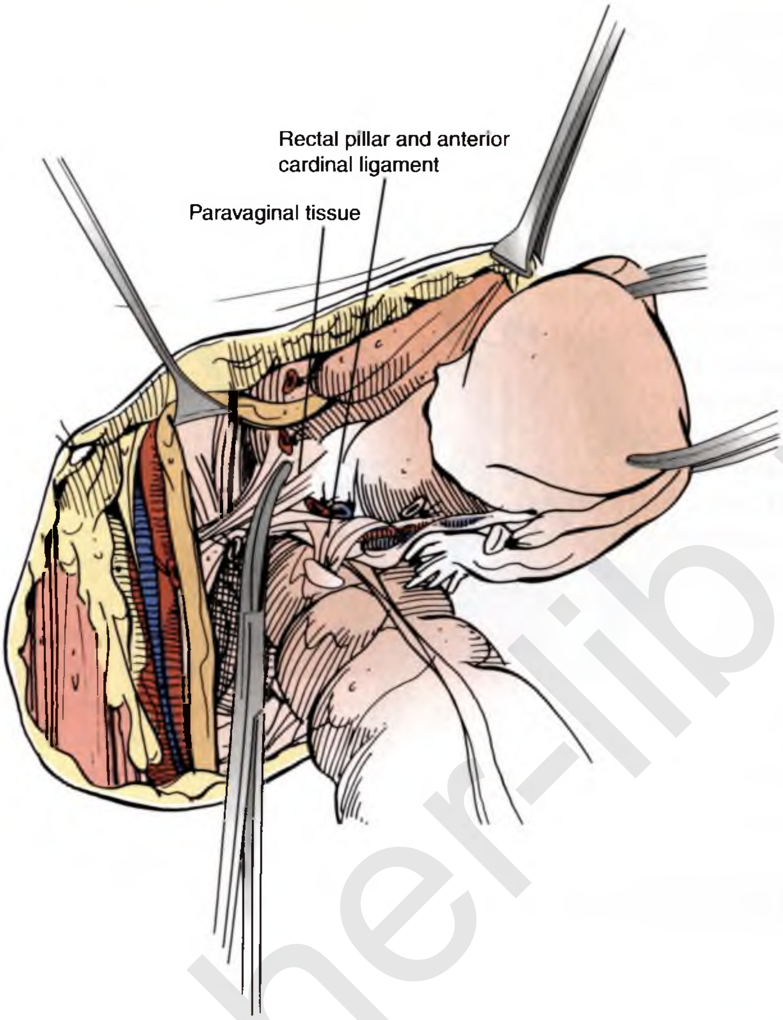

FIGURE 10.7 Radical abdominal hysterectomy: Resection of paravaginal tissue (paracolpos).

utero-ovarian ligament/fallopian tube complex pedicle is suspended to the round ligament stump as described in Chapter 2. If adjuvant pelvic radiation is anticipated, the adnexa are transposed out of the pelvis by widely mobilizing the infundibulopelvic ligament pedicles and suturing the utero-ovarian ligament/fallopian tube pedicles into the right and left paracolic gutters by tunneling beneath the cecum and ascending colon (on the right) and the sigmoid/descending colon (on the left).

The pelvis is irrigated, and all dissection areas are inspected to ensure hemostasis. The course and safety of the ureters should be verified. If there is any concern over a possible ureteral or bladder injury, cystoscopic examination with intravenous methylene blue or indigo carmine should be performed to assess the integrity of the urinary tract. Routine closed suction drainage of the pelvis is unnecessary but may be utilized at the discretion of the surgeon.

Radical hysterectomy variations

The modified radical hysterectomy is a scaled-back version of the Wertheim procedure, achieving a wider margin of resection than a simple extrafascial hysterectomy but with reduced morbidity. In this variation: 1) the uterine vessels are divided at the point where they cross the ureter within the cardinal ligament instead of at the pelvic wall, 2) the ureters are not completely extracted from the vesicouterine ligament, rather only the anterior leaf is resected with the hysterectomy specimen, 3) the cardinal ligaments/uterosacral ligaments are divided midway between the pelvic wall/rectum and uterus, and 4) only the upper 1 to 2 cm of vagina is removed.

The extended radical hysterectomy (Meigs/Okabayashi procedure) is indicated when a wider margin of resection is desired (e.g., large cervical lesion) and differs from the Wertheim procedure in the

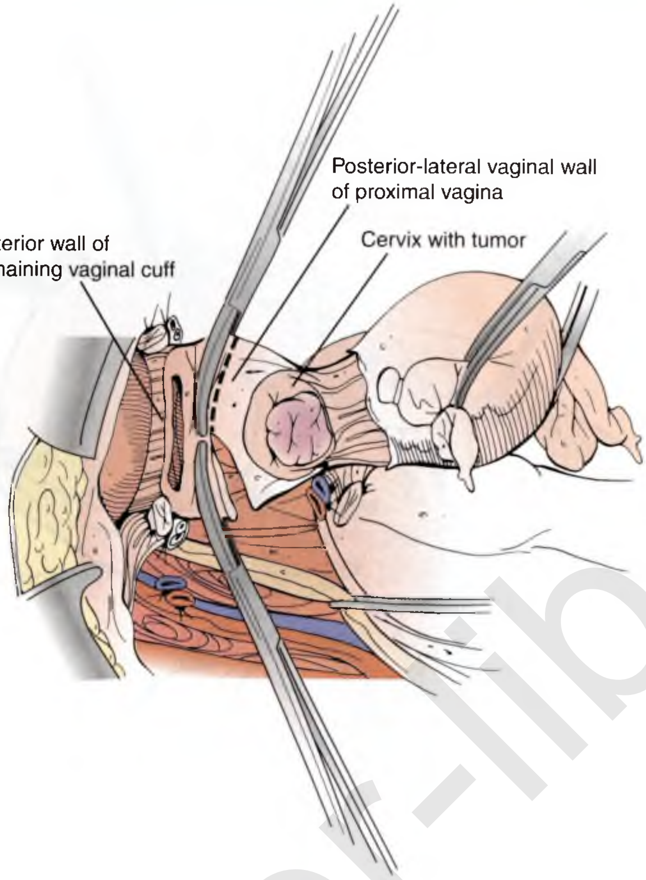

FIGURE 10.8 Radical abdominal hysterectomy: Circumferential resection of proximal vagina.

following ways: 1) the cardinal ligament (both anterior and posterior components) is completely transected at the pelvic wall, independent of the rectal pillars, down to the pelvic floor, 2) the uterosacral ligaments and rectal pillars are divided at the level of the rectum, and 3) the upper one-third to one-half of the vagina is removed. Some clinicians also include the anterior division of the hypogastric artery in the scope of resection. The extended radical hysterectomy has a higher incidence of bladder, rectal, and sexual dysfunction compared to the Wertheim operation. Prolonged (2 to 3 weeks) bladder drainage is the norm.

POSTOPERATIVE CONSIDERATIONS

Postoperative care following radical abdominal hysterectomy is similar to that for any other major abdominal surgery. Estimated blood loss associated with radical abdominal hysterectomy averages between 800 and 1,500 cc, and approximately 50% of patients require intraoperative or postoperative transfusion. Diet can usually be advanced rapidly according to patient tolerance and clinical examination. Thromboembolic prophylaxis is continued until discharge or for a period of 4 to 6 weeks if the patient is at especially high risk for deep vein thrombosis. An indwelling Foley catheter is maintained 3 to 7 days postoperatively, depending on the radicality of resection and timing of hospital discharge. Bladder function is evaluated with a voiding trial by ensuring the bladder is completely emptied and back-filling it with 300 cc of saline solution through the Foley catheter. The catheter is removed and the patient is asked to void. If the residual volume is less than 75 cc (i.e., voided volume ≥225 cc), the catheter is not reinserted and the patient is instructed on timed voiding (every 3 to 4 hours) for the next several weeks. A failed voiding trial calls for reinsertion of the Foley catheter and re-examination in 4 to 7 days or instruction in intermittent self-catheterization. Criteria for discharge include: afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, satisfactory bowel function, and evidence of appropriate wound healing. Postoperative activity should be individualized; however, vaginal intercourse should be restricted for 8 weeks and a pelvic examination should be performed to confirm the integrity of the vaginal cuff.

Operative Note

PROCEDURE: RADICAL ABDOMINAL HYSTERECTOMY

The uterus was grasped and elevated and the round ligaments were suture ligated and divided laterally on the pelvic wall. The pelvic peritoneal sidewalls were incised parallel to the external and common iliac vessels, and the pararectal and paravesical spaces were developed down to the pelvic floor. The ureters were placed within vessel-loops for traction and dissected from the pelvic brim down to the tunnel of Wertheim. Pelvic lymphadenectomy was performed (described in Chapter 12). The infundibulopelvic ligaments were isolated, doubly clamped, divided, and ligated with 1-0 delayed absorbable suture or the utero-ovarian ligament/fallopian tube complexes were clamped, divided, and ligated with 1-0 delayed absorbable suture and the adnexa tucked above the pelvic brim out of the field of dissection.

The vesicouterine peritoneal reflection was incised and the bladder reflected off of the anterior lower uterine segment, cervix, and proximal 3 to 4 cm of vagina. The uterine artery was dissected to its origin at the hypogastric artery, at which point it was doubly ligated with 1-0 delayed absorbable sutures and divided. The uterine vein was divided in a similar fashion. The uterine vascular pedicles were then reflected ventrally and medially and the ureter dissected along the tunnel of Wertheim and extricated from cardinal ligament. The ureteral tunnel was further developed within the vesicouterine ligament. The anterior and posterior leaves of the vesicouterine ligament were divided between clamps and ligated with 3-0 delayed absorbable sutures. The ureter was completely mobilized from its attachments to the vesicouterine ligament and rolled laterally, leaving both anterior and posterior leaves of the vesicouterine ligament attached to the hysterectomy specimen. The same maneuvers were repeated on the contralateral side.

The Douglas cul-de-sac was incised, and the rectovaginal space was developed inferiorly for a distance of 4 cm. The uterosacral ligaments were clamped and divided anterior to the rectum, and the pedicles secured with 1-0 delayed absorbable sutures. The proximal rectal pillar and the anterior portion of the cardinal ligament were clamped as a unit and divided at the level of the pelvic sidewall and the pedicle secured with a 1-0 delayed absorbable suture ligature. The same maneuvers were repeated on the contralateral side. Curved Heaney clamps were placed across the paracolpos approximating the lateral vaginal wall 3 cm below the cervicovaginal junction. An anterior colpotomy was created 3 cm below the cervicovaginal junction using the electrosurgical unit over a spongestick introduced transvaginally. The proximal vagina was circumferentially resected using a series of bites with curved Heaney clamps, each pedicle being sequentially divided and secured with a Heaney transfixion stitch of 1-0 delayed absorbable suture and held long for traction. The final two bites incorporated the posterior-lateral vaginal wall and met in the midline, and the specimen was removed intact. The vaginal cuff was closed with a series of figure-of-eight stitches of 1-0 delayed absorbable sutures. The pelvis was irrigated and all dissection areas inspected and noted to be hemostatic.

COMPLICATIONS

- The overall incidence of intraoperative complications (excluding major blood loss) is approximately 7%, with the most common being major vessel injury (2% to 3%), bladder injury (1% to 2%), and ureteral injury (1%).
- The overall incidence of postoperative morbidity is approximately 20%, with the most common complications being infectious morbidity (wound, urinary tract), thromboembolic events, lymphocyst formation, bladder dysfunction, ureteral or bladder fistula, and ureteral stricture.
- Excessive resection of the proximal vagina should be avoided unless clearly indicated by clinical factors, as it is associated with a high incidence of sexual dysfunction.

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CHAPTER 11

Pelvic Lymphadenectomy

Robert E. Bristow

INTRODUCTION

The pelvic lymph nodes may be a site of early metastatic spread of cervical, endometrial, and ovarian cancers. Consequently, surgical removal of pelvic lymph nodes is an important component of surgical staging for these cancers and may serve as a diagnostic procedure, a therapeutic procedure, or both. For cervical cancer, pelvic lymphadenectomy is considered both diagnostic and therapeutic when performed in conjunction with radical hysterectomy. Pelvic lymphadenectomy performed for ovarian cancer apparently confined to the pelvis has been associated with improved progression-free survival but does not impact overall survival. The role of pelvic lymphadenectomy for endometrial cancer has not been conclusively determined; however, knowledge of lymph node status permits individualization of adjuvant therapy. Finally, removal of gross lymphadenopathy for patients with ovarian and endometrial cancers may be required to achieve optimal or complete tumor cytoreduction.

Pelvic lymphadenectomy reflects complete or near-complete removal of all lymph node tissue within well-defined anatomic boundaries. The important anatomic landmarks are: proximal—the mid-portion of the common iliac artery; distal—deep circumflex iliac vein; lateral—tendon of the psoas muscle and fascia of obturator internus; medial—internal iliac (hypogastric) artery and ureter; and posterior—obturator nerve or hypogastric vein (depending on the extent of resection) (**Figure 11.1**). An adequate nodal yield from pelvic lymphadenectomy has been variably defined. The Gynecologic Oncology Group requires documentation of at least 4 lymph nodes harvested from each side; however, a minimum total pelvic count of 11 lymph nodes has been shown to correlate with clinical outcome in endometrial cancer. A median total pelvic node count in excess of 30 lymph nodes is not uncommon but is also associated with a higher risk of complications. Pelvic lymph node sampling is a more limited procedure within the same general anatomic boundaries as pelvic lymphadenectomy; however, lymph node sampling is not associated with the same diagnostic accuracy as lymphadenectomy and is not a reliable method of excluding lymph node metastasis. Lymph node sampling is usually intended to remove any enlarged or clinically suspicious nodes. Pelvic lymph node dissection is a vague term that may describe a procedure ranging from lymph node sampling to lymphadenectomy.

PREOPERATIVE CONSIDERATIONS

In preparation for pelvic lymphadenectomy, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate major surgery or place the patient at elevated risk for postoperative complications. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, a chest radiograph, and electrocardiogram for women aged 50 years and older. Preoperative computed tomography of the abdomen and pelvis (and chest, depending on clinical indications) is helpful to

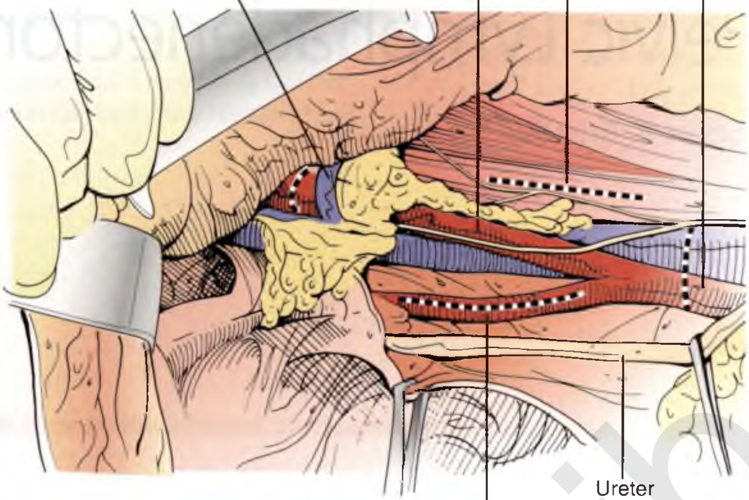

FIGURE 11.1 Pelvic lymphadenectomy: Anatomic boundaries of the dissection.

evaluate the extent of disease and for surgical planning purposes.

Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) is unnecessary for pelvic lymphadenectomy but may be recommended according to the surgeon's preference for other concurrent components of the procedure (e.g., hysterectomy). Prophylactic antibiotics (Cephazolin 1 g, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. A self-retaining retractor (e.g., Bookwalter, Codman Division, Johnson & Johnson, Piscataway, NJ) with a fixed arm attaching the retractor ring to the operating table is advisable to optimize exposure, maximize patient safety, and reduce surgeon fatigue. Following is a brief description of the surgical procedure used (see also video: *Pelvic Lymphadenectomy*).

SURGICAL TECHNIQUE

The patient may be positioned in the dorsal low-lithotomy (perineal lithotomy) position using Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH) or supine on the operating table, depending on the requirements for concurrent procedures. Pelvic lymphadenectomy can be performed through a variety of incisions: low transverse, vertical midline, vertical lateral or paramedian, J-incision, extraperitoneal, laparoscopic, or robotically assisted. Similarly, the surgeon may choose from a variety of instruments to perform pelvic lymphadenectomy, including scissors, hemo-clips, the electrosurgical unit, a vessel-sealing device, and the Argon beam coagulator. The most important point, however, is to develop a routine and proceed through the dissection in a systematic fashion to ensure anatomic consistency from one case to the next.

A self-retaining retractor is placed with particular attention to exposure of the pelvic sidewall and elevation of the peritoneum in the area of the round ligament to expose the distal external iliac node (Jackson's node). The lateral retractor blades should not be resting on the psoas muscle, as this can result in traumatic injury to the femoral nerve. Usually, the round ligaments would have been ligated and divided as part of a preceding hysterectomy. The suture ligature on the round ligament pedicle is elevated and the pelvic wall peritoneum is opened lateral and parallel to the external iliac and common iliac vessels. To improve exposure to the common iliac vessels, the descending and sigmoid colon are mobilized from its attachments to the left lateral pelvic wall and paracolic gutter. On the right side, the peritoneum surrounding the proximal ascending colon,

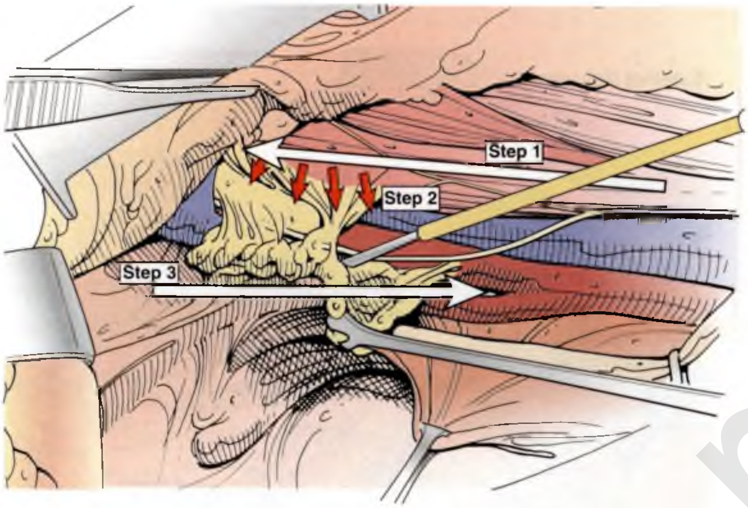

FIGURE 11.2 **Pelvic lymphadenectomy:** Operative view of pathway and sequence of dissection.

cecum, and terminal ileum is incised and the bowel is packed cephalad. The psoas muscle and tendon, genitofemoral nerve, external iliac and common iliac vessels are visualized. The paravesical and pararectal spaces are developed. The ureter is identified within the pararectal space, mobilized from its attachments to the medial leaf of the broad ligament, and held for traction with a vessel loop to improve exposure to the pelvic wall.

The dissection begins at the midpoint of the common iliac artery and proceeds distally (**Figure 11.2**). The nodal tissue along the psoas tendon lateral to the artery is grasped and placed on upward traction, and the ESU or scissor dissection used to delicately separate the nodal tissue from the underlying artery's adventitial sheath. The nodal tissue is rotated medially, proceeding from proximally to distally, until the deep circumflex iliac vein is identified as it crosses over the external iliac artery. The genitofemoral nerve is frequently entangled in this portion of the specimen and can usually be dissected free of the surrounding nodal tissue and fat. Injury to the genitofemoral nerve results in paresthesias to the upper anterior thigh and lateral vulva. The entire length of the external iliac and common iliac nodal bundle is mobilized medially and dissected off the external iliac vein in a similar fashion (**Figures 11.3 and 11.4**). The ventral portion of the obturator space can be developed by continuing this dissection along the dorsal surface of the external iliac vein toward the fascia of obturator internus. Alternatively, the obturator space can be developed by gentle finger dissection along the pelvic sidewall lateral to the external iliac vessels, placing the external iliac vessels on medial traction until the obturator

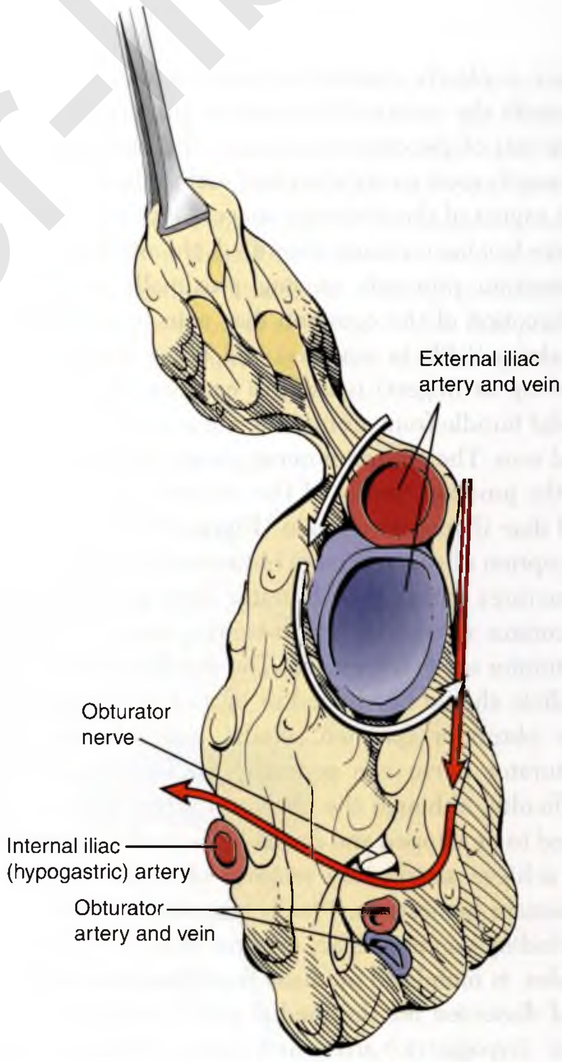

FIGURE 11.3 **Pelvic lymphadenectomy:** Cross-sectional view of pathway of dissection.

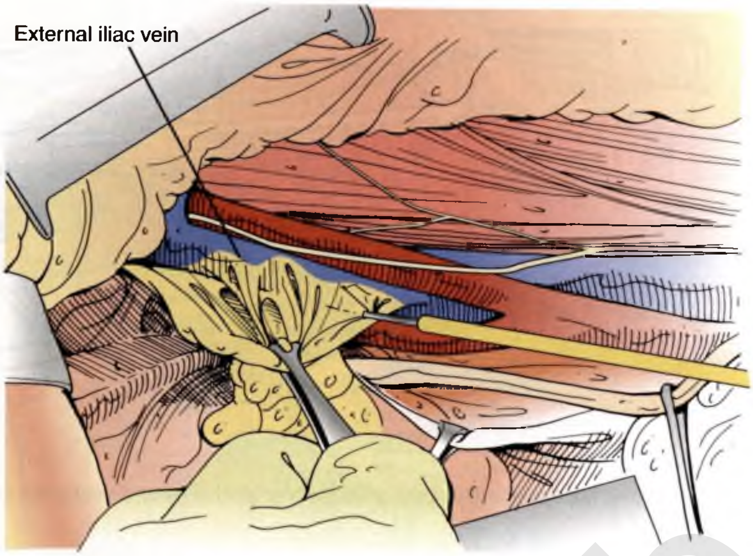

FIGURE 11.4 Medial mobilization of nodal bundle from external iliac vessels.

nerve is clearly visualized. A vein retractor is placed beneath the external iliac vein to further expose the contents of the obturator space. The obturator nerve is usually most easily identified within the caudal (distal) aspect of the obturator space. Once the obturator nerve has been clearly identified, the obturator space dissection proceeds moving proximally toward the bifurcation of the common iliac vein. A combination of sharp (ESU or scissors) and blunt (Yankour suction tip or fingers) is used to extricate the obturator nodal bundle from around the obturator nerve, artery, and vein. The obturator nerve always enters the pelvis at the junction (axilla) of the external iliac and internal iliac (hypogastric) vein (**Figure 11.5**). With the exception of the accessory obturator vein, all vascular structures within the obturator fossa lie deep to the obturator nerve. All lymph-bearing tissue above the obturator nerve is removed. The distal-most lymphatic pedicle should be clipped or ligated as it approaches the obturator foramen. Nodal tissue beneath the obturator nerve can generally be removed without difficulty, although the obturator artery and vein my need to be clipped and divided proximally and distally to achieve satisfactory removal of nodal tissue and maintain hemostasis. Finally, the nodal bundle, now including common iliac, external iliac, and obturator nodes, is mobilized medially from the obturator fossa and dissected off the medial surface of the internal iliac (hypogastric) artery and excised (**Figure 11.6**). It is generally easier to remove the entire pelvic nodal "package" en bloc rather than piecemeal, although some surgeons prefer to separate the different nodal basins for separate pathologic processing.

Caution should be exercised in the region of the obturator foramen, as 25% of patients will have an accessory obturator vein draining from the obturator foramen directly into the undersurface of the external iliac vein. The accessory obturator vein is subject to avulsion injury from excessive ventral traction on the external iliac vein. The internal iliac (hypogastric) vein runs along the lower lateral border of the obturator space and can have a variable pattern of venous tributaries. Venous injury in the area of the axilla of the common iliac vein can be associated with profuse hemorrhage, as this region represents the confluence of three venous drainage systems (external iliac, internal iliac, and common iliac). Repair of vascular injury encountered during pelvic lymphadenectomy is discussed in Chapter 22.

The pelvis is irrigated and inspected for hemostasis. It is unnecessary to place a closed suction drain in the pelvis, and in fact drain placement has been associated with increased morbidity. The peritoneal incision is left open.

POSTOPERATIVE CONSIDERATIONS

Postoperative care following pelvic lymphadenectomy is similar to that for any other major abdominal surgery and is usually dictated by the extent of any concurrent procedures (e.g., radical hysterectomy). The

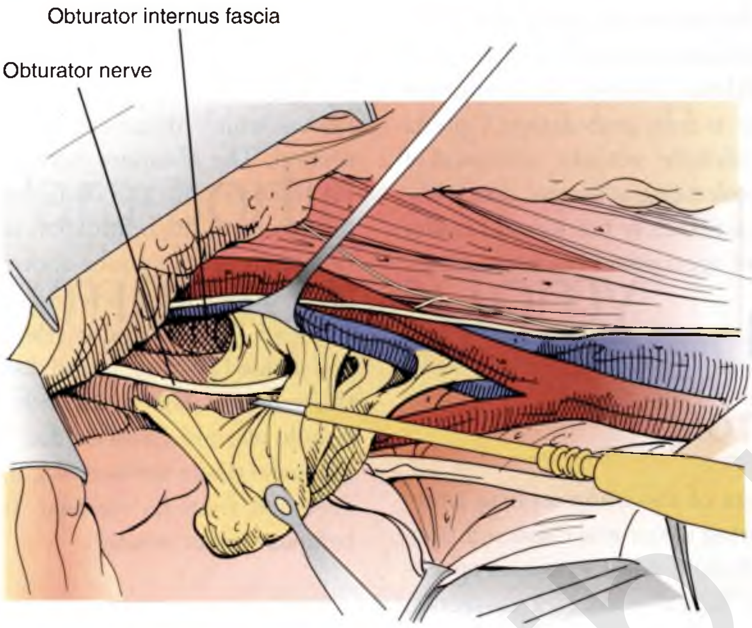

FIGURE 11.5 Pelvic lymphadenectomy: Visualization and dissection of the obturator nerve.

overall incidence of morbidity ranges from 2% to 25%, with most occurrences being related to lymphocyst formation or febrile morbidity. Symptomatic (pain, ureteral obstruction, venous obstruction, lower extremity edema, and infection) lymphocyst formation occurs in approximately 5% of cases and can almost always be successfully managed by percutaneous drainage by interventional radiology. Uncommon complications related to pelvic lymphadenectomy include neurological injury (obturator nerve trauma/transection, retractor blade trauma to the femoral nerve) and arterial thrombosis. Although rare, arterial thrombosis of the external iliac artery can precipitate catastrophic complications; consequently, lower extremity pulses should be monitored and recorded for 24 hours postoperatively. An indwelling catheter is continued overnight and removed on the first postoperative day unless there has been a bladder or ureteral

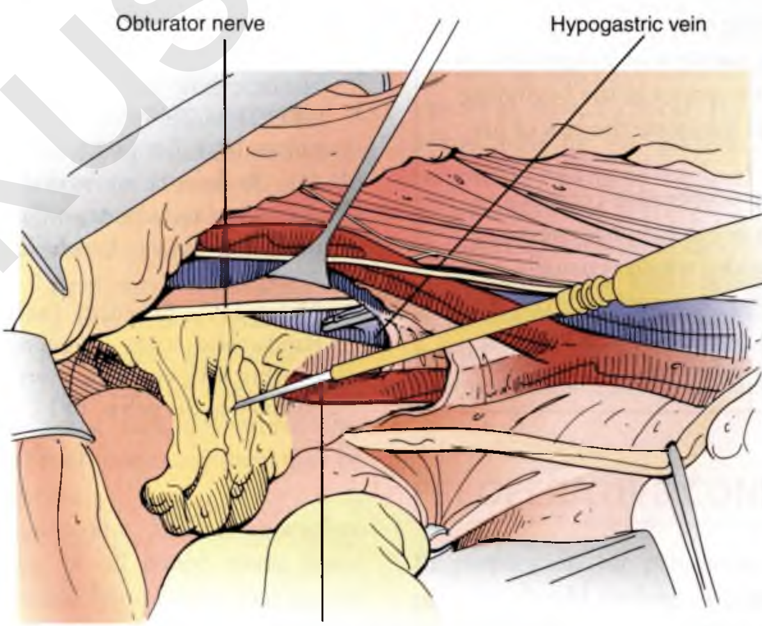

FIGURE 11.6 Pelvic lymphadenectomy: Dissection of nodal bundle from the surface of the hypogastric artery.

repair. Diet can usually be advanced rapidly according to patient tolerance and clinical examination. Routine thromboembolic prophylaxis should be continued at least until the patient is fully ambulatory. Criteria for discharge include: afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, satisfactory bowel and bladder function, and evidence of appropriate wound healing.

Operative Note

PROCEDURE: PELVIC LYMPHADENECTOMY

Beginning at the midpoint of the common iliac artery and vein, the lymph-bearing tissue was dissected from the underlying vessels distally down to the deep circumflex iliac vein. The lateral border of dissection was demarcated by the psoas tendon, and all lymph-bearing tissue medial to this was mobilized medially, rotating the nodal bundle over the external iliac vessels. The dissection was continued along the undersurface of the external iliac vein to the obturator internus fascia, which demarcated the lateral border of dissection. The obturator nerve was identified distally at its entrance into the obturator foramen and followed proximally to the bifurcation of the common iliac vein. All lymph-bearing tissue above and below the obturator nerve, down to the level of the hypogastric vein, was removed. The obturator artery and vein were clipped and divided proximally and distally and included within the scope of the nodal resection. Finally, the nodal bundle was placed on medial traction, and the remaining nodal tissue surrounding the hypogastric artery was dissected from its vascular attachments. Satisfactory hemostasis was assured.

COMPLICATIONS

- The most common intraoperative complications associated with pelvic lymphadenectomy are hemorrhage from venous or arterial injury.
- Injury (trauma, transection) to the obturator nerve is a rare complication of pelvic lymphadenectomy.
- Imprecise retractor blade placement can result in compression of the psoas muscle and traumatic injury to the underlying femoral nerve.
- Development of the paravesical and pararectal spaces and tagging the ureter at the beginning of the procedure will minimize the risk of urinary tract injury.
- The most common postoperative complication associated with pelvic lymphadenectomy is lymphocyst formation, which is usually asymptomatic but may be associated with pain, ureteral obstruction, venous obstruction, leg edema, or secondary infection.

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CHAPTER 12

Para-aortic Lymphadenectomy

Robert E. Bristow

INTRODUCTION

The para-aortic lymph nodes are a common site of metastatic spread of ovarian cancer and endometrial cancer. Ovarian cancer has a predilection for lymphatic dissemination along the drainage routes of the ovarian vessels to the high para-aortic lymph nodes in proximity to the renal vessels. Endometrial cancer located in the uterine fundus may follow a similar spread pattern. In contrast, endometrial cancer located in the lower uterine segment or lower fundus will follow a more orderly lymphatic progression to the pelvic, common iliac, and low para-aortic (below the inferior mesenteric artery [IMA]) lymph nodes before reaching the high para-aortic nodal basins. Consequently, surgical removal of para-aortic lymph nodes is an important component of surgical staging for these cancers and may serve as a diagnostic procedure, a therapeutic procedure, or both. The extent of dissection, however, should be tailored to the specific disease process. Removal of gross para-aortic lymphadenopathy for patients with ovarian and endometrial cancers may be required to achieve optimal or complete tumor cytoreduction. Para-aortic lymphadenectomy may also be indicated for selected cases of cervical cancer undergoing radical hysterectomy when the common iliac lymph nodes are known to be involved by metastatic disease.

Para-aortic lymphadenectomy reflects complete or near-complete removal of all lymph node tissue within well-defined anatomic boundaries. The important anatomic landmarks are: distal—the mid-portion of the common iliac arteries; proximal—the left renal vein; lateral—the psoas muscles and ureters; and posterior—the anterior surface of the vertebral bodies. Within these boundaries, nine anatomic lymphatic zones are relevant to staging gynecologic cancers: right and left proximal common iliac, interiliac, precaval, right paracaval, aortocaval, preaortic, left para-aortic, and suprahilar (suprarenal) (**Figure 12.1**). Typically, each of these anatomic regions will yield between 3 and 6 lymph nodes, and the total lymph node count for para-aortic lymphadenectomy ranges from 10 to 26 lymph nodes. The retrocaval and retroaortic nodal basins are not routinely dissected during staging para-aortic lymphadenectomy. Some surgeons will limit the cephalad extent of para-aortic lymphadenectomy to the level of the IMA for selected cases of endometrial cancer or cervical cancer. However, para-aortic lymphadenectomy for the purpose of staging ovarian cancer should extend to the level of the renal vessels and include resection of the gonadal vessels at their origin. Para-aortic lymph node sampling is a more limited procedure within the same general anatomic boundaries as para-aortic lymphadenectomy but usually does not extend above the IMA and is intended to remove any enlarged or clinically suspicious nodes.

PREOPERATIVE CONSIDERATIONS

In preparation for para-aortic lymphadenectomy, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate major surgery

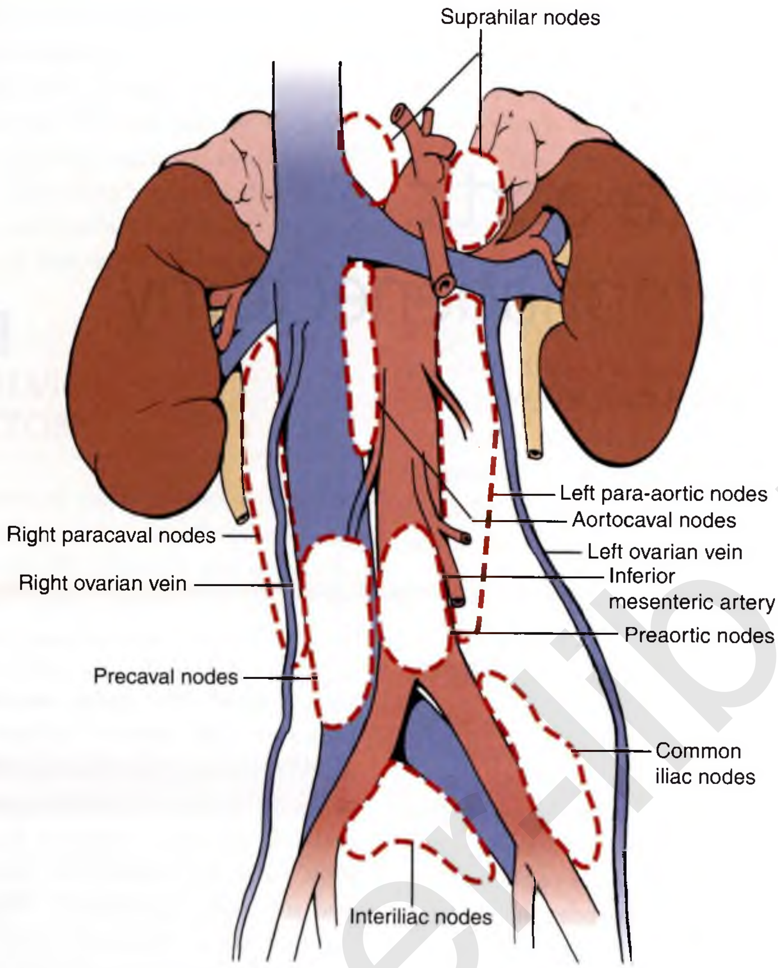

FIGURE 12.1 Para-aortic lymphadenectomy: Anatomic boundaries of the para-aortic lymphatic regions.

or place the patient at elevated risk for postoperative complications. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, a chest radiograph, and electrocardiogram for women aged 50 years and older. Preoperative computed tomography of the abdomen and pelvis (and chest, depending on clinical indications) is helpful to evaluate the extent of disease and for surgical planning purposes.

Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) is unnecessary for para-aortic lymphadenectomy but may be recommended according to the surgeon's preference for other concurrent components of the procedure (e.g., hysterectomy and ovarian cancer surgery). Prophylactic antibiotics (Cephazolin 1, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. A self-retaining retractor (e.g., Bookwalter, Codman Division, Johnson & Johnson, Piscataway, NJ) with a fixed arm attaching the retractor ring to the operating table is advisable to optimize exposure, maximize patient safety, and reduce surgeon fatigue. Following is a brief description of the surgical procedure used (see also video: *Para-aortic Lymphadenectomy*).

SURGICAL TECHNIQUE

The patient may be positioned in the dorsal low-lithotomy (perineal lithotomy) position using Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH) or supine on the operating table, depending on the requirements for concurrent procedures. Para-aortic lymphadenectomy can be performed through a vertical midline incision extended above the umbilicus to the mid-epigastrium (or higher), laparoscopically, or robotically assisted. In general, it is not technically feasible to reach the high para-aortic nodes through any of the low transverse incisions (Pfannenstiel, Maylard, Cherney), although these may be adequate for reaching the level of the IMA in thin patients. The surgeon may choose from a variety of instruments to perform para-aortic lymphadenectomy including scissors, hemo-clips, the electrosurgical unit (ESU) a vessel-sealing device, or the Argon beam coagulator. Lymphatic pedicles of the proximal and distal margins of dissection should be controlled either with clips or a vessel-sealing device to reduce the risk of post-operative lymphocyst formation. The specific choice of instrumentation is less important than achieving proper exposure and adhering to the anatomic boundaries of dissection.

Para-aortic lymphadenectomy is normally performed following concurrent hysterectomy, and a self-retaining retractor will already be in place. The vertical midline incision should be extended to the mid-epigastrium or above to allow adequate exposure. Three peritoneal incisions are created to expose the abdominal retroperitoneum (**Figure 12.2**). The first incision starts inferior to the cecum and is extended along the right paracolic gutter up to and including the hepatic flexure of the ascending colon. The second incision is a continuation of the first incision, beginning inferior to the cecum and extending along the base of the small bowel mesentery to the inferior duodenal fold. The third part of the duodenum should be carefully mobilized cephalad, exposing the abdominal retroperitoneum up to the level of the renal vessels. The third incision is carried from the mid-point of the sigmoid colon along the paracolic gutter of the descending colon up to and including the splenic flexure. This incision facilitates medial mobilization of the descending and sigmoid colon, which may be necessary to access the proximal left common iliac nodes and left para-aortic nodes below the IMA. At this point, retractor blades can be placed to keep the bowel out of the field of dissection, or the ascending colon and small bowel can be exteriorized and placed

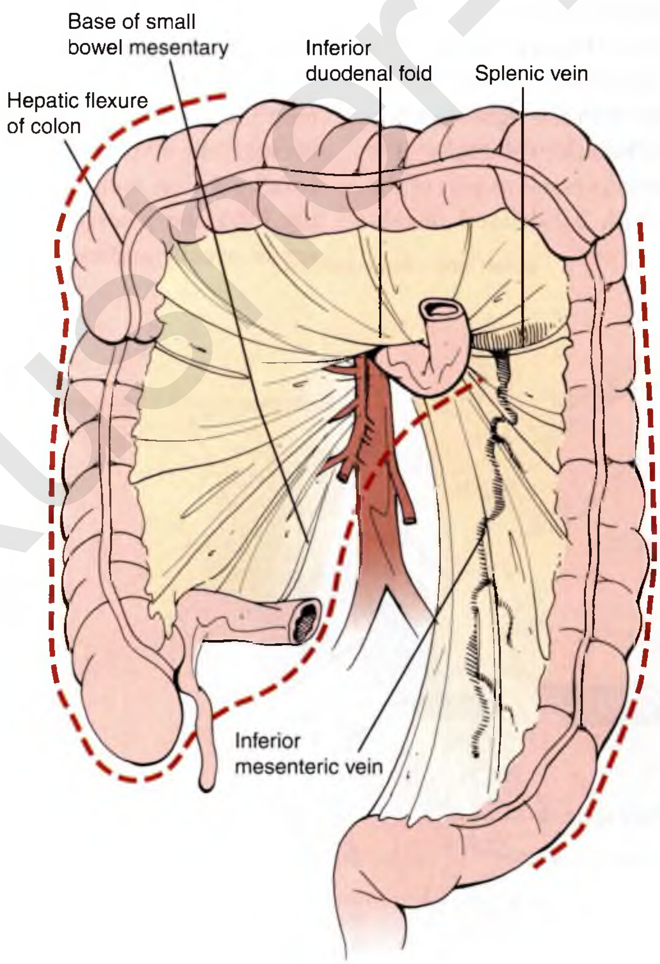

FIGURE 12.2 Para-aortic lymphadenectomy: Three peritoneal incisions are created to expose the abdominal retroperitoneum.

inside a moistened laparotomy pack onto the patient's abdominal wall. Placing the patient in Trendelenburg position will facilitate achieving proper exposure. The ureters should be identified and placed within vessel loops for traction, if not done previously.

The dissection begins by incising the areolar sheath over the right common iliac artery and elevating the proximal right common iliac fat pad off the underlying artery and vein. Proceeding cephalad along the lateral margin of the vena cava, the right paracaval nodal tissue is dissected laterally from the anterior surface of the vertebral bodies up to the level of the left renal vein. The lumbar arteries and veins will be encountered, and these vessels should be preserved, if possible. Next, the precaval fat pad and associated nodal tissue are dissected by elevating the inferior extent of the common iliac nodal tissue and separating the specimen from the underlying vena cava (**Figure 12.3**). In most cases, there is a delicate venous tributary running from the precaval nodes to the anterior surface of the vena cava (the "fellow's vein"), which if torn will result in laceration of the vena cava and significant hemorrhage. The "fellow's vein" should be identified, clipped, and divided under direct vision (**Figure 12.4**). The precaval nodes are elevated up to the level of the left renal vein and removed en bloc with the right common iliac and right paracaval node bundle. Generally, it is easiest to include the right ovarian vessels as part of the specimen after ligating them with 2-0 delayed absorbable suture

The focus turns medially to the interiliac, preaortic, and aortocaval, nodal basins. The areolar sheath over the proximal left common iliac artery and aortic bifurcation is incised and the line of incision carried cephalad along the lateral border of the anterior surface of the aorta to the level of the left renal vein, identifying the IMA in the process. The nodal tissue between the proximal common iliac arteries is elevated off the underlying left common iliac vein and sacral promontory and resected. It is usually easiest to remove the preaortic and aortocaval lymph nodes as a single unit. The lateral margin of the preaortic fat pad inferior to the IMA is reflected medially and the tissue dissected from the anterior surface of the aorta. As the dissection proceeds cephalad toward the left renal vein, the preaortic fat pad is rotated medially and left attached to the aortocaval nodes, which are carefully extirpated from the groove between the vena cava and aorta (**Figure 12.5**). Lumbar arteries and veins may be encountered in this area, and they should be preserved if possible. The proximal lymphatic tissue pedicle should be clipped just inferior to the left renal vein before transecting the specimen, or it can be divided using a vessel-sealing device.

Finally, attention is directed toward the left common iliac and left para-aortic nodal basins. The space beneath the IMA is developed bluntly and a fixed or handheld thin malleable retractor inserted caudad to the IMA and placed on lateral traction. This maneuver is usually sufficient to expose the entire field of

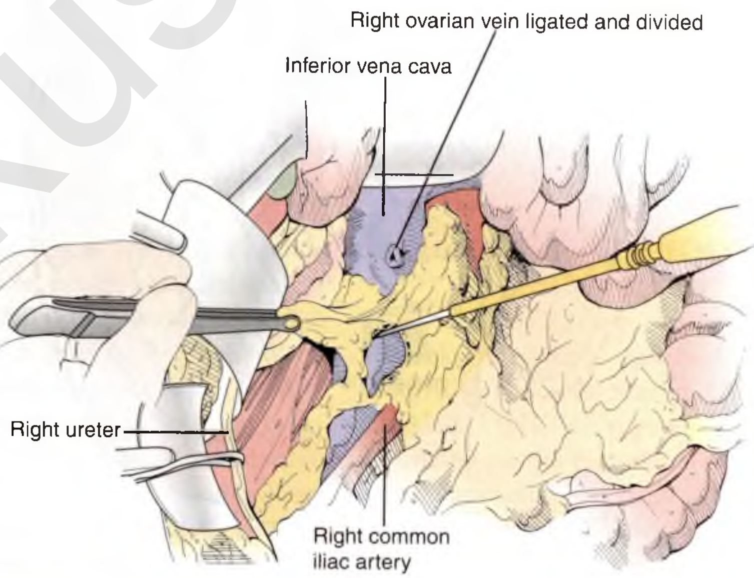

FIGURE 12.3 Para-aortic lymphadenectomy: Dissection of the right paracaval and precaval lymph nodes.

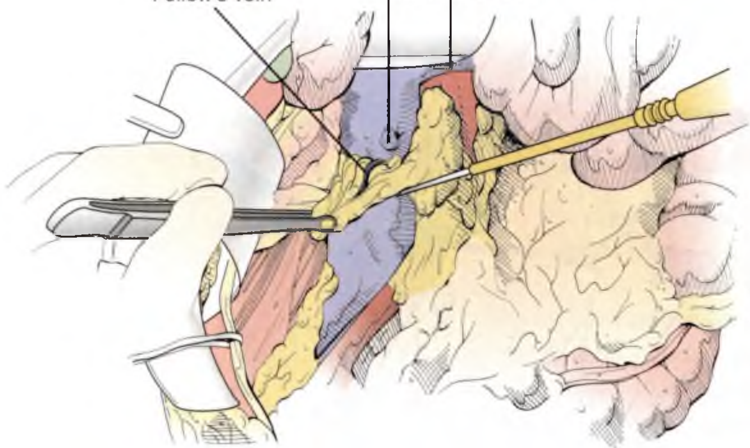

FIGURE 12.4 Para-aortic lymphadenectomy: Identification of the "fellow's vein."

dissection. If exposure to the left common iliac and left para-aortic nodal basins is inadequate, these areas can be approached from the left side by mobilizing the descending and sigmoid colon medially, as previously described. Alternatively, the IMA can be doubly ligated with 2-0 silk sutures and divided. The areolar sheath along the lateral border of the left common iliac artery is incised and the incision extended cephalad along the lateral surface of the aorta. The lymph-bearing tissue lateral to the aorta is elevated and mobilized down to the anterior longitudinal ligament of the vertebral bodies and removed up to the level of the left renal vein (**Figure 12.6**). The left ovarian artery is usually divided at its origin and resected. The left ovarian vein should be identified at its juncture with the left renal vein, clipped (or suture ligated) and divided. The proximal

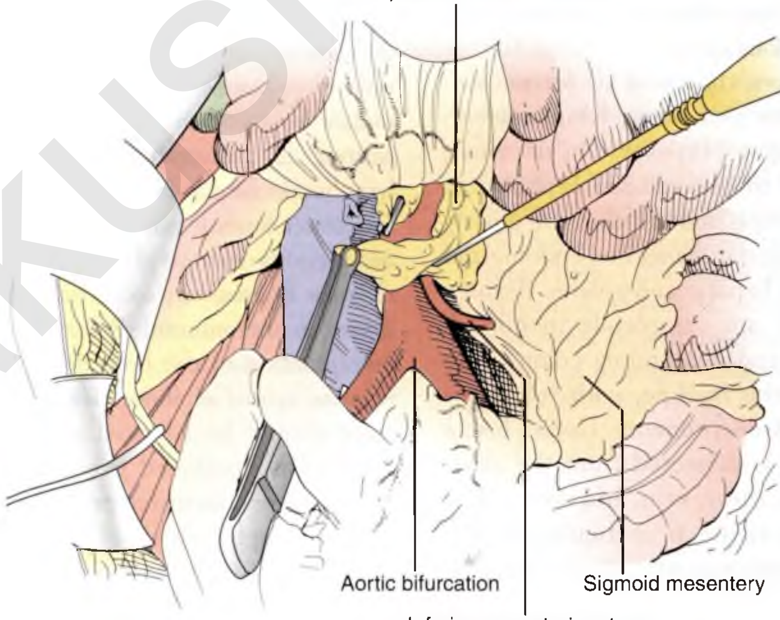

FIGURE 12.5 Para-aortic lymphadenectomy: Dissection of the preaortic lymph nodes.

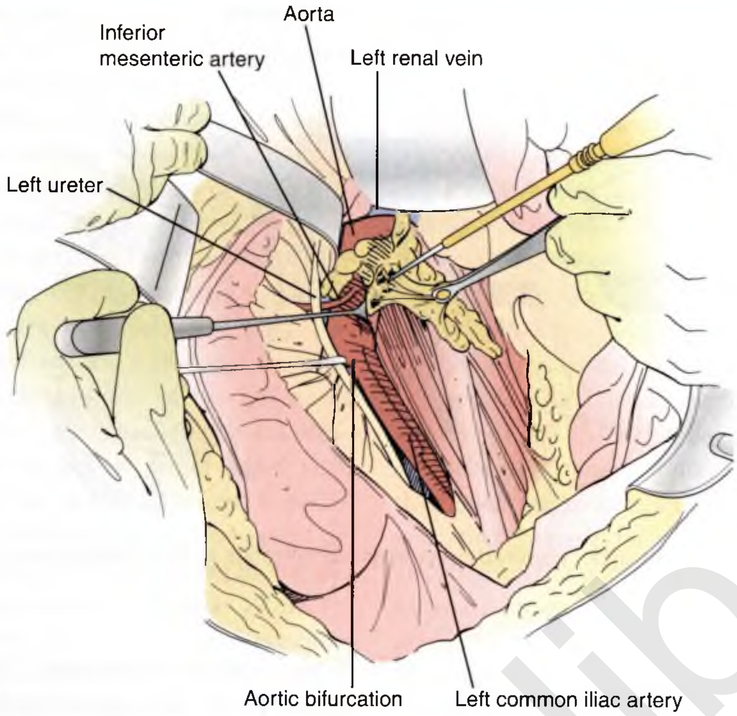

FIGURE 12.6 Para-aortic lymphadenectomy: Medial mobilization of the descending colon facilitates exposure to the left common iliac and left para-aortic nodal basins.

lymphatic tissue pedicle is clipped prior to transecting it just inferior to the left renal vein or divided using a vessel-sealing device. Failure to secure the large, proximal lymphatic tissue pedicles in the aortocaval and para-aortic regions can result in accumulation of lymphatic fluid (lymphocyst) or continued lymphatic leakage and formation of chylous ascites.

In the majority of cases, the above dissection satisfies the requirement for para-aortic lymphadenectomy performed for staging purposes. On occasion, the dissection will need to be extended cephalad to remove the suprahilar lymph nodes if they are grossly involved by metastatic ovarian cancer or endometrial cancer. In this case, the hepatic and splenic flexures of the transverse colon are completely mobilized, allowing the ascending and descending colon to be reflected medially past the midline, with full exposure of the abdominal retroperitoneum. Gerota fascia surrounding the kidney is dissected from the renal hilum exposing the renal artery, vein, and ureter. The suprahilar node-bearing tissue is meticulously dissected from the underlying vascular structures, kidney, and ureter.

The surgical field is irrigated and inspected for hemostasis. The peritoneal incisions are left open, and routine drain placement is unnecessary.

POSTOPERATIVE CONSIDERATIONS

Postoperative care following para-aortic lymphadenectomy is similar to that for any other major abdominal surgery and is usually dictated by the extent of the overall operation. The incidence of morbidity is somewhat difficult to separate from that associated with concurrent procedures (e.g., ovarian cancer cytoreduction) but ranges from 7% to 24%, with most occurrences being related to intraoperative/postoperative hemorrhage, lymphocyst formation, and paralytic ileus. Lymphocyst formation is rarely symptomatic, but may be associated with venous or ureteral compression and require percutaneous drainage by interventional radiology. Ureteral injury is uncommon. Patients undergoing extensive manipulation of the bowel (exteriorization) are prone to slow return of bowel function, and diet advancement should be adjusted accordingly. An indwelling catheter is continued overnight and removed when indicated for concurrent procedures. Routine thromboembolic prophylaxis should be continued at least until the patient is fully ambulatory. Criteria for discharge include: afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, satisfactory bowel and bladder function, and evidence of appropriate wound healing.

Operative Note

PROCEDURE: PARA-AORTIC LYMPHADENECTOMY

The peritoneum beneath the cecum was incised cephalad along the right paracolic gutter and the hepatic flexure mobilized medially. The incision was taken around the cecum and extended along the base of the small bowel mesentery to the inferior duodenal fold, and the third part of the duodenum was carefully mobilized cephalad. An incision was created lateral to the proximal sigmoid colon and extended cephalad up to and including the splenic flexure. The patient was placed in Trendelenburg position, and the bowel was placed in a moist laparotomy pack and exteriorized onto the abdominal wall. The areolar tissue overlying the midpoint of the right common iliac artery was incised, and the right common iliac lymph-bearing tissue was elevated. The lateral paracaval fat pad was mobilized medially up to the level of the left renal vein. The node-bearing tissue was carefully dissected cephalad along the surface of the vena cava up to the proximal margin of resection and removed en bloc. Communicating vessels were individually clipped and divided. Attention was directed toward the aorta, where an incision was created in the areolar sheath at the bifurcation and extended cephalad along the anterior surface of the aorta to the level of the left renal vein. The preaortic lymphatic tissue was mobilized medially across the anterior surface of the aorta, and the dissection was extended to include the aortocaval lymph nodes up to the level of the left renal vein. The proximal pedicle of the dissection was secured with a large hemo-clip before being divided. The descending colon was mobilized medially, and the areolar tissue overlying the left common iliac artery incised. The incision was extended cephalad along the lateral border of the para-aortic nodal tissue up to the level of the left renal vein. The lymphatic tissue bundle was separated from its attachments down to the anterior surface of the vertebral bodies and reflected cephalad, where the proximal pedicle of dissection was secured with a large hemo-clip before being divided. The surgical field was irrigated and satisfactory hemostasis was assured.

COMPLICATIONS

- The most common vascular injury is laceration of the "fellow's vein" on the anterior surface of the vena cava.
- Extensive manipulation of the bowel predisposes to postoperative paralytic ileus.
- Proximal and distal lymphatic tissue pedicles should be clipped, ligated, or divided using a vessel-sealing device to reduce the risk of lymphatic fluid accumulation (lymphocyst, chylous ascites).

Suggested Reading

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CHAPTER 13

Simple Vulvectomy—Partial

Robert E. Bristow

INTRODUCTION

The variations of simple (or superficial) vulvectomy can be classified as partial or total, depending on the extent of tissue excised. The purpose of partial simple vulvectomy is to remove the skin and subcutaneous tissues of the vulva affected by disease. Contemporary surgical treatment strives to preserve as much normal tissue as can be done safely without compromising the efficacy of therapy and to achieve a cosmetic result, restoring the vulva to as close to a normal appearance as possible.

The indications for and surgical principles of partial simple vulvectomy are similar to those for total simple vulvectomy described in Chapter 14. Partial simple vulvectomy is indicated for the treatment of 1) extensive vulvar intraepithelial neoplasia that is not amenable to ablative (e.g., CO_2 laser and cavitational ultrasonic surgical aspirator) therapy or for lesions that require complete pathological evaluation due to concern for an underlying invasive cancer, 2) Paget disease of the vulva with no evidence of an underlying adenocarcinoma, 3) selected cases of lichen sclerosis unresponsive to medical management, and 4) specific benign lesions such as extensive condyloma acuminata and hidradenitis suppurativa. As partial simple vulvectomy is performed for preinvasive disease, concomitant inguinofemoral lymphadenectomy is not indicated. Lower genital tract dysplasia may be multifocal; therefore, a thorough examination of the vulva, vagina, and cervix for preinvasive and invasive disease is a prerequisite.

Surgical principles for partial simple vulvectomy dictate only that a visibly disease-free margin of tissue be excised, usually 3 to 5 mm, and that the full thickness of the involved skin or mucosa is removed. Additional subcutaneous tissue may be excised to facilitate wound closure as needed. The surgical approach should be individualized and the extent of resection tailored to the extent of disease. Usually, the vulvar lesion will be sharply demarcated and frozen section examination of surgical margins is unnecessary. The exception may be vulvar Paget disease; however, the accuracy and utility of frozen section surgical margins to guide the extent of resection in this setting is debated.

PREOPERATIVE CONSIDERATIONS

In preparation for partial simple vulvectomy, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate surgery or disease-related characteristics (e.g., primary lesion clinically suspicious for invasive cancer, inguinal adenopathy) that would contraindicate a conservative surgical approach. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, and electrocardiogram for women aged 50 years and older. Preoperative imaging is unnecessary.

Prophylactic antibiotics (Cephazolin 1, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery if the procedure is expected to last more than

30 minutes. The instrumentation required includes a basic vaginal surgery set and candy-cane or Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH). Enemas should be administered the evening before surgery, but a full mechanical bowel preparation is unnecessary.

SURGICAL TECHNIQUE

Either general or regional anesthesia is acceptable. The patient should be positioned in dorsal lithotomy position using Allen-type or candy-cane stirrups with the buttocks protruding slightly over the edge of the operating table. The vulva and vagina are prepped and a Foley catheter is placed. Examination under anesthesia should pay particular attention to the size and topography of the vulvar lesion, mobility of surrounding tissues, the vagina and cervix (to exclude a synchronous lesion), and the inguinofemoral lymph nodes.

The surgical margins are outlined with a surgical marking pen, allowing a 3- to 5-mm margin of normal-appearing tissue in all directions. The resection is typically limited to the skin of the vulva and mucosa of the vaginal vestibule. Surgical planning at the time of incision should give specific consideration to the plan for wound closure and ensure that the wound can be closed in a tension-free fashion. Primary closure is achieved by raising the surrounding vulvar skin as advancement flaps and suturing it to the mucosa of the vestibule. If a tension-free closure is not achievable, the wound can be left open and covered with a nonadherent dressing to close by secondary intention.

The typical skin incision for total simple vulvectomy (Chapter 14) is oval-shaped and extends from an anterior apex superior to the clitoris laterally through the skin of the labia majora and medially to meet in the midline at the perineal body (**Figure 13.1**). The incision for partial simple vulvectomy will encompass one or more regions of vulva, encompassed by simple total vulvectomy, defined by a midline axis and a transverse axis through the introitus (**Figure 13.1**). As such, the partial simple vulvectomy can be described as "anterior," "posterior," "extended posterior," "right or left hemivulvectomy," or some combination (e.g., "anterior, right hemivulvectomy"). For cases of extensive disease on the posterior vulva and perianal region, the incision line extends posteriorly around the anus to the intergluteal cleft as far as necessary to encompass the disease ("extended posterior vulvectomy").

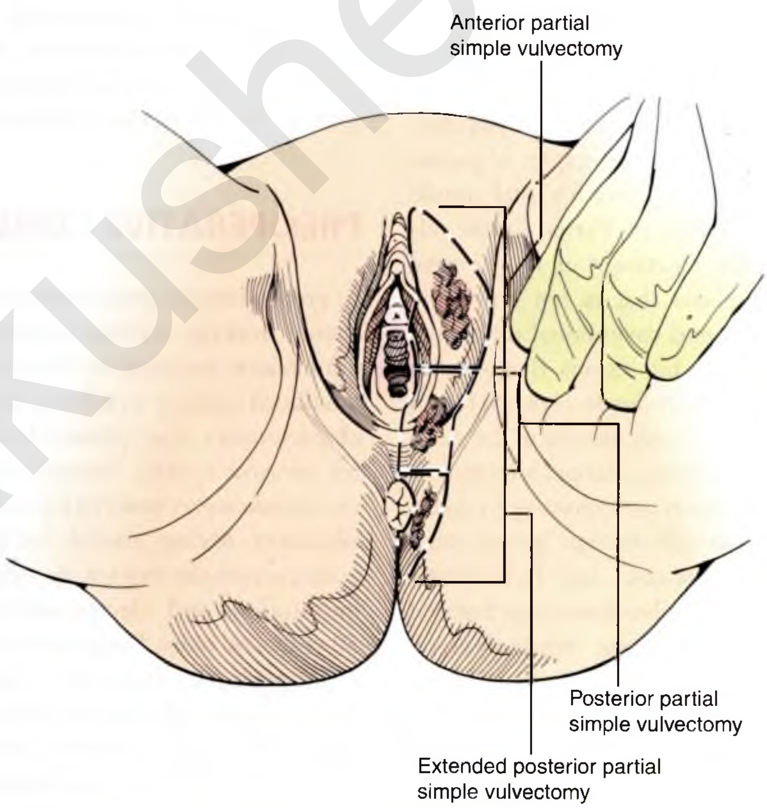

FIGURE 13.1 Delineation of incision lines for total simple vulvectomy and variants of partial simple vulvectomy.

The following example is a left partial simple vulvectomy. The incision line should be injected with local anesthetic (1% plain lidocaine or 0.25% marcaine) to 1) improve postoperative pain control and 2) help delineate the appropriate subcutaneous plane of dissection. The proper plane of dissection is better defined anteriorly. As such, the incision and dissection for partial simple vulvectomy is initiated anteriorly and the posterior dissection, which may be accompanied by more blood loss secondary to less well-defined tissue planes, is deferred to the end of the procedure. The incision is initiated at the apex of the vulva and carried laterally over the labia majora to a point midway between the apex and the perineal body as well as down the midline, encompassing the disease with a visibly disease-free margin. Generally, the knife blade is used for the skin incision to preserve interpretability of the surgical margins of resection. The electrosurgical unit (ESU) is used for all subsequent dissection to minimize blood loss. Using the ESU, the dissection proceeds into the superficial subcutaneous tissue until the plane between the skin and labial fat pad becomes apparent (**Figure 13.2**). This is the correct plane of dissection for simple partial/total vulvectomy. The labial fat pad should be spared to the greatest extent possible to preserve the normal contour of the vulva. However, the labial fat pad may need to be sacrificed, in part or in its entirety, to facilitate re-approximating the skin edges and achieve a tension-free closure.

The dissection proceeds simultaneously from lateral to medial and from anterior to posterior, down the mons pubis and around the clitoris (or inclusive of the clitoris, if clitorectomy is required). Traction and countertraction should be applied by the surgeon and assistant using a series of Allis clamps to facilitate exposure of the correct plane of dissection. The medial incision is extended inferiorly to meet the outline of the inner margin of resection. The skin incisions are then extended further posteriorly to the base of the labia majora or lower, depending on the extent of resection, and along the perineal body. Dissection with the ESU is in the subcutaneous plane and proceeds from lateral to medial and posterior to anterior, working toward the inner resection margin at the introitus. Superficial branches of the internal pudendal artery are ligated and divided as they are encountered. The specimen is removed and hemostasis obtained by a combination of the ESU and 3-0 delayed absorbable sutures in figure-of-eight stitches (**Figure 13.3**). In circumstances with disease extending to the perianal region, the posterior resection margins are carried around the anus to the intergluteal cleft.

Closure of the underlying fatty tissue layer with interrupted stitches of 3-0 delayed absorbable suture (layered closure) has the dual advantage of obliterating

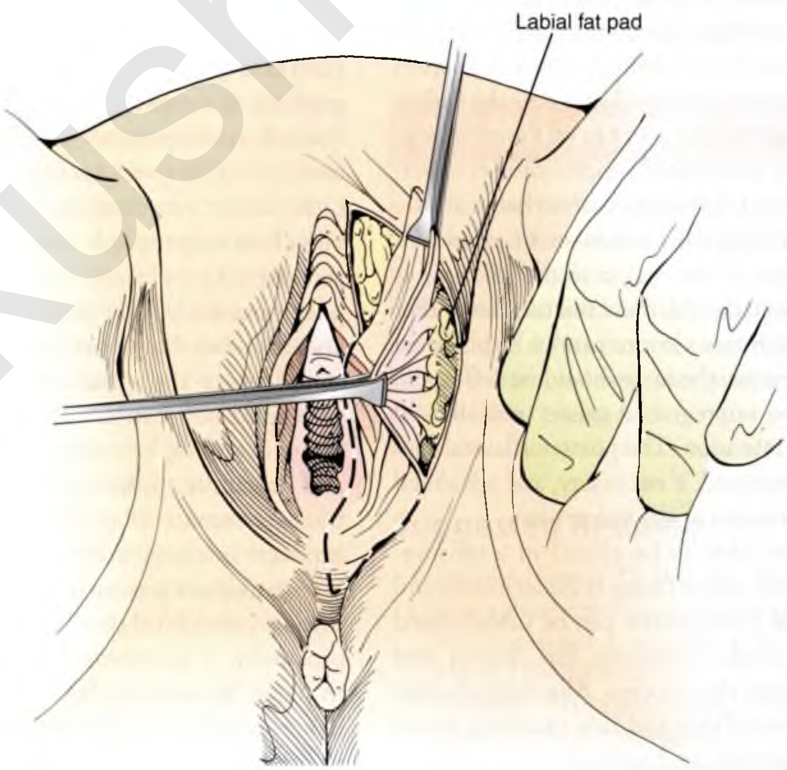

FIGURE 13.2 Partial simple vulvectomy: Anterior and lateral dissection in the subcutaneous plane.

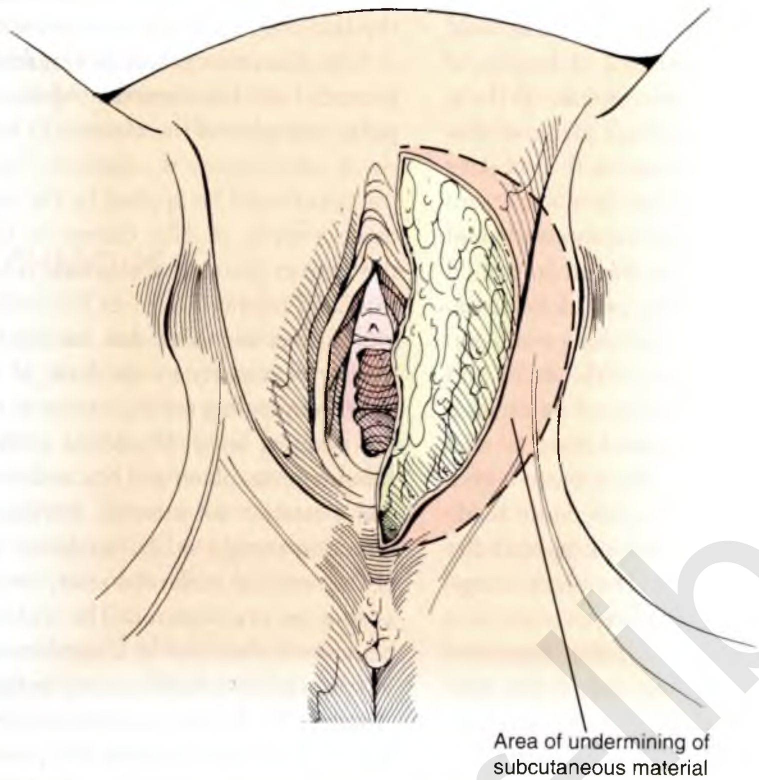

FIGURE 13.3 Surgical defect after completed partial simple vulvectomy.

dead space to reduce the chance of seroma formation and redistributing tension from the skin closure into the subcutaneous tissues. Anteriorly, the skin edges are re-approximated in a vertical direction using a series of interrupted simple stitches or vertical mattress stitches of 2-0 delayed absorbable suture. Laterally, the vulvar skin is re-approximated to the mucosa of the vestibule, again using a series of interrupted simple stitches or vertical mattress stitches of 2-0 delayed absorbable suture (**Figure 13.4**). It is especially important to avoid tension on the suture line in the region of the urethra, as this may distort the urethra and affect micturition and/or continence. If a tension-free closure cannot be obtained in the periurethral region, the area should be left open, dressed with Vaseline-impregnated gauze, and allowed to heal by secondary intention. The posterior/lateral vaginal wall can be undermined, if necessary, and advanced distally to reach the margin of the vulvar skin.

If the defect is not able to be closed in a tension-free fashion, the lateral vulvar tissue is undermined and advanced. The lateral vulvar tissue can be undermined out to the medial thigh. Reducing hip flexion and abduction may facilitate this process. Alternatively, one or more rotational flaps of skin and subcutaneous tissue ("rhomboid" flap) can be raised and advanced to cover defects laterally or posteriorly, or a split-thickness skin graft can be used to cover the defect.

POSTOPERATIVE CONSIDERATIONS

The primary issues during the postoperative period are local wound care and pain control. Ambulation should begin on postoperative day #1 or even the evening of surgery for more limited resection cases. Forced constipation may be advantageous in the case of extensive posterior or perianal dissection. Otherwise, no measures are required to restrict bowel movements. A stool softener should be prescribed routinely and continued for 1 to 2 weeks postoperatively. The perineum should be kept clean and dry. Sitz baths are to be avoided, as they tend to macerate the tissue and increase the likelihood of wound separation. The timing of Foley catheter removal should be tailored to the extent of resection and proximity to the urethra. If the margins of resection are remote from the urethra and unlikely to be exposed to urine during voiding, then the catheter is removed on postoperative day #1. If the resection involves the distal urethra or the margins are in close proximity, it may be advisable to leave the catheter in place for several days until the raw wound edges have sealed. Discharge from the hospital is indicated once adequate pain control is achieved with oral analgesia and the patient is tolerating a regular diet.

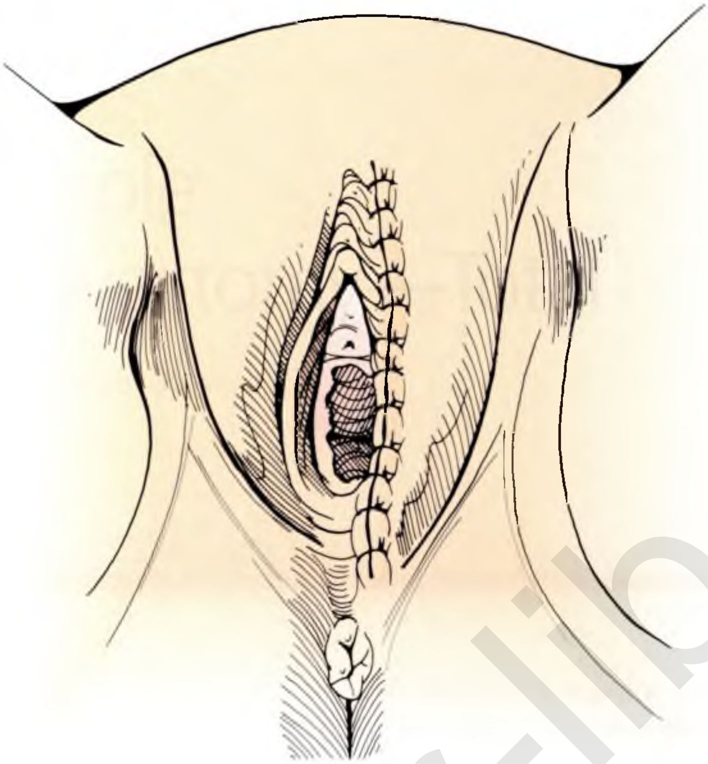

FIGURE 13.4 Closure of operative defect after partial simple vulvectomy.

Operative Note

PROCEDURE: SIMPLE VULVECTOMY—PARTIAL

The vulvar lesion was demarcated with a 3- to 5-mm margin of normal-appearing tissue using a surgical marking pen prior to prepping and draping the vulva and perineum. The resection line was injected with 0.25% marcaine solution. The anterior vulvar incision was created using the knife blade. The specimen was grasped with Allis clamps and the ESU was used to develop the correct plane of dissection in the subcutaneous tissue beginning anteriorly and working from lateral to medial and anterior to posterior. The dissection was carried inferiorly, lateral to the clitoris, and around the lateral aspect of the introitus. Superficial branches of the internal pudendal artery were ligated and divided as they were encountered. The posterior vulvar incision was extended using the knife blade and the subcutaneous tissue dissection continued using the ESU. The specimen was excised and hemostasis achieved using a combination of 3-0 delayed absorbable suture ligatures and electrocautery.

The lateral skin and subcutaneous tissue of the vulva was undermined out to the medial thigh and an advancement flap was raised. The posterior and lateral vaginal margins or resection were similarly undermined to achieve satisfactory mobility for a tension-free closure. The underlying subcutaneous tissue was re-approximated in layers using interrupted stitches of 3-0 delayed absorbable suture. The skin edges were re-approximated with 2-0 delayed absorbable sutures in vertical mattress stitches. The closure was tension-free and hemostatic.

COMPLICATIONS

- Tension on the wound closure will lead to wound breakdown with potential infection and tissue necrosis.
- The most common complications after partial simple vulvectomy are wound separation and infection, urinary tract infection, and thromboembolic events.

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CHAPTER 14

Simple Vulvectomy—Total

Robert E. Bristow

INTRODUCTION

The purpose of the total simple vulvectomy is removal of the skin and subcutaneous tissues of the vulva. Total simple vulvectomy is associated with a less appealing cosmetic alteration in the vulva compared to the partial resection procedure described in Chapter 13. Total simple vulvectomy is indicated for treatment of: 1) extensive vulvar intraepithelial neoplasia that is not amenable to ablative (e.g., CO_2 laser and cavitational ultrasonic surgical aspirator) therapy or for lesions that require complete pathological evaluation to exclude an underlying invasive cancer, 2) Paget disease of the vulva without suspicion for an underlying adenocarcinoma, 3) selected cases of lichen sclerosis unresponsive to medical management, and 4) specific benign lesions such as extensive condyloma acuminata and hidradenitis suppurativa. As total simple vulvectomy is performed for preinvasive disease, concomitant inguinofemoral lymphadenectomy is not indicated. Lower genital tract dysplasia may be multifocal; therefore, a thorough examination of the vagina and cervix for preinvasive and invasive disease is a prerequisite.

As with partial simple vulvectomy, a visibly disease-free margin of the full thickness of vulvar skin and mucosa is all that is required, usually 3 to 5 mm. The classic total simple vulvectomy removes the vulvar skin and superficial fat including the clitoris with prepuce, the labia minora, the labial fat pads, and the labia majora to the junction of the hair-bearing and non-hair-bearing skin. Contemporary practice dictates a more individualized approach tailored to the extent of disease with regard to the clitoris. If the clitoris is uninvolved by disease, it should be preserved.

PREOPERATIVE CONSIDERATIONS

In preparation for total simple vulvectomy, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate surgery or disease-related characteristics (e.g., primary lesion clinically suspicious for invasive cancer, and inguinal adenopathy) that might dictate a more radical surgical approach. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, and electrocardiogram for women aged 50 years and older. Preoperative imaging is unnecessary.

Prophylactic antibiotics (Cephazolin 1, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. The instrumentation required includes a basic vaginal surgery set and candy-cane or Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH). Enemas should be administered the evening before surgery. Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) is unnecessary unless an extensive resection is anticipated around the anus including the anal skin.

SURGICAL TECHNIQUE

Either general or regional anesthesia is acceptable. The patient should be positioned in dorsal lithotomy position using Allen-type or candy-cane stirrups with the buttocks protruding slightly over the edge of the operating table. The vulva and vagina are prepped and a Foley catheter placed. Examination under anesthesia should pay particular attention to the size and topography of the vulvar lesion(s), the vagina and cervix (to exclude a synchronous lesion), and the inguinofemoral lymph nodes.

The outer and inner surgical margins of dissection are outlined with a surgical marking pen. The typical outer skin incision for total simple vulvectomy is oval shaped and extends from an anterior apex superior to the clitoris laterally through the skin of the labia majora and medially to meet in the midline at the perineal body (**Figure 14.1**). For cases of extensive disease on the posterior vulva and perianal region, the incision line extends posteriorly around the anus to the intergluteal cleft as far as necessary to encompass the disease. The inner incision circumscribes the vaginal vestibule, extends around the urethra, and may extend anteriorly around the prepuce of the clitoris if clitorectomy is not required. The incision line should be injected with local anesthetic (1% plain lidocaine or 0.25% marcaine) for the purposes of postoperative pain control and to help delineate the appropriate subcutaneous plane of dissection.

The incision for total simple vulvectomy is initiated at the apex of the vulva and carried laterally over the labia majora to a point midway between the apex and the perineal body. Generally, the knife blade is used for the skin incision to preserve interpretability of the surgical margins of resection. The electrosurgical unit (ESU) is used for all subsequent dissection to minimize blood loss. Using the ESU, the dissection proceeds into the superficial subcutaneous tissue until the plane between the skin and labial fat pad becomes apparent (**Figure 14.2**). This is the correct plane of dissection for simple partial/total vulvectomy. In the typical case, the labial fat pad will need to be removed to facilitate a tension-free wound closure. However, if there is sufficient laxity in the lateral vulvar skin, the labial fat pad may be preserved. The dissection proceeds from anterior to posterior (down the mons pubis) and from lateral to medial (across the labia majora). Traction and countertraction using a series of Allis clamps on the specimen and preserved vulvar tissue should be applied by the surgeon and assistant to facilitate exposure of the correct plane of dissection.

If clitorectomy is to be performed, the anterior dissection is extended inferiorly, removing a wedge-shaped area of tissue (to facilitate closure) down to the suspensory ligament of the clitoris. The clitoris and its associated vasculature are clamped and divided just beneath the skin and vestibular mucosa and suture ligated with 2-0 delayed absorbable suture. For simple vulvectomy, there is no need to dissect into the

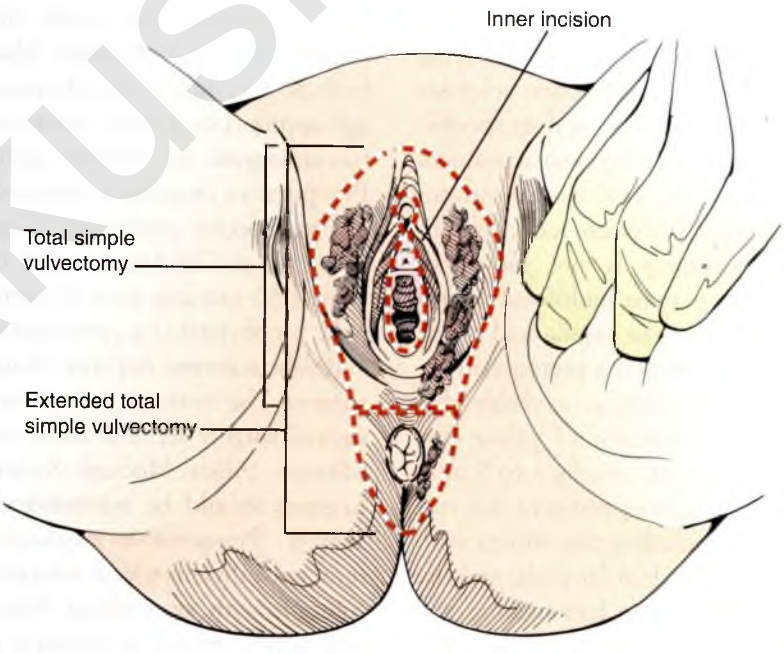

FIGURE 14.1 Delineation of incision lines for total simple vulvectomy variations.

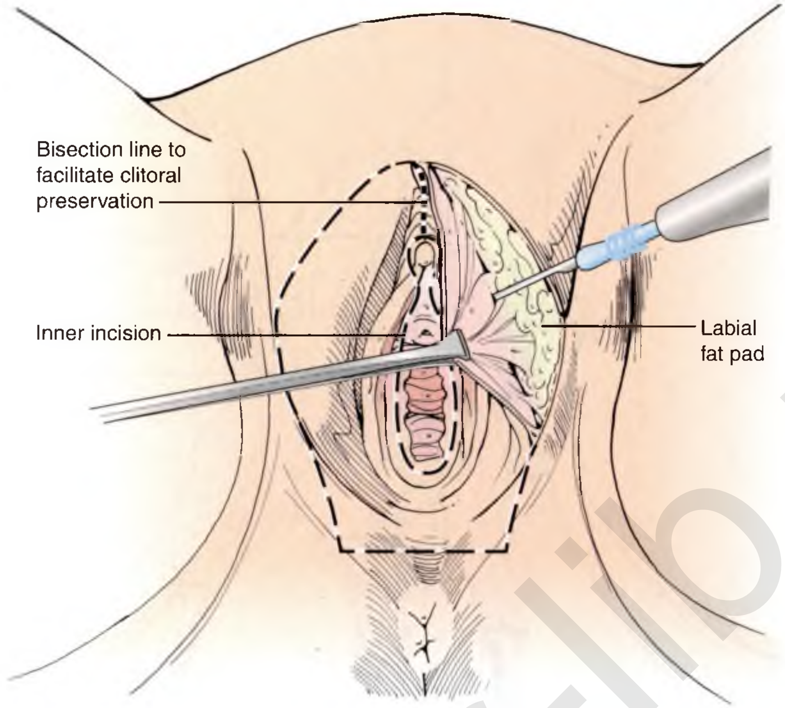

FIGURE 14.2 Total simple vulvectomy: Anterior and lateral dissection in the subcutaneous plane.

deeper tissue around the base of the clitoral shaft, as the venous plexus in this area can produce troublesome bleeding if injured. If clitorectomy is not required, the anterior dissection in the subcutaneous tissue is carried down to the prepuce of the clitoris, which is then circumscribed, and the incision line is extended laterally and inferiorly to meet the inner incision. Bisecting the anterior half of the specimen down to the clitoral prepuce may facilitate making the circumscribing incision for clitoral preservation (**Figure 14.3**).

Once this phase of the dissection has been completed, the lateral skin incisions are extended further posteriorly to the base of the labia majora or lower, depending on the extent of posterior vulvar resection, and across the perineal body. Dissection with the ESU is in the subcutaneous plane and proceeds from lateral to medial and posterior to anterior, working toward the inner incision at the introitus. The superficial branches of the internal pudendal artery are ligated and divided as they are encountered. A separate inner incision is created around the urethral meatus and around the introitus just distal to the hymenal ring (unless disease extends onto the hymenal ring into the vagina canal). The lateral dissection plane is carried medially to connect with the inner incisions. Alternatively, if the specimen is split down the midline during clitoral preservation, this incision is carried around the urethra and continued to the inner incision on either side. The specimen is removed and hemostasis obtained by a combination of the ESU and 3-0 delayed absorbable sutures in figure-of-eight stitches.

The most important aspect of closing the vulvar defect is that the re-approximation of tissue edges be tension-free. If necessary to facilitate closure, the labial fat pads and some of the anterior vulvar subcutaneous tissue may be removed. The subcutaneous tissue of the lateral vulva is undermined out the medial thigh and advanced to reach the mucosa of the vaginal vestibule. The posterior and lateral vaginal walls can be undermined and advanced if necessary. Reduction of hip flexion and abduction will facilitate closure. Anterior to the urethra, the skin edges are re-approximated in a vertical direction using a series of interrupted simple stitches or vertical mattress stitches of 2-0 delayed absorbable suture. Closure of the underlying fatty tissue layer with interrupted stitches of 3-0 delayed absorbable suture (layered closure) has the dual advantage of obliterating dead space to reduce the chance of seroma formation and redistributing tension from the skin closure into the subcutaneous tissues. Laterally, the vulvar skin is re-approximated to the mucosa of the vestibule, again using a series of interrupted simple stitches or vertical mattress stitches of 2-0 delayed absorbable suture.

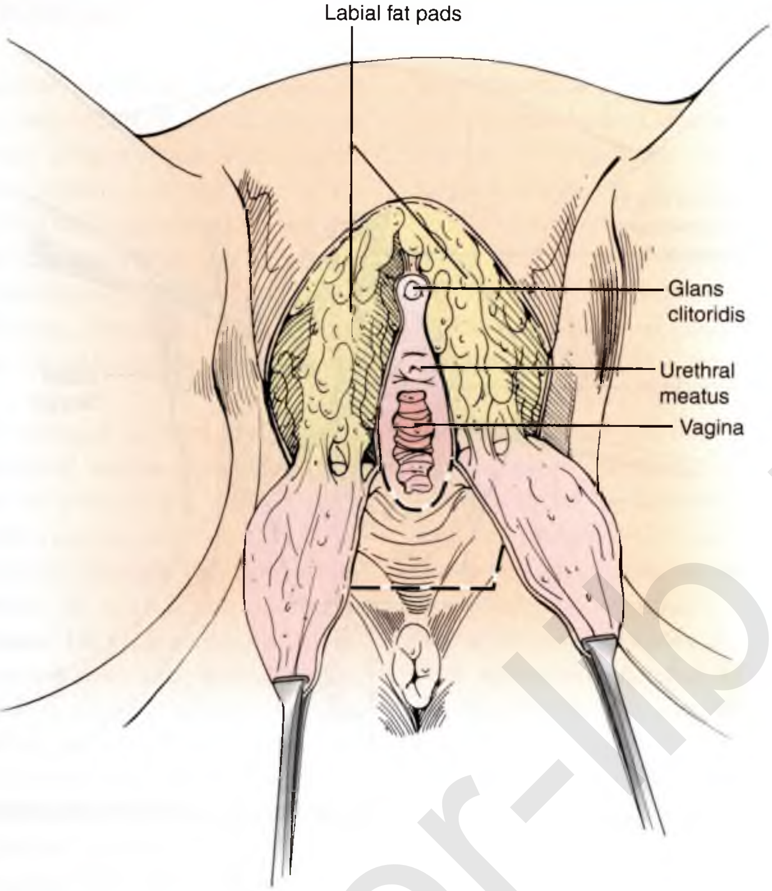

FIGURE 14.3 Surgical defect after completed total simple vulvectomy.

Excessive dead space within the lateral subcutaneous tissue should be obliterated using the layered closure technique prior to skin closure. The posterior vulva can be closed in either a vertical or transverse fashion, whichever produces the best cosmetic result with the least amount of tension (**Figure 14.4**). Tension on the suture line in the region of the urethra may distort the anatomy and affect micturition and/or continence. If efforts to achieve a tension-free closure fail, the wound can be left open and covered with a nonadherent dressing to close by secondary intention.

POSTOPERATIVE CONSIDERATIONS

During the immediate postoperative period, specific attention should be directed toward pain control and keeping the vulvar area clean and dry. Sitz baths are not recommended, as they tend to macerate the tissue and increase the likelihood of wound separation. Ambulation should begin on postoperative day #1. Forced constipation for several days will help reduce the risk of contamination of the surgical wound in the case of extensive posterior or perianal dissection. Otherwise, no measures are required to restrict bowel movements. A stool softener should be prescribed routinely and continued for 1 to 2 weeks postoperatively. The timing of Foley catheter removal should be tailored to the extent of resection and proximity to the urethra. If the margins of resection are remote from the urethra and unlikely to be exposed to urine during voiding, then the catheter can be removed on postoperative day #1. If the resection involves the distal urethra or the margins are in close proximity, it may be advisable to leave the catheter in place for several days until the raw wound edges have sealed. Discharge from the hospital is indicated once adequate pain control is achieved with oral analgesia and the patient is tolerating a regular diet.

Operative Note

PROCEDURE: SIMPLE VULVECTOMY—TOTAL

A surgical marking pen was used to delineate the vulvectomy resection, beginning at the apex above the clitoris on the mons pubis, extending inferiorly and laterally along

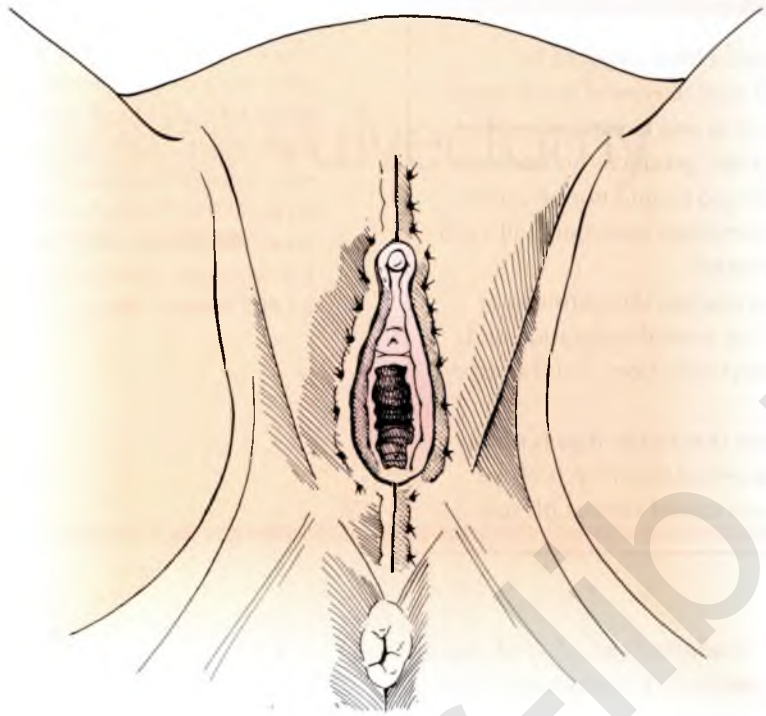

FIGURE 14.4 Closure of operative defect after total simple vulvectomy.

the junction of the hair-bearing and non-hair-bearing tissue of the labia majora, crossing the perineal body and meeting in the midline. A 3- to 5-mm margin of normal-appearing tissue was ensured in all directions. A second, inner incision was delineated with the surgical marking pen just distal to the hymenal ring and circumscribing the urethra and clitoris. The vulva was prepped and draped and a Foley catheter inserted. Both outer and inner incision lines were injected with 0.25% marcaine solution.

The resection was initiated anteriorly by incising the skin of the mons pubis and lateral vulva with the knife blade and extending the skin incision down to a level approximating the midpoint of the introitus. The specimen was grasped with Allis clamps and the ESU was used to develop the correct plane of dissection in the subcutaneous tissue beginning anteriorly and working from lateral to medial and anterior to posterior. The labial fat pads were preserved. The anterior portion of the specimen was bisected down the midline to the level of the prepuce of the clitoris. This incision was carried inferiorly, circumscribing the clitoris and urethra to join the inner incision at the introitus. The lateral vulvar incisions were extended posteriorly and medially across the perineal body using the knife blade. The subcutaneous tissue dissection was continued with the ESU, working from lateral to medial and from posterior to anterior toward the inner incision line. Superficial branches of the internal pudendal artery were ligated and divided as they were encountered. The inner incision was completed using the cutting current of the ESU and the specimen excised. Hemostasis was achieved using a combination of 3-0 delayed absorbable suture ligatures and electrocautery.

The anterior and lateral skin and subcutaneous tissue of the vulva were undermined out to the medial thigh. Interrupted simple stitches of 3-0 delayed absorbable suture were used to re-approximate the subcutaneous tissue and fat anteriorly and laterally on either side of the vulva. Anteriorly, the skin edges were closed in a vertical direction using a series of vertical mattress sutures of 2-0 delayed absorbable suture down to the clitoris. The lateral vulvar skin edges were re-approximated to the mucosa of the vestibule, again using a series of vertical mattress stitches or interrupted simple stitches of 2-0 delayed absorbable suture. The posterior vaginal wall was undermined and advanced distally, and the posterior vulvar defect closed in a transverse direction using vertical mattress stitches of 2-0 delayed absorbable suture. The closure was tension-free and hemostatic.

COMPLICATIONS

- Tension on the wound closure should be avoided, as this will lead to wound breakdown with potential infection and tissue necrosis.
- Total simple vulvectomy produces an undesirable cosmetic result and should not be undertaken if a more conservative resection will yield adequate disease control.
- The most common complications after total simple vulvectomy are wound separation and infection, urinary tract infection, and thromboembolic events.
- Excessive deep dissection in the region of the clitoral shaft can be associated with profuse bleeding from the associated venous plexus.

Suggested Reading

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CHAPTER 15

Radical Vulvectomy

Robert E. Bristow

INTRODUCTION

Radical vulvectomy has two major variations: en bloc radical vulvectomy and bilateral inguinal lymphadenectomy and the technique with separate vulvar and groin incisions. Historically, all cases of vulvar cancer were treated by the classic en bloc radical vulvectomy popularized by Stanley Way in the 1950s and 1960s. This procedure demonstrated superior outcomes compared to simple vulvectomy and as a result became the therapeutic approach for virtually all cancers of the vulva. Advances in the understanding of disease etiology, natural history, and prognostic factors precipitated changes in practice focusing more on individualization of care and paralleled the more contemporary realization that it is possible to adhere to the important principles of wide excision of the primary tumor and diagnostic/therapeutic removal of groin lymph nodes without performing radical vulvectomy with bilateral inguinal lymphadenectomy on all patients. In addition, recent advances in irradiation therapy combined with sensitizing chemotherapy have greatly reduced the requirement for radical vulvectomy as primary treatment of locally advanced vulvar cancer. Today, the procedure using separate groin incisions (or wide radical excision, described in Chapter 17) is the preferred technique for most cases of locally advanced disease not amenable to treatment with chemoradiation, since it is associated with less risk of wound breakdown and overall morbidity.

The most common indication for radical vulvectomy is invasive squamous carcinoma of the vulva Stages II-IVA: nonlateralized T2 lesions (>2 cm in maximal diameter), T3 lesions (adjacent spread to the lower urethra, vagina, or anus), and T4 lesions (spread to the upper urethra, bladder or rectal mucosa, or pubic bone) not amenable to radical wide excision or combined chemoradiation. Additional indications may include extensive Paget disease of the vulva with an underlying adenocarcinoma, advanced adenocarcinoma of the Bartholin gland with infiltration of vulvar soft tissues, locally advanced vulvar melanoma without evidence of regional or distant spread, and extensive verrucous carcinoma of the vulva (generally not treated with radiation therapy, which may aggravate the disease and lead to dedifferentiation). Extensive hidradenitis suppurativa not amenable to more conservative resection may also be managed by radical vulvectomy, although there is no requirement for formal node dissection.

Traditionally, radical vulvectomy is defined by a visibly normal tissue resection margin of at least 2 cm in all directions; the deep margins of resection are the pubic aponeurosis anteriorly, the pubic rami and superficial perineal fascia laterally, and the levator plate/ischiorectal fossa/anal sphincter posteriorly. At least one study has suggested that a 1 cm margin of uninvolved tissue prior to pathological processing may be adequate, and this is particularly applicable to the areas of the perineal body/rectovaginal septum and introitus/urethra, where a 2-cm surgical margin may be impractical due to the proximity of underlying or juxtaposed structures to be retained.

PREOPERATIVE CONSIDERATIONS

In preparation for radical vulvectomy, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate surgery. The vagina and cervix should be thoroughly evaluated to exclude a synchronous lesion or metastatic lesion. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, and electrocardiogram for women aged 50 years and older. Preoperative computed tomography imaging of the abdomen and pelvis is advisable, particularly if the groin nodes are clinically suspicious. A chest radiograph should be obtained, or alternatively computed tomography scanning can be extended to include the chest.

Prophylactic antibiotics (Cephazolin 1, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. The instrumentation required includes a basic vaginal surgery set and Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH). Enemas should be administered the evening before surgery. Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) combined with forced constipation for a period of several days may facilitate healing by reducing the likelihood of fecal contamination of the incision in the immediate postoperative period if there is an extensive posterior component to the dissection.

SURGICAL TECHNIQUE

Either general or regional anesthesia is acceptable. The patient should be positioned in dorsal lithotomy position using Allen-type stirrups with the buttocks protruding slightly over the edge of the operating table. The vulva, vagina, and thighs are prepped and a Foley catheter is placed. Examination under anesthesia should pay particular attention to the size and topography of the vulvar lesion, the vagina and cervix, and the groin lymph nodes.

En bloc radical vulvectomy

En bloc radical vulvectomy includes removal of the vulva, mons pubis, and a contiguous "horn" of skin and underlying fatty tissue extending from the vulva over each groin (**Figure 15.1**). The skin incision is outlined and consists of a curvilinear incision connecting a point 2 cm medial and 2 cm inferior to each anterior superior iliac spine and extending along the superior border of the mons pubis. Lateral incisions are created by extending downward along the groin crease into the labiocrural folds on each side. The lateral incisions are carried into the posterior vulva and directed medially and anterior to the anus tailored to the extent of disease.

The procedure is best initiated by starting anteriorly, with the patient's thighs flexed at a 15° angle in the Allen stirrups; the legs are repositioned into hyperflexion later to facilitate the posterior dissection. Using the knife blade, the skin of the anterior portion of the specimen is incised down to midpoint of the vulva. The electrosurgical unit (ESU) is utilized for deeper dissection.

The anterior curvilinear incision is extended into the deep tissues between the lower abdominal wall and upper border of the mons pubis, through Camper's fascia and Scarpa's fascia, exposing the lower border of the anterior rectus sheath fascia and inguinal ligaments. An advancement flap of anterior abdominal wall skin and subcutaneous fat is then raised superiorly from the anterior rectus sheath to facilitate incision closure. This flap can be extended as far as the umbilicus if necessary. Working inferiorly, the subcutaneous tissue is dissected off the underlying symphysis pubis, and the lateral incisions of each groin are carried into the subcutaneous tissue and extended down to the labiocrural folds, exposing the femoral triangle on each side (**Figure 15.2**). The superficial epigastric and external pudendal vessels are ligated with 2-0 or 3-0 delayed absorbable suture and divided as they are encountered. At this point, the bilateral inguinofemoral lymphadenectomy is performed (Chapter 16).

Following completion of the inguinofemoral lymphadenectomy, the anterior portion of the specimen is undermined along the fascia of the anterior abdominal wall and medial thigh. Closed suction drains are placed in each groin and brought out through separate incisions in the lateral abdominal wall. The groin incisions are closed in layers using interrupted simple stitches of 3-0 delayed absorbable suture. The skin can be closed with staples or a series of vertical mattress sutures of 2-0 or 3-0 delayed absorbable sutures. The legs are repositioned into hyperflexion (45° or more) to provide exposure for the lower vulvar dissection (**Figure 15.3**). The labiocrural fold incisions are extended lateral to the labial fat pads, past the perineal body, and then directed medially around the anus and meeting in the midline. The specimen is drawn sharply downward and separated from the symphysis pubis until the lower border of the pubic arch is reached.

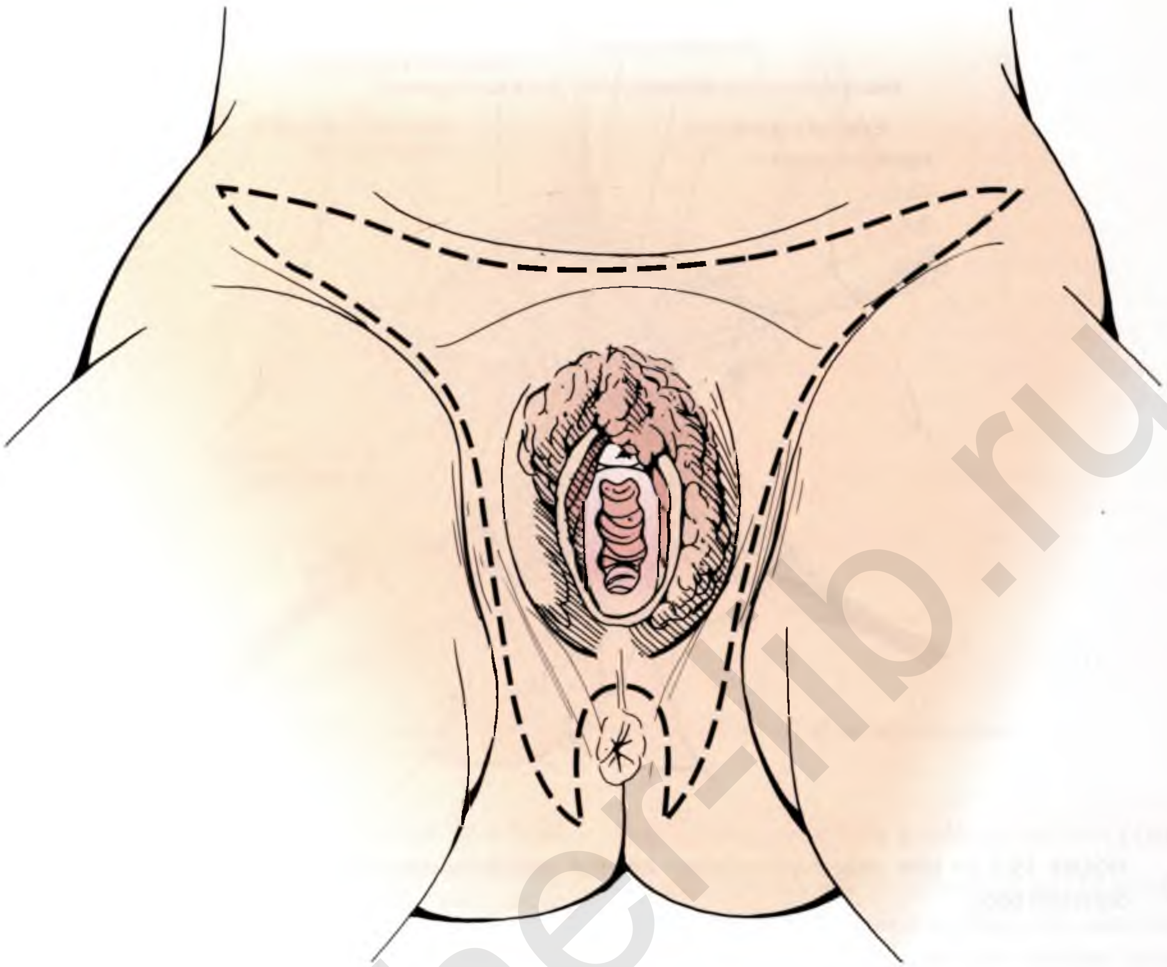

FIGURE 15.1 En bloc radical vulvectomy: Extent of the incision encompassing the entire vulva and a "horn" of contiguous skin and subcutaneous tissue overlying each groin.

The dissection is taken down to the pubic aponeurosis and the suspensory ligament of the clitoris, the clitoral shaft, and clitoral vessels are clamped, divided, and the pedicle(s) secured with 1-0 delayed absorbable suture ligatures.

The lateral incisions are developed down to the pubic arches and the specimen dissected from the inferior urogenital diaphragm working medially. The inferior pudendal vessels are ligated with 2-0 or 3-0 delayed absorbable suture and divided. The inner vulvar incision is created circumscribing the urethra and vaginal introitus. The dissection is carried inferiorly along the inferior fascia of the urogenital diaphragm and around the urethra, which is identified by palpating the Foley catheter. The specimen is reflected inferiorly and dissected off the perineal body (**Figure 15.4**). The posterior dissection is completed by working from lateral to medial, carefully dissecting the deep vulvar tissue from the external anal sphincter and meeting in the midline at the posterior fourchette.

Primary closure of the en bloc radical vulvectomy defect requires that the incision margins be approximated in a tension-free fashion, which is especially important in the areas of the urethra and vagina. If the defect cannot be closed without tension, one of a variety of rotational or pedicle-based flaps can be utilized; however, a discussion of these is beyond the scope of this text. The anterior extent of the defect was closed following completion of the inguinal lymphadenectomy. The thighs are taken out of hyperflexion and the lateral margins of the defect are undermined along the fascial investments of the anterior and medial thighs. The distal vaginal wall can be undermined for a short distance circumferentially, but extensive dissection around the urethra should be minimized. The wound is closed in layers with deep sutures of 2-0 or 3-0 delayed absorbable suture to obliterate dead space. Closed suction drains can be placed prior to closing the deep tissue layer and brought out through separate stab incisions. Anterior to the urethra, the skin edges are re-approximated in

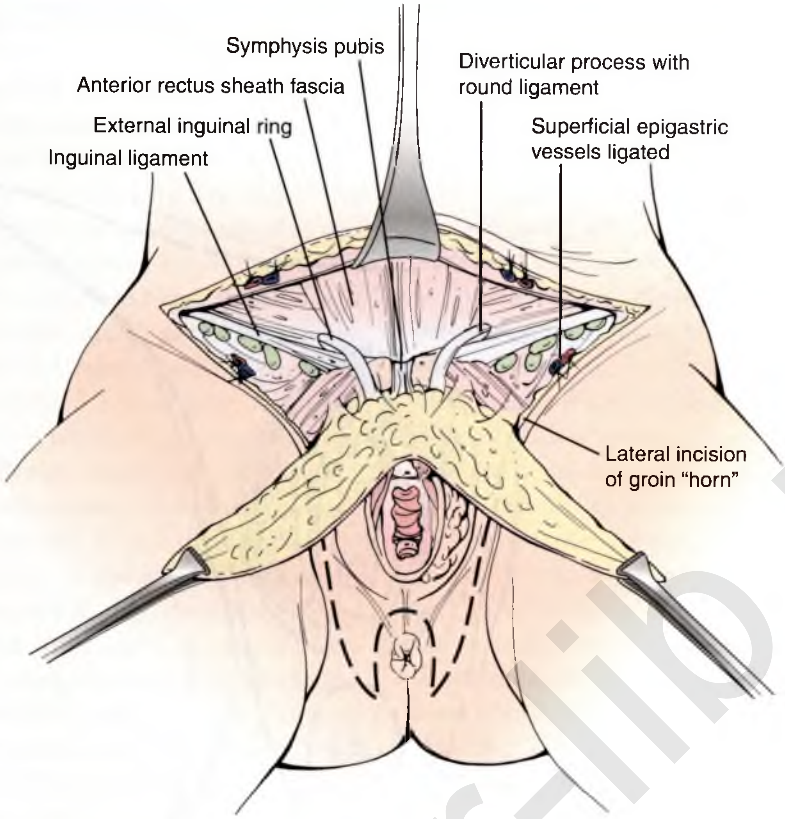

FIGURE 15.2 En bloc radical vulvectomy: Anterior incision exposing abdominal wall and groin node dissection beds.

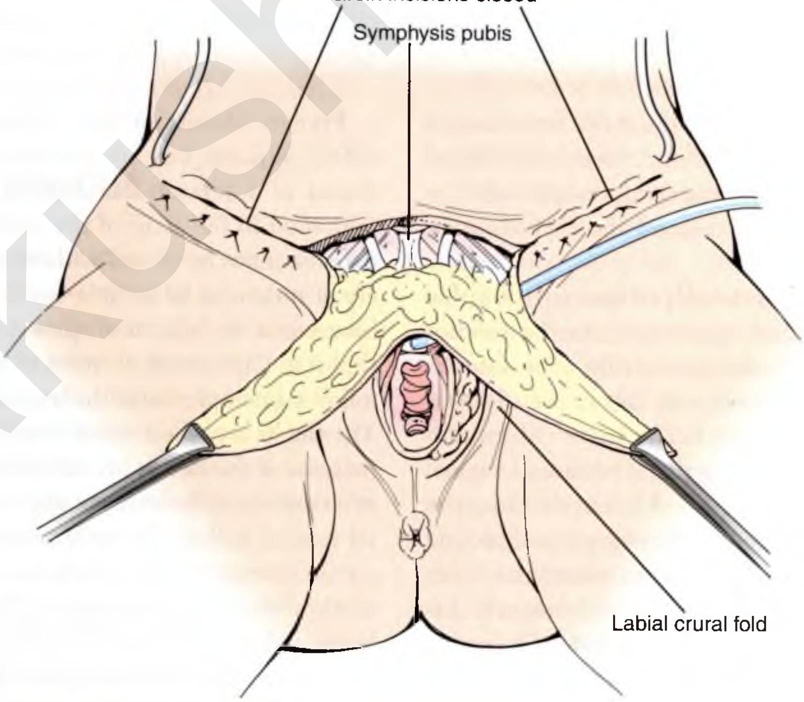

FIGURE 15.3 En bloc radical vulvectomy: Vulvectomy phase after closure of groin defects; the specimen is dissected from the symphysis pubis.

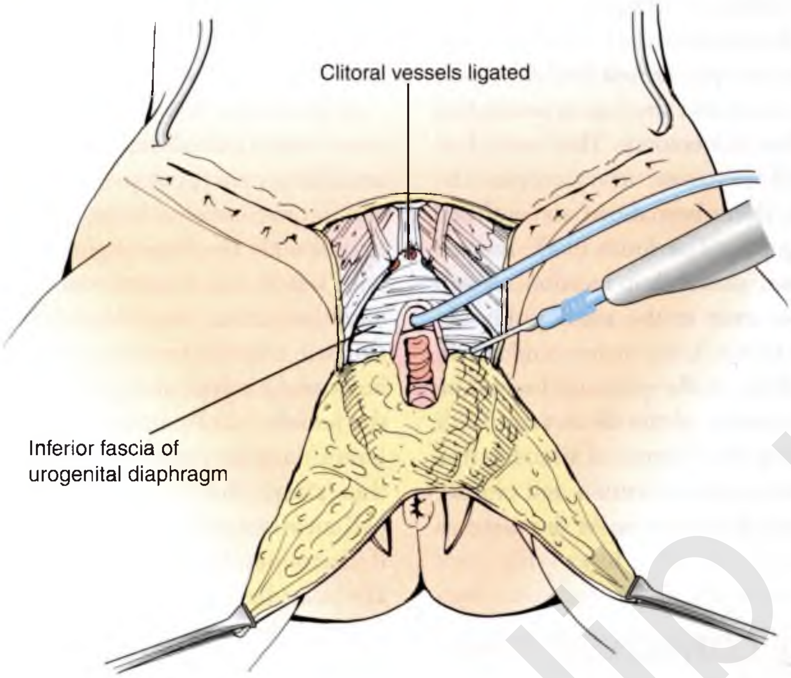

FIGURE 15.4 En bloc radical vulvectomy: Posterior dissection of vulvectomy phase.

a vertical direction. Closure of the skin and superficial fat is best accomplished by a series of interrupted vertical mattress stitches of 2-0 delayed absorbable suture (**Figure 15.5**). If a tension-free closure cannot be obtained in the periurethral region, the area should be left open, dressed with Vaseline-impregnated gauze, and allowed to heal by secondary intention.

Separate incision radical vulvectomy

Separate incision radical vulvectomy and bilateral groin lymph node dissection accomplishes the same surgical objective as the en bloc procedure without removing the skin overlying each groin or a bridge of skin and subcutaneous fat between the central vulvar resection

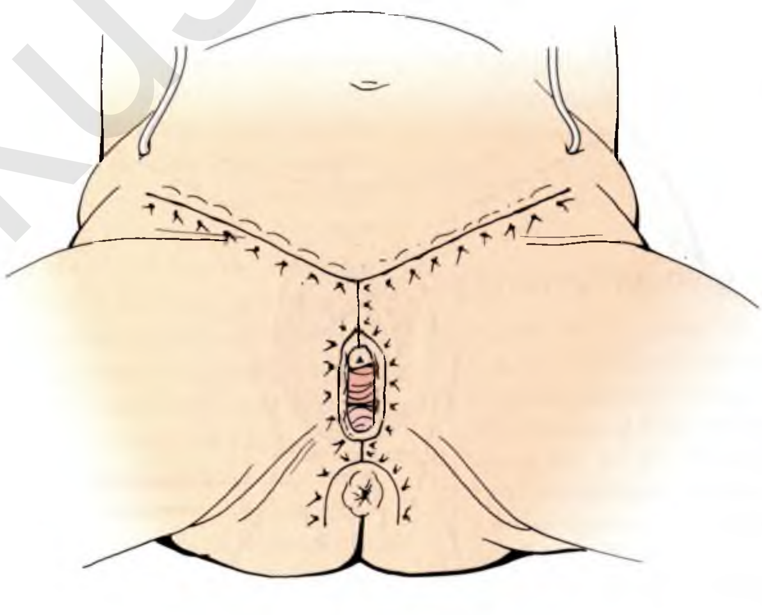

FIGURE 15.5 En bloc radical vulvectomy: Primary closure.

and each groin node dissection (**Figure 15.6**). For separate incision radical vulvectomy, the bilateral groin lymph node dissections are performed first (Chapter 16); the incisions are closed and the legs repositioned before proceeding to the vulvectomy. The outer and inner surgical margins of dissection to encompass the central vulvar resection described above are outlined with a surgical marking pen. The knife blade is used to make the oval-shaped outer skin incision, which extends from an anterior apex in the mons pubis laterally through the skin of the labia majora and medially to meet in the midline at the perineal body. The ESU is used for the remainder of the dissection. With the exception of removing the "horns" of tissue in the en bloc radical vulvectomy, the dissection and closure for separate incision radical vulvectomy is the same as described above.

POSTOPERATIVE CONSIDERATIONS

Radical vulvectomy, whether en bloc or as separate incision, with bilateral inguinal lymphadenectomy is associated with a substantial risk (75%) of early postoperative complications, most notably wound breakdown and infection, thromboembolic events, urinary tract infection, and lower extremity lymphedema. Because of the extensive nature of the en bloc resection, elderly patients or those with preexisting cardiovascular disease are prone to myocardial infarction and cerebrovascular accidents. Late complications include sexual dysfunction, pelvic floor relaxation (e.g., cystocele and rectocele), urinary incontinence, and chronic lower extremity lymphedema. Rarely, osteomyelitis of the pubic bone can occur.

If there are no concerns about disrupting the vulvar closure, ambulation should be initiated as early as possible in the postoperative period. To reduce tension on the incision lines, the patient should be positioned with the hips slightly flexed while in bed. As with simple vulvectomy, sitz baths should be avoided, and the vulvar area should be kept clean and dry. Routine thromboembolic prophylaxis should include both mechanical and pharmacologic measures until the patient is fully ambulatory; pharmacologic prophylaxis should be continued for a period of several weeks thereafter. The Foley catheter is removed once the patient is ambulatory but may be continued for 7 days if there has been extensive periurethral dissection. Diet can be advanced as tolerated. Forced constipation is unnecessary unless there has been a significant posterior (perianal) dissection, and avoidance of fecal contamination is desirable. Because of the risk of lymphedema of the lower extremities, it is advisable to have the patient fitted for anti-edema stockings in the immediate postoperative period.

Operative Note

PROCEDURE: RADICAL VULVECTOMY

The patient was positioned in dorsal lithotomy position in Allen-type stirrups with the buttocks protruding slightly over the edge of the operating table

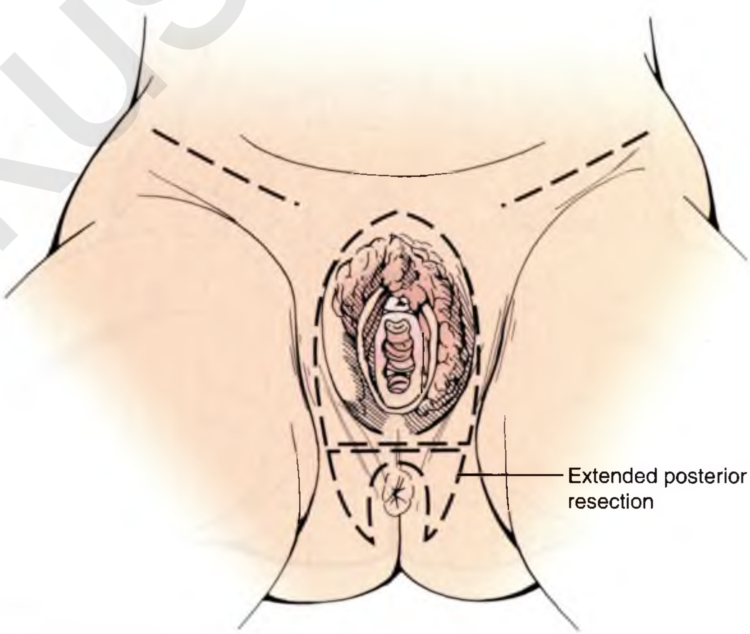

FIGURE 15.6 Separate incision radical vulvectomy: Lines of incision.

and the thighs flexed at 15°. The en bloc radical vulvectomy incision was outlined with a marking pen and extended from a point 2-cm medial and 2-cm inferior to each anterior superior iliac spine in a curvilinear fashion along the superior border of the mons pubis. The lateral incisions were drawn along the groin creases bilaterally, through the labiocrural folds, and into the posterior vulva meeting in the midline anterior to the anus. The anterior aspect of the incision was created with the knife blade and taken down to the midpoint of the vulva. The ESU was used to take the dissection down to the anterior abdominal wall fascia and inguinal ligament and to mobilize the "horns" of subcutaneous tissue overlying each groin. The superficial epigastric and external pudendal vessels were ligated and divided. An advancement flap of anterior abdominal wall skin and subcutaneous fat was created by undermining the upper margin of the incision superiorly. Bilateral groin lymphadenectomy was performed with removal of the superficial inguinal and deep femoral lymph nodes bounded by the femoral triangle (inguinal ligament, medial border of the sartorius muscle, and lateral border of the adductor longus muscle). The thighs were then flexed and closed suction drains were placed in the node dissection beds and brought out through separate incisions in the lower lateral anterior abdominal wall. The groin incisions were irrigated and the deep tissue was closed in layers with interrupted stitches of 3-0 delayed absorbable suture. The groin skin incisions were then closed with a series of vertical mattress stitches of 3-0 delayed absorbable suture.

Attention was then directed to the vulvar resection. The thighs were repositioned into hyperflexion to provide adequate exposure. The labiocrural fold incisions were extended lateral to the labial fat pads into the posterior vulva and medially, meeting in the midline anterior to the anus. The anterior specimen was dissected off the pubic aponeurosis and the clitoral shaft and associated vessels were clamped, divided, and ligated with 2-0 delayed absorbable suture. Laterally, the dissection was developed down to the pubic arches and carried medially along the inferior fascia of the urogenital diaphragm. The inferior pudendal vessels were clamped, divided, and ligated with 3-0 delayed absorbable suture. An inner incision was created with the knife blade circumscribing the urethra and vaginal introitus. The ESU was used to extend the dissection into the subcutaneous tissue and unify the central dissection plane with those of the lateral dissections on either side. The specimen was drawn downward and the posterior dissection was completed by using the ESU to dissect the posterior vulvar tissue from the underlying external anal sphincter and posterior fourchette. All dissection areas were irrigated, inspected, and noted to be hemostatic.

To facilitate a tension-free closure, the lateral margins of the vulvar resection were undermined along the fascial investments of the anterior and medial thighs. The anterior abdominal wall advancement flap was drawn downward, and the vulvar defect was closed in layers with deep sutures of 3-0 delayed absorbable suture to obliterate dead space. Anterior to the urethra, the skin edges were re-approximated in a vertical direction using a series of interrupted vertical mattress stitches of 2-0 delayed absorbable suture. The lateral margins were re-approximated to the vaginal introitus using interrupted vertical mattress stitches of 2-0 delayed absorbable suture, with care taken to avoid tension on the periurethral tissue. The posterior vulva was closed using the same technique, with the suture line oriented vertically and to either side of the anus.

COMPLICATIONS

- Wound breakdown with potential infection and tissue necrosis occur in as many as 60% of patients undergoing en bloc radical vulvectomy.
- Thromboembolic events and lower extremity lymphedema are common complications in the early postoperative period.
- Elderly patients undergoing radical vulvectomy are susceptible to myocardial infarction and cerebrovascular accidents.
- Late complications include sexual dysfunction, pelvic relaxation, and chronic lower extremity lymphedema.

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CHAPTER 16

Inguinal Lymphadenectomy

Robert E. Bristow

INTRODUCTION

Inguinal lymphadenectomy is primarily indicated for the diagnostic assessment and/or treatment (resection of gross adenopathy) of squamous carcinoma of the vulva. Inguinal lymphadenectomy is an essential component of therapy for almost all patients undergoing primary surgery for vulvar cancer of squamous histology. With the exception of patients with low-risk Stage IA disease (lateralized lesion, tumor size <2 cm, maximum depth of invasion ≤1 mm, absence of lymphovascular space invasion, clinically negative groins), either unilateral or bilateral inguinal lymphadenectomy is indicated depending on the size, location, and laterality of the primary lesion. Recent data indicate that sentinel lymph node biopsy may be a safe and accurate alternative to inguinal lymphadenectomy for patients with Stage I and II squamous tumors. Inguinal lymphadenectomy is also indicated for patients with invasive adenocarcinoma of the vulva and vulvar melanoma as well as patients with invasive cancer of the lower one-third of the vagina. Rarely, inguinal lymphadenectomy is performed for the purpose of resecting gross lymph node metastases and surrounding subclinical nodal disease as part of the therapeutic approach to selected patients with advanced ovarian or endometrial cancers.

The superficial inguinal lymph nodes are almost always the primary node basin for cancers of the vulva and usually include 8 to 10 lymph nodes. The deep femoral nodes usually consist of three to five nodes, are located beneath the cribriform fascia, and are generally thought to represent the secondary node basin before drainage into the deep pelvic nodes occurs. The most proximal deep femoral node, Cloquet's node, is located in the femoral canal just beneath the inguinal ligament. Lymphatic drainage of the vulva follows a systematic flow pattern from the posterior vulva to the anterior region on either side, always running medial to the labiocrural fold. The mons pubis and anterior vulva contain drainage pathways to the contralateral groin (**Figure 16.1**). For lateralized lesions (≥2 cm from the midline) in the mid- to posterior-vulva, a unilateral inguinal lymphadenectomy is sufficient unless there are grossly suspicious or pathologically positive nodes in the ipsilateral groin. For lesions located <2 cm from the midline, lesions on the anterior vulva, and patients with grossly or pathologically positive ipsilateral groin nodes, a bilateral inguinal lymphadenectomy is the procedure of choice. The risk of pelvic node metastasis increases directly with the size and number of inguinal nodes involved by disease. Approximately 25% to 30% of patients with gross inguinal adenopathy and/or pathologic confirmation of disease in less than or equal to three nodes will have positive pelvic nodes. When more than four groin nodes are positive for disease, the risk of pelvic node spread increases to 60%.

PREOPERATIVE CONSIDERATIONS

Most patients undergoing inguinal lymphadenectomy will simultaneously require a radical vulvectomy or wide radical excision of the vulva and should be prepared

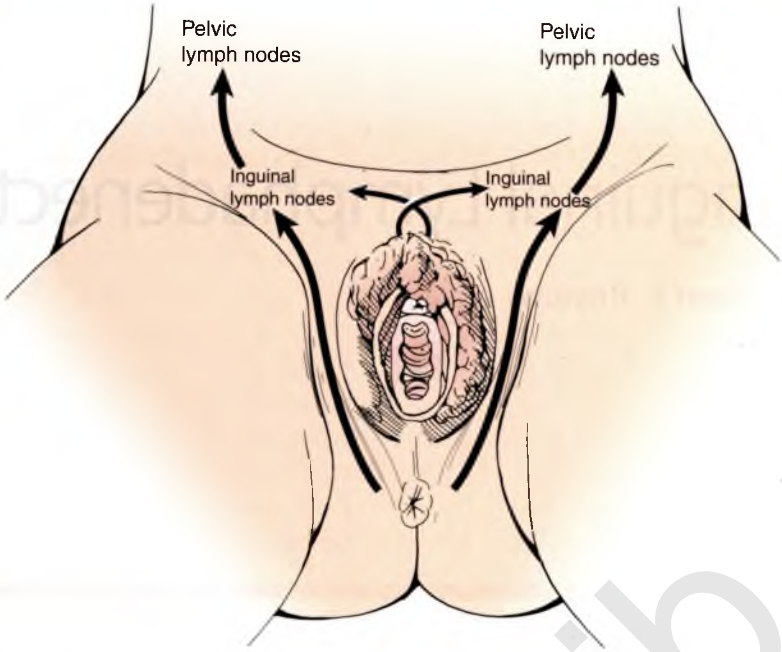

FIGURE 16.1 Inguinal lymphadenectomy: Lpsilateral and contralateral vulvar lymphatic drainage pathways.

accordingly. All patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate surgery. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, and electrocardiogram for women aged 50 years and older. Preoperative computed tomography imaging of the abdomen and pelvis is advisable if the groin nodes are clinically suspicious or the primary lesion is large (>4 cm). A chest radiograph should be obtained, or alternatively computed tomography scanning can be extended to include the chest.

Prophylactic antibiotics (Cephazolin 1 g, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. The instrumentation required includes a basic vaginal surgery set and Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH). Enemas should be administered the evening before surgery. Preoperative mechanical bowel preparation is not necessary unless dictated by the extent of resection of the primary lesion.

SURGICAL TECHNIQUE

Either general or regional anesthesia is acceptable. The patient should be positioned in dorsal lithotomy position using Allen-type stirrups with the thighs externally rotated and flexed at 15° or less to optimize exposure to the groin. A Foley catheter is placed as dictated by the operation for the primary lesion.

An 8- to 10-cm incision is drawn with a marking pen in the groin crease, 1 to 2 cm below the inguinal ligament, midway between the anterior superior iliac spine and the ipsilateral pubic tubercle (**Figure 16.2**). It is useful to also mark the anatomic area of the femoral triangle by tracing a line from the anterior superior iliac spine to the medial femoral condyle (sartorius muscle) and a line from the pubic tubercle to the lateral femoral condyle (adductor longus muscle). The knife blade is used to create the incision, which should be carried to a depth of approximately 1 cm, depending on patient body habitus and the amount of subcutaneous fat. The initial incision needs to be deep enough to facilitate creation of the upper and lower skin/subcutaneous tissue flaps that will not be so thin as to become devascularized. Once the proper depth of incision has been attained, the skin and associated subcutaneous tissue are undermined using either the electrosurgical unit or sharp scissor dissection. Superiorly, the tissue is undermined for a to an extent at least 2 to 3 cm above the superior margin of the inguinal ligament. The superficial epigastric vessels are clamped, divided, and ligated with 3-0 delayed absorbable suture as they are encountered. Inferiorly, the flap is raised for a distance of 8 cm to 10 cm and encompasses the area of the femoral triangle previously demarcated. The lateral borders of

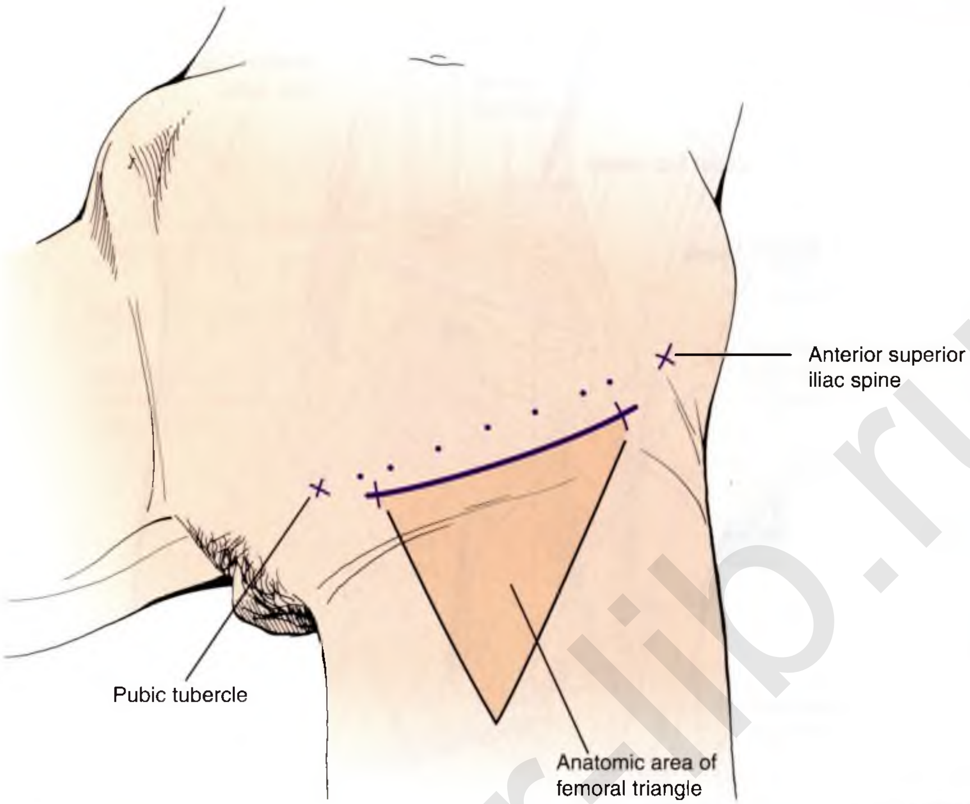

FIGURE 16.2 Inguinal lymphadenectomy: Line of incision; landmarks are the anterior superior iliac spine and pubic tubercle.

the node dissection are defined by creating tunnels in the subcutaneous tissue underneath the preoperative markings delineating the medial and lateral margins of the femoral triangle. The subcutaneous tunnels are developed with either gentle finger dissection or a long Kelly clamp placed along the anatomic margin just above the fascia lata (**Figure 16.3**).

The dissection begins at the superior margin of the femoral triangle, where the node-containing fat pad is elevated off the inguinal ligament. The dissection proceeds systematically, working from superior to inferior and from lateral to medial. The superficial circumflex iliac vessels are located at the superior-lateral margin of the dissection and clamped, divided, and ligated with 3-0 delayed absorbable suture (**Figure 16.4**). At the superior-medial margin of the dissection, the superficial external pudendal vessels are identified, clamped, divided, and ligated with 3-0 delayed absorbable suture.

As the dissection proceeds into the center of the femoral triangle, the surgeon must be cautious of the neural and vascular structures in this area. A useful pneumonic for the location of the femoral nerve, femoral artery, and femoral vein is N-A-V-E-L proceeding from lateral to medial for nerve, artery, vein, empty space, and lymphatic space. The specimen is reflected medially off the iliopsoas muscle (the femoral nerve runs deep to this structure), and the lateral margin of the cribriform fascia is incised, exposing the underlying femoral vessels. The femoral branch of the genitofemoral nerve runs parallel to the iliopsoas muscle along its medial margin and should be preserved. The deep femoral nodal tissue beneath the cribriform fascia is left attached to the superficial specimen and resected en bloc. As the specimen is reflected medially off the femoral artery, the femoral vein is identified and traced distally. The great saphenous vein enters the medial surface of the femoral vein and should be carefully dissected from within the superficial and deep nodal fat pad and preserved if at all possible (**Figure 16.5**). Preservation of the great saphenous vein during inguinal lymphadenectomy has been shown to reduce both short- and long-term complications without compromising treatment outcomes. The deep external pudendal artery is identified passing just beneath the great saphenous vein as it enters the femoral vein. This arterial branch can be ligated with 3-0 delayed absorbable suture either medial or lateral to the great saphenous vein, whichever location

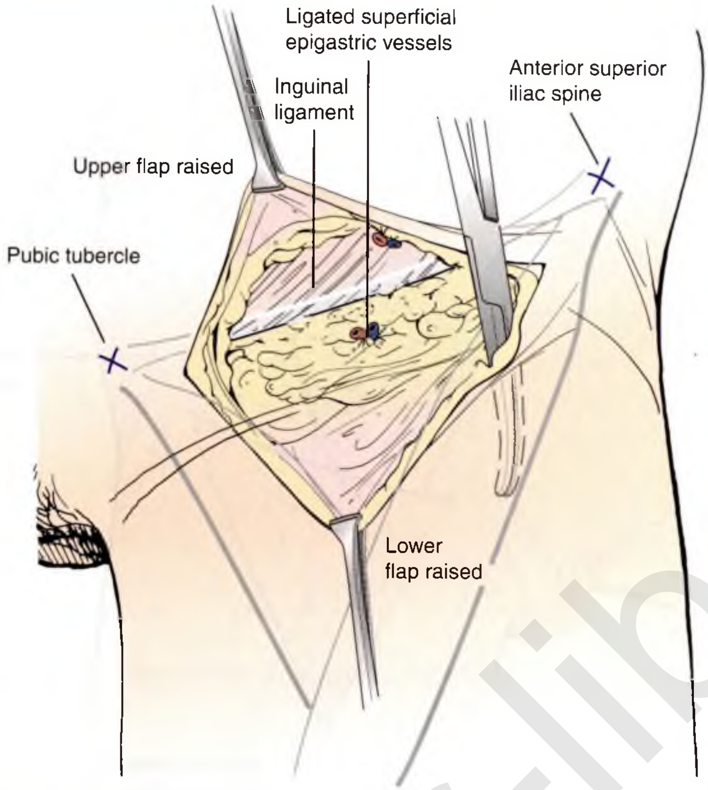

FIGURE 16.3 Inguinal lymphadenectomy: Raising superior and inferior skin flaps and development of boundaries of femoral triangle dissection.

is more convenient. The most proximal of the deep femoral nodes, Cloquet's node, is located within the femoral canal, just medial to the femoral vein, and should be removed if present and submitted separately for pathologic analysis. The nodal fat pad is raised until the medial margin of dissection, the adductor longus muscle, is reached. The dissection then proceeds toward the inferior margin, or apex, of the femoral triangle, gently stripping the nodal tissue from the underlying femoral vessels. Once the apex is reached, a long Kelly clamp is placed across the distal aspect of the specimen; the pedicle is divided and secured with a ligature of 3-0 delayed absorbable suture and the specimen removed (**Figure 16.6**).

When a unilateral inguinal lymphadenectomy is planned for a small, lateralized lesion, the nodal specimen should be sent for frozen section analysis. If positive nodes are detected, the procedure is repeated on the contralateral side. The nodal dissection beds are irrigated and inspected for hemostasis. A closed-suction drain is placed and brought out through a separate stab incision in the lower lateral abdominal wall. The groin defect is closed in layers. The fatty tissue of the superior and inferior skin flaps is re-approximated using a series of interrupted stitches of 3-0 delayed absorbable suture. The skin incision can be closed with a series of vertical mattress stitches of 3-0 delayed absorbable suture or surgical clips. Placement of a pressure dressing may reduce the incidence and severity of postoperative lymphocyst formation and is left to the discretion of the surgeon.

POSTOPERATIVE CONSIDERATIONS

Patients undergoing inguinal lymphadenectomy are at increased risk for femoral deep vein thrombosis and femoral artery thrombosis. Careful inspection of the lower extremities should be performed every 8 hours for the first 48 hours. Both mechanical and pharmacologic thromboembolic prophylaxis should be maintained until the patient is fully ambulatory; the pharmacologic measure should be continued for a period of several weeks thereafter. The patient may begin ambulation on postoperative day #1 or as dictated by the extent of any concomitant vulvar resection. The wound edges should be inspected daily for the presence of necrosis. If the

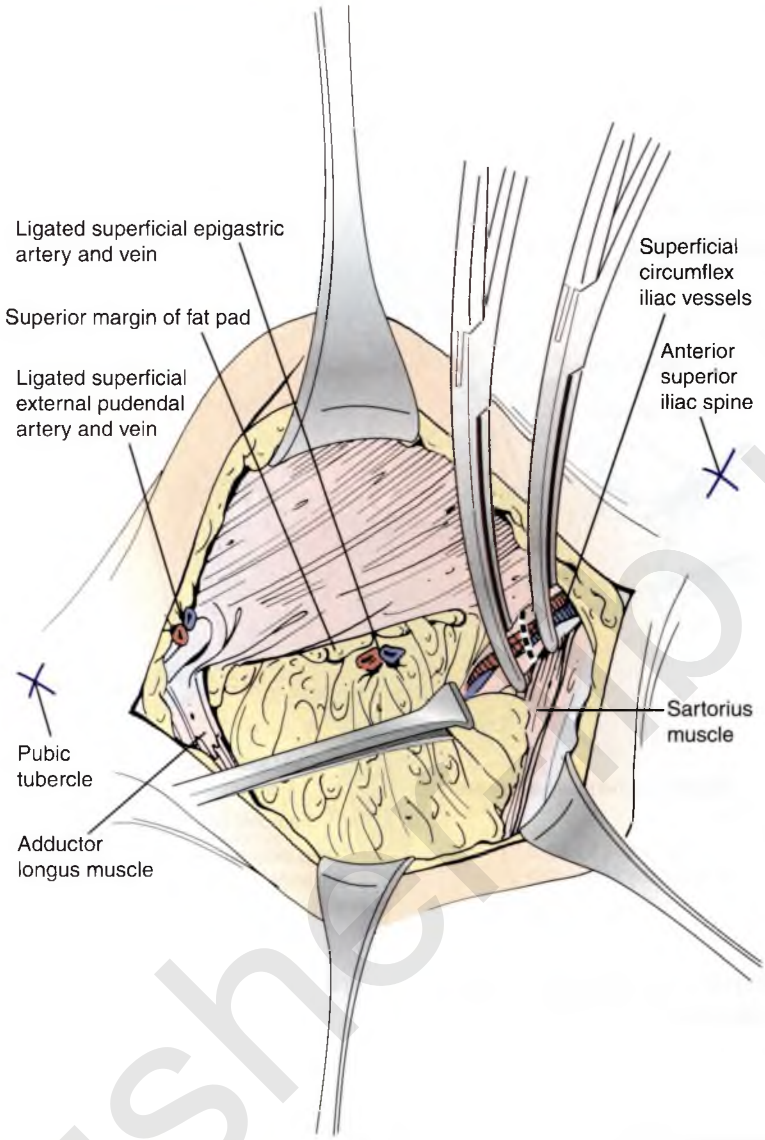

FIGURE 16.4 Inguinal lymphadenectomy: Anatomic boundaries and vascular structures of the superior aspect of the dissection.

wound edges become dusky and necrotic, it can either be managed 1) conservatively with sterile dressings with the expectation that the resulting defect will heal by secondary intention or 2) by an immediate return to the operating room for excision of the necrotic wound edges and reclosure of the incision. Anti-lymphedema stockings should be fitted early in the postoperative period, and while in bed the patient should keep her legs elevated. Diet may be advanced as tolerated. The closed suction groin drain may be removed once the output is <20 cc/day. It is not uncommon for the drain output to increase in volume as the patient undertakes progressively more vigorous ambulation, so the drains should not be removed prematurely.

Operative Note

PROCEDURE: INGUINAL LYMPHADENECTOMY

The patient was positioned in dorsal lithotomy position in Allen-type stirrups with the buttocks protruding slightly over the edge of the operating table and the thighs flexed at 15°. A 10-cm incision in the groin crease, 2 cm below the inguinal ligament, was created using the knife blade. The incision was carried into the subcutaneous fat for a distance of 1 cm. The superior skin flap was raised and the dissection taken to the anterior abdominal wall fascia above the inguinal ligament. The

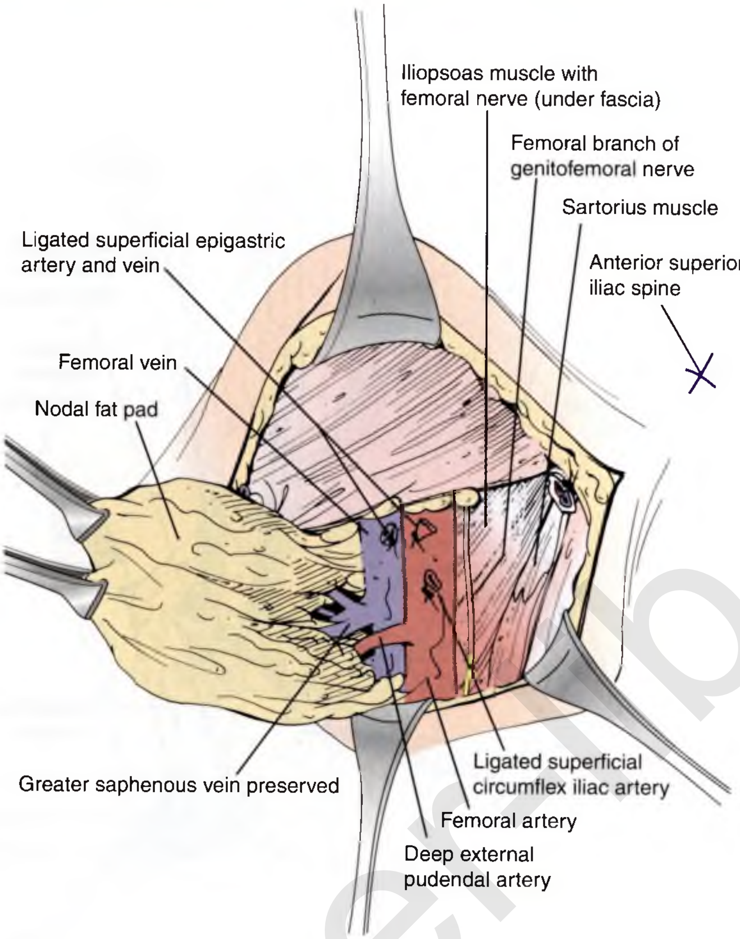

FIGURE 16.5 Inguinal lymphadenectomy: Medial mobilization of the nodal fat pad revealing the underlying femoral vessels and great saphenous vein.

superficial epigastric vessels were clamped, divided, and ligated with 3-0 delayed absorbable suture. The inferior skin flap was raised in a similar fashion toward the apex of the femoral triangle and the medial and lateral margins of the femoral triangle dissection was defined by developing subcutaneous tunnels with a large Kelly clamp. The superior aspect of the specimen was raised off its attachments to the inguinal ligament and the superficial circumflex iliac vessels and superficial external pudendal vessels clamped, divided, and ligated.

The dissection proceeded in a systematic fashion, working from superior to inferior and from lateral to medial. The femoral branch of the genitofemoral nerve was identified and preserved. The nodal fat pad was reflected medially off the iliopsoas muscle and the cribriform fascia incised, exposing the deep femoral nodes and femoral vessels. All nodal tissue was carefully stripped from the underlying femoral vessels. The proximal deep femoral node (node of Cloquet) was removed from the femoral triangle and submitted separately. Care was taken to preserve the great saphenous vein at its entrance to the femoral vein. The dissection was carried medially to the adductor longus muscle and then inferiorly. A large Kelly clamp was placed across the specimen at the apex of the femoral triangle and the pedicle divided and secured with a ligature of 3-0 delayed absorbable suture. The nodal dissection bed was irrigated and inspected for hemostasis. A closed-suction drain was placed and brought out through a separate stab incision in the lower lateral abdomen. The incision was closed in layers. The subcutaneous tissue was re-approximated with interrupted stitches of 3-0 delayed absorbable suture. The skin was closed with a series of vertical mattress stitches of 3-0 delayed absorbable suture. A dressing was applied.

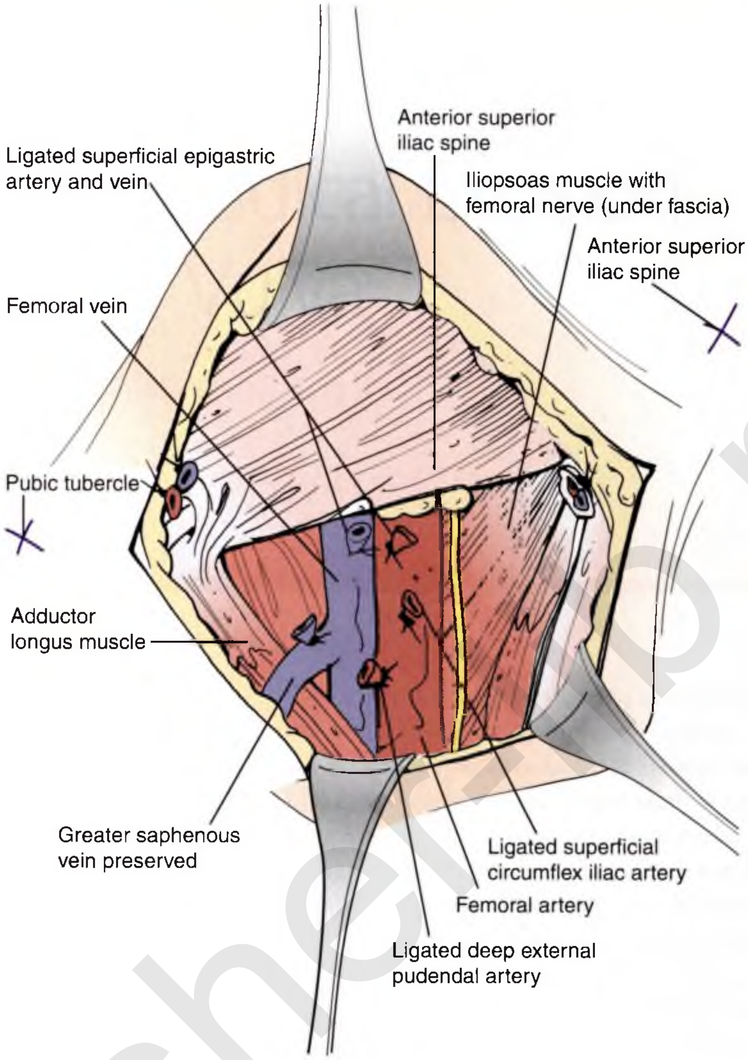

FIGURE 16.6 Inguinal lymphadenectomy: Completed dissection.

COMPLICATIONS

- The most common early and late complications associated with inguinal lymphadenectomy are lower extremity lymphedema and lymphocyst formation.
- In the immediate postoperative period, the groin(s) should be examined every 8 hours for signs of femoral artery thrombosis and femoral deep vein thrombosis.
- Insufficient subcutaneous tissue on the superior and inferior skin flaps will lead to necrosis of the wound edges, which should be inspected daily.

Suggested Reading

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CHAPTER 17

Wide Radical Excision of the Vulva

Robert E. Bristow

INTRODUCTION

The wide radical excision of the vulva procedure arose from the move toward individualized treatment for patients with vulvar cancer in the wake of the universal treatment period when all patients underwent en bloc radical vulvectomy with bilateral inguinal lymphadenectomy popularized by Stanley Way in the 1950s and 1960s (Chapter 15). In properly selected patients, radical wide excision has been associated with recurrence and survival outcomes similar to radical vulvectomy, while offering a substantial reduction in morbidity and improved quality of life and self-image.

Although the scope of resection should be tailored to the individual patient's anatomy and lesion topography, there are three major variations of wide radical excision of the vulva: lateral, anterior, and posterior types. Classically defined, radical wide excision of the vulva includes a 2-cm resection margin of visibly disease-free tissue in all dimensions. Depending on the anatomic region of resection, the deep margins of resection are the pubic aponeurosis anteriorly, the pubic rami and superficial perineal fascia laterally, the deep fascia of the vulva medially, and the levator plate/ischiorectal fossa/anal sphincter posteriorly. At least one study suggests that a surgical margin of at least 1 cm prior to tissue fixation yields similar recurrence rates compared to the more traditional 2-cm specification. Obtaining adequate surgical margins can be particularly challenging in the area of the perineum and posterior fourchette. If a satisfactory surgical margin cannot be achieved in these areas, the patient may be better treated with preoperative irradiation combined with chemotherapy followed by completion surgery. Radical wide excision as an alternative to radical vulvectomy is generally indicated for malignant tumors up to 2 cm in diameter without clinically apparent nodal involvement. For lateralized lesions (>2 cm from the midline), radical wide excision is combined with unilateral inguinal lymphadenectomy (Chapter 16). For midline lesions, lesions of the anterior vulva or mons pubis, and cases with microscopically positive ipsilateral groin nodes, a bilateral inguinal lymphadenectomy is the procedure of choice.

PREOPERATIVE CONSIDERATIONS

In preparation for wide radical excision of the vulva, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate surgery. The vagina and cervix should be thoroughly evaluated to exclude a synchronous lesion or metastatic lesion. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, and electrocardiogram for women aged 50 years and older. Preoperative computed tomography imaging of the abdomen and pelvis is usually unnecessary. A chest radiograph should be obtained.

Prophylactic antibiotics (Cephazolin 1, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. The instrumentation required includes a basic vaginal surgery set and Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH). Enemas should be administered the evening before surgery. Preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) combined with forced constipation for a period of several days may facilitate healing by reducing the likelihood of fecal contamination of the incision in the immediate postoperative period if there is an extensive posterior component to the dissection.

SURGICAL TECHNIQUE

Either general or regional anesthesia is acceptable. The patient should be positioned in dorsal lithotomy position using Allen-type stirrups with the buttocks protruding slightly over the edge of the operating table. The vulva, vagina, and thighs are prepped and a Foley catheter is placed. Examination under anesthesia should pay particular attention to the size and topography of the vulvar lesion, the vagina and cervix, and the groin lymph nodes. Generally, the inguinal lymphadenectomy (Chapter 16) is performed prior to the vulvar resection and the thighs are initially positioned in 15° of flexion and slightly externally rotated. The thighs are repositioned into hyperflexion for the vulvar resection.

The surgical principles of wide radical excision of the vulva are the same as for radical vulvectomy (Chapter 15); however, the specific anatomic boundaries of resection and techniques are tailored to the anatomic region of the vulva—anterior, lateral, or posterior location (**Figure 17.1**). Lateralized lesions can be accompanied by unilateral inguinal lymphadenectomy, while anterior and posterior lesions require a bilateral inguinal lymphadenectomy. Wide local excision of the vulva is illustrated in this chapter using the example of an anterior lesion replacing the clitoris with extension into the left hemi-vulva (i.e., anterior-lateral wide radical excision).

The skin incision is outlined and consists of a curvilinear triangular incision over the mons pubis, extending through the labia majora bilaterally (inclusive of the bilateral labia minora) to the level of the perineal body on the left and to the mid-vulva on the left (**Figure 17.2**). The inner incision is designed around the introitus and between the urethral meatus and the prepuce of the clitoris. To ensure adequate clearance of the left-sided lateral extent of the lesion, the line of resection is extended to include the distal vagina. Anteriorly, the shaft, glans, and prepuce of the clitoris are included in the scope of resection.

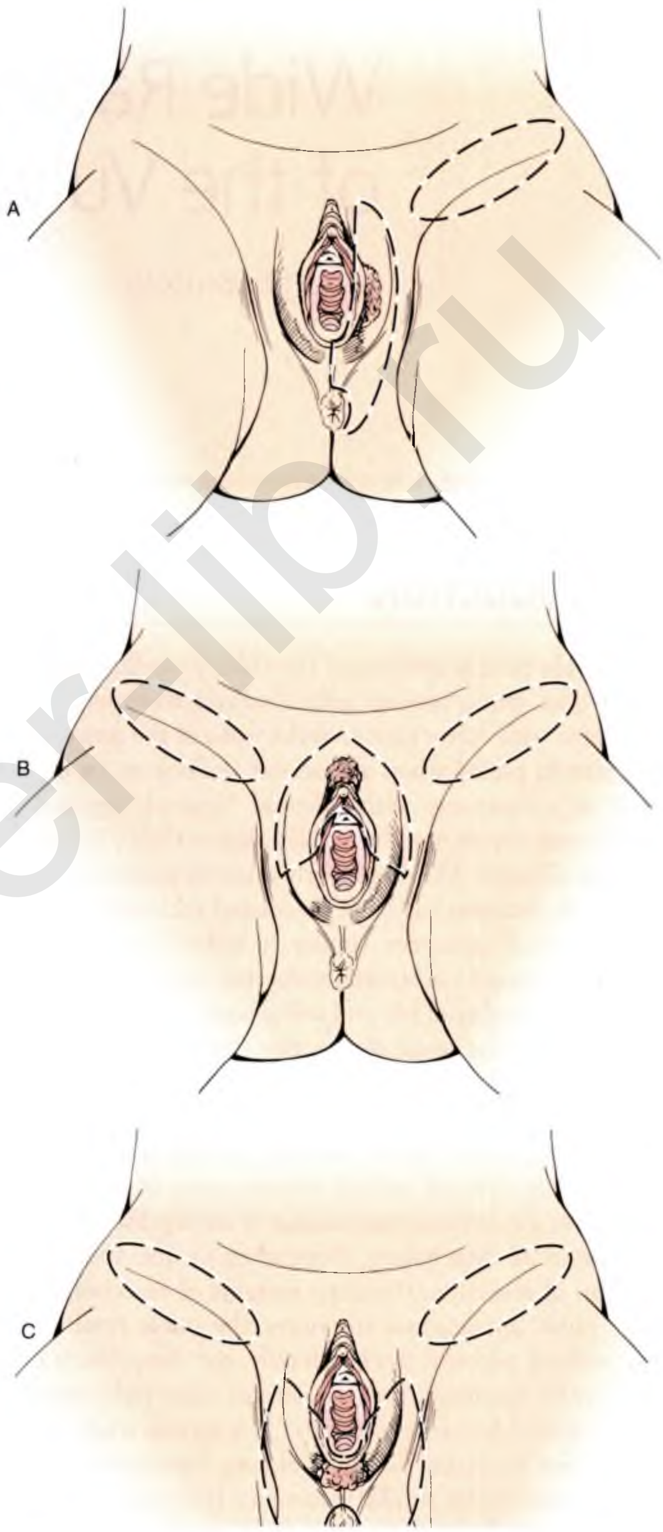

FIGURE 17.1 Wide radical excision of the vulva: Types of resection: A—lateral excision with unilateral inguinal lymphadenectomy, B—anterior excision with bilateral inguinal lymphadenectomy, C—posterior excision with bilateral inguinal lymphadenectomy.

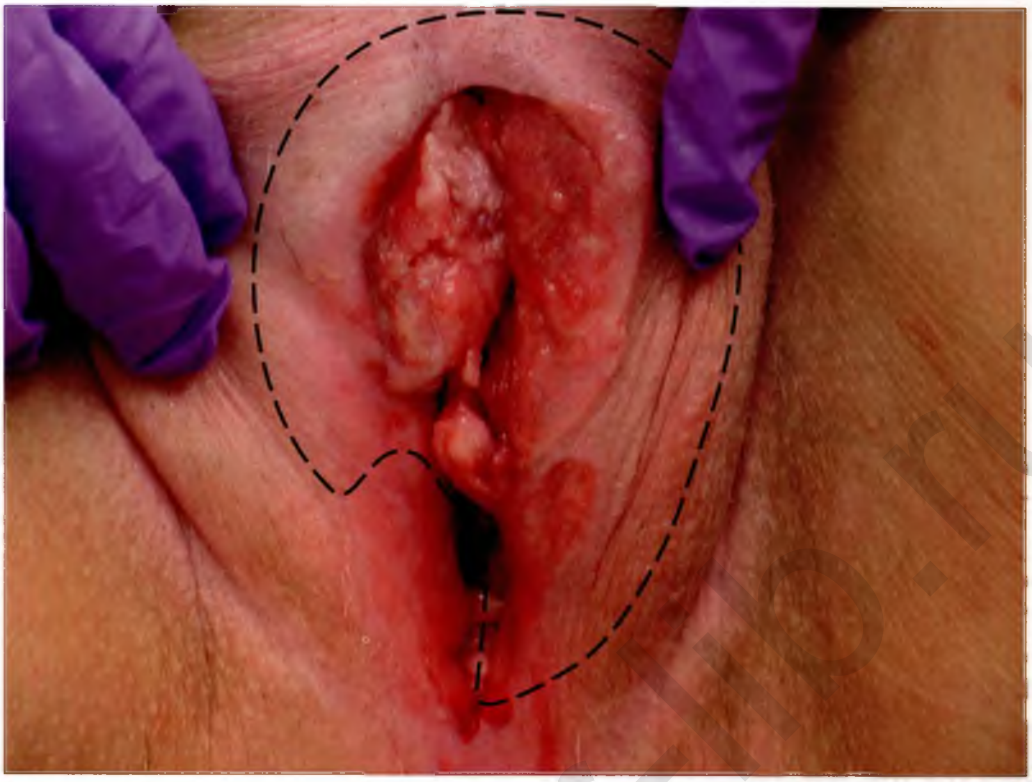

FIGURE 17.2 Wide radical excision of the vulva: Squamous cell carcinoma of the anterior and left lateral vulva.

The outer incision is created using the knife blade, and the dissection is taken into the subcutaneous tissue using the electrosurgical unit (ESU). Anteriorly, the dissection is carried down to the aponeurosis over the symphysis pubis. The suspensory ligament of the clitoris is divided using the ESU. The clitoral shaft and associated vessels are clamped, divided, and the pedicle is secured with a transfixion stitch of 2-0 delayed absorbable suture. Using Allis clamps to provide traction on the specimen and counter-traction on the vulva, the ESU is used to extend the lateral incisions into the subcutaneous tissue (**Figure 17.3**). The lateral dissection on either side includes the entire labial fat pad, which is resected with the specimen and mobilized medially to expose the deep margin of resection, the adductor fascia and pubic ramus (**Figure 17.4**). The lateral incisions on either side are carried medially along the deep perineal fascia to the inner incision line previously demarcated with the marking pen. The inner incision is then completed using the ESU and the specimen excised (**Figure 17.5**).

Primary closure of the defect requires that the incision margins be approximated in a tension-free fashion, which is especially important in the areas of the urethra and vagina. The thighs are taken out of hyperflexion and the lateral margins of the defect are undermined along the fascial investments of the anterior and medial thighs. The distal vaginal wall can be undermined for a short distance circumferentially, but extensive dissection around the urethra should be minimized. A closed suction drain is placed in the deep subcutaneous space and brought out through a separate stab incision in the mons pubis. Once adequate mobility of the remaining vulvar tissue has been achieved, the defect is closed as an inverted "Y" in layers, with deep sutures of 2-0 or 3-0 delayed absorbable suture to obliterate dead space. Anterior to the urethra, the skin edges are re-approximated in a vertical direction. Closure of the skin and superficial fat is best accomplished by a series of interrupted vertical mattress stitches of 2-0 delayed absorbable suture (**Figure 17.6**). If a tension-free closure cannot be obtained in the periurethral region, the area should be left open, dressed with Vaseline-impregnated gauze, and allowed to heal by secondary intention.

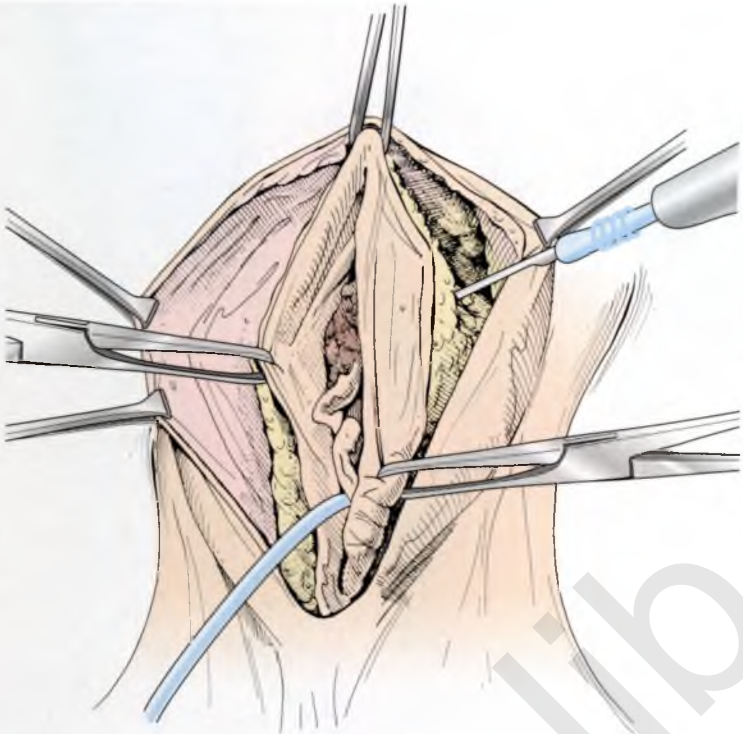

FIGURE 17.3 **Wide radical excision of the vulva:** The anterior and lateral incisions are extended into the subcutaneous tissue, and the suspensory ligament of the clitoris is divided.

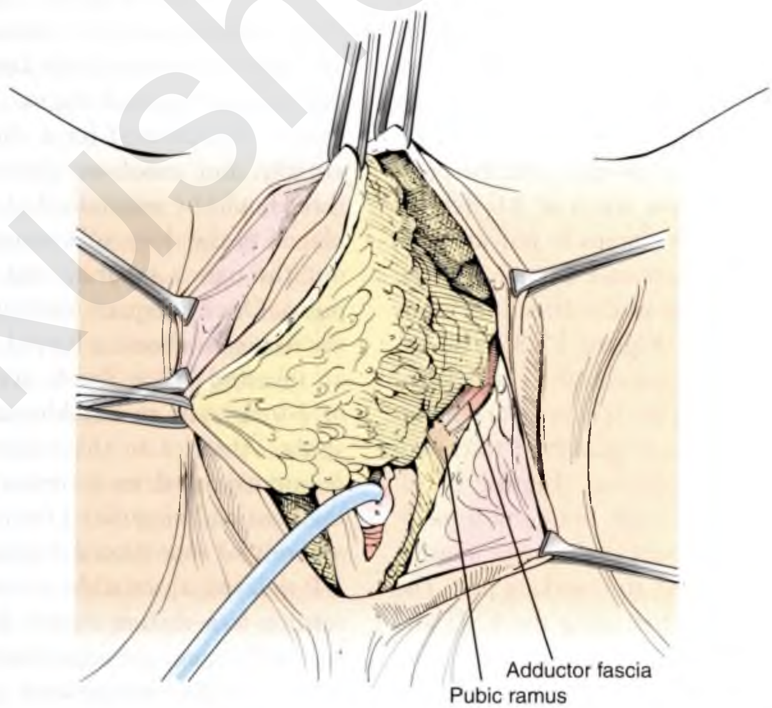

FIGURE 17.4 **Wide radical excision of the vulva:** The lateral incisions are extended to the pubic rami and adductor fascia, and the labial fat pads are reflected medially as the specimen is dissected from the deep perineal fascia.

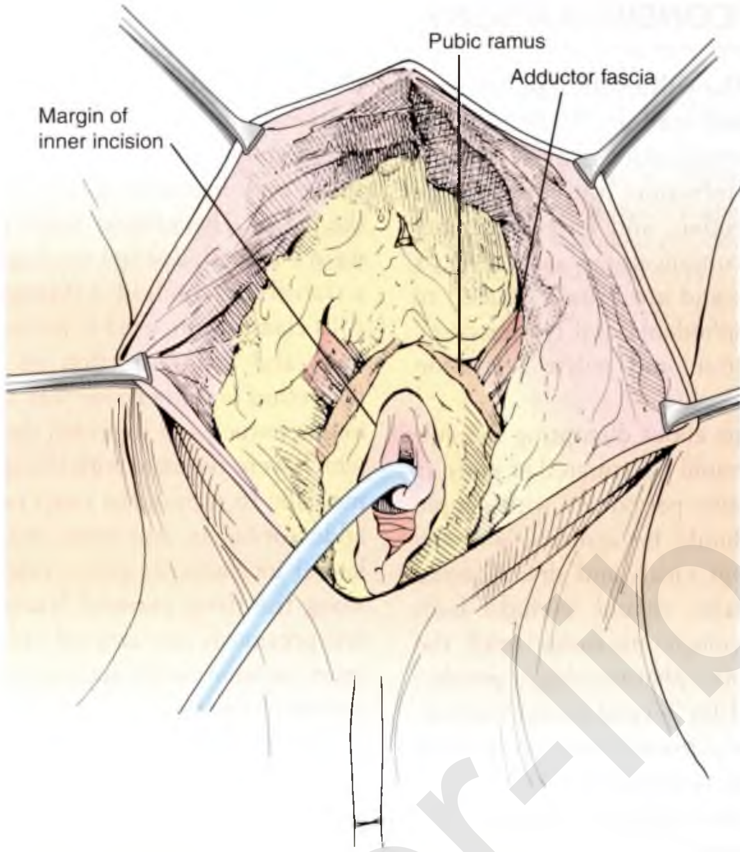

FIGURE 17.5 Wide radical excision of the vulva: Completed resection.

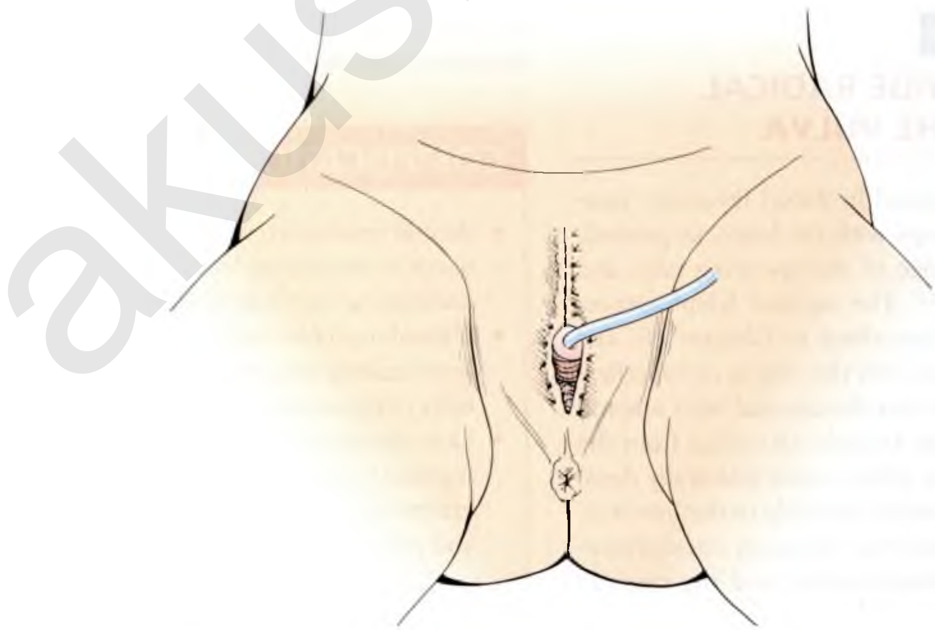

FIGURE 17.6 Wide radical excision of the vulva: Closure of the defect in an inverted "Y" using a series of vertical mattress sutures.

POSTOPERATIVE CONSIDERATIONS

Radical wide excision of the vulva with inguinal lymphadenectomy is associated with a 15% to 20% risk of early postoperative complications, most notably wound breakdown and infection, thromboembolic events, urinary tract infection, and lower extremity lymphedema. Delayed complications occur in as many as 30% of patients and are usually related to the groin dissection (lymphedema and lymphocyst), although sexual dysfunction and pelvic relaxation may also occur.

If there are no concerns about disrupting the vulvar closure, ambulation should be initiated as early as possible in the postoperative period. As with simple vulvectomy, sitz baths should be avoided, and the vulvar area should be kept clean and dry. Routine thromboembolic prophylaxis should include both mechanical and pharmacologic measures until the patient is fully ambulatory; pharmacologic prophylaxis should be continued for several weeks thereafter. The Foley catheter is removed once the patient is ambulatory but may be continued for 7 days if there has been extensive periurethral dissection. Diet can be advanced as tolerated. Forced constipation is unnecessary unless there has been a significant posterior (perianal) dissection, and avoidance of fecal contamination is desirable. Because of the risk of lymphedema of the lower extremities, it is advisable to have the patient fitted for anti-edema stockings in the immediate postoperative period.

Operative Note

PROCEDURE: WIDE RADICAL EXCISION OF THE VULVA

The patient was positioned in dorsal lithotomy position in Allen-type stirrups with the buttocks protruding slightly over the edge of the operating table and the thighs flexed at 15°. The inguinal lymphadenectomy was completed (described in Chapter 18) and the patient repositioned with the thighs in hyperflexion. The outer incision was demarcated with a marking pen as a curvilinear triangle extending from the mons pubis through the labia majora bilaterally down to the mid-vulva and carried medially to the introitus, where the inner incision was designed circumferentially between the urethral meatus and the prepuce of the clitoris. The anterior and lateral aspects of the incision were created with the knife blade, and the ESU was used to develop the deeper planes of dissection. Anteriorly, the dissection was carried down to the aponeurosis over the symphysis pubis, and the suspensory ligament of the clitoris was divided using the ESU. The clitoral shaft and associated vessels were clamped, divided, and the pedicle secured with a transfixion stitch of 2-0 delayed absorbable suture. Allis clamps were used to provide traction on the specimen and countertraction on the vulva. The lateral dissection on either side was taken into the subcutaneous tissues and included the entire labial fat pads, which were resected with the specimen and mobilized medially to expose the deep margin of resection, the adductor fascia, and pubic ramus on either side. The lateral incisions on either side were carried medially along the deep perineal fascia to the inner incision line previously demarcated with the marking pen. The inner incision was completed using the ESU and the specimen excised.

To facilitate a tension-free closure, the lateral margins of the vulvar resection were undermined along the fascial investments of the anterior and medial thighs. A closed suction drain was placed in the deep subcutaneous space and brought out through a separate stab incision in the mons pubis. The defect was closed as an inverted "Y" in layers, with deep sutures of 2-0 or 3-0 delayed absorbable suture to obliterate dead space. Anterior to the urethra, the skin edges were re-approximated in a vertical direction. Closure of the skin and superficial fat was accomplished by a series of interrupted vertical mattress stitches of 2-0 delayed absorbable suture.

COMPLICATIONS

- Wound breakdown with potential infection occur in as many as 5% to 10% of patients undergoing wide radical excision.
- Thromboembolic events and lower extremity lymphedema are common complications in the early postoperative period.
- Late complications are usually related to the inguinal lymphadenectomy (chronic lower extremity lymphedema), but sexual dysfunction and pelvic relaxation may occur.

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CHAPTER 18

Surgery for Ovarian Cancer: Exploration and Staging

Robert E. Bristow

INTRODUCTION

Approximately 15% to 30% of patients with epithelial ovarian cancers will have disease confined to the ovary or extraovarian pelvis and can be expected to have a favorable long-term survival outcome. For these patients, a comprehensive surgical staging procedure is important both for prognostic purposes as well as determining the prescription for adjuvant chemotherapy. In a classic study, Young and colleagues systematically restaged 100 patients referred to them with apparent early-stage ovarian cancer. Thirty-one percent were found to have a more advanced stage, and most (75%) of these patients had stage III disease. As these data indicate, there is a substantial likelihood of finding metastatic disease if a formal staging surgery is performed in women with epithelial ovarian cancer apparently confined to the ovary or ovaries. While most patients with borderline tumors, ovarian germ cell tumors, and sex cord-stromal tumors will have early-stage disease, the information gleaned from surgical staging is no less relevant. Consequently, a gynecologic surgeon embarking upon exploratory surgery on a patient with a pelvic mass should be prepared to perform comprehensive staging.

Staging for ovarian cancer is usually accomplished via exploratory laparotomy. In experienced hands, laparoscopic- or robotically assisted surgical staging is feasible and safe; however, the focus of this chapter is the more conventional open approach. The required steps for ovarian cancer staging include an exploration, inspection, and selective biopsy of both intra-abdominal and retroperitoneal spaces and structures and are summarized in **Table 18.1**. For most patients with ovarian cancer, comprehensive staging will include hysterectomy and bilateral salpingo-oophorectomy. However, for a carefully selected group of young women with apparent early-stage disease desiring to maintain child-bearing capacity, the uterus and normal-appearing contralateral ovary may be preserved. Commonly accepted criteria for conservative surgical treatment are listed in **Table 18.2**.

PREOPERATIVE CONSIDERATIONS

In preparation for surgery for a suspected ovarian cancer, all patients should undergo a comprehensive history and physical examination. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, a chest radiograph, and electrocardiogram for women aged 50 years and older. Serum tumor markers are not a prerequisite; however, a preoperative serum CA125 level is recommended, not so much for its diagnostic value, but rather to serve as a baseline level in the event that an ovarian cancer diagnosis is confirmed pathologically. In young women, serum markers for germ cell tumors may be appropriate if clinically indicated (lactic dehydrogenase, human chorionic gonadotropin, α-fetoprotein). Preoperative computed tomography of the abdomen, pelvis, and chest is recommended to evaluate the possible extent of disease but is not required. A preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate

Table 18.1

Components of Comprehensive Surgical Staging for Ovarian Cancer

• Peritoneal cytology (pelvis and upper abdomen)
• Careful and systematic abdominal exploration—inspect and palpate all peritoneal surfaces
• Omentectomy (infra-colic)
• Total abdominal hysterectomy and bilateral salpingo-oophorectomy
• Pelvic and para-aortic lymphadenectomy
• Random and directed peritoneal biopsies—posterior cul-de-sac, bladder reflection, both pelvic sidewalls, and both paracolic spaces
• Biopsy or scrapings from the undersurface of both diaphragms
• Appendectomy in selected cases (e.g., mucinous histology)

solution with or without bisacodyl) can be used according to the surgeon's preference. Prophylactic antibiotics (Cephazolin 1 g, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and some form of thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. A self-retaining retractor (e.g., Bookwalter, Codman Division, Johnson & Johnson, Piscataway, NJ), with a fixed arm attaching the retractor ring to the operating table, may be beneficial.

SURGICAL TECHNIQUE

The patient may be positioned in the dorsal low-lithotomy (perineal lithotomy) position using Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH) or supine on the operating table. Abdominal entry and exposure are best achieved through a vertical midline incision extending from the pubic bone to the umbilicus followed by placement of a self-retaining retractor. This incision provides easy access to the deep pelvis and can be easily extended to accommodate the required extra-pelvic staging procedures. Transverse incisions are appropriate for small, benign pathology or when dissection is primarily limited to the pelvis. The main disadvantage of a transverse incision is limited access to the upper abdomen. If a surgeon makes a transverse incision and needs access to the upper abdomen, either a separate vertical incision (T-incision) must be made or the transverse incision can be extended upward laterally (J-incision). If a Pfannenstiel incision has been performed and the pelvic exposure is inadequate, the incision should not be converted to a Maylard incision (division of the rectus abdominis muscles) because the ends of the rectus muscles will retract beneath the previously dissected rectus fascia and will not be easily re-approximated.

A preliminary assessment is taken of the extent of disease, with particular attention to the primary tumor and those areas at high risk for metastatic spread (**Figures 18.1 and 18.2**). If ascites is present, it

Table 18.2

Criteria for Conservative Surgical Management of Apparent Early-stage Ovarian Cancer

• Young patient desirous of future childbearing
• Patient and family consent and agree to close follow-up
• No evidence of dysgenetic gonads
• Specific situations:
Any unilateral malignant germ cell tumor
Any unilateral stromal tumor
Any unilateral borderline (low malignant potential) tumor
Stage Ia invasive epithelial tumor

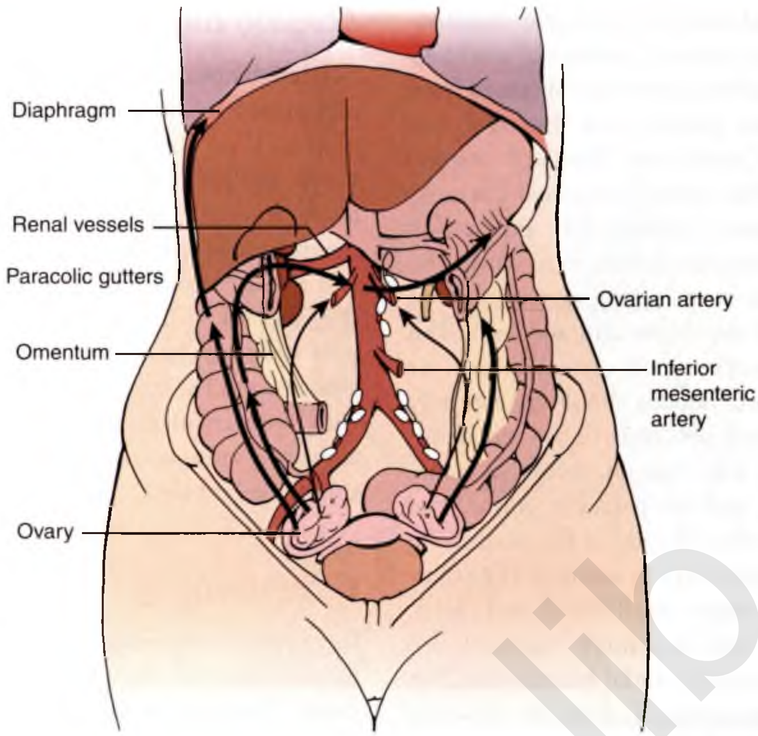

FIGURE 18.1 Ovarian cancer spread by the intraperitoneal route follows the pathway of peritoneal fluid along the paracolic gutters to the subhepatic space and along the bowel mesenteric surfaces: Lymphatic spread occurs to the pelvic and high para-aortic nodal basins, while hematogenous spread is largely to the liver or lung parenchyma.

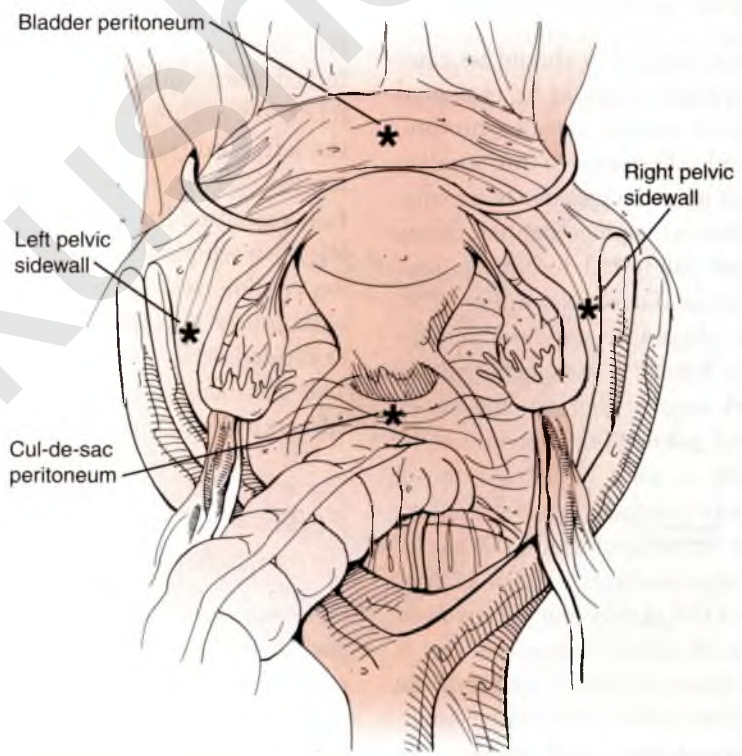

FIGURE 18.2 Pelvic spread of ovarian cancer can occur by direct extension to contiguous organs or by noncontiguous peritoneal metastasis.

should be aspirated and sent for cytologic examination. When no ascites is present, peritoneal washings with 100 to 150 cc of saline solution are obtained from the pelvis, the paracolic gutters, and the right and left upper quadrants. Careful and thorough inspection and palpation of the entire peritoneal cavity is performed in a systematic fashion. The exploration begins with the right paracolic gutter, moves over the right kidney and into the suprahepatic space followed by careful inspection of the diaphragm and liver. The gallbladder and Morrison's pouch are examined for tumor implants. The porta hepatis should be carefully examined. The exploration proceeds to the left hemidiaphragm, left hepatic lobe, spleen, stomach, transverse colon, left kidney, and left paracolic gutter. The lesser sac is entered on the left side of the gastrocolic ligament (during omentectomy) to evaluate the stomach and pancreas. The entire small bowel and colon, including both serosal and mesenteric surfaces, are carefully examined. During the initial examination, the retroperitoneal areas are palpated along the vascular structures in the pelvis and along the aorta and vena cava up to the level of the renal vessels. The results from this exploration are carefully noted with regard to tumor size, extent, and location. Any other abnormalities are also recorded.

Management of the primary tumor

The primary ovarian tumor and pelvis should be carefully examined, and both ovaries should be evaluated for size, presence of gross tumor, capsule rupture, external excrescences, and adherence to surrounding structures. If surgical findings are suggestive of a malignant ovarian tumor, a unilateral salpingo-oophorectomy should be performed and submitted for frozen section evaluation. If bilateral ovarian masses are present, the more suspicious side should be removed initially. If frozen section analysis reveals a malignant epithelial tumor, then standard surgical therapy consists of hysterectomy and bilateral salpingo-oophorectomy. In patients for whom fertility is not a concern, removal of the contralateral ovary is justified even if it appears normal, as it may harbor occult metastatic disease or even a primary lesion. Hysterectomy is also recommended in most cases, as the uterus may be involved by microscopic lymphatic or serosal metastasis and is a potential site for a synchronous primary tumor of the endometrium. The indications for conservative management of the contralateral ovary and uterus were described earlier.

Staging biopsies

Surgical biopsies are taken to evaluate for microscopic metastases in high-risk areas, which grossly appear normal. If no abnormalities on peritoneal surfaces are noted, then directed biopsies of the peritoneum are taken from the posterior cul-de-sac, bladder peritoneum, bilateral pelvic sidewalls, both paracolic gutters, and the undersurface of the diaphragm on both sides (**Figure 18.3**). Some surgeons prefer to take peritoneal scrapings from the diaphragms rather than biopsies, and put the specimen on a slide, fixed immediately with a preservative. Adhesions and any other abnormal appearing areas on the peritoneum or visceral surfaces should be biopsied.

Omentectomy

In apparent early-stage ovarian cancer patients, subclinical omental disease is detected in 5% to 10% of cases. The vascular supply of the omentum comes from the right and left gastroepiploic arteries, which arise from the gastroduodenal artery and the splenic artery, respectively. The omentum is elevated and the posterior reflection onto the transverse colon is incised to enter the lesser sac (**Figure 18.4**). The lesser sac is further developed by dissecting between the posterior layer of the gastrocolic ligament and the anterior layer of the transverse mesocolon (**Figure 18.5**). During this dissection, the middle colic artery must be protected from injury. The dissection is then continued bilaterally toward the hepatic and splenic flexures. On the left, hard traction should be avoided to avoid tearing the splenic capsule. After the omentum has been fully mobilized from the transverse colon, the right and left gastroepiploic vascular pedicles and the intervening epiploic vessels are clamped, divided, and secured with suture ligatures (2-0 delayed absorbable suture) or divided using a vessel-sealing device (**Figure 18.6**). The gastroepiploic vascular arcade along the greater curvature of the stomach should not be sacrificed.

Pelvic and para-aortic lymphadenectomy

Assessment of the retroperitoneal nodes is a critical part of the initial staging for ovarian cancer. The frequency of lymphatic spread in patients with apparent stage I ovarian cancer ranges from 5% to 20%. Ovarian cancer drains preferentially to the high aortic nodes in the vicinity of the junction of the ovarian veins and

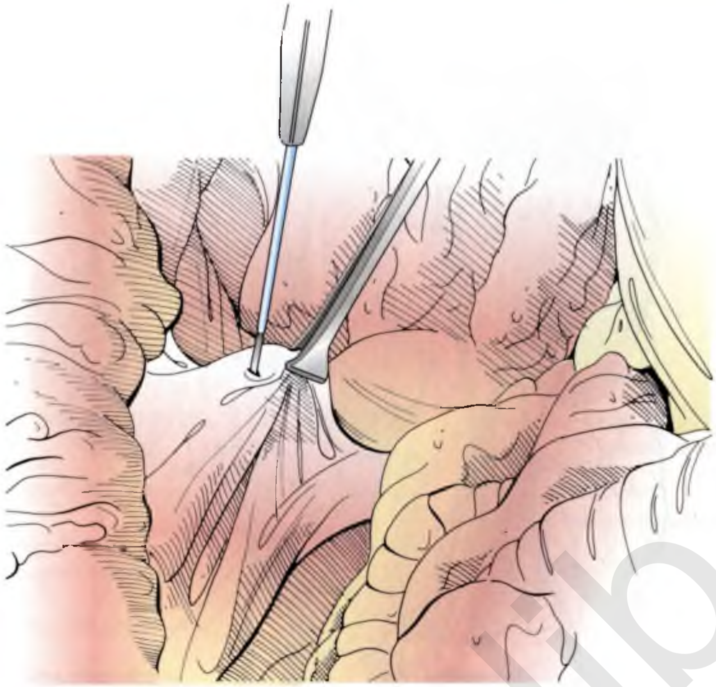

FIGURE 18.3 **Peritoneal biopsy of the right paracolic gutter:** The peritoneum is elevated with an Allis clamp and excised with scissors or the electrosurgical unit.

the vena cava on the right side and the renal vein on the left side (**Figure 18.7**). Therefore, the diagnostic aortic lymph node dissection should include the high aortic and caval nodes as well as the lower aortic and common iliac regions. Additionally, ovarian lymphatics drain from the hilus of the ovary and traverse the broad ligament into the obturator, external, and common iliac lymph nodes. The techniques of pelvic and para-aortic lymphadenectomy are described in detail in Chapters 12 and 13.

Appendectomy

Appendectomy for ovarian cancer staging is indicated when the primary tumor is of mucinous histology or when there is grossly visible pathology involving the

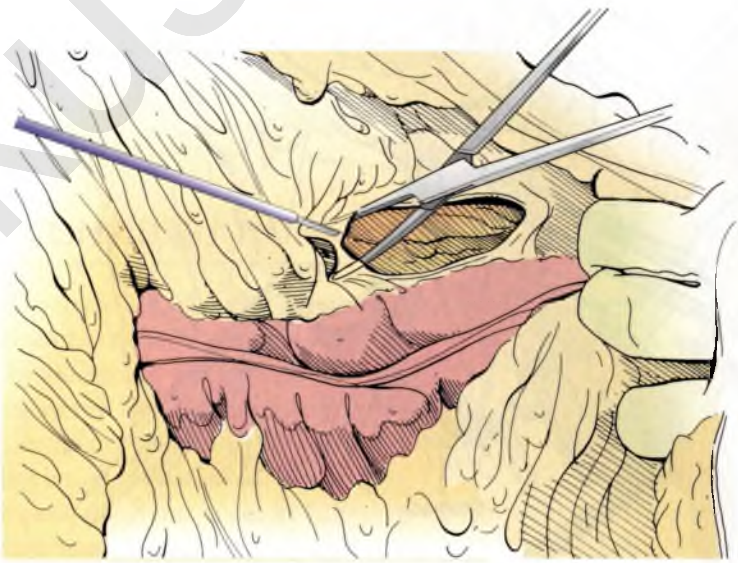

FIGURE 18.4 **Omentectomy:** The omentum is elevated and the posterior reflection onto the transverse colon incised to enter the lesser sac.

FIGURE 18.5 Omentectomy: The lesser sac is further developed by dissecting between the posterior layer of the gastrocolic ligament and the anterior layer of the transverse mesocolon.

appendix. The appendix is mobilized from any surrounding attachments and grasped with a Babcock clamp. For a retrocecal appendix, the cecum may need to be mobilized by incising the peritoneum laterally. A window is created in the mesoappendix, which is clamped, divided, and secured with a 2-0

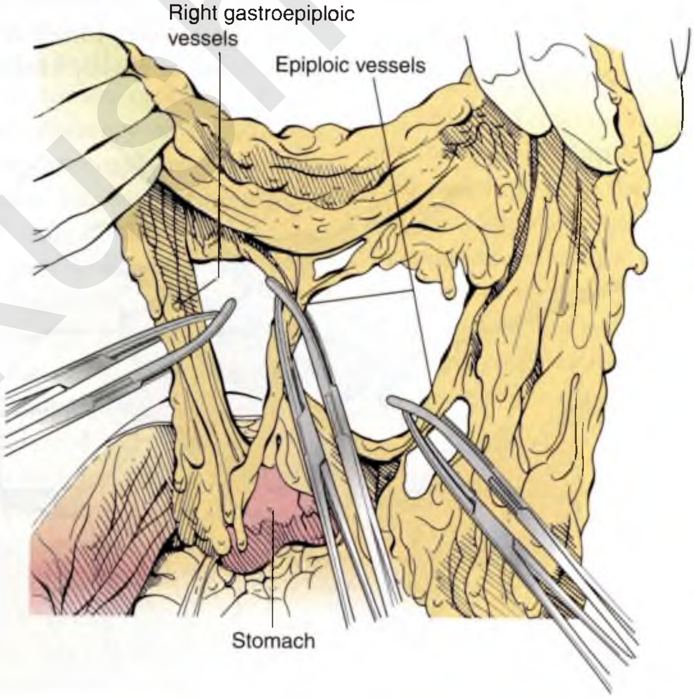

FIGURE 18.6 Omentectomy: A series of clamps are placed across the right and left gastroepiploic vascular pedicles and the intervening epiploic arteries and veins, avoiding the gastroepiploic vascular arcade along the greater curvature of the stomach.

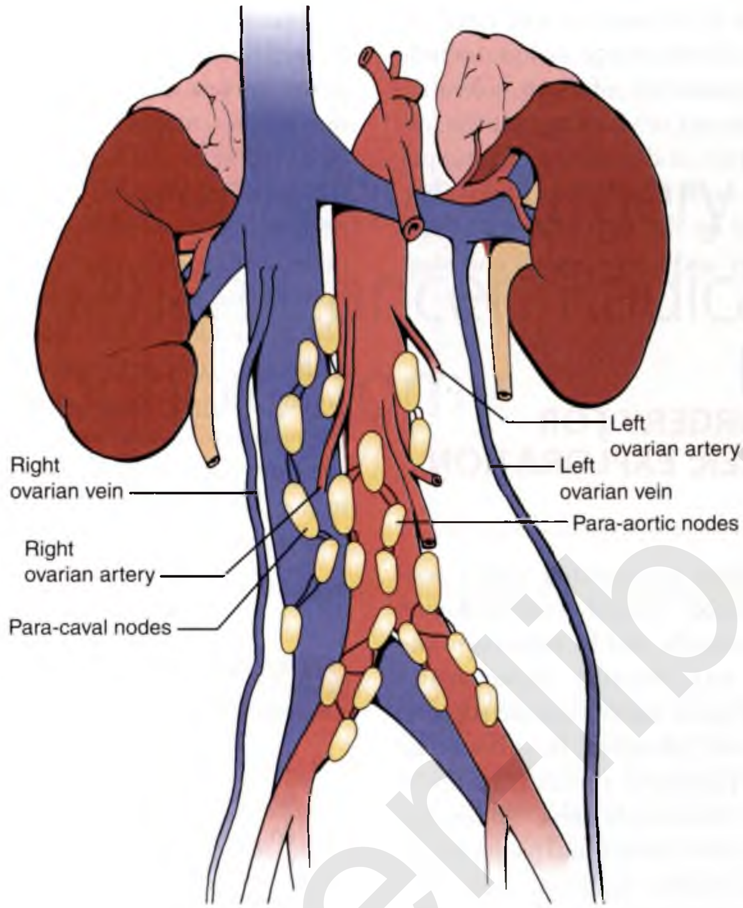

FIGURE 18.7 High para-aortic and para-caval lymph nodes to be removed in ovarian cancer staging.

delayed absorbable suture ligature (**Figure 18.8**). The appendiceal base is clamped and the clamp moved distally. The appendiceal base is doubly suture ligated with 2-0 delayed absorbable or permanent suture, and the appendix is divided between the distal ligature and the clamp. Some gynecologic surgeons cauterize the exposed appendiceal mucosa or invert the appendiceal stump.

POSTOPERATIVE CONSIDERATIONS

Postoperative care after ovarian cancer staging is similar to that for patients after any other major abdominal surgery such as abdominal hysterectomy. Routine thromboembolic prophylaxis measures should be observed until the patient is fully ambulatory. There is no need for perioperative antibiotics beyond the standard preoperative dose. Postoperative complications occur in 12% to 18% of patients following ovarian cancer staging and include: ileus, wound cellulitis, urinary tract infection, pneumonia, thromboembolic events, and hemorrhage. Postoperative diet may be advanced with adequate

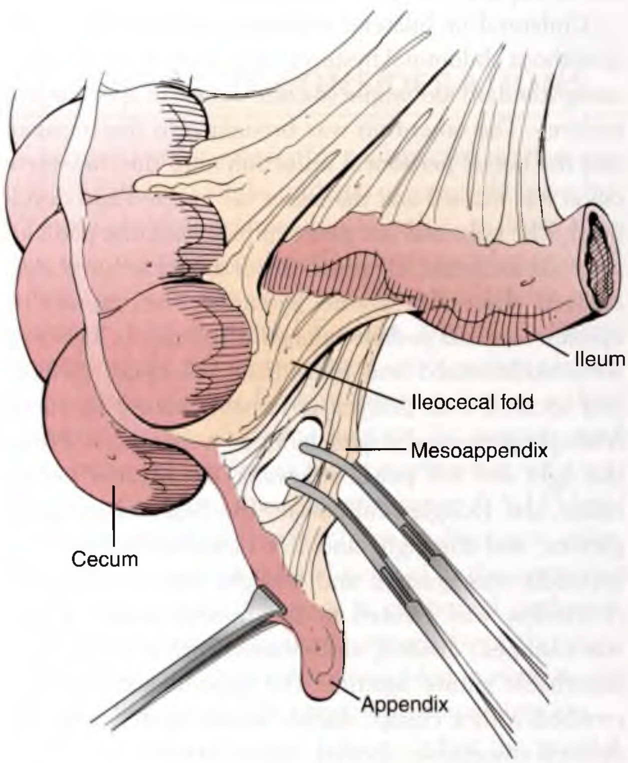

FIGURE 18.8 Appendectomy.

bowel sounds, but there is no need to wait until the passage of flatus. Criteria for discharge include afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, satisfactory bowel and bladder function, and evidence of appropriate wound healing. The need for adjuvant chemotherapy is determined based on the individual pathologic features (tumor histology and tumor grade) and stage of disease.

Operative Note

PROCEDURE: SURGERY FOR OVARIAN CANCER: EXPLORATION AND STAGING

A vertical midline incision was created and a self-retaining retractor positioned. The pelvis and abdomen were carefully explored visually and by palpation. The primary ovarian tumor was (describe characteristics such as size, presence of gross tumor, capsule rupture, external excrescences, and adherence to surrounding structures). The pelvic peritoneal surfaces, paracolic gutters, right and left hemidiaphragms, Morrison's pouch, gallbladder fossa, liver surface and parenchyma, infracolic omentum, gastrocolic ligament, lesser sac, stomach, spleen, pancreas, para-aortic and pelvic nodal basins were...(describe the presence or absence of tumor implants or other abnormalities).

Unilateral or bilateral salpingo-oophorectomy, with or without abdominal hysterectomy, were accomplished using standard technique (dictate details of specific procedure). The omentum was brought into the incision, and the dorsal peritoneal reflection onto the transverse colon was incised and the lesser sac entered and developed. The right and left gastroepiploic vascular pedicles were skeletonized, clamped, divided, and secured with delayed absorbable suture ligatures. The intervening epiploic vascular pedicles along the gastrocolic ligament were skeletonized and individually clamped, divided, and secured with delayed absorbable suture ligatures. Multiple peritoneal staging biopsies were obtained from the right and left pelvic sidewalls, the bladder peritoneum, the Douglas cul-de-sac, the bilateral paracolic gutters, and the right and left hemidiaphragms. The appendix was grasped and brought into the incision. A window was created in the mesoappendix, which was clamped, divided, and secured with a 2-0 delayed absorbable suture ligature. The appendiceal base was crushed with a clamp, double suture ligated with 2-0 delayed absorbable, divided, and cauterized.

Bilateral pelvic lymphadenectomy was then performed by removing the lymph-bearing tissue along the pelvic vessels extending proximally from the midportion of the common iliac artery down to the circumflex iliac vein. All lymph-bearing tissue from within the obturator fossa above the obturator nerve was also removed. The ascending colon, cecum, and terminal ileum were widely mobilized and the base of the small bowel mesentery incised up to the ligament of Treitz. The descending colon and sigmoid colon were widely mobilized, fully exposing the abdominal retroperitoneum. Bilateral para-aortic lymphadenectomy was then performed with removal of the lymph-bearing tissue from the midportion of the common iliac artery up to the level of the renal veins. Satisfactory hemostasis was assured.

COMPLICATIONS

- The overall incidence of postoperative morbidity ranges from 12% to 18%, most commonly ileus and infectious complications.
- Excessive traction on the omentum during omentectomy may result in an avulsion injury to the splenic capsule.

Suggested Reading

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2. Bese T, Kosebay D, Kaleli S, et al. Appendectomy in the surgical staging of ovarian carcinoma. Int J Gynaecol Obstet 1996;53:249-252.
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4. Cass I, Li AJ, Runowicz CD, et al. Pattern of lymph node metastases in clinically unilateral stage I invasive epithelial ovarian carcinomas. Gynecol Oncol 2001;80:56-61.
5. Piver SM, Barlow J, Lele SB. Incidence of subclinical metastasis in stage I and II ovarian carcinoma. Obstet Gynecol 1978;52:100-104.
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CHAPTER 19

Cytoreductive Surgery for Ovarian Cancer: Radical Oophorectomy

Robert E. Bristow

INTRODUCTION

Metastatic spread of ovarian cancer to local pelvic structures is a common occurrence, with International Federation of Gynecology and Obstetrics Stage IIB-IV disease representing a majority (70%) of all patients newly diagnosed with epithelial ovarian cancer. Survival determinants are multi-factorial; however, the strongest clinician-driven predictors of clinical outcome are the administration of platinum-based chemotherapy and the amount of residual tumor following primary surgery, with complete tumor resection being associated with the most favorable survival outcome. Resection of the primary tumor mass is a key component of the initial cytoreductive surgical effort to achieve optimal (≤1 cm) or no gross residual disease.

In 1968 and 1973, Hudson and Chir described the technique of "radical oophorectomy" designed for the intact removal of a fixed ovarian tumor en bloc with attached peritoneum and surrounding structures. The cardinal feature of the radical oophorectomy procedure is the retroperitoneal approach to ovarian cancer encasing the pelvic viscera, using the "false capsule" within the pouch of Douglas to effect en bloc excision. The most commonly performed variant of radical oophorectomy is the Type II procedure, which includes en bloc modified radical hysterectomy, bilateral salpingo-oophorectomy, rectosigmoid colectomy, and pan-pelvic peritonectomy. The indications for radical oophorectomy have been summarized by Eisenkop et al. as follows: 1) gross evidence of ovarian cancer supported by frozen section biopsy; 2) extensive confluent tumor involvement of one or both adnexae and their adjacent peritoneum, cul-de-sac, posterior uterine serosa (if present), and the sigmoid colon; 3) the surgeon subjectively judges that complete removal of disease could not be effected simple hysterectomy and salpingo-oophorectomy and piecemeal dissection, resection, or ablation of serosal and peritoneal metastases; 4) an overall optimal resection would be otherwise achievable; and 5) the procedure is not medically contraindicated.

PREOPERATIVE CONSIDERATIONS

In preparation for surgery for a suspected ovarian cancer, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate major surgery or place the patient at elevated risk for postoperative complications. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health screening studies, a chest radiograph, and electrocardiogram for women aged 50 years and older. Serum tumor markers are not a prerequisite; however, a preoperative serum CA-125 level is recommended, not so much for its diagnostic value, but rather to serve as a baseline level in the event that an ovarian cancer diagnosis is confirmed pathologically. Preoperative computed tomography of the abdomen, pelvis, and chest is recommended to evaluate the extent of disease and for surgical planning purposes.

Because ovarian cancer surgery carries the possibility of bowel resection or injury, preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) is recommended according to the surgeon's preference. Prophylactic antibiotics (Cephazolin 1 g, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and/or subcutaneous heparin) should be initiated prior to surgery. Reservation of an intensive care unit bed postoperatively is advisable if extensive or prolonged surgery is anticipated, and type and cross-matched blood should be available.

Surgery for ovarian cancer requires access to both pelvic and abdominal structures, often simultaneously. A self-retaining retractor (e.g., Bookwalter, Codman Division, Johnson & Johnson, Piscataway, NJ) with a fixed arm attaching the retractor ring to the operating table is essential to optimizing exposure, maximizing patient safety, and reducing surgeon fatigue. At the surgeon's discretion, additional standard equipment may include: an electrosurgical unit (ESU or "Bovie"), vessel-sealing device, argon beam coagulator, cavitron ultrasonic surgical aspirator, and automated stapling devices. Following is a brief description of the surgical procedure used (see also video: *Cytoreductive Surgery for Ovarian Cancer: Radical Oophorectomy*).

SURGICAL TECHNIQUE

The patient may be positioned in the dorsal low-lithotomy (perineolithotomy) position using Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH) or supine on the operating table. The low-lithotomy position is preferable, as it permits intraoperative bimanual examination to accurately ascertain the extent of cul-de-sac tumor involvement and allows access to the perineum for resection and re-anastomosis of the rectosigmoid colon. Abdominal entry and exposure are best achieved through a midline xiphopubic incision with placement of a self-retaining retractor. A preliminary assessment is taken of the extent of disease, with particular attention to the feasibility of resecting upper abdominal disease. Directing initial cytoreductive efforts toward bulky upper abdominal disease and exploring the abdominal retroperitoneum will facilitate exposure to the pelvis and ensure a reasonable likelihood of achieving an optimal (<1 cm) or complete (no macroscopic residual) overall resection prior to undertaking the radical pelvic dissection.

The Type II radical oophorectomy procedure is initiated by incising the paracolic gutters bilaterally and mobilizing the cecum, terminal ileum, and sigmoid colon. The paracolic gutter incisions are extended into the pelvis, along the psoas muscles, moving ventromedially along the posterior margin of the symphysis pubis. All pan-pelvic disease is circumscribed and included within this peritoneal incision (**Figure 19.1**). The pelvic dissection proceeds in a centripetal fashion. The round ligaments should be located retroperitoneally, ligated, and divided as laterally as possible.

An early step of the pelvic operation is development of the retroperitoneal potential spaces. The pelvic viscera are separated from one another and the pelvic walls by eight potential spaces (**Figure 19.2**). These potential spaces are filled with fatty or areolar connective tissue and are two-dimensional until surgically developed, thereby serving as natural cleavage planes and allowing relatively bloodless isolation of diseased tissue or viscera. The pararectal and paravesical spaces are developed using a combination of sharp and blunt dissection, exposing the cardinal ligament. The ureters are identified within the pararectal space and mobilized from their attachments to the medial leaf of the broad ligament, moving from the pelvic brim to the tunnel of Wertheim, and held for traction with vessel loops. The central pelvic tumor mass should be devascularized early in the course of the operation by dividing the infundibulopelvic ligaments at or above the pelvic brim.

The anterior pelvic peritoneum is grasped and placed on traction with Allis clamps, and the retropubic space of Retzuis is developed. A plane of dissection is established between the anterior pelvic peritoneum and the bladder dome muscularis using the ESU or argon beam coagulator. The anterior pelvis is then deperitonealized moving ventral to dorsal and lateral to medial toward the uterus until the pubo-vesico-cervical fascia is reached (**Figure 19.3**).

The uterine vascular pedicles are skeletonized, doubly ligated, and divided at the level of the ureters in the fashion of a modified radical hysterectomy, allowing lateral displacement of the ureters from the central specimen (**Figure 19.4**). The ureters are extricated from within the bladder pillars by developing the ureteral tunnels using a right angle clamp and dividing them with the ESU or securing them with suture ligatures.

Division of the proximal sigmoid colon can be performed whenever it is most convenient during the operation, once it has been determined that bowel resection is necessary to achieve an optimal surgical result. The sigmoid colon is divided 2 to 3 cm above the most proximal extent of gross tumor in an area that is free of diverticuli. A variety of methods can be used to divide the bowel; however, the Gastrointestinal anastomosis (GIA)

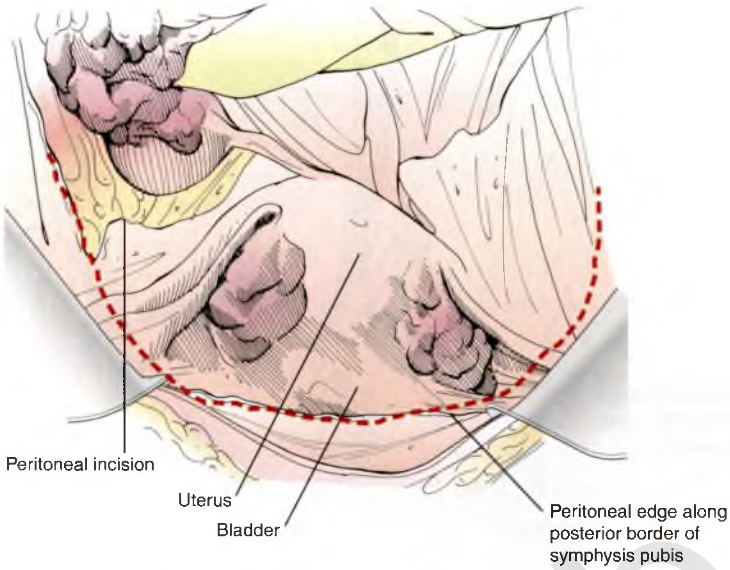

FIGURE 19.1 Radical oophorectomy: Circumscribing peritoneal incision with early deperitonealization of pelvis. A circumscribing peritoneal incision extends from the paracolic gutters into the pelvis to encompass the pan-pelvic disease.

stapling device (4.8 mm) is the most expedient and has the advantage of placing two rows of staples on either side of the divided bowel, thus controlling both proximal and distal fecal contamination (**Figure 19-5**). To ensure an adequate resection of mesocolon and associated mesenteric lymph nodes, the peritoneal incision is extended along the sigmoid mesentery from the point of proximal bowel division medially toward the right sacroiliac joint to join the right-sided circumscribing pelvic peritoneal incision, thus incorporating a "wedge" of colonic mesentery with the central pelvic tumor.

The deep dissection proceeds from the pararectal spaces posteriorly and medially, behind the sigmoid vessels and inferior mesenteric artery (continuing as the superior hemorrhoidal artery) toward the entrance of the presacral space just caudal to the sacral promontory. Individual vessels within the sigmoid mesentery are isolated, clamped, and suture ligated as they

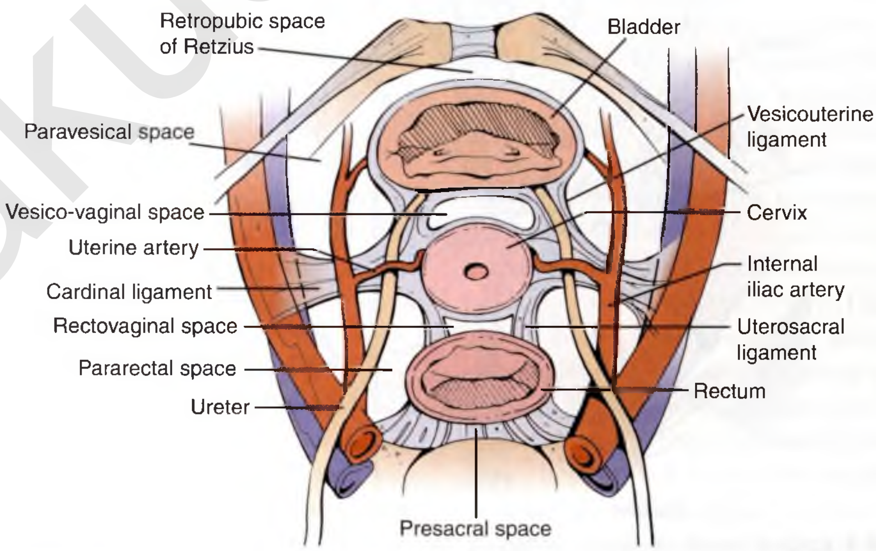

FIGURE 19.2 Eight potential spaces of the pelvis. The spaces are: retropubic space of Retzius, paravesical spaces (2), vesicovaginal space, pararectal spaces (2), rectovaginal space, and presacral space.

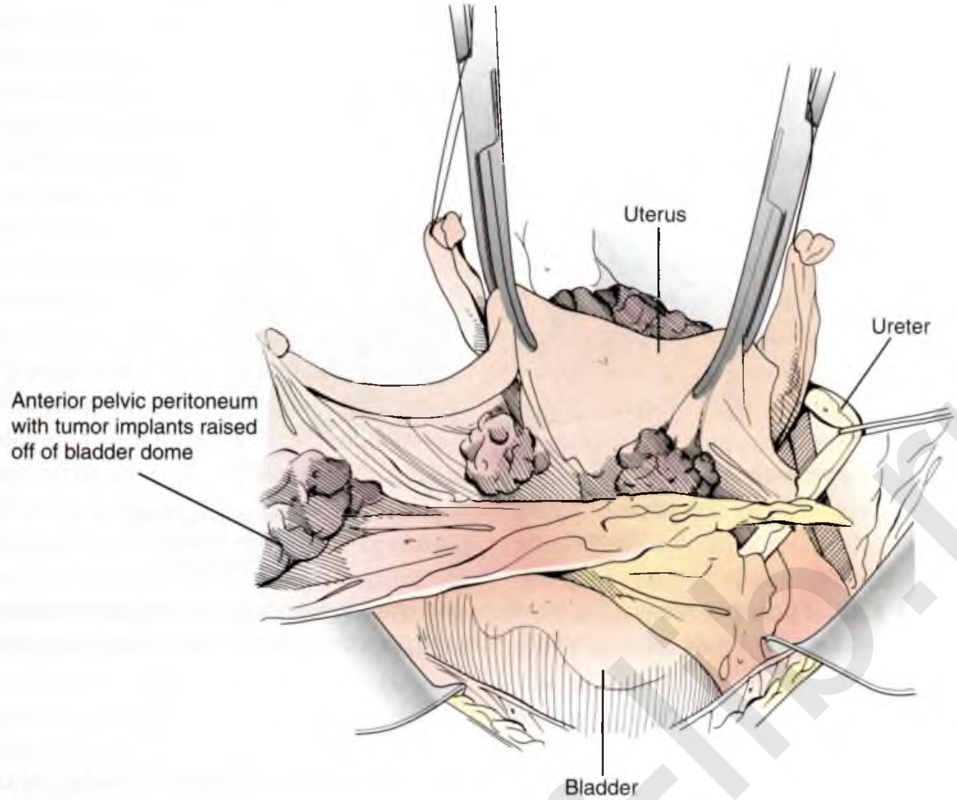

FIGURE 19.3 Radical oophorectomy: Anterior pelvic peritonectomy, deperitonealization of bladder, dissection of vesicovaginal space. The bladder is placed on traction and anterior pelvis is deperitonealized by dissecting in the sub-peritoneal plane, exposing the underlying bladder.

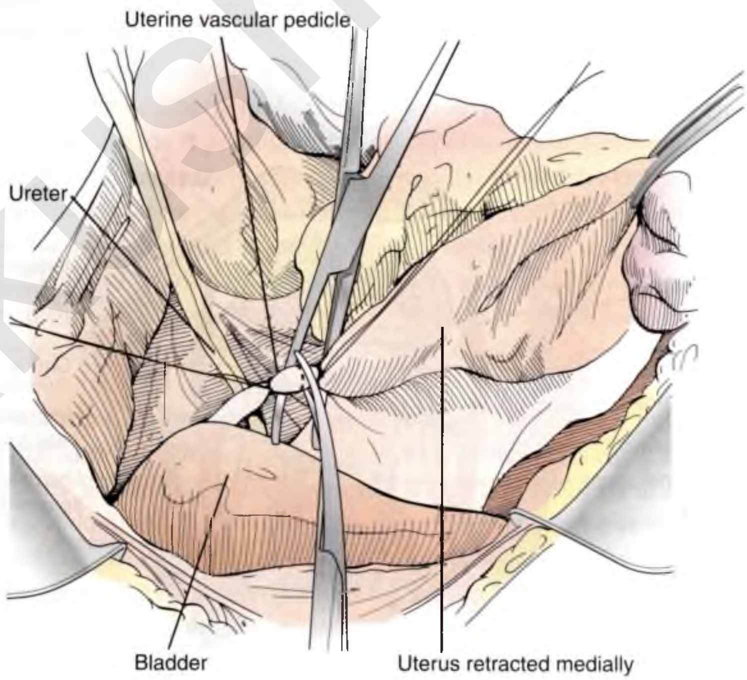

FIGURE 19.4 Radical oophorectomy: Modified radical hysterectomy ureteral dissection. The uterine vascular pedicle is developed with a right angle clamp, doubly suture ligated and divided at the level of the ureter.

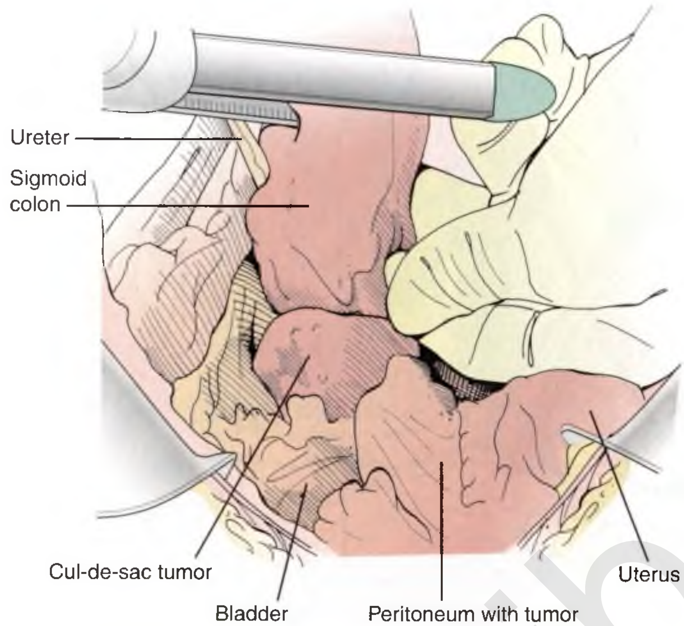

FIGURE 19.5 Radical oophorectomy: Division of sigmoid colon. The proximal sigmoid colon and inferior mesenteric vessels are divided and the sigmoid mesentery mobilized anteriorly.

are encountered. When the inferior mesenteric artery and vein are sacrificed, care must be taken to preserve the left colic artery with its blood supply to the descending colon. From a functional standpoint, the pararectal and presacral potential spaces are unified into one large posterior pelvic retroperitoneal space. The posterior pelvis is further mobilized by developing the presacral space caudally to the level of pelvic floor musculature, where the presacral ligament is sharply divided in the midline with the ESU just below the sacral curvature. The dissection should remain anterior to the presacral fascia, as the presacral veins lie just beneath and may produce troublesome bleeding if injured. Once the presacral space has been adequately developed, the lateral ligaments (or stalks) of the rectum, containing the middle hemorrhoidal vessels, are divided between clamps and ligated, taken down with the ESU, or controlled with a vessel-sealing device to achieve additional mobilization by detaching the rectosigmoid colon from its attachments to the lateral pelvic wall. Any remaining mesorectal attachments can be taken down with the ESU or divided between clamps.

The bladder is sharply mobilized ventro-caudally to expose the proximal 2 to 3 cm of vagina. The tumor-laden peritoneum is retracted cephalad while the bladder is mobilized inferiorly off the anterior vaginal wall. The hysterectomy is completed in a retrograde fashion by first creating an anterior colpotomy. An intraoperative bimanual examination or placement of a spongestick into the anterior vaginal fornix will facilitate selecting the proper site for incising the anterior vaginal wall transversely with the ESU 1 to 2 cm below the cervicovaginal junction, exposing the inner vagina (**Figure 19.6**). The cervix is grasped with a Kocher clamp and retracted to expose the inner vagina. Heaney clamps are used to circumscribe the anterior and lateral proximal vagina just below the level of the cervix, dividing and securing each successive pedicle with a suture ligature (**Figure 19.7**).

The posterior vaginal wall is incised with the ESU, and the rectovaginal space is developed caudally, until the lowermost extent of the cul-de-sac tumor has been reached and bypassed for a distance of 2 to 3 cm. The retrograde approach is continued by retracting the cul-de-sac tumor mass sharply upward, exposing the remaining cardinal ligament attachments medial to the ureters, the uterosacral ligaments, and the rectal pillars, which are sequentially divided between clamps and secured with suture ligatures or taken down with electrocautery (**Figure 19.8**).

The bowel wall should be adequately cleared of surrounding fat and any remaining mesorectal attachments. The proximal rectum or rectosigmoid junction is then divided 2 to 3 cm distal to the lowermost extent of tumor between a TA (4.8 mm) stapler (**Figure 19.9**). At this time, the vagina is closed with interrupted sutures or a running stitch, according to the surgeon's preference. Following resection of the central pelvic tumor, consideration should be given to performing

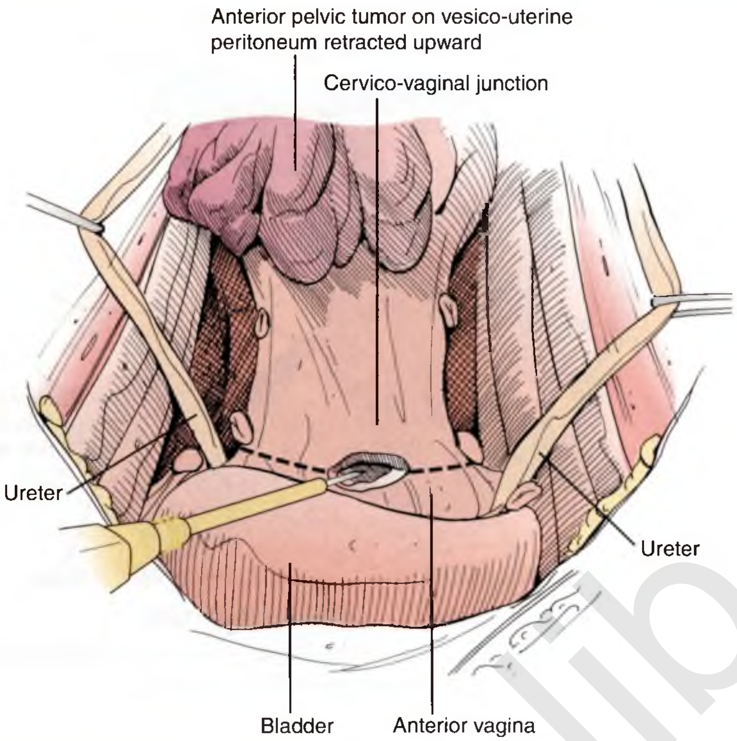

FIGURE 19.6 Radical oophorectomy: Retrograde hysterectomy. An anterior colpotomy is created using the ESU over a spongestick placed in the anterior vaginal fornix, exposing the inner vagina.

any additional pelvic debulking procedures and pelvic lymphadenectomy prior to re-establishing intestinal continuity to reduce the risk of disrupting the intestinal anastomosis.

Intestinal continuity can be re-established by a variety of methods using either automated stapling devices or hand-sewn techniques. The use of automated stapling devices is at least as safe as a conventional

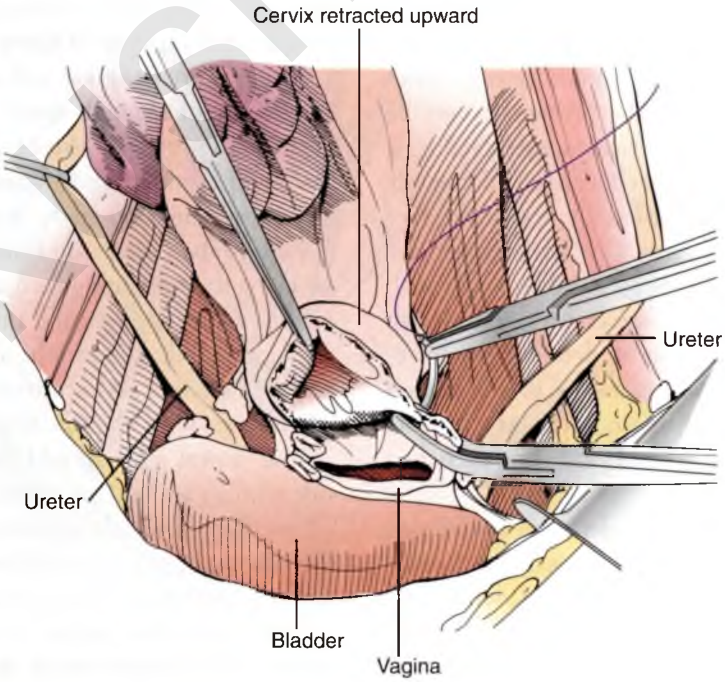

FIGURE 19.7 Radical oophorectomy: Retrograde hysterectomy. The vaginal tube is circumscribed with Heaney clamps, each pedicle is divided and secured in sequence with a transfixion stitch.

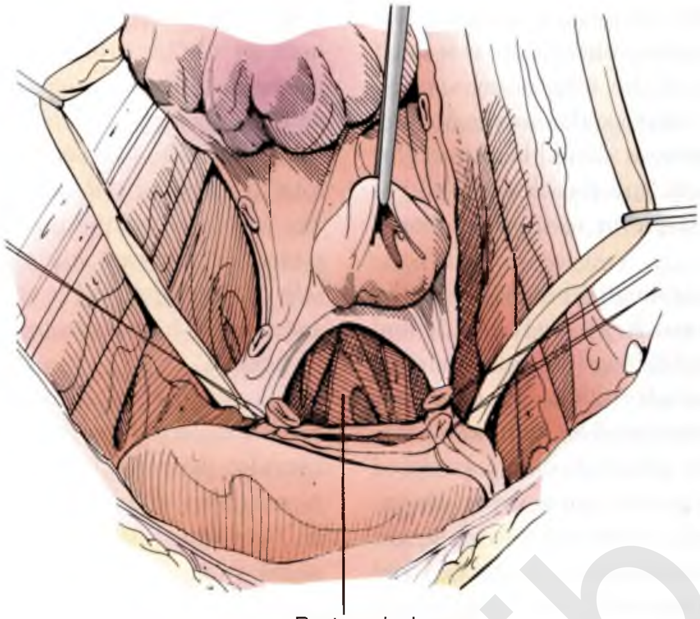

FIGURE 19.8 Radical oophorectomy: Retrograde hysterectomy. The posterior vaginal wall is incised and the rectovaginal space is developed exposing the uterosacral ligaments/rectal pillars.

hand-sewn anastomosis (depending on the operator's skill and experience) and in many circumstances offers distinct advantages. By and large, a stapled low rectal anastomosis is faster, has comparable complication rates, and is easy to perform given the limited access to suturing in the deep pelvis. Although the end-to-end anastomosis is most commonly employed, an end-to-side or side-to-side anastomosis may be more desirable under certain circumstances. The anastomosis selected is determined largely by the fit and surgeon's preference.

Irrespective of the type of procedure, a successful colorectal anastomosis requires an adequate blood supply based on the premise that the lower/mid

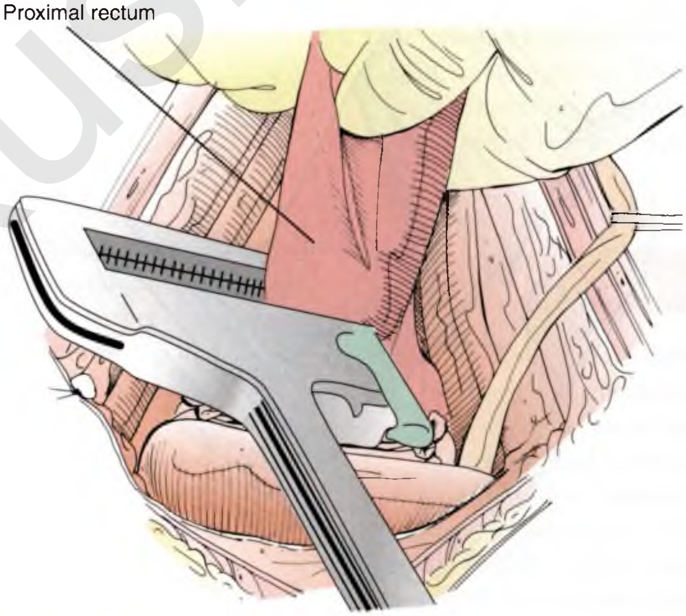

FIGURE 19.9 Radical oophorectomy: The proximal rectum is divided with a TA stapler to complete the resection. The lateral ligaments of the rectum and mesorectum have been divided; the specimen is lifted sharply upward, straightening the rectum to preserve maximal length prior to resection.

rectum can be sustained by the inferior hemorrhoidal vessels and that the descending colon can be sustained by the left colic branch of the inferior mesenteric artery or the middle colic artery via the marginal artery of Drummond. The anastomosis should be watertight, have meticulous hemostasis, and the absence of tension on the anastomotic staple or suture line should be assured.

The transanal double-stapling technique using the circular end-to-end anastomosis (CEEA) is a safe and efficient method of re-establishing intestinal continuity. The largest circular stapler (28 or 31 mm) that will be comfortably accommodated by both bowel segments should be used. The proximal colon is prepared by inserting a 2-0 polypropylene purse-string suture. The CEEA anvil is inserted and the purse-string suture is tied. The main CEEA instrument is lubricated and inserted into the rectum transanally and approximated against the staple line of the rectal stump. The wing nut is rotated clockwise until the trocar pierces the closed rectum adjacent to or through the staple line. The anvil shaft is inserted into the cartridge shaft of the main CEEA instrument until it engages with an audible click (**Figure 19.10**). The wing nut is rotated clockwise until the color-bar indicator on the handle indicates adequate compression of the bowel wall. The safety on the main CEEA instrument is released and the stapler fired by squeezing the handles together until an audible crunch of the staples being engaged is heard, thus releasing two circular rows of staples and making a circumferential cut inside the innermost staple ring. The handles are released and the wing nut rotated counterclockwise no more than one full turn. The handpiece of the main CEEA instrument is then rotated 90 degrees and gently moved ventrally, dorsally, to the right, and to the left to release the stapled anastomosis from the surrounding colon soft tissue and withdrawn.

The security of the anastomosis is confirmed by several means. First, the resection rings around the cartridge shaft should be inspected to ensure two complete donuts of colonic tissue. Second, the "water test" or "bubble test" is performed by filling the pelvis with sterile water or saline and manually obstructing the proximal colon prior to insufflating the rectum with 200 to 300 cc of air through a rigid sigmoidoscope or Asepto syringe. The presence of air bubbles indicates an anastomotic leak, which should be repaired by over-sewing the defect with interrupted stitches of 3-0 delayed absorbable or silk suture. If the leak is inaccessible for repair, the anastomosis must be taken down and repeated. Finally, some surgeons also recommend direct inspection of the anastomotic staple line for defects using a rigid sigmoidoscope.

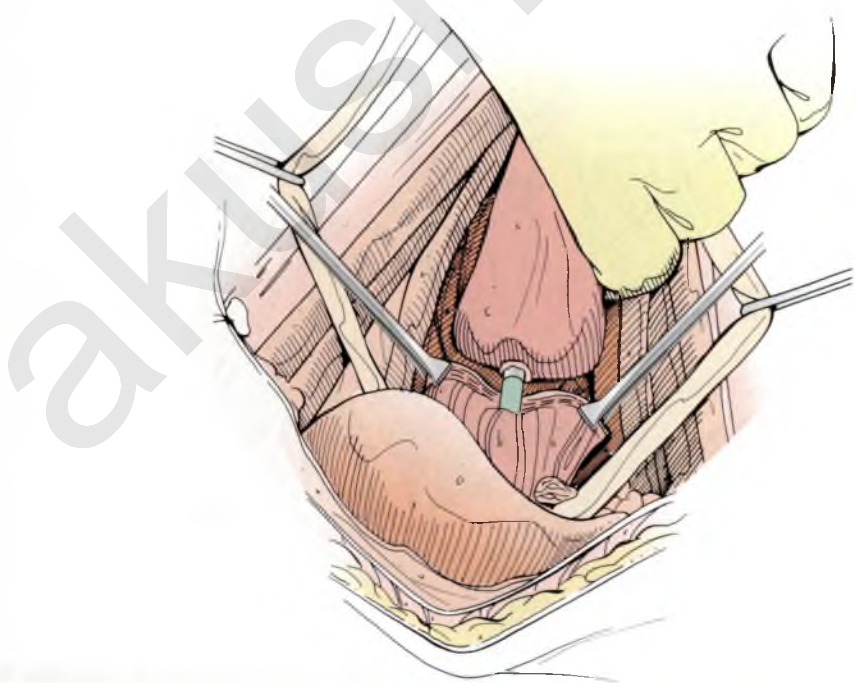

FIGURE 19.10 Circular end-to-end stapled anastomosis using the automated CEEA stapler: The CEEA anvil is introduced into the proximal colon; the main CEEA instrument is passed transanally.

POSTOPERATIVE CONSIDERATIONS

Postoperative, central hemodynamic monitoring and intensive care unit admission are useful in selected patients. Adequate intravenous access and monitoring is essential to replace fluid deficits and maintain intravascular volume. In addition to third space losses, intraoperative blood loss may be significant, requiring transfusion (approximately 30% of patients) for correction of anemia and/or coagulopathy. Patients should be monitored closely for metabolic and electrolyte abnormalities. Selected patients may benefit from perioperative β-blockade to decrease cardiac comorbidity.

Following radical oophorectomy, approximately 35% of patients will experience minor morbidity (urinary tract infection, pneumonia, wound cellulitis, and ileus) and 13% will have significant morbidity (thromboembolic event and sepsis). Routine thromboembolic prophylaxis with three daily doses of low-dose unfractionated heparin is recommended. Alternatively, low-dose unfractionated heparin may be combined with pneumatic compression devices, or prophylactic doses of low molecular weight heparin may be given.

A Foley catheter should be maintained postoperatively and a voiding trial performed after 72 hours. Postoperative diet may be advanced with adequate bowel sounds, but there is no need to wait until the passage of flatus. Criteria for discharge include afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, satisfactory bowel and bladder function, and evidence of appropriate wound healing.

Operative Note

PROCEDURE: CYTOREDUCTIVE SURGERY FOR OVARIAN CANCER: RADICAL OOPHORECTOMY

A circumscribing incision was created around the pelvis along the psoas tendons bilaterally, over the round ligaments, and along the posterior border of the symphysis pubis. The dissection was developed in a centripetal fashion, mobilizing the entire pelvic peritoneum from its retroperitoneal attachments. The pararectal and paravesical spaces were developed and the ureters identified and placed within vessel loops for traction. The infundibulopelvic ligaments were ligated and divided bilaterally above the pelvic brim.

The sigmoid colon was cleared of surrounding fat and divided at its midpoint, 3 cm above the nearest gross tumor involvement, using the 4.8-mm GIA stapling device. The retrorectal space was developed down to the pelvic floor. The sigmoid mesentery was incised with electrocautery; sigmoid vessels and the inferior mesenteric vessels pedicles were clamped, divided, and suture ligated.

The anterior pelvis was deperitonealized by dissecting from the symphysis pubis toward the uterus, raising the peritoneum off the underlying detrusor muscle until the vesicovaginal space was reached. Ureterolysis was performed down to the tunnel of Wertheim and the uterine vascular pedicles skeletonized, doubly suture ligated, and divided at the level of the ureters (midway between the uterus and pelvic sidewall) bilaterally. The ureteral tunnels were developed with a right angle clamp, suture ligated, and divided, leaving the anterior leaves of the tunnels attached to the specimen. The ureters were reflected further laterally and inferiorly away from uterus and central tumor specimen.

An anterior colpotomy was created over a spongestick placed transvaginally, and Heaney clamps used to circumscribe the proximal antero-lateral vagina, first dividing each pedicle and securing it with a transfixion stitch. The posterior vaginal wall was incised and the rectovaginal space was developed caudally then cranially, mobilizing the associated tumor-laden cul-de-sac peritoneum. The rectal pillars and mesorectal attachments were taken down with electrocautery or suture ligatures. The proximal rectum was cleared of surrounding fat and divided using a 4.8-mm TA stapling device and the specimen excised.

A tension-free, stapled, circular, end-to-end anastomosis between the midsigmoid colon and proximal rectum (coloproctostomy) was performed using the 31-mm CEEA stapling device. Two complete donuts of tissue were documented on the stapler anvil. The "water test" was performed to confirm an air-tight anastomosis.

COMPLICATIONS

- The risk of massive hemorrhage can be limited by devascularizing the central pelvic tumor early in the operation by ligating and dividing the ovarian and uterine vessels.
- Confining dissection to the retroperitoneal plane will limit the risk of unintended injury to the bladder, ureters, and pelvic vasculature.
- Significant tension or compromised blood supply increase the risk of colorectal anastomosis breakdown.

Suggested Reading

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CHAPTER 20

Cytoreductive Surgery for Ovarian Cancer: Upper Abdominal Procedures

Robert E. Bristow

INTRODUCTION

Approximately 70% of patients with epithelial ovarian cancer will have advanced-stage disease at the time of diagnosis. For this group, survival determinants are multifactorial; however, the strongest clinician-driven predictors of clinical outcome are the administration of platinum-based chemotherapy and the amount of residual tumor following primary surgery, with complete tumor resection being associated with the most favorable outcome. As many as 42% of patients with Stage IIIC ovarian cancer will have bulky (>1 cm) disease in the upper abdomen above the greater omentum. These patients often require a more extensive upper abdominal cytoreductive surgical effort to achieve optimal (≤1 cm) or no gross residual disease prior to initiating chemotherapy. For example, while the omentum represents the location of the largest tumor site in many patients with advanced-stage ovarian cancer, direct invasion of the transverse colon and adjacent structures is not infrequent and dictates a broader scope of surgical resection. Splenectomy may also be required, as tumor may extend from the greater omentum to affect the spleen in 5% to 30% of patients with advanced-stage disease. Similarly, metastatic tumor spread to the diaphragm will be encountered in 18% to 41% of patients with Stage III and IV epithelial ovarian cancer. As a result, a maximal surgical effort is dependent on the surgeon's capacity to successfully manage disease involving the structures of the upper abdomen.

PREOPERATIVE CONSIDERATIONS

In preparation for surgery for ovarian cancer, all patients should undergo a comprehensive history and physical examination focusing on those areas that may indicate a reduced capacity to tolerate major surgery or place the patient at elevated risk for postoperative complications. Routine laboratory testing should include a complete blood count, serum electrolytes, age-appropriate health-screening studies, a chest radiograph, and electrocardiogram for women aged 50 years and older. Serum tumor markers are not a prerequisite; however, a preoperative serum CA125 level is recommended, not so much for its diagnostic value, but rather to serve as a baseline level in the event that an ovarian cancer diagnosis is confirmed pathologically. Preoperative computed tomography of the abdomen, pelvis, and chest is recommended to evaluate the extent of disease and for surgical planning purposes.

Because ovarian cancer surgery carries the possibility of bowel resection or injury, preoperative mechanical bowel preparation (oral polyethylene glycol solution or sodium phosphate solution with or without bisacodyl) is recommended according to the surgeon's preference. Prophylactic antibiotics (Cephazolin 1 g, Cefotetan 1 to 2 g, or Clindamycin 800 mg) should be administered 30 minutes prior to incision, and thromboembolic prophylaxis (e.g., pneumatic compression devices and subcutaneous heparin) should be initiated prior to surgery. Reservation of an intensive care unit bed postoperatively is advisable if extensive or prolonged surgery is anticipated, and type and cross-matched blood should be available. If splenectomy is anticipated, a single one-time polyvalent pneumococcal vaccination (Pneumovax) and vaccines against *Haemophilus influenza* (Hib) and *Neisseria meningitidis* (Menomune) should be given 10 to 14 days preoperatively. In the circumstance of an unplanned splenectomy, the vaccines should be given 14 days postoperatively.

A self-retaining retractor (e.g., Bookwalter, Codman Division, Johnson and Johnson, Piscataway, NJ) with a fixed arm attaching the retractor ring to the operating table is essential to optimize exposure, maximize patient safety, and reduce surgeon fatigue. At the surgeon's discretion, additional standard equipment may include an electrosurgical unit (ESU or "Bovie"), vessel-sealing device, argon beam coagulator (ABC), cavitron ultrasonic surgical aspirator (CUSA), and automated stapling devices. Following are brief descriptions of the surgical procedures used (see also videos: *Cytoreductive Surgery for Ovarian Cancer—Upper Abdominal Disease: Transverse Colectomy; Splenectomy; Diaphragm*).

SURGICAL TECHNIQUE

The patient may be positioned in the dorsal low-lithotomy (perineolithotomy) position using Allen Universal Stirrups (Allen Medical Systems, Cleveland, OH) or supine on the operating table. Mechanical ventilation should be confirmed prior to undertaking upper abdominal cytoreductive procedures. Abdominal entry and exposure are achieved through a midline xiphopubic incision, which can be extended alongside the xyphoid process for additional exposure, with placement of a self-retaining retractor positioned to provide firm, upward traction on the costal margins. A preliminary assessment is taken of the extent of disease, with particular attention to the feasibility of resecting upper abdominal disease. Many surgeons prefer to begin the operation with the removal of the omentum, as it is usually extensively involved with tumor and provides a convenient starting point for surgical extirpation of metastatic disease in the upper abdomen. From an anatomic perspective, contiguous extension to the transverse colon, spleen, or diaphragm may require an en bloc resection of one or a combination of these organs with the omental tumor. Even if the omental disease does not directly involve adjacent structures, its removal will improve exposure and facilitate mobilization of the surrounding anatomy so that subsequent resection of isolated metastases can be accomplished with maximum safety.

Omentectomy with en bloc transverse colectomy

Bulky omental disease extending to or infiltrating into the transverse colon or pericolonic soft tissue and mesentery necessitates partial or total transverse colectomy en bloc with an omentectomy and resection of gastrocolic ligament, provided this component of the operation will make a significant contribution to the overall surgical result of achieving minimal residual disease. Tumor spread into the lesser sac and involving the transverse colon mesentery is also an indication for transverse colectomy.

En bloc omentectomy and transverse colectomy begins by dividing the attachments of the omentum to the lateral aspects of the transverse colon. The right and left gastroepiploic vascular pedicles are clamped, divided, and secured with suture ligatures or taken down with a vessel-sealing device. The dorsal reflection of the omentum onto the transverse colon is incised with the ESU, and the potential space of the lesser sac is developed (**Figure 20.1**). The transverse colon is then completely mobilized by dividing the gastrocolic ligament from the greater curvature of the stomach and by taking town the hepatocystocolic, phrenicocolic, and splenocolic ligaments to free the hepatic flexure and splenic flexure, respectively (**Figure 20.2**).

Once the omental attachments have been freed, the en bloc tumor specimen to be resected is clearly delineated and the vascular supply to the remaining proximal and distal ends of the transverse colon inspected. The surgeon must make certain that the marginal artery of Drummond is intact and will provide sufficient blood supply to both ends of the planned anastomosis (transverse colocolostomy). The proximal and distal segments of the involved section of transverse colon are cleared of surrounding fat and divided with the Gastrointestinal anastomosis (GIA) stapling device (**Figure 20.3**). A wedge-shaped section of transverse colon mesentery is demarcated and incised, the middle colic artery and vein identified, divided, and ligated, and the specimen removed (**Figure 20.4**). Any associated arterial arcades are similarly individually divided and suture ligated or controlled with electrocautery. If the marginal artery of Drummond is discontinuous at the splenic flexure, the distal transverse colon and proximal descending colon should be included in the scope of resection.

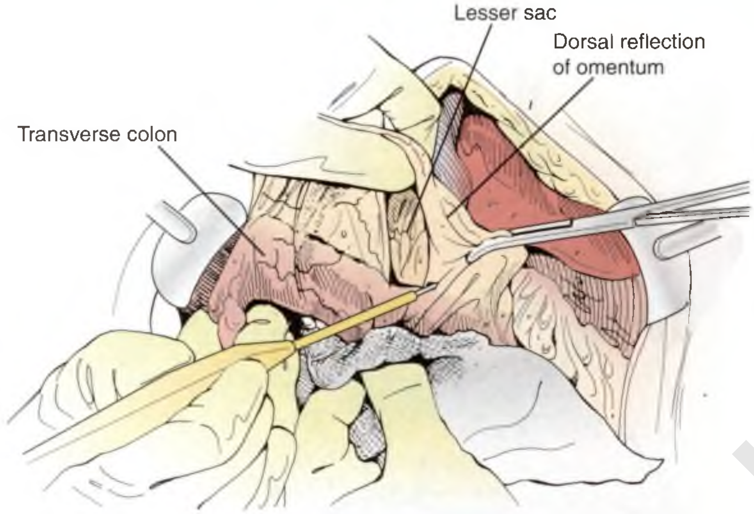

FIGURE 20.1 Omentectomy with partial transverse colectomy: The dorsal reflection of the omentum onto the transverse colon is incised with the ESU, and the potential space of the lesser sac is developed.

Intestinal continuity is reestablished via either an end-to-end or functional end-to-end stapled or hand-sewn anastomosis. A functional end-to-end stapled colocolostomy using the GIA and Thoraco-abdominal (TA) stapling devices is safe, efficient, and produces a capacious anastomotic lumen (**Figure 20.5**). In addition to having an adequate blood supply, the avoidance of tension on the staple or suture line is critical to creating a viable anastomosis, and additional mobilization of the hepatic flexure and/or splenic flexure may be required. Finally, the mesenteric defect is closed with interrupted stitches of 2-0 delayed absorbable suture; however, the duodenojejunal junction should be carefully inspected to confirm that re-approximating the colonic mesentery does not produce a functional stricture at this point.

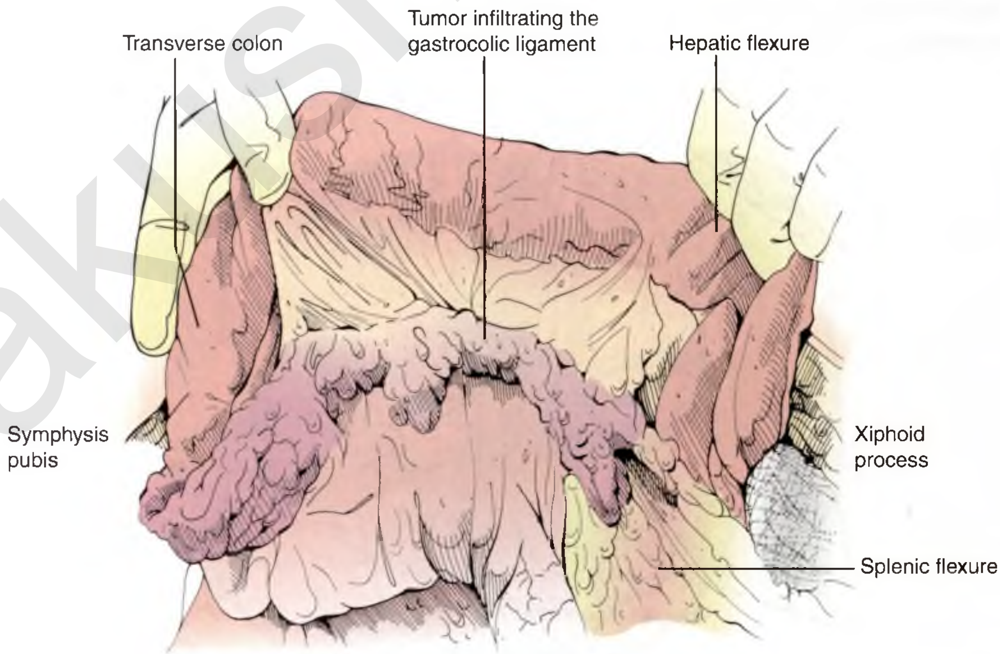

FIGURE 20.2 Omentectomy with partial transverse colectomy: The transverse colon is completely mobilized by dividing the gastrocolic ligament from the greater curvature of the stomach and taking down the hepatocystocolic, phrenicocolic, and splenocolic ligaments to free the hepatic and splenic flexures, respectively.

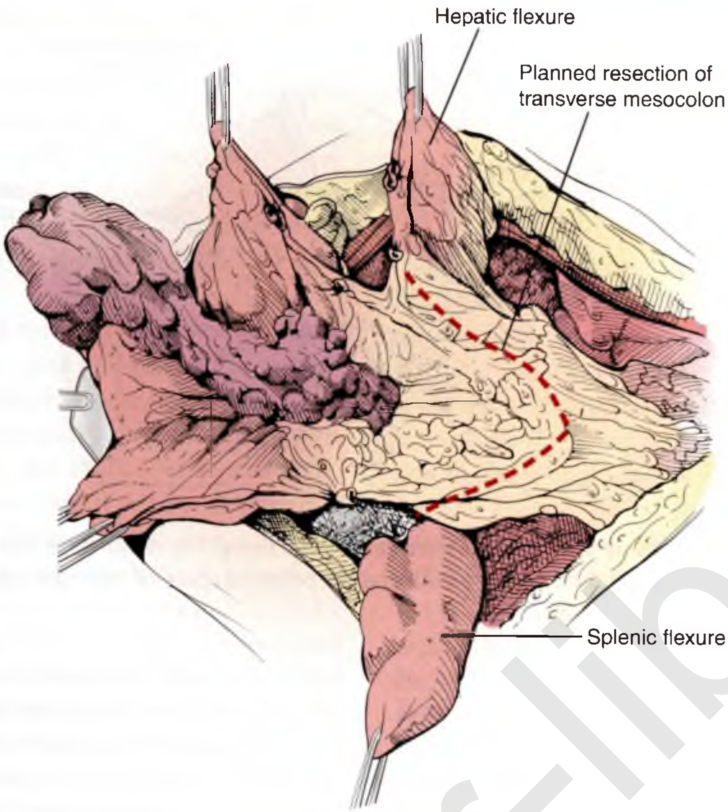

FIGURE 20.3 Omentectomy with partial transverse colectomy: The proximal and distal segments of the involved section of transverse colon are cleared of surrounding fat and divided with the GIA stapling device; a wedge-shaped section of transverse colon mesentery is demarcated and incised.

Splenectomy

The most common location of ovarian cancer involving the spleen is the hilum (65%), followed by the capsule (52%), and parenchyma (16%). The surgical approach to splenectomy is individualized and may proceed anteriorly through the gastrosplenic ligament, posteriorly through the lienorenal ligament, or a combination of the two, depending

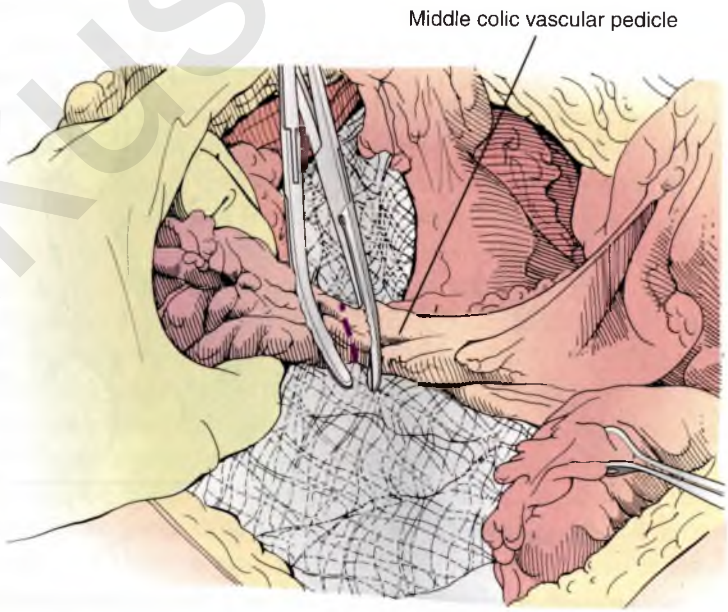

FIGURE 20.4 Omentectomy with partial transverse colectomy: The middle colic artery and vein identified, divided, and ligated, and the specimen removed.

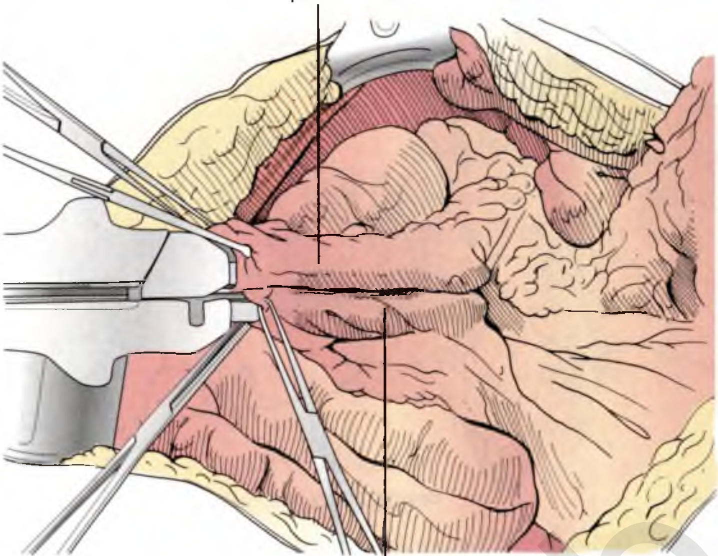

FIGURE 20.5 Omentectomy with partial transverse colectomy: A functional end-to-end stapled colocolostomy using the GIA and TA stapling devices is safe, efficient, and produces a capacious anastomotic lumen.

on the location and extent of tumor growth. If the anterior surface of the spleen and splenic hilum are not obscured by tumor, the anterior approach is the most direct route to control the splenic blood supply. Following mobilization of the omentum, the splenocolic, gastrocolic, and gastrosplenic ligaments are divided (**Figure 20.6**). The two to five short gastric arteries running in the upper portion of the gastrosplenic ligament are serially ligated and divided or taken down with a vessel-sealing device. The stomach is retracted cephalad to reveal the lesser sac and provide maximal exposure to the splenic vessels as they

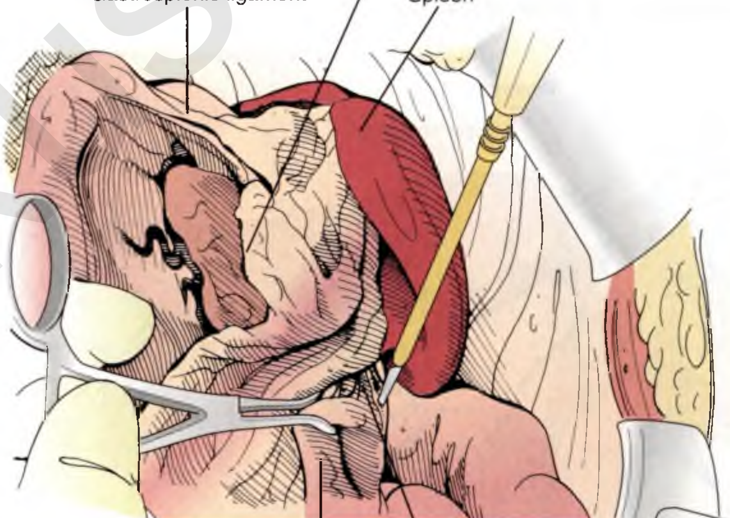

FIGURE 20.6 Splenectomy: Following mobilization of the omentum, the splenocolic, gastrocolic, and gastrosplenic ligaments are divided. The two to five short gastric arteries running in the upper portion of the gastrosplenic ligament are serially ligated and divided or taken down with the vessel-sealing device.

FIGURE 20.7 Splenectomy: The stomach is retracted cephalad to reveal the lesser sac and provide maximal exposure to the splenic vessels as they enter the hilum.

enter the hilum (**Figure 20.7**). The tortuous splenic artery can be identified along the superior border of the pancreas and traced distally toward the splenic hilum. Preliminary ligation of the splenic artery may be performed at this point to minimize the risk of hemorrhage related to manipulation of the spleen during further mobilization and will also allow the spleen to decompress, making it smaller and easier to maneuver. The peritoneum overlying the splenic artery is carefully incised, and a right angle clamp is introduced beneath the artery. The splenic artery is doubly ligated with 2-0 silk sutures (**Figure 20.8**).

At this juncture, placing the patient in reverse Trendelenburg position allows the spleen to descend into the abdominal cavity and may improve exposure. The spleen is brought anteriorly and rotated medially, exposing the lienorenal ligament on the posterior lateral surface of the spleen. The lienorenal ligament is incised with the ESU, allowing the spleen to be delivered into the incision and exposing the posterior surface, splenic hilum, and the tail of the pancreas (**Figure 20.9**). If necessary, the tail of the pancreas is gently dissected away from the splenic vessels. If not done previously, the splenic artery is carefully dissected from the

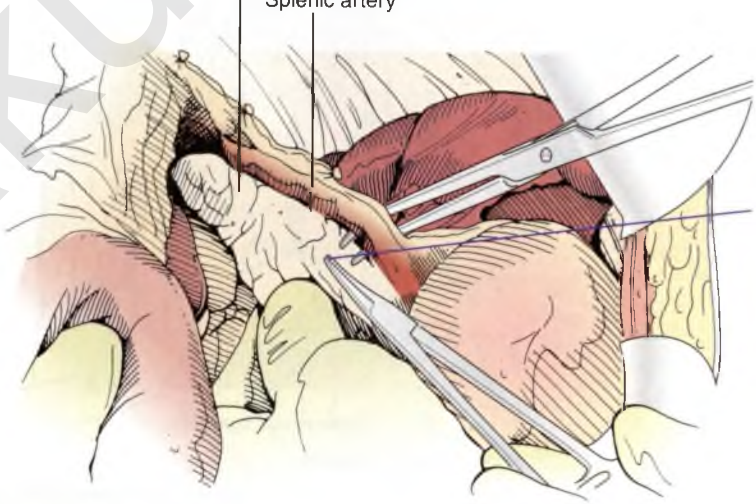

FIGURE 20.8 Splenectomy: The peritoneum overlying the splenic artery is carefully incised and a right angle clamp introduced beneath the artery. The splenic artery is doubly ligated with 2-0 silk sutures.

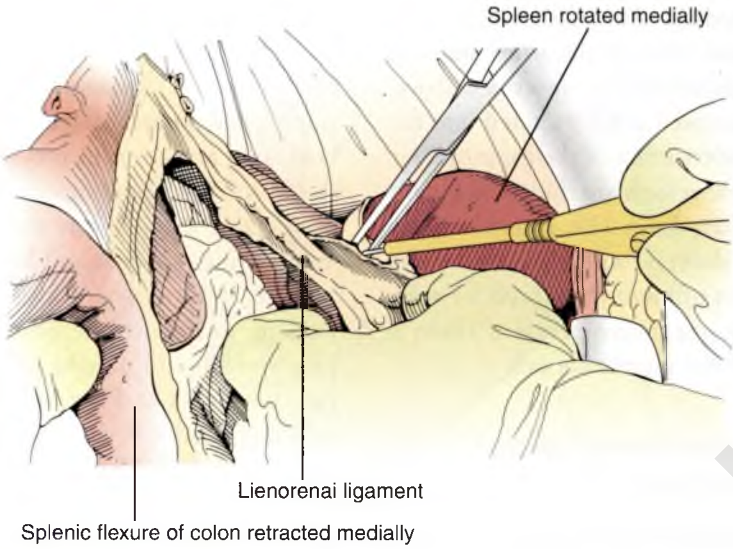

FIGURE 20.9 Splenectomy: The lienorenal ligament is incised with the ESU, allowing the spleen to be delivered into the incision and exposing the posterior surface, splenic hilum, and the tail of the pancreas.

adjacent splenic vein and pancreatic tail, doubly ligated with 2-0 silk sutures, and divided. Some surgeons favor placing an additional transfixion stitch with 3-0 prolene suture through the tip of the proximal arterial pedicle for added security. The spleen is gently compressed to ensure decompression followed by double suture ligation and division of the splenic vein (**Figure 20.10**). Separate ligation of the splenic artery and splenic vein reduces the risk of arteriovenous fistula formation.

The posterior approach to splenectomy is advantageous when bulky omental disease with extensive tumor infiltration of the gastrocolic and gastrosplenic ligaments obscures the splenic hilum and allows only limited surgical access to the splenic vessels via the anterior approach. In this technique, the stomach is placed on medial traction, but no attempt is made to divide the gastrosplenic ligament at this juncture; the splenocolic ligament is divided, if not done previously.

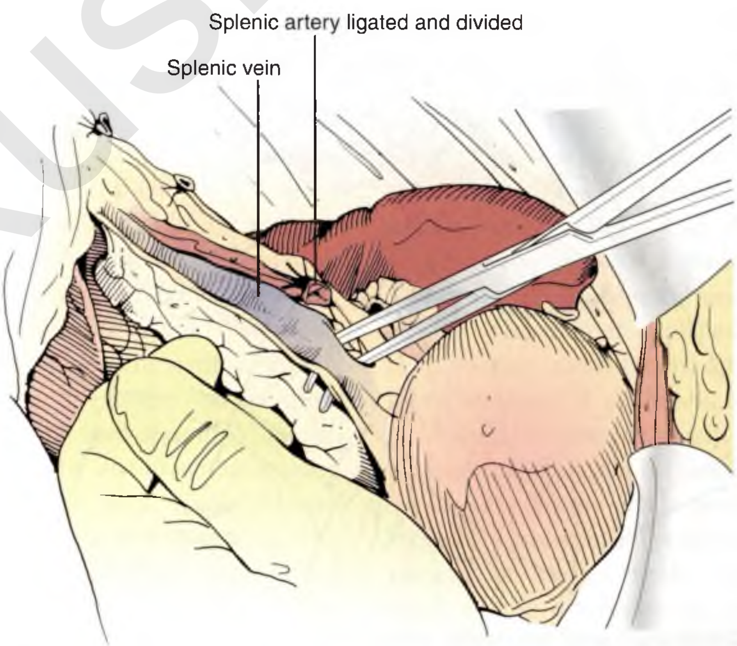

FIGURE 20.10 Splenectomy: The spleen is gently compressed to ensure decompression followed by double suture ligation and division of the splenic vein.

The spleen is rotated medially and anteriorly, and the lienorenal ligament divided. The splenic artery and vein are individually ligated and divided, as described above. As the final step, the specimen is fully rotated into the incision, exposing the undersurface of the gastrosplenic ligament. The short gastric vessels are then individually ligated and divided or taken down with a vessel-sealing device. A closed-suction drain is routinely placed in the splenic bed and the drain effluent monitored for amylase levels during the postoperative period if there is concern over an injury to the pancreatic tail.

Diaphragm peritonectomy with full-thickness resection

The right hemidiaphragm is more often involved than the left side due to the propensity of ovarian cancer cells to accumulate in Morison pouch and the subhepatic recess. Extensive involvement of the diaphragm by ovarian cancer military tumor spread or confluent tumor plaque is most effectively managed with diaphragm peritonectomy. Not infrequently, the tumor will partially or completely invade into or through the diaphragm muscle and a full-thickness resection of the diaphragm muscle will also be necessary. Additional techniques include piecemeal resection, ablation with the ABC, or aspiration with the CUSA.

Exposure of the right upper quadrant is achieved by mobilizing the right lobe of the liver caudally and medially. The round ligament of the liver is divided between clamps and suture ligated; the proximal suture can be held long and used to provide downward traction on the liver. The membranous portion of the faliciform ligament is taken down with the ESU until it splits into the anterior right and left coronary ligaments. The anterior right coronary ligament is carefully divided, working just above the peritoneal reflection onto the liver surface and moving from medial to lateral, with care taken not to injure the underlying right hepatic vein and inferior vena cava (**Figure 20.11**). Laterally, the right triangular ligament is reached and divided with the ESU above the renal and adrenal peritoneal reflection (**Figure 20.12**). The right triangular ligament is formed by the confluence of the anterior and posterior right coronary ligaments, which along with the vena cava form the boundaries of the bare area of the liver. Once the ligamentous attachments have been divided and the bare area exposed, the liver is placed on downward traction with a moist laparotomy sponge and rotated medially. Placing the patient in reverse Trendelenburg position allows the liver to descend into the abdominal cavity and may improve exposure.

The peritonectomy is begun by grasping the peritoneal edge of the diaphragm with two or three Allis

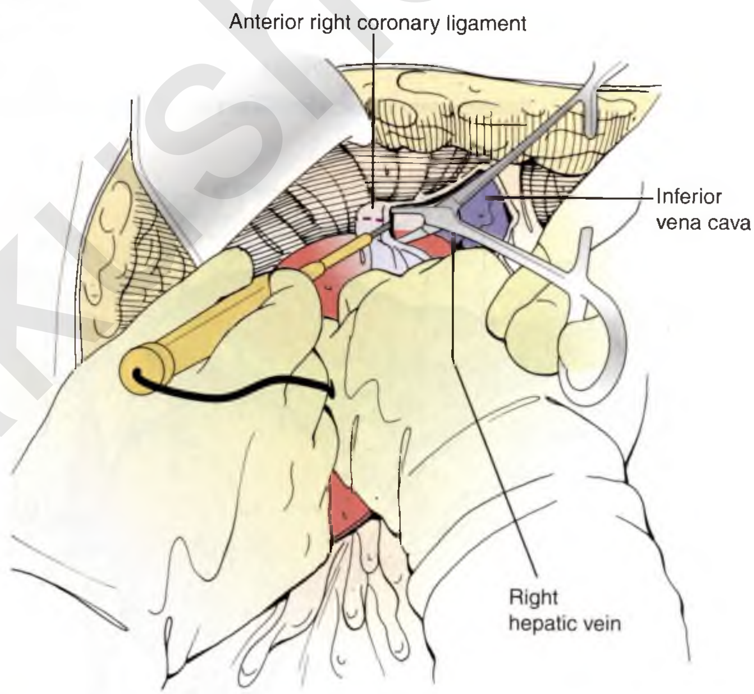

FIGURE 20.11 Diaphragm peritonectomy with full-thickness resection: The anterior right coronary ligament is divided, working just above the peritoneal reflection onto the liver surface and moving from medial to lateral, with care taken not to injure the underlying right hepatic vein and inferior vena cava.

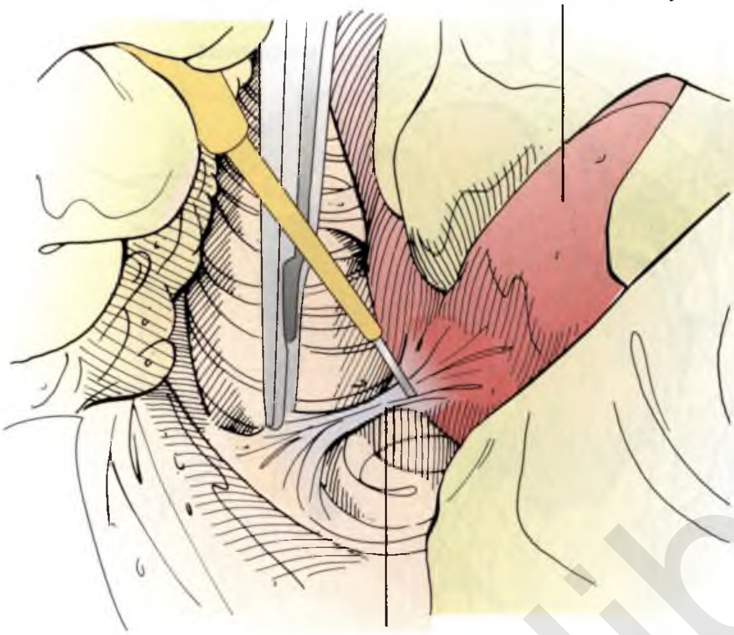

FIGURE 20.12 Diaphragm peritonectomy with full-thickness resection: Laterally, the right triangular ligament is reached and divided with the ESU above the renal and adrenal peritoneal reflection.

clamps just beneath the right costal margin and placing it on traction. The ESU is used to create a curvilinear incision extending the length of the costal margin, working down to Morrison's pouch so that the full extent of tumor involvement is included in the resection. The dissection is in the subperitoneal plane, carefully separating the peritoneum from the underlying diaphragm muscle, and proceeds systematically from lateral to medial and from ventral to dorsal (**Figure 20.13**). Because it is retroperitoneal, the bare area is virtually always free of disease and will form the lower margin of the peritonectomy or full-thickness resection (**Figure 20.14**). Perforating branches of the inferior phrenic artery and vein should be individually ligated as they are encountered. This systematic approach ensures that the later stages of the procedures will be confined to the area of the central tendon. The central tendon is the thinnest portion of the diaphragm and the most difficult from which to raise the peritoneum. When the tumor is densely adherent to the diaphragm or invades through the muscle to the pleural space, a full-thickness resection of the diaphragm muscle is required. The pleural space is entered and explored both digitally and visually to assess the extent of pleural involvement. The anesthesiologist should be notified that the pleural cavity has been entered. The involved portion of the diaphragm muscle/central tendon is circumscribed with the ESU and removed (**Figure 20.15**).

Primary closure of the resulting diaphragmatic defect is possible in most cases; even large (10 cm) defects can be repaired by re-approximating the redundant diaphragm muscle edges. The edges (or angles) of the long axis of the diaphragmatic defect are held with Allis clamps and a series of interrupted or figure-of-eight stitches of 2-0 prolene suture placed, working from each angle toward the middle of the defect. Prior to placement of the final stitch, a 14-French Robinson catheter is inserted into the pleural space and placed on continuous suction; as the final suture is tied, the catheter is simultaneously withdrawn, decompressing the pneumothorax and obviating the need for a chest tube (**Figure 20.16**). The "bubble test" is performed to confirm an air-tight closure. The patient is placed in shallow Trendelenburg position and the right upper quadrant filled with saline solution. If air bubbles are identified during a mechanical inspiratory breath, a diaphragmatic defect is present and should be located and repaired. Rarely, satisfactory closure of a large defect will require placement of a prosthetic (polytetrafluoroethylene, woven Dacron, or Marlex mesh), which is sutured to the edges of the diaphragmatic defect circumferentially with interrupted stitches of 2-0 prolene suture. Occasionally, small penetrating lesions of the diaphragm can be resected full-thickness using the TA (4.8 mm) or Endo-GIA stapling devices. This technique is

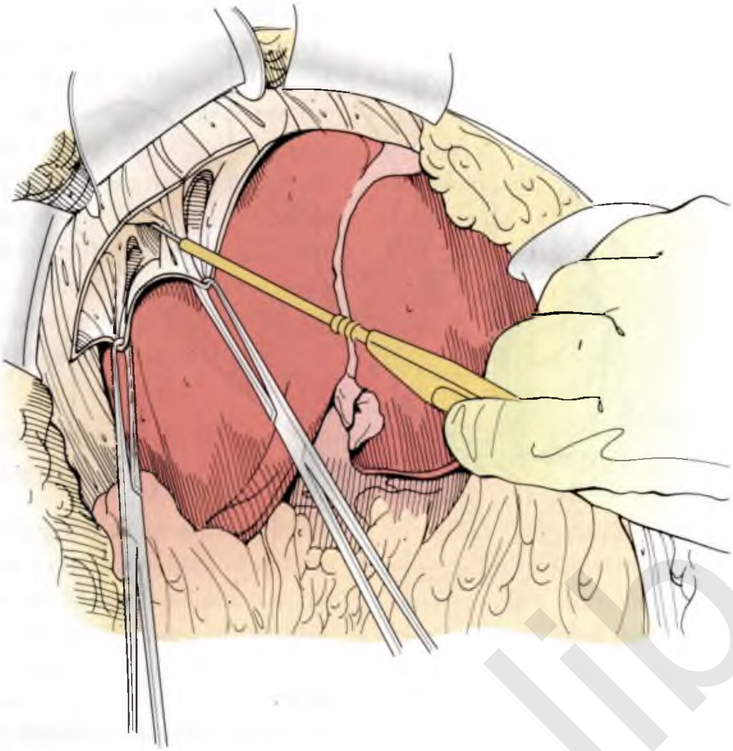

FIGURE 20.13 Diaphragm peritonectomy with full-thickness resection: The dissection is in the subperitoneal plane, carefully separating the peritoneum from the underlying diaphragm muscle, and proceeds systematically from lateral to medial and from ventral to dorsal.

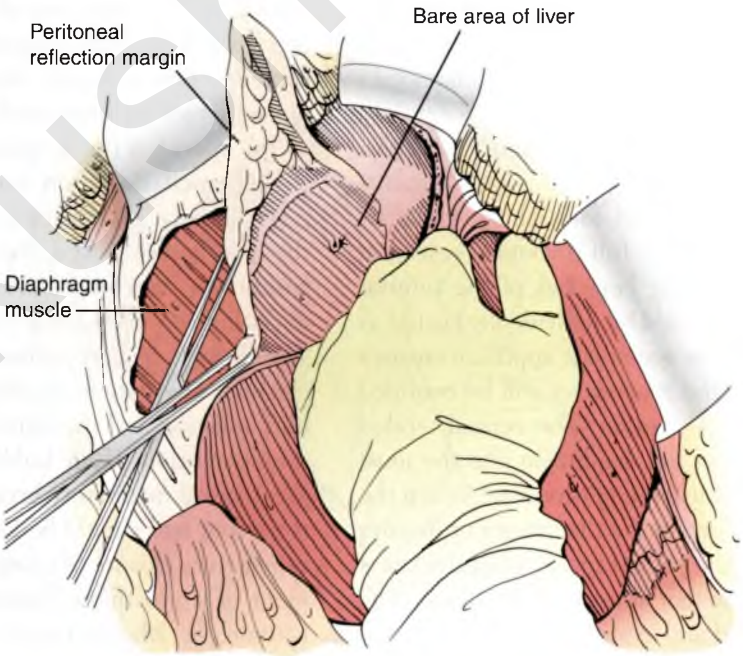

FIGURE 20.14 Diaphragm peritonectomy with full-thickness resection: The bare area of the liver is virtually always free of disease and will form the lower margin of the peritonectomy or full-thickness resection.

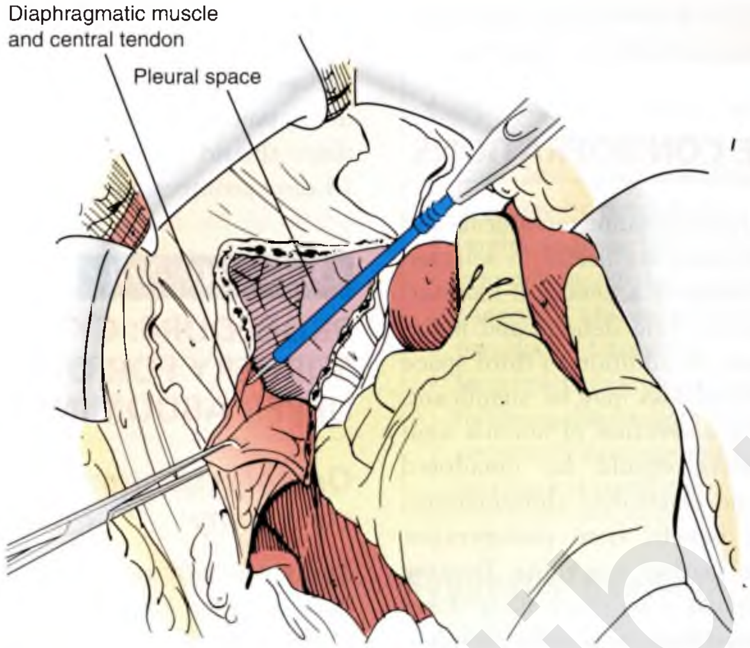

FIGURE 20.15 Diaphragm peritonectomy with full-thickness resection: The involved portion of diaphragm muscle/central tendon is circumscribed with the ESU and removed.

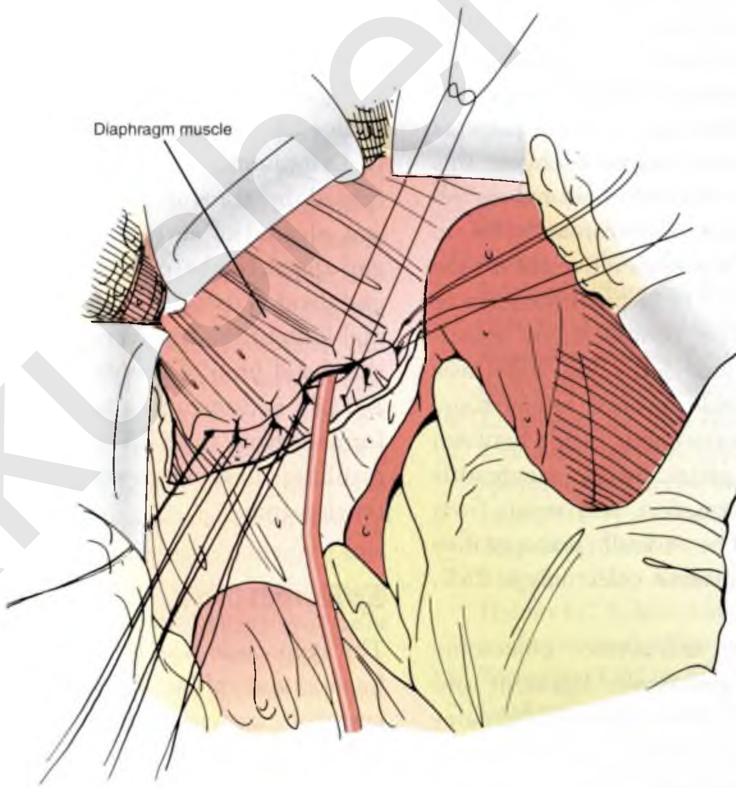

FIGURE 20.16 Diaphragm peritonectomy with full-thickness resection: Prior to placement of the final stitch, a 14-French Robinson catheter is inserted into the pleural space and placed on continuous suction; as the final suture is tied, the catheter is simultaneously withdrawn, decompressing the pneumothorax and obviating the need for a chest tube.

generally only applicable to a tumor mass that has a relatively narrow or pedunculated (1 to 2 cm) base.

POSTOPERATIVE CONSIDERATIONS

Postoperatively, central hemodynamic monitoring and intensive care unit admission are useful in selected patients. Adequate intravenous access and monitoring are essential to replace fluid deficits and maintain intravascular volume. In addition to third space losses, intraoperative blood loss may be significant, requiring transfusion for correction of anemia and/or coagulopathy. Patients should be monitored closely for metabolic and electrolyte abnormalities. Selected patients may benefit from perioperative β-blockade to decrease cardiac morbidity. Routine thromboembolic prophylaxis with three daily doses of low-dose unfractionated heparin is recommended. Alternatively, low-dose unfractionated heparin may be combined with pneumatic compression devices, or prophylactic doses of low molecular weight heparin may be given.

Patients undergoing diaphragm peritonectomy with or without full-thickness diaphragm resection should have a chest radiograph in the recovery room to evaluate the presence of a pneumothorax. Often, a small apical pneumothorax can be identified. As these patients do not have an air leak from the lung parenchyma, this will improve spontaneously. A daily chest radiograph be performed until resolution. Approximately 8% to 12% of patients will require a postoperative chest tube or thoracentesis for a large (>15%) pneumothorax or pleural effusion. Perioperative complications associated with splenectomy include left-sided atelectasis or pneumonia, thromboembolic events, hemorrhage, splenic vein thrombosis, arteriovenous fistula between the splenic artery and vein, gastric fistula, pancreatitis or pancreatic pseudocyst formation, and sepsis from encapsulated organisms. The overall postoperative morbidity rate following transverse colectomy is 26%, with a fistula rate of 5%.

When splenectomy or transverse colectomy includes resection of the gastrocolic ligament and suture ligatures are placed flush along the greater curvature of the stomach, postoperative gastric decompression with a nasogastric tube is recommended for 72 hours to avoid gastric distension. Otherwise, postoperative diet may be advanced with adequate bowel sounds, but there is no need to wait until passage of flatus. Criteria for discharge include: afebrile without evidence of uncontrolled infection, tolerating a normal diet without nausea or vomiting, satisfactory bowel and bladder function, and evidence of appropriate wound healing. If not done preoperatively, patients undergoing splenectomy should receive the aforementioned vaccines 14 days postoperatively.

Operative Note

PROCEDURE: CYTOREDUCTIVE SURGERY FOR OVARIAN CANCER: UPPER ABDOMINAL PROCEDURES

Omentectomy with partial transverse colectomy

The colon attachments at the hepatic and splenic flexures were taken down, with wide mobilization of the ascending and descending colon. The dorsal reflection of the omentum onto the transverse colon was incised and the lesser sac entered and developed. The right and left gastroepiploic vascular pedicles were clamped, divided, and secured with 1-0 delayed absorbable suture. The hepatocystocolic ligament was divided and the gastrocolic ligament divided from the greater curvature of the stomach out to the gastrosplenic ligament using the vessel-sealing device. A continuous circuit of the marginal artery of Drummond across the transverse colon was confirmed by trans-illumination. The transverse colon was cleared of surrounding fat, 2- to 3-cm proximal and distal to the extent of gross tumor involvement and divided using the GIA stapling device. The proximal limb of the transverse colon was approximated to the distal limb of the divided transverse colon using 3-0 silk sutures and a transverse colocolostomy performed using the GIA and TA stapling devices. The resulting anastomosis was capacious, hemostatic, and tension-free.

Splenectomy

The colon was widely mobilized by taking down the hepatic and splenic flexures and dividing the hepatocystocolic and splenicocolic ligaments. The right and left gastroepiploic vascular pedicle were clamped, divided, and secured with 1-0 delayed absorbable suture, and the gastrocolic ligament divided from the greater curvature of the stomach using a vessel-sealing device. The gastrosplenic ligament was taken down with the ESU, with the individual short gastric vessels being secured and divided with clamps and suture ligatures or a vessel-sealing device. The spleen was rotated medially and the lienorenal ligament divided. The tail of the pancreas was gently dissected from the splenic hilum and the splenic vessels skeletonized. The splenic artery was doubly ligated with 2-0 silk suture and divided; a 3-0 prolene suture was placed in a transfixion stitch at the proximal stump of the splenic artery. The splenic vein was clamped, divided, and doubly ligated with 2-0 silk suture and the specimen excised. A closed suction drain was placed in the left upper abdomen and brought out through a separate stab incision.

Diaphragm peritonectomy with full-thickness resection

After ensuring satisfactory exposure, the round ligament of the liver was clamped, divided, and secured with 1-0 delayed absorbable suture and the faliciform ligament divided with the ESU. The anterior leaf of the right coronary ligament was taken down laterally, with care taken to avoid the underlying right hepatic vein, until the right triangular ligament was reached and divided. The liver was rotated medially and caudally, fully exposing the bare area of the liver. A curvilinear incision was created with the ESU just beneath the right costal margin in the subperitoneal plane, and the peritonectomy dissection carried from lateral to medial and from anterior to posterior. At the point of deep tumor penetration into the diaphragm muscle, the pleural cavity was entered, and the portion of the diaphragm muscle involved with tumor (describe measurements) was resected in its entirety using the ESU. The pleural cavity was inspected visually and palpably and no other sites of disease were noted. The diaphragmatic defect was closed with a series of figure-of-eight 2-0 prolene sutures. Prior to tying the final suture, a 14-French Robinson catheter was inserted into the pleural cavity and placed on continuous suction while the anesthesiologist delivered several large mechanical inspiratory breaths, evacuating the pneumothorax. The catheter was withdrawn from the pleural cavity as the final suture was tied. The patient was placed in Trendelenburg position and the right upper quadrant filled with saline solution while several large mechanical inspiratory breaths were delivered. No air leaks were noted, ensuring an air-tight closure. A closed suction drain was placed in the right upper quadrant and brought out through a separate stab incision.

COMPLICATIONS

- Significant tension on the transverse colocolostomy or a discontinuous blood supply along the transverse colon mesentery increase the risk of anastomotic breakdown.
- Imprecise dissection of the splenic artery and vein may lead to unrecognized injury to the pancreatic tail and result in pancreatic leak or pseudocyst formation.
- Incomplete evacuation of pneumothorax following diaphragm resection will precipitate respiratory decompensation upon removal of mechanical ventilation.

Suggested Reading

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CHAPTER 21

Control of Pelvic Hemorrhage

Robert E. Bristow

INTRODUCTION

The most effective strategy to control pelvic hemorrhage is to prevent it in the first place through diligent preoperative preparation, sound surgical judgment, and the use of careful and meticulous surgical technique. Nevertheless, significant pelvic hemorrhage is a potential complication in any patient undergoing gynecologic or obstetrical surgery. Intraoperative, postoperative, or postpartum bleeding can occur as a result of unexpected or unrecognized vascular injury or an inability to control excessive bleeding during a surgical procedure. Effective management of pelvic hemorrhage requires an expert knowledge of pelvic anatomy and the relevant vascular supply, as well as the coagulation system, with its intrinsic and extrinsic pathways. Immediate recognition and prompt response to pelvic hemorrhage can minimize the sequelae of this life-threatening complication.

The pelvic surgeon will encounter a number of clinical scenarios that may be complicated by significant pelvic hemorrhage, the more common of which include: uncontrolled bleeding from a uterine incision, typically at cesarean section, diffuse central pelvic bleeding as a result of extensive surgery for malignancy or infection, and direct injury or laceration of a pelvic artery or vein during extensive dissection (e.g., lymphadenectomy and surgery for severe endometriosis). The pelvic surgeon should be familiar with the techniques of uterine artery ligation, hypogastric (internal iliac) artery ligation (HAL), repair of vascular injury, and packing outlined in this chapter. In addition, the surgeon should be able to institute corrective measures for abnormalities in the coagulation system and selectively employ intravascular embolization techniques by interventional radiology, when appropriate, to control pelvic hemorrhage.

PREOPERATIVE CONSIDERATIONS

Although significant hemorrhage is a risk in any surgical procedure, the presence of certain risk factors should prompt a higher level of anticipation and preparation: 1) any cesarean section, especially if it involves repeat surgery or a risk of uterine atony; 2) surgery for extensive pelvic malignancy, particularly involving deep pelvic structures or the pelvic retroperitoneum; 3) surgery for severe pelvic infection (e.g., tubo-ovarian abscess) or endometriosis, with obliteration of normal tissue planes compounding the difficulty of dissection; 4) obesity; 5) the presence of a large pelvic mass; 6) prior pelvic radiation treatment; and 7) coagulation dysfunction. In these circumstances, the surgeon can enhance his or her capacity to deal with hemorrhage, should it occur, by ensuring that the following instrumentation is close at hand: additional suction devices, electrosurgical unit (ESU or "Bovie"), an argon beam coagulator, vascular hemoclips (medium and large), vascular clamps (e.g., "bulldog" and Satinsky), and fine (5-0) monofilament suture with a vascular needle. It may also be advisable to have access to hemostatic agents that can be used to help control diffuse venous oozing such as oxidized, regenerated cellulose (Surgicel®, Ethicon, San Angelo, TX), absorbable gelatin foam (Gelfoam®, Pfizer, New York, NY), microfibrillar collagen (Avitene®, Bard Davol, Murray Hill, NJ), and fibrin glue (Floseal® hemostatic matrix, Baxter, Deerfield, IL). Preparations should be made with the blood bank to ensure the availability of type and cross-matched packed red blood cells as well as component therapy (e.g., cryoprecipitate and platelets) to replace specific deficiencies that may be associated with massive hemorrhage.

SURGICAL TECHNIQUE

A general prerequisite to the effective control of pelvic hemorrhage is an expert knowledge of the pelvic vasculature and the relationships to critical surrounding structures (**Figure 21.1**). In the face of significant pelvic hemorrhage, the initial effort should be directed at locating the source of bleeding and applying pressure either with a fingertip, a spongestick, or laparotomy packs. Direct pressure will stem the hemorrhage and allow the surgeon to get organized for more definitive management. The surgeon must resist the urge to try and get the bleeding quickly under control by blindly applying traumatic clamps, using electrocautery indiscriminately, or placing sutures or clips without precise localization of the vascular injury.

After pressure control has been established, the surgeon should quickly and efficiently: 1) notify the anesthesia team of the situation and consult with them on the proposed plan of management (including adequate

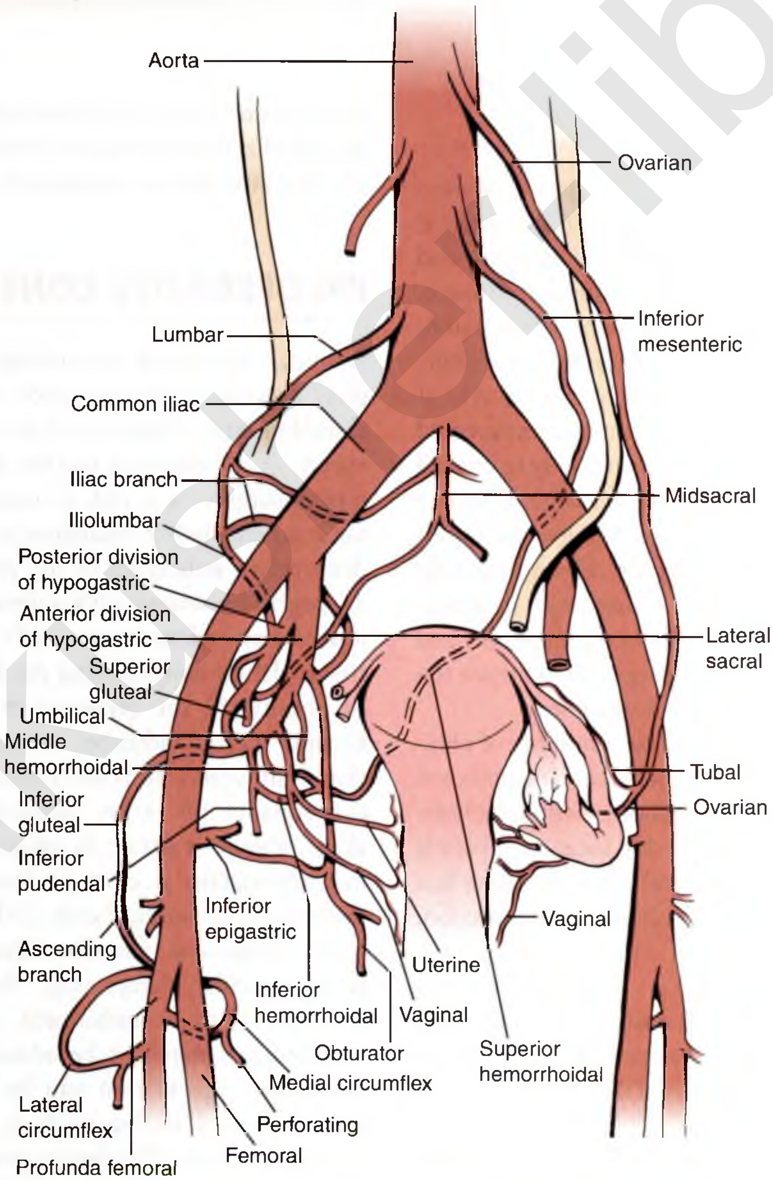

FIGURE 21.1 Overview of pelvic arterial system.

intravenous access and the possible need for ICU care postoperatively); 2) call for blood bank resources (packed red blood cells, fresh frozen plasma, platelets, and whole blood) for possible transfusion; 3) gather the necessary instrumentation and equipment; and 4) request additional surgical assistants or specialized personnel (e.g., vascular surgeon), if necessary.

Next, the adequacy of exposure of the operative field should be evaluated. Sufficient lighting should be assured. The adequacy of the incision and surgical approach should be reassessed; a vertical incision may need to be extended, a Pfannenstiel incision may need to be converted to a Cherney incision, or a laparoscopic or vaginal procedure may need to be converted to laparotomy. Retractors may need to be added or replaced. The surgical field should be cleared of excess instrumentation and packs, and any blood clot should be evacuated. To the greatest extent possible, the surgeon should normalize anatomy around the site of bleeding and mobilize and retract nearby vulnerable structures (e.g., bladder, ureter, and other vessels). At this point, the pressure control measures can be carefully withdrawn to identify the source of hemorrhage and allow the surgeon to assess the situation and formulate an appropriate plan of action (e.g., use of clamps, suture ligatures, electrosurgical sealing, hemostatic agents, or a combination of measures).

Uterine artery ligation

Uterine artery ligation is appropriate for cases of significant bleeding from the uterine incision at cesarean section, either intraoperatively or postoperatively, and uterine bleeding complicating an extensive abdominal myomectomy procedure. The technique is straightforward and can rapidly arrest uncontrolled bleeding from the cesarean section uterine incision. In their original report, O'Leary and O'Leary reported a success rate of over 90% in controlling postcesarean hemorrhage with this technique, such that hysterectomy was necessary in just 4 of 90 cases.

Uterine artery ligation is most easily performed with the surgeon standing on the patient's left side. The uterus is grasped and elevated with the surgeon's left hand. To ligate the left uterine artery, a No. 1 or 1-0 delayed absorbable or chromic catgut suture on a large needle is passed into and through the myometrium 1 cm medial to the uterine vessels at the level of the uterine isthmus, driving the needle from anterior to posterior. The needle is brought forward through the avascular area of the broad ligament 2 to 3 cm lateral to the uterine vessels and the knot tied on the ventral surface. To ligate the right uterine artery, the needle is passed first through the avascular area of the broad ligament 2 to 3 cm lateral to the uterine vessels, anterior to posterior, then it is brought anteriorly through the myometrium 1 cm medial to the uterine vessels, and the knot is tied on the ventral surface (**Figure 21.2**). With proper placement of the ligatures at the level of the uterine isthmus, there is negligible risk of bladder or ureteral injury and no need for extensive bladder mobilization or ureteral dissection. Generally, the ligatures should be placed below the level of the transverse uterine incision for maximal control of bleeding. If bleeding from the uterine incision persists, the collateral blood supply to the uterus from the ovarian vessels should be controlled by placing a No. 1 or 1-0 delayed absorbable suture in a figure-of-eight stitch through the utero-ovarian ligament on each side.

Hypogastric artery ligation

HAL can be used to control hemorrhage from cesarean section as well as any gynecologic surgery complicated by bleeding from the central pelvis or parametria due to small vessel injury. The procedure is effective for arterial bleeding from the vaginal apex and in the broad ligament. It is not effective for venous oozing anywhere in the pelvis. HAL was first described by Howard A. Kelly at the Johns Hopkins Hospital in 1894, who performed the procedure as an emergency measure to control massive pelvic bleeding in a patient undergoing hysterectomy for cervical cancer. Although Kelly hypothesized that bilateral HAL achieved hemostasis by "cutting off all pelvic circulation," Burchell later conducted a series of elegant studies of the physiology of HAL and concluded that the key mechanism was actually a reduction in pulse pressure distal to the site of occlusion, which presumably allowed a clot to form at the more distal site of vessel injury. In these studies, the pulse pressure distal to the point of ligation on the ipsilateral side was reduced by 77% with unilateral HAL. When bilateral HAL was performed, the pulse pressure was decreased by 85%. Actual blood flow in vessels distal to the point of ligation was reduced by just 48%. The reduction in pulse pressure may also reduce the amount of blood loss to the point where a specific vascular injury can be accurately localized and controlled.

The effectiveness of HAL in reducing arterial pulse pressure distal to the site of ligation is dependent on successful prevention of collateral circulation beyond the ligature via branches of the posterior division of the hypogastric artery. The branches of the posterior

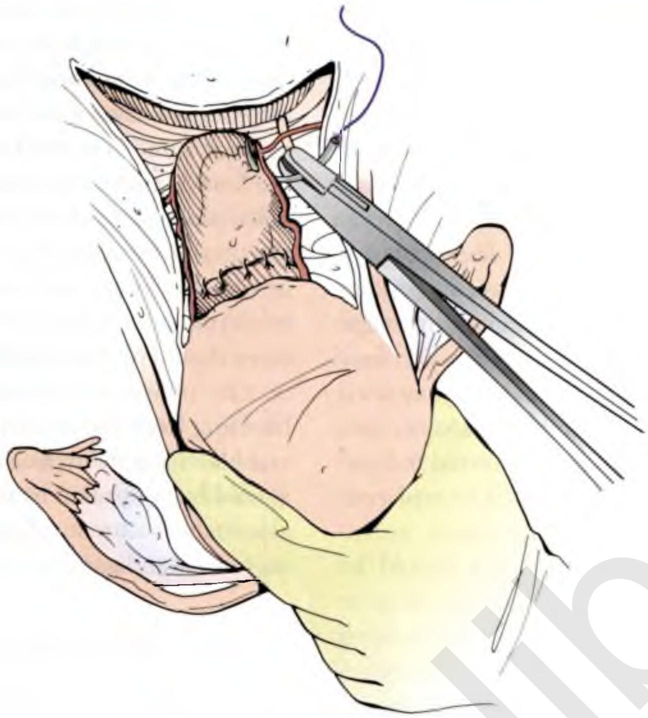

FIGURE 21.2 Uterine artery ligation.

division form a well-defined anastomotic network with the systemic arterial circulation proximal to the site of occlusion (iliolumbar/lumbar, lateral sacral/middle sacral, and superior gluteal/medial circumflex femoral) (**Figure 21.1**). Ligation of the hypogastric artery above or proximal to the posterior division will allow a redirection of arterial flow through these collateral pathways, ultimately reaching the site of vessel injury and bypassing the ligature. For this reason, it is critical that the ligature be placed distal to the origin of the posterior division. Anatomic studies conducted by Bleich and coworkers have shown that the posterior division and its branches arise from a common trunk in only 62% of cases, with the remaining cases having the branches arising independently from one another. In all cases, however, the branches of the posterior division originate from the posterior and lateral surface of the hypogastric artery. The average distance from the bifurcation of the common iliac artery to the posterior division branches is 2.7 cm, with a range of 0.2 to 5.6 cm. Therefore, when performing HAL it is recommended that the ligatures be placed 5 cm distal to the common iliac artery bifurcation, which will spare the posterior division branches in 95% of patients.

The operative approach to HAL begins with achieving satisfactory exposure to the pelvic retroperitoneum by opening the pelvic sidewall peritoneum along the psoas tendon, lateral to the external iliac artery and parallel to the infundibulopelvic ligament and ovarian vessels. The round ligament should be ligated and divided, if not done previously. The critical structures to be identified are the common iliac artery and vein, the external iliac artery and vein, the hypogastric artery, and the ureter (**Figure 21.3**). The pararectal space should be carefully developed using a combination of gentle blunt finger dissection and sharp dissection with a Kelly clamp. To open the pararectal space, the axis of dissection should first be directed dorsally, then caudally, and finally medially within the pelvis. The ureter should be located on the medial peritoneal reflection and retracted with a retractor blade. Alternatively, the ureter can be placed within a vessel loop for traction out of harm's way. The common iliac artery should be definitively identified and traced distally to the bifurcation into the external iliac artery and hypogastric artery. This step is critical, because inadvertent ligation of the common iliac artery or external iliac artery will result in vascular compromise of the lower extremity. The hypogastric vein is located deep and lateral to the hypogastric artery along the pelvic wall, and may be readily apparent. It is not necessary to specifically identify the hypogastric vein, however, when performing HAL, as these efforts may injure the vein and compound the bleeding problem. Once the hypogastric artery

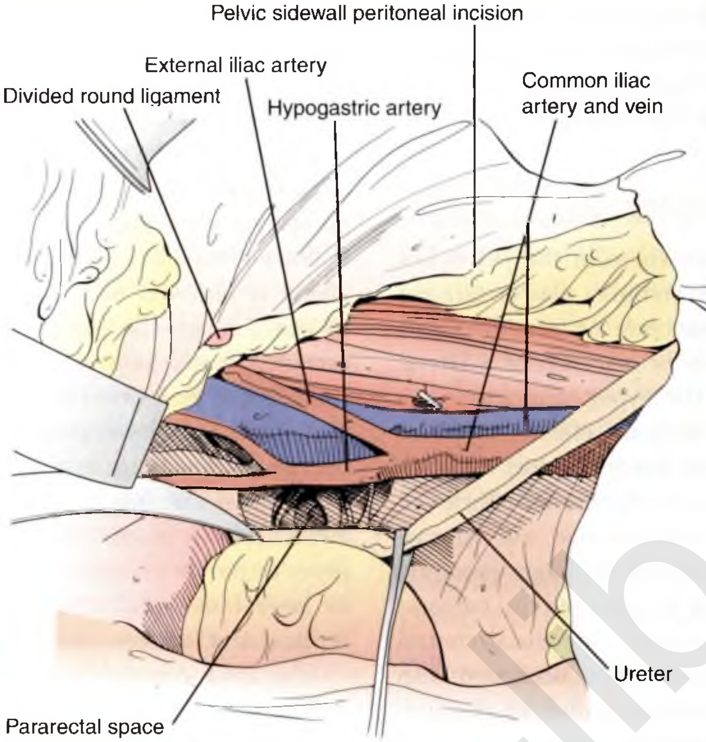

FIGURE 21.3 Hypogastric artery ligation: Opening the pelvic sidewall, identification of critical structures.

has been clearly identified, a blunt-tipped right angle clamp is carefully passed underneath the artery, working from lateral to medial to minimize the risk of lacerating the underlying hypogastric vein. Lifting the artery from its bed with a Babcock clamp may be helpful. The right angle clamp should be passed beneath the hypogastric artery 5 cm distal to its origin from the common iliac artery (**Figure 21.4**). Two ligatures of 1-0 delayed absorbable or silk suture are handed to the right angle clamp and passed simultaneously around

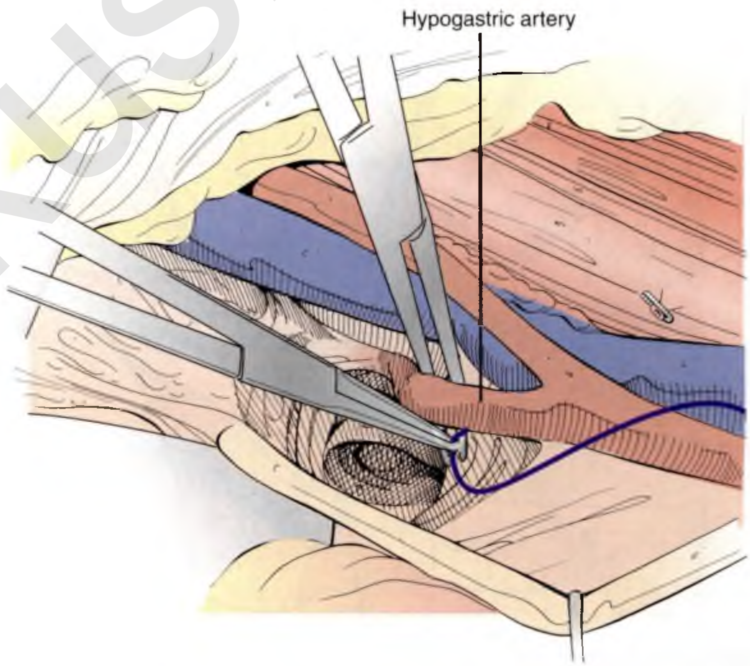

FIGURE 21.4 Hypogastric artery ligation: Dissection technique.

the hypogastric artery and sequentially tied, doubly ligating the artery to prevent recanalization. The artery should not be divided after ligation. The identical procedure is then performed on the contralateral side.

Repair of vascular injury

Arterial injury can occur anywhere in the pelvis but most commonly involves the common iliac or external iliac artery as a result of puncture or laceration during pelvic lymphadenectomy or insertion of a lateral laparoscopic trocar. While the hypogastric artery can be safely ligated without untoward effects, injury to the external or common iliac artery requires repair or replacement. Small puncture or laceration injuries to the major pelvic arteries (common iliac and external iliac) should be controlled initially by finger pressure, while additional equipment is gathered in preparation for repair. Definitive proximal and distal control of the lacerated artery is achieved by occlusion with vessel loops. Alternatively, proximal and distal pressure with spongesticks or placement of atraumatic vascular clamps (e.g., Debakey) can be used to obtain control of the arterial blood flow. Mobilization of surrounding structures (bowel, ureter, and other vessels) may be necessary to permit adequate visualization and control of both proximal and distal blood flow to the site of injury. Small puncture or laceration injuries to the major pelvic arteries (common iliac and external iliac) are repaired using a continuous stitch of fine monofilament suture (5-0 polypropylene) on a vascular needle. The suture line closure should be perpendicular to the long axis of the artery, such that repair does not result in narrowing of the vessel lumen. Bites should be taken approximately 2 mm from the laceration edge and be spaced approximately 2 mm apart (**Figure 21.5**). Following repair, the distal vessel loop or vascular clamp is removed first to permit air or microemboli to exit through the suture line before removing the proximal vessel loop or clamp. Doppler examination for pulsatile flow distal to the site of repair should be performed and a lower extremity pulse confirmed intraoperatively. Excessive manipulation of the external iliac or common iliac artery may result in dissection of an atherosclerotic plaque or intimal hematoma leading to lower extremity ischemia. These complications, as well as large transmural arterial injuries requiring vessel replacement, are best managed by a vascular surgeon.

The most commonly encountered venous injuries during pelvic surgery are to the external iliac vein, hypogastric vein, obturator vein, and presacral venous plexus. The external iliac, hypogastric, and obturator veins may be lacerated or punctured during pelvic lymphadenectomy or resection of a malignant or inflammatory process that has distorted the normal anatomy. Injury to the ventral or medial surface of the external iliac vein can be controlled with digital pressure, spongesticks, one or more Allis clamps, or a peripheral

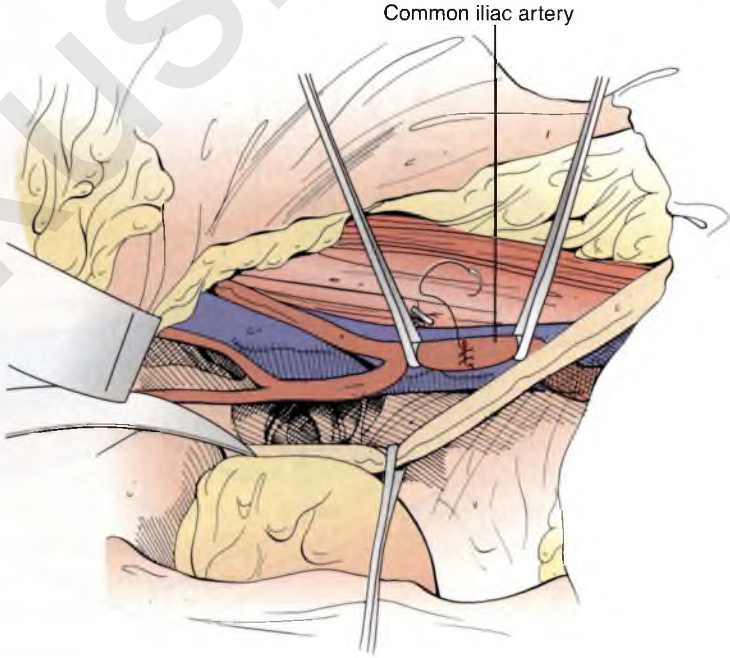

FIGURE 21.5 Repair of external iliac artery laceration with vessel loops.

vascular clamp (e.g., Satinsky) while adequate suction and exposure are established. The defect is then repaired with 5-0 monofilament suture on a vascular needle in a figure-of-eight stitch or running, nonlocking closure (**Figure 21.6**). As with arterial injury repair, the axis of the suture line closure should be perpendicular to the long axis of the vein to prevent narrowing of the vessel lumen. Injury to the inferior surface of the external iliac vein can occur at the entry point of the accessory obturator vein (present in 25% of patients) near the superior pubic ramus, requiring lateral rotation of the external iliac vein to obtain adequate exposure, prior to suture repair or application of one or two vascular hemoclips.

Injury to the hypogastric vein can be troublesome, given the complex venous drainage of the lower pelvis. Placement of crushing clamps should be avoided. Rather, the precise bleeding site or sites should be identified and repaired with figure-of-eight stitches of fine monofilament suture. Laceration of the hypogastric vein in close proximity to its confluence with the external and common iliac veins can be particularly difficult to control as a result of the three-way venous drainage; successful repair is dependent upon achieving good visualization through distal occlusion of the hypogastric and external iliac veins and proximal occlusion of the common iliac vein (**Figure 21.7**). The obturator nerve should be clearly identified as it emerges into the pelvis from behind the bifurcation of the common iliac vein. The hypogastric vein should be repaired with a figure-of-eight or running closure of fine (5-0) monofilament suture on a vascular needle. A small puncture injury may be controlled with one or two vascular hemoclips. Application of multiple clips to the hypogastric vein should be avoided, however, because if the hemorrhage is not successfully controlled, the presence of multiple clips makes definitive suture repair more difficult. Injury to the obturator vein most commonly occurs at its entrance into the obturator canal, into which the distal end of the vein may retract. Bleeding is controlled by placing a figure-of-eight stitch of 5-0 monofilament suture at the opening of the canal, again taking care to avoid the obturator nerve.

Management of hemorrhage from the deep pelvis and presacral space

Diffuse venous hemorrhage in the deep pelvis can be a significant clinical challenge because of the unpredictable anatomical pattern of venous plexuses and the fragile nature of these vessels. Attempts at electrocoagulation or to place sutures and hemoclips may only make the problem worse, and application of hemostatic agents may be unsuccessful in stemming the hemorrhage. In these rare instances, the surgeon's best option may be the "pack-and-go-back" approach, particularly if

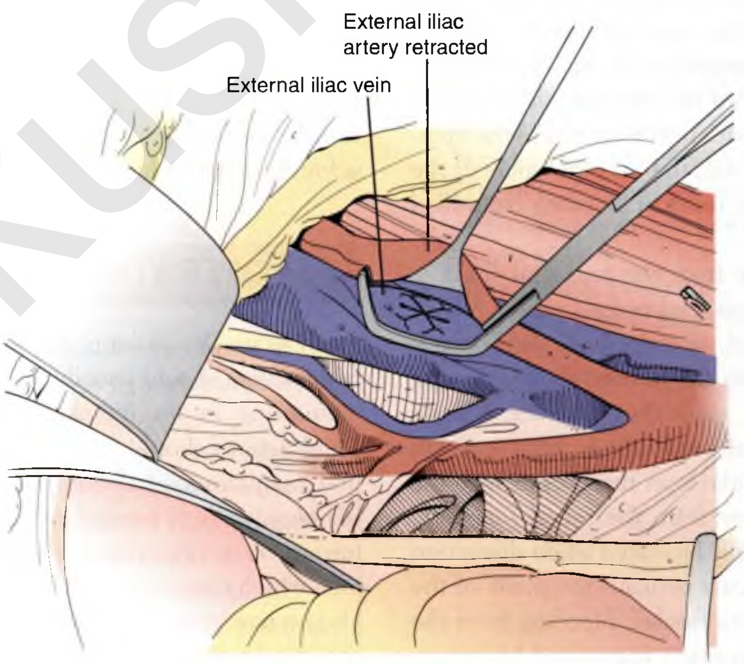

FIGURE 21.6 Repair of external iliac vein laceration with placement of a Satinsky clamp to control bleeding.

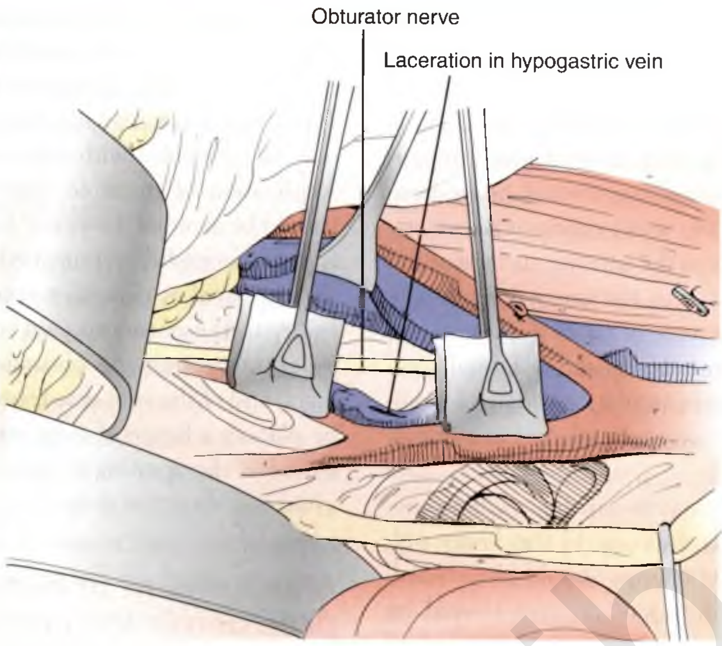

FIGURE 21.7 Repair of hypogastric vein laceration with occlusion of proximal and distal venous blood flow.

the blood loss has been significant and the situation is further complicated by coagulopathy. In this approach, laparotomy sponges are packed tightly in the pelvis. If the procedure has been prolonged and the bowel distended, no attempt should be made to re-approximate the fascia at this time. Rather, the skin can be closed with a running stitch of large caliber monofilament suture, or the incision left open and covered with sterile towels and an adhesive biodrape. The patient is transferred to the intensive care unit and stabilized, with correction of any coagulopathy and replacement of blood products. Provided the bleeding is controlled after 24 to 48 hours, the patient is returned to the operating room under anesthesia, the incision opened, the packing removed, and any residual bleeding controlled with standard techniques.

Significant hemorrhage from the presacral space is a result of injury to the presacral venous plexus, which includes the middle sacral, lateral sacral, and basivertebral veins. Bleeding from the basivertebral veins can be especially problematic, since they originate as open canals in the spongiosa of the sacral body, have very thin walls, and have an adventitial layer that blends with the periosteum as they emerge from the sacral foramina. The venous plexus is usually lacerated when dissection in the presacral space occurs beneath the plane of the presacral fascia (Waldeyer's fascia). Bleeding from the presacral venous plexus is often aggravated by imprecise placement of sutures or attempted electrocautery. Management of presacral bleeding should start with immediate packing and compression for 5 to 7 minutes. If bleeding persists, topical procoagulants may be of some benefit. Floseal® hemostatic matrix (Baxter, Deerfield, IL) combines collagen-derived particles and topical thrombin that conform to irregular bleeding surfaces such as the sacral foramina. Alternatively, sterile metal thumbtacks can be pressed directly over the bleeding areas in the presacral fascia and pushed all the way into the sacrum or placed directly into each bleeding sacral foramen (**Figure 21.8**). Sacral foramina may also be occluded (packed) with bone wax prior to placement of sterile thumbtacks. Placement is facilitated by loading the thumbtack into the end of a Kelly clamp to achieve sufficient leverage to penetrate the sacral bone.

POSTOPERATIVE CONSIDERATIONS

Postoperatively, patients experiencing massive pelvic hemorrhage should usually have central hemodynamic monitoring in an intensive care unit environment. Fluid deficits should be replaced and intravascular volume maintained, with additional transfusion of packed red blood cells as needed. Attention should be directed toward correcting coagulopathy and avoiding hypothermia, which causes platelet dysfunction. Patients should also be monitored closely for metabolic and electrolyte abnormalities. Venous thromboembolism remains a significant risk after gynecologic surgery, even after a massive hemorrhagic event, so thromboembolic measures

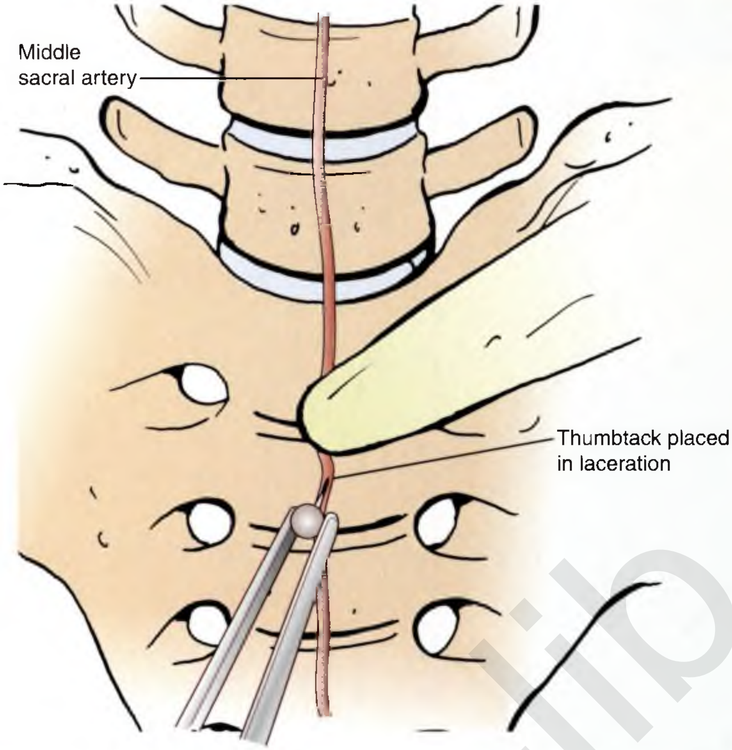

FIGURE 21.8 Placement of sterile thumbtack using a Kelly clamp to control presacral bleeding.

should be instituted as long as there is no evidence of active bleeding and when coagulopathy has been corrected. If the external iliac artery has been repaired or replaced, the ipsilateral lower extremity pulse should be checked regularly using a Doppler probe.

Operative Note

PROCEDURE: CONTROL OF PELVIC HEMORRHAGE

Not applicable.

COMPLICATIONS

- Uterine artery ligation must be performed at the level of the uterine isthmus to minimize the risk of ureteral ligation or kinking.
- Optimizing exposure and lighting when controlling hemorrhage deep in the pelvis or on the pelvic sidewall will minimize the risk of ureteral injury or damage to the obturator nerve.
- Potential complications of HAL include inadvertent ligation of the common iliac or external iliac artery, laceration of the hypogastric vein, ureteral injury, and lower extremity paresis.

Suggested Reading

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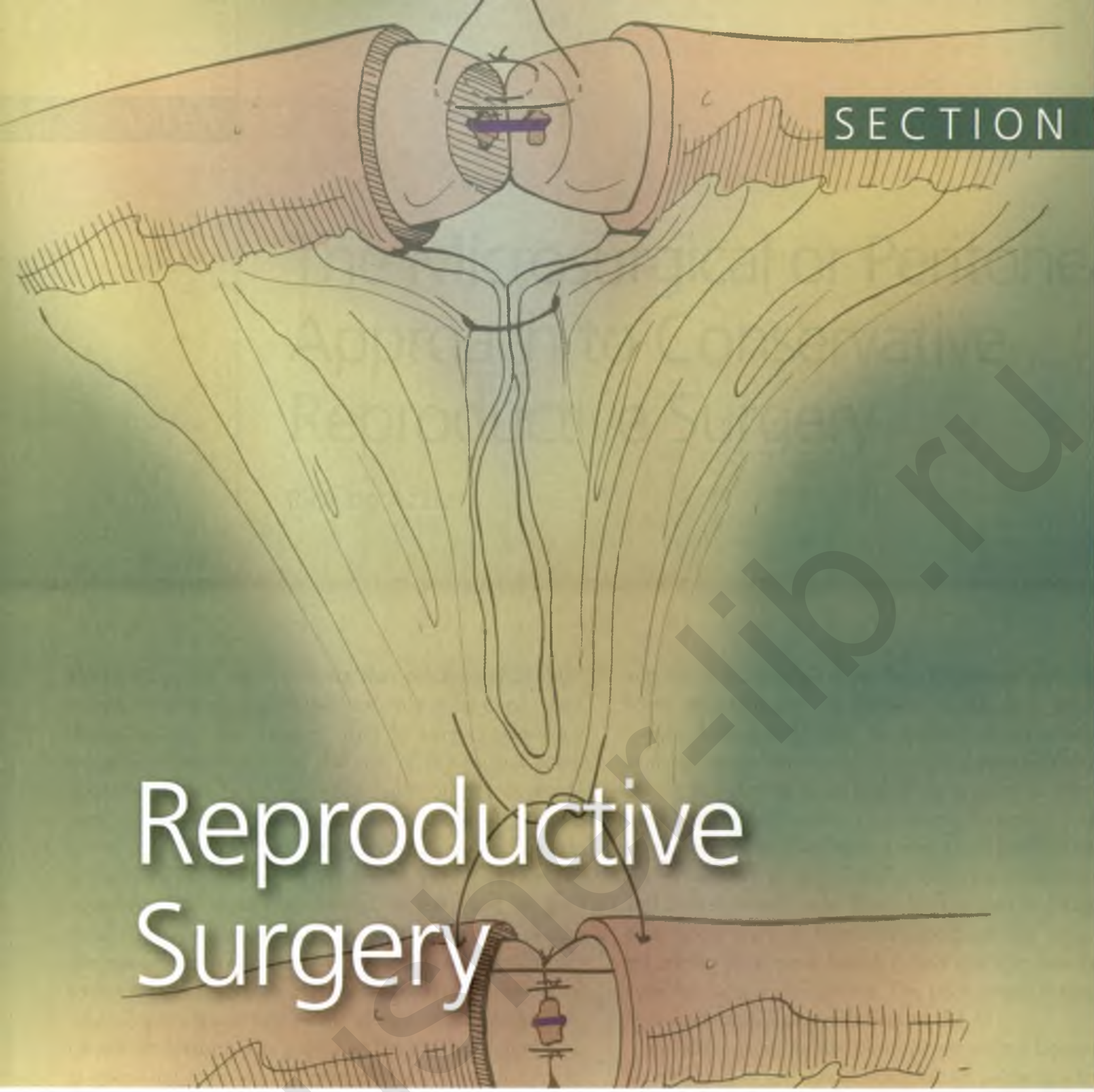

SECTION III

Reproductive Surgery

CHAPTER 22

The Microsurgical or Peritoneal Approach to Conservative Reproductive Surgery

Ricardo Azziz

While surgeons often assume that microsurgical (also called peritoneal) techniques are only to be used when doing microscopic surgery, that is surgery requiring magnification because of the size of the organs being operated upon (e.g., fallopian tube or vas deferens lumens) or size of the sutures being used (i.e., equal to or smaller than 8-0 gauge), these approaches are actually valuable when doing any surgery that involves preserving or restoring normal organs, and in particular reproductive organs. In fact, to a large degree the success of reproductive surgery (i.e., reconstructive/reparative surgery of or around the reproductive organs) principally lies in the ability of the surgeon to clearly understand the nature of the tissues that she/he is operating upon and to maximize efforts to minimize the degree of tissue damage. The general principles of microsurgical surgery are reviewed briefly below.

UNDERSTANDING PERITONEAL ANATOMY, HEALING, AND ADHESION FORMATION

Much of the damage performed during surgery, in particular pelvic surgery, stems from the surgeon's lack of understanding of peritoneal anatomy and the process of peritoneal healing. Although beyond the purview of this atlas, a few principles are well worth remembering.

First, *the peritoneum is not anatomically analogous to the skin (epidermis)*. The latter is composed of multiple layers of squamous cells, the outermost of which are keratinized embryonically arising from the ectoderm, and which is designed to protect the human body against harm and intrusion by foreign agents. It is relatively tough. Alternatively, the peritoneum is embryonically of mesodermic origin and is designed primarily to allow contiguous organs to slide over each other as the body moves and to help contain infections. It is composed of a single layer of nonkeratinized mesothelial cells overlying a rich network of tiny blood vessels, connective tissue, and inflammatory cells. The mesothelium is composed of a single layer of flattened squamous-like cells with microvilli, peripheral vesicles, and discrete bundles of cytoplasmic microfilaments. The peritoneum is very delicate and easily damaged (**Figure 22.1**).

As such, rubbing the peritoneum with a laparotomy sponge that is seemingly nonabrasive (although to test the true abrasiveness of these fabrics, try rubbing your nose with one), such as when packing the bowel away from the pelvis, will effectively destroy millions of peritoneal cells, denuding large areas of tissue. Likewise when we allow this tissue to become desiccated as we expose it to ambient air and forget to continuously irrigate, or macerate it as we repeatedly grasp and release it with forceps or hemostat, or leave behind foreign material, irritating fluids (e.g., dermoid or endometrioma contents), or bacteria which result in inflammation and further damage to the peritoneum.

Second, *fibrous tissue and adhesive bridges between tissues begin on a scaffold of fibrin*. Fibrin is released by blood as it coagulates and by peritoneum as it is damaged, and is quite adherent, covering and bridging damaged areas. In turn, fibrin is broken down into fibrin split products (FSPs) by a process called

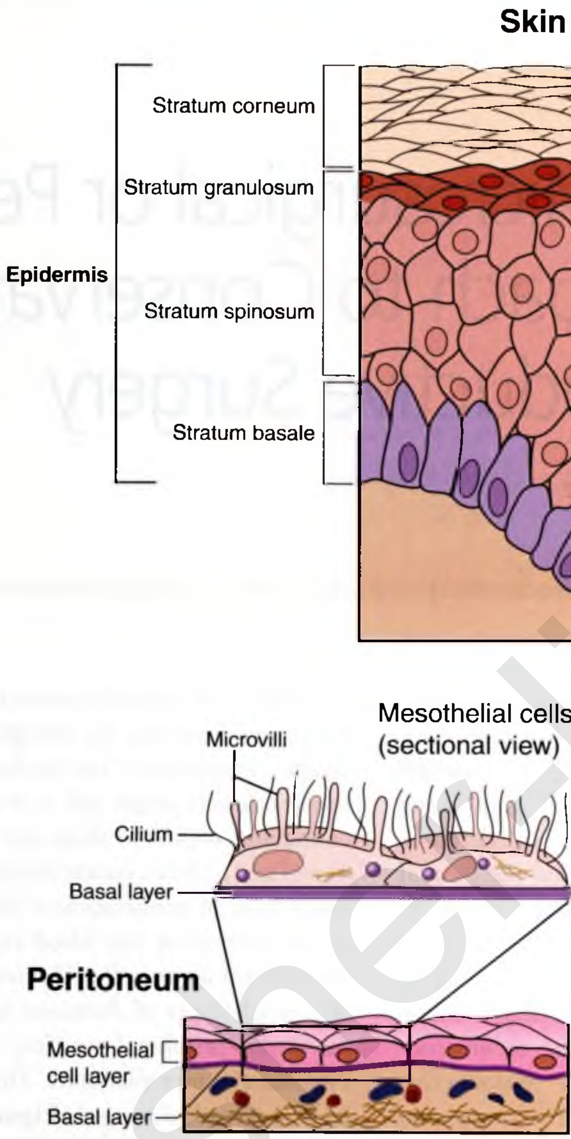

FIGURE 22.1 Depiction of the relative anatomies of skin and peritoneum: Note that while skin is a relatively tough multilayered keratinized protective coat designed to protect the human body against harm and intrusion by foreign agents, peritoneum is very delicate and easily damaged, designed primarily to allow contiguous organs to slide over each other as the body moves. Peritoneum is composed of a single layer of flattened nonkeratinized mesothelial cells overlying a rich network of tiny blood vessels, connective tissue, and inflammatory cells.

fibrinolysis. Blood and peritoneal (mesothelial) cells contain plasminogen, which is converted to the active enzyme, plasmin, through the action of plasminogen inhibitors (PAI_1 and PAI_2). In turn, plas min breaks down fibrin into the biologically inactive FSPs through the tissue plasminogen activator (tPA) pathway. This process occurs within the first week of surgery (**Figure 22.2**).

If fibrin is removed rapidly through fibrinolysis, then the peritoneum heals normally. For example, a clot formed by free-flowing blood sitting on otherwise healthy peritoneum rarely leads to the formation of a more permanent adhesion. Alternatively, if fibrin is formed and not resorbed sufficiently rapidly, the fibrin bridge is then invaded by small blood vessels, inflammatory cells, and fibroblasts that deposit collagen and other more permanent materials, leading to the formation of an adhesive band (an "adhesion"). For example, this would be observed if blood is deposited on a peritoneum surface that has been damaged, such as a denuded and cauterized surface, resulting in the formation of a fibrin band or bridge

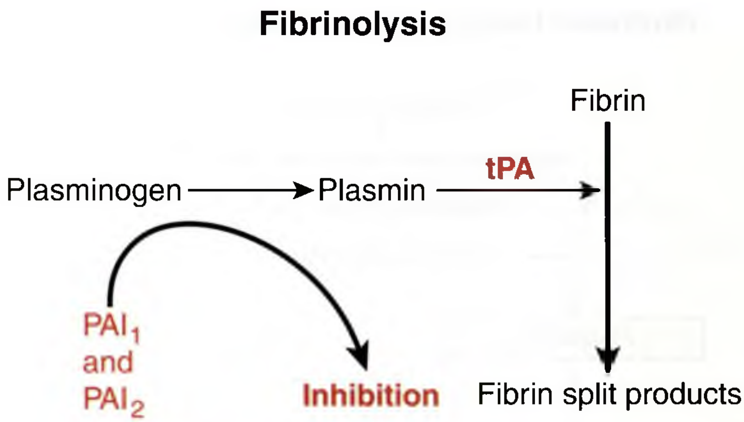

FIGURE 22.2 Fibrinolysis is a system for removal of fibrin: The peritoneal cells (mesothelial cells) contain plasminogen, which is converted to the active enzyme, plasmin. The plasmin breaks down the fibrin into the biologically inactive fibrin split products by the tissue plasminogen activator pathway (tPA). The fibrinolytic system is modulated by plasminogen inhibitors (PAI_1 and PAI_2), which may regulate individual differences in fibrin removal.

that is resorbed less rapidly, allowing the fibrin to become organized and an adhesive band to form.

Third, *peritoneum heals itself from below, not just from side-to-side.* When skin heals it does so by growing cells from each side of the wound or break, which protrude into the damaged area from side to side, eventually meeting in the middle. And this takes time, which is why the scar (fibrosis tissue deposition) is always in the middle of the wound. The peritoneum, however, heals through the growth of colonies of cells, much like bacteria grow in a petri dish, each colony growing radially outward and eventually covering the entire area. The colonies arise from remaining mesothelial cells and from mesenchymal stem cells imbedded in the subperitoneum that differentiate into superficial peritoneal cells. This form of healing is much more efficient and rapid than side-to-side healing, and is most effective in the healing of large damaged surface areas, such as the peritoneum.

However, this type of healing also depends heavily on the health of the remaining tissues, which albeit denuded, are not damaged further and are well oxygenated. Hypoxia of the underlying tissues will result in a slowing down of normal tissue healing, allowing adhesions to form. And this is why excessive suturing to try and create a "quilt" of peritoneum to cover denuded areas, particularly when using running stitching, is not necessarily the optimum strategy to promote healthy peritoneal healing.

Overall, the healing of tissues, including the peritoneum, represents a balance between normal tissue regeneration and the development of that "all-purpose" repair tissue, fibrosis (i.e., scar tissue or adhesions) (**Figure 22.3**). It represents a race of sorts between these two processes. If the peritoneum is well perfused, well oxygenated, with a minimum of nonresorbed fibrin, foreign materials, or dead tissue, regeneration occurs rapidly, and the amount of fibrous tissue (adhesions) formed is minimized. Alternatively, if tissue regeneration occurs slowly or not at all, and the remaining tissue is hypoxic or damaged, then most, or all, of the repair will be composed of fibrous scar. Remember, the body must repair itself as fast as possible with whatever it has at hand.

Anything that delays the regeneration of normal peritoneum, generally reducing oxygenation to the tissue (i.e., causing hypoxia), for example by excessive damage to the surrounding blood vessels, by swelling decreasing blood flow, by strangulation with sutures, and so on, will delay the regeneration of new peritoneum and allow fibrous tissue to develop instead, resulting in adhesion and scar formation.

PRINCIPLES OF MICROSURGICAL TECHNIQUE

Understanding the tissue, and in particular the peritoneal surfaces that a reproductive surgeon is required to operate upon, the principles of the microsurgical technique will include (see also Box 22.1):

a. ***Minimization of tissue damage:*** Excess tissue damage during reproductive surgery can be caused by excessive manipulation of peritoneal surfaces, absence of continuous irrigation and

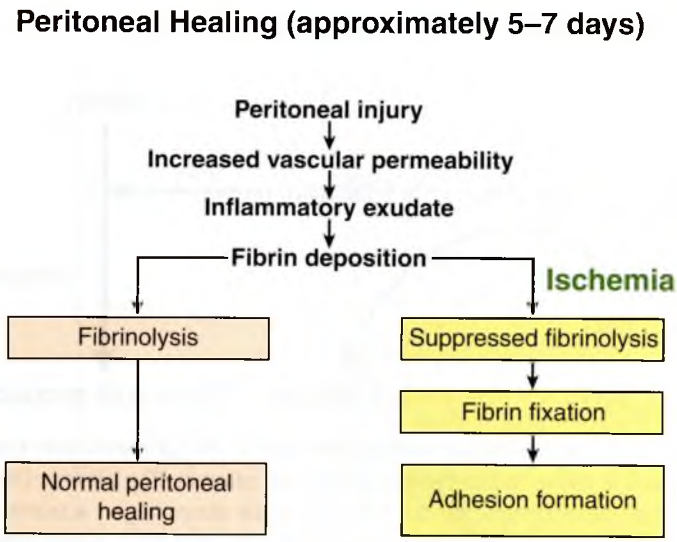

FIGURE 22.3 The steps of peritoneal healing are depicted: Injuries to the peritoneal surface can cause stimulation of mast cells, resulting in the release of histamine and vasoactive kinins. These substances cause an increase in capillary permeability that leads to the formation of an inflammatory exudate that, in turn, results in deposition of fibrin. Fibrinolysis is vital to the removal of this fibrin deposit. Under ischemic conditions that result from peritoneal injury, the tissue loses its abundant fibrinolytic activity. The fibrin is allowed to persist as re-epithelization occurs. The fibrin becomes covered with a mesolethial surface and, in some cases, actually undergoes endothelial cell migration and neovascularization. This process leads to adhesions. Adhesion formation, therefore, requires both raw surface areas weeping fibrin exudate, as well as the failure to readily remove fibrin by fibrinolysis.

hydration, suturing that strangulates or decreases tissue perfusion, and excessive use of hemostatic or destructive energy. Thus, careful consideration of where and when to use electrosurgery, or where, which, and how sutures are placed, should be continuously assessed during surgery.

b. ***Minimization of excess fibrin accumulation:*** As noted, adhesions form on fibrin scaffolds. Thus, meticulous irrigation and hemostasis should be maintained during microsurgical surgery, albeit not at the expense of excessive cauterization or suturing. Expectant management, followed by gentle washing of the tissues once a clot has had time to form, is the preferred technique for most minor bleeding.

c. ***Minimization of inflammation and infection:*** Inflammation can result from infection, foreign body deposition, excess necrotic tissue, etc. Inflammation will result in tissue swelling, uneven tissue perfusion, tissue hypoxia, and the deposition of inflammatory exudate, containing a myriad of macrophage and inflammatory cell products that accelerate the formation of fibrous tissue. Infection can also result in continued and progressive tissue damage long after the surgery is complete. Thus, in addition to minimizing the amount of compromised tissue and the deposition of foreign materials, careful avoidance of surgical site contamination, and vigilant postoperative monitoring for signs of incipient infection, with rapid and aggressive response, will be critical.

In addition, it will be important to minimize the amount of dead or necrotic tissue left behind. Leaving behind too much tissue that has been compromised and that will become necrotic ensures that there is a ready focus of inflammation and adhesion formation. Careful consideration of where sutures are placed or what blood vessels have been compromised will be critical to ensure that only a minimum of damaged tissue is left behind.

d. ***Minimization of foreign body deposition:*** Foreign bodies include not only suture materials, clips and the like, but also corn starch, cloth fibers, and other products from gloves, drapes, etc. These materials serve as irritants, increasing the formation of adhesions. Careful washing of gloves before surgery, minimizing the amount and gauge of sutures used, and avoiding the deposition of other foreign materials is paramount.

BOX 22.1

Principles of microsurgical/peritoneal approach

- *Minimizing tissue damage, by:*
  - Minimizing manipulation of peritoneal surfaces
  - Maintaining continuous irrigation and hydration of surfaces
  - Avoiding suturing that strangulates or decreases tissue perfusion
  - Avoiding excessive use of hemostatic or destructive energy
- *Minimizing excess fibrin accumulation, by:*
  - Frequent irrigation of accumulating fibrin
  - Maintaining meticulous hemostasis during surgery, albeit not at the expense of excessive cauterization or suturing
- *Minimizing risk and development of inflammation and infection, by:*
  - Minimizing the amount of compromised tissue and the deposition of foreign materials
  - Carefully avoiding surgical site contamination
  - Vigilant postoperative monitoring for signs of incipient infection, with rapid and aggressive response
  - Reducing amount of dead or necrotic tissue left behind
- *Reducing foreign body deposition, by:*
  - Minimizing the use, and the reactivity and diameter, of suture materials, clips, and the like
  - Reducing contamination by incidental materials, such as corn starch, cloth fibers, etc.

Surgeons in general, pelvic surgeons in particular, and every single reproductive surgeon, should ensure that they keep in mind at all times the principles of peritoneal anatomy and healing, microsurgery, as they perform their procedures.

Suggested Reading

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CHAPTER 23

Microsurgical Tubal Reanastomosis

Ricardo Azziz, Melinda Henne, M. Jonathon Solnik

INTRODUCTION

The microsurgical tubal (or "microtubal") reanastomosis (MTR) can be performed via laparotomy, minilaparotomy, or laparoscopy (either direct or by robotics), although the principles and precepts of the procedure remain the same. Surgeons today also need to understand the impact the advent of advanced reproductive technologies, and in particular in vitro fertilization (IVF), has had on the care of patients with prior tubal ligation and the selection of patients for MTR.

First, these procedures have created a viable option to MTR for many patients who have undergone a prior tubal interruption, particularly for those women who are younger, are willing to undergo more than one IVF cycle if necessary, and do not want more than one additional child. Alternatively, for women who have undergone a tubal ligation and desire more than one child, are concerned about the maternal and pediatric risks of multiple pregnancies, or are older (~38 years of age), MTR may prove to be a viable and useful alternative. Both types of procedures are expensive if the full cost is bore by the patients, and so finances are also a factor in the decision between MTR and IVF.

Second, we should note that as the number of patients who undergo IVF has increased, the number of MTR procedures performed has declined, decreasing the availability of skilled and experienced reproductive surgeons.

PREOPERATIVE CONSIDERATIONS

Factors affecting pregnancy success following MTR include: a) total tubal length remaining (>4 cm best); b) type of sterilization (Pomeroy, clip, and ring sterilization best); c) site of reanastomosis (isthmic–isthmic best); d) time from sterilization (the less time the better); e) techniques employed (microsurgical technique best); f) surgeon expertise (best if done more than 50 cases); g) patient's age (younger the better); and h) presence or absence of other infertility factors. In well-selected patients, MTR results in 60% to 80% intrauterine pregnancy rates.

Thus, careful patient selection is critical prior to undertaking the procedure. Usually this should include a review of the prior tubal ligation (tubal interruption) operative note, and the associated pathology report if pertinent, along with a brief assessment of the couple's fertility potential. The latter should include a semen analysis, ovulation monitoring, and ultrasonographic assessment of the uterine and pelvic anatomy. In women who are older, say over the age of 35 years, or who have begun to experience other concerning signs or symptoms, including irregularity in menstrual cycles, vasomotor flushing or hirsutism, intermittent or persistent pelvic pain, and dyspareunia, a more comprehensive evaluation may be required.

The presence of obesity should also be a consideration, as it not only impacts on the obstetrical outcome of any resulting pregnancy but also on the technical ease and feasibility of the MTR itself, at least via laparotomy or minilaparotomy. Thus, many reproductive surgeons advise obese patients to lose weight prior to an MTR, if age is not an issue.

Of importance, and beyond the scope of the current discussion, is for the surgeon to recognize the various types of tubal ligation or interruption performed, as some are not amenable to reanastomosis. Only those anastomoses in which relatively healthy and sufficient tubal segments are left behind should be attempted, including those with a total tubal length of at least 4 cm and in which the intramural and fimbriated portions of the tube are preserved. For example, tubal ligation by fimbriectomy or sterilization using cornual occlusion (e.g., using the Essure® and Adiana® procedures) are not amenable to reanastomosis. Likewise, patients who have undergone a monopolar "triple-burn" tubal interruption often have so much destruction of the tube that MTR is not possible.

The condition of the intramural and proximate portions of the occluded tube can be assessed preoperatively using a hysterosalpingogram (HSG). Assessment of the proximate portion of the tube is particularly critical in patients who have undergone cauterization of the tubes, either as the primary interruption procedure or after the tubes have been severed. While the condition of the uterine cavity today can be easily and less invasively assessed using transvaginal ultrasonography and/or sonohysterography, these procedures are not helpful in visualizing the intramural/proximate portions of the occluded fallopian tube.

If no portion of the occluded tube is visualized by HSG, it is possible that most, or all, of the intramural portion of the fallopian tube has been destroyed, often by excessive use of electrosurgery at the time of the original tubal ligation. If this is the case, the prognosis for a successful MTR is significantly reduced. This information will help in guide the surgeon at the time of the procedure, allowing him/her to know how far back they may need to resect the proximal portion of the tube before a healthy lumen is identified; arrangements to have the HSG films available for intraoperative examination at the time of the MTR should be made. This information may also help in counseling the patient concerning the best method of approaching her secondary infertility.

The condition of the distal portion of the occluded/interrupted fallopian tube may be guessed at preoperatively based on the description provided in the tubal ligation procedure note. This report should optimally note whether or not periadnexal or peritubal adhesions or endometriosis were observed and the condition of the tubal ostia and fimbria. In addition, particularly in those procedures where a portion of the tube is resected (e.g., Pomeroy's tubal ligation), a description of what tubal length was removed and confirmation of the same by the pathologic report is also helpful. Unfortunately, because the original operator is often focused primarily on destroying the fallopian tubes, not considering that the patient may change her mind and desire later fertility, often little useful description is available in the tubal ligation operative note beyond the type of procedure performed.

In patients scheduled to undergo a laparoscopic MTR, the absence of such information is offset by the fact that at the time of surgery the operator will be able to inspect the pelvis in a minimally invasive fashion. Alternatively, for those surgeons who are planning to perform the MTR via laparotomy, consideration should be given to performing a concomitant initial laparoscopy if the condition of the distal segment of the tubes is unclear (e.g., in "triple-burn" procedures). In these circumstances, only if the tubal condition appears to be favorable at laparoscopy should the surgeon proceed with the laparotomy and MTR or laparoscopic MTR.

For this the patient may be placed supine on the operating table, an insufflating needle placed through the umbilicus and a laparoscope placed as per routine. Manipulation of the uterus and adjacent structures through a vaginally placed sponge on a grasper, or via a suprapubically placed probe, is usually sufficient to expose the tubal ligation sites. Performing the diagnostic laparoscopy on a day separate from the MTR is not recommended, due to the added costs and risks, except when a more thorough discussion of the pelvic findings with the patient may alter the decision for surgery.

SURGICAL TECHNIQUE

The MTR is a microsurgical procedure, in other words a reproductive surgery that utilizes sutures best viewed with magnification, that is, equal to or smaller than 8-0G. These procedures usually call for the use of magnification of some type, either using magnifying loupes (1.7× to 6×) or an operating microscope (2× to 40×), although the need for magnification obviously varies according to the surgeon's visual acuity. Some of us even use loupes when performing macroscopic surgical procedures, a response more to failing eyesight than the need for microsurgical technique.

However, the true basis of microsurgery, as discussed in Chapter 22, is not the size of the sutures used or the degree of magnification utilized. The success of reproductive microsurgery principally lies in the ability of the surgeon to intimately understand the tissues that she/he is operating upon, thus minimizing the degree of tissue damage. Reproductive surgeons should be well acquainted with what is commonly called the *microsurgical technique*, as its principles are applicable to surgery in general, and to reproductive organ surgery in particular. Following we will review the surgical technique of MTR step by step, initially describing the procedure when performed by laparotomy (see also video: *Microsurgical Tubal Reanastomosis*). However, during the entire procedure surgeons should be fully aware and use all principals related to micro or peritoneal surgery.

1. **Ensuring all necessary instruments are available and ready:** In addition to the standard laparotomy instruments, specialized instruments for microsurgery should be available. The microsurgeon should have intimate knowledge of the surgical instruments used during an MTR (see **Box 23.1** and **Figure 23.1**) and should check them immediately before surgery to ensure they are available on the surgical table and are in good working condition, as these delicate instruments are easily damaged during sterilization and storage.

   A needle or wire-tip monopolar electrosurgery tip (0.3 mm or less) should be available and should be set to 10 W cutting current or less, depending on the electrosurgical unit, and the patient appropriately grounded. The tip should not become red hot or melt when the current is turned on; otherwise the wattage should be reduced. Likewise, if the instrument does not cut through fine adhesions, cauterizing them instead, the wattage should be increased slightly. In addition a fine bipolar forceps (e.g., McPherson curved bipolar uncoated forceps, 3½ inch in length with 5-mm tips) should be available.

   Continuous irrigation of the surgical site to minimize the risk of desiccation is critical to the success of the procedure. This surgeon prefers the use of Lactate Ringer's as there is some evidence to indicate that this isotonic crystalloid solution causes less peritoneal swelling than other solutions. To the extent possible the fluid should be warmed to body temperature, but no more, to avoiding freezing or scalding the peritoneal surfaces. Various filled syringes with 20-18G IV catheter (e.g., Angiocath®) tips should be available for this purpose.

   Before beginning, the surgeon should also examine and set up the operating microscope, if one is available and to be used, fixing the height and separation of the ocular pieces. The microscope should also be sterilely draped at this time. In addition, if magnifying loupes are to be used, they should be put on.

2. **Preparation of the surgical field:** Before proceeding further the surgeon should wash his/her gloves off with irrigating fluid, which is then discarded, to remove any potential contaminating talc or, more commonly, corn starch.

   a. **Ensuring access:** Ensuring adequate access to and exposure of the surgical site is critical, and greatly depends on the patient's body mass. In thinner patients access to the surgical site can be achieved easily through

BOX 23.1

Specialized instruments necessary for microtubal reanastomosis

- Buxton uterine manipulator
- 22 to 20G IV catheter (e.g., Angiocath®) for transfundal chromotubation
- 20 to 18G IV catheter (e.g., Angiocath®) and 20 cc syringes for irrigation
- Electrosurgical wire-tip (0.3 mm or less) electrode
- Microbipolar (with tips 5 mm or less)
- Fine-tip suction probe
- Atraumatic tubal graspers
- Atraumatic ovarian graspers
- Jeweler's forceps
- Micro-Adson forceps, with and without teeth
- Straight and curved iris scissors
- Microsurgical (microinfertility) scissors
- Locking and nonlocking microsuture holders (Castroviejo)

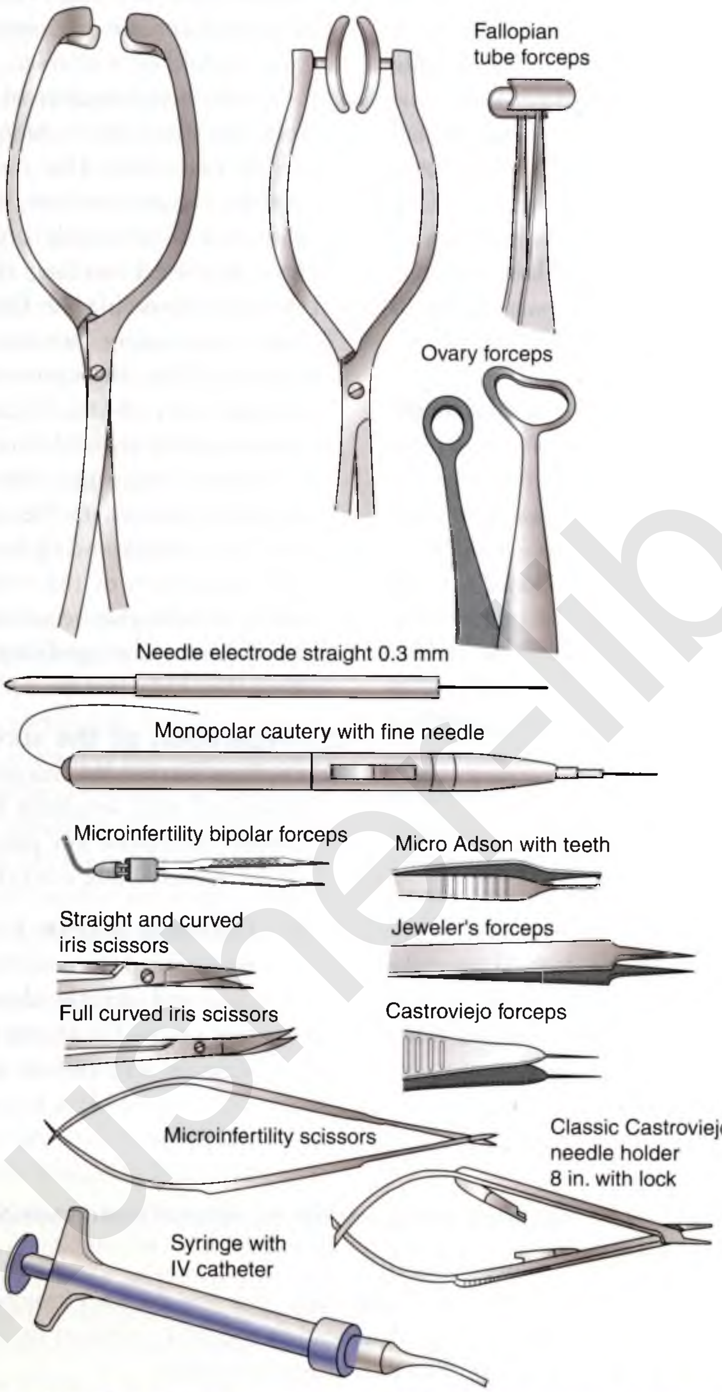

FIGURE 23.1 Common microsurgical instruments used for MTR.

a small Pfannenstiel or minilaparotomy incision. Alternatively, access to the pelvic cavity of an obese patient is more difficult, and may require a more extensive abdominal port, including a Mallard incision. And even in this setting, it may be difficult to operate on a very obese patient due to the short length of most microsurgical instruments. Thus, many surgeons consider marked obesity to be a relative contraindication to MTR via laparotomy, and either suggest weight loss, if time and patient inclination permits, or performing the procedure via laparoscopy. Once an incision has been made, the sides of the wound are often wrapped in lap packs to minimize bleeding into the surgical site.

b. **Examining the anastomosis sites and surroundings:** At this point the surgeon should examine the surgical site, determine the status of the tubes and adjacent pelvic organs, ensure adequate exposure of the surgical field, and arrange the surgical field. In most circumstances, the surgeon should have determined the adequacy of the tubes for reanastomosis preoperatively, or at least before performing the laparotomy (see above). However, the surgeon should verify his/her preoperative assessment directly.

c. **Exposing the anastomosis site and ensuring a surgical platform for the microsurgical reanastomosis:** The bowel is gently packed away from the pelvis, over the pelvic brim, a procedure assisted by placing the patient in moderate Trendelenburg. This surgeon prefers to use laparotomy packs placed inside sterile plastic sandwich bags, one per bag, thus protecting the peritoneum from abrasion by this material. It also allows the bagged laparotomy packs to be used as the surgical platform upon which the anastomosis is performed (see below).

d. **Establishing an avenue for intraoperative chromotubation:** Next, a method for intraoperatively insufflating the tubes with a dilute solution of saline and indigo carmine (chromopertubation) is readied. One method is to place a small pediatric Foley bulb into the uterine cavity vaginally once the patient is draped, and then chromotubating with indigo carmine as needed via a syringe held by an assistant. While this is a simple method, this surgeon prefers to chromotubate through the uterine fundus, in order to minimize the risk of tubal contamination by vaginal organisms.

First, a Buxton uterine manipulator is placed abdominally, which not only allows for atraumatic manipulation of the uterus during surgery but also can be used to clamp the cervical os closed (**Figure 23.2**), allowing for transfundal chromotubation. Grasping the uterus at its base, a 20G needle and IV catheter is then placed through the fundus of the uterus, at a point midway between each tubal insertion and in the direction of the uterine cavity, until a gentle pop is felt when entering the cavity.

A syringe containing indigo carmine is connected via an IV connector to the IV catheter, after all air has been expressed from the line and the IV catheter needle has been removed. Proper placement of the IV catheter into the uterine cavity can be verified when symmetric distention of the uterus is palpated (and often seen) as insufflation of dye via the syringe is pulsated. A moderate amount of skill is necessary

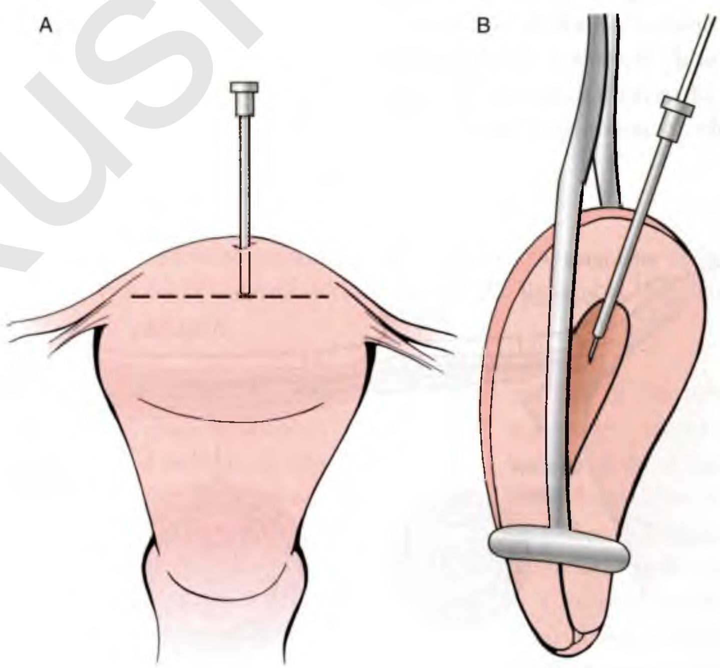

FIGURE 23.2 Insertion of the transfundal chromotubation catheter, including top (A) and lateral transverse (B) views.

to place the IV catheter transfundally correctly into the uterine cavity and, of course, a relatively normal uterus is necessary. Only at this point is the surgeon ready to proceed with the actual tubal reanastomosis.

3. **Preparation of tubal stumps and anastomosis site anchoring:** Microsurgery of the tubes, including dissection, preparation, and reanastomosis, is best performed over a stable platform of uniform height (to facilitate manipulation of the tubes while keeping tissues in within the focal length of the microscope. We use bagged laparotomy packs placed into the cul-de-sac as a suitable and stable platform.

The preparation of the tubal stumps varies according to the type of anastomosis to be performed, whether it is isthmic–isthmic, ampullary–ampullary, or isthmic–ampullary, and reference to these types will be made below (**Figure 23.3**). Different types of anastomosis may be necessary for each side. Less frequently performed anastomoses, such as the cornual–isthmic or cornual–ampullary (i.e., anastomosing the intramural portion of the tubal lumen to the distal isthmic or ampullary lumen) will not be discussed further, as these patients should preferably be treated by IVF.

In preparing and opening the lumens of the tubal segments for anastomosis, the surgeon should keep in mind two factors that will improve the success of the procedure. First, the proximal and distal lumen diameters opened should be as similar in size as possible. Second, the tubes should be, and should heal, as free of peritubal and tubo-ovarian adhesions as possible to maximize their mobility during ovulation.

a. **Exposure and preparation of the proximal (uterine side) stump:** Exposure and preparation of the tubal stumps can usually be accomplished by either direct visualization, or better still using magnifying loupes. While an operating microscope is not necessary for this part of the procedure, it may be useful when opening the lumen in the distal ampulla of an isthmic–ampullary reanastomosis (see below).

i. **Proximal isthmic segment:** In the vast majority of patients the proximal stump will be 0.5 to 2 cm in length, representing an isthmic interruption. The distal portion of the proximal tubal stump will be buried in the adhered mesosalpinx that connects the proximal and distal tubal stumps. The tube should be grasped with a jeweler's forceps, or preferably an atraumatic tubal grasper, and the occluded distal end is released and cleared of surrounding mesosalpinx and adhesions using the wire-tip electrosurgery (**Figure 23.4A and B**).

Care should be taken to not undermine excessively the tube during this process, a constant temptation, as the proximal stump will have to be approximated to the distal stump and anchored via the mesosalpinx (see below), which will be made more difficult if excessive undermining of the tube has occurred (**Figure 23.4C**). Furthermore, excessive undermining will risk bleeding and may compromise the inferior tubal blood vessels, increasing the risk of tissue hypoxia. Hence, it is preferable at this point to do less than too much. The surgeon can always undermine the tubal stumps further as needed.

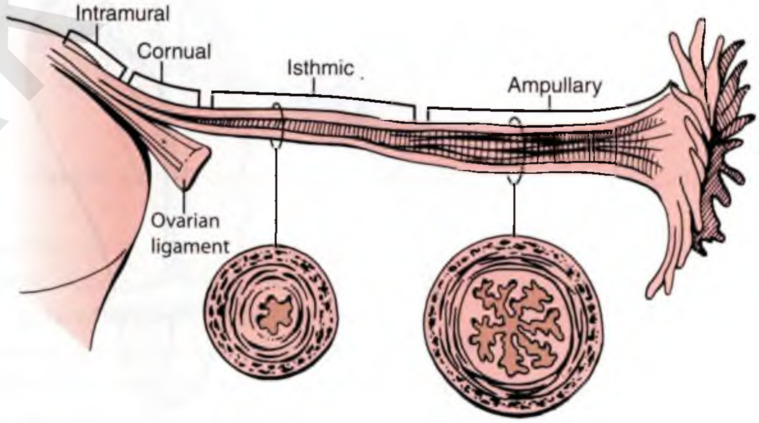

FIGURE 23.3 Transverse tubal anatomy, indicating layers of muscle/serosa from intramural seg ment to ostia.

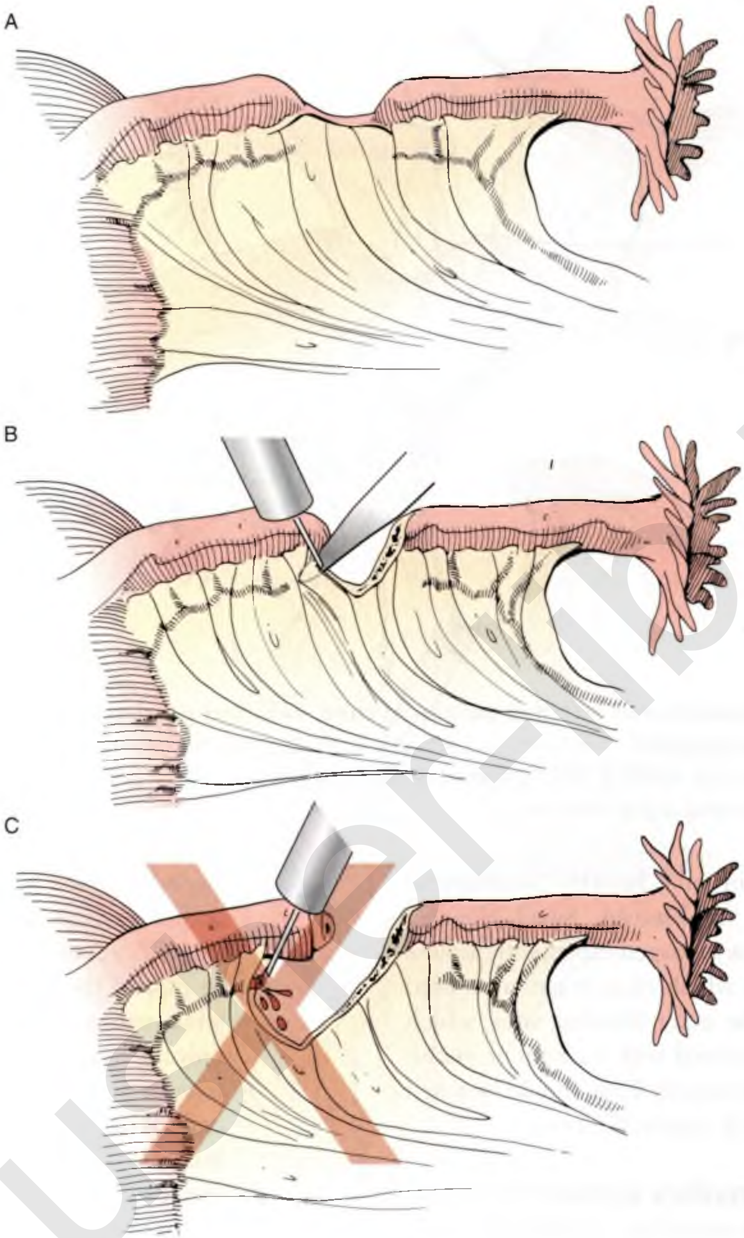

FIGURE 23.4 Exposure and preparation of tubal stumps. Before (**A**) and after correctly undermining tubal stumps (**B**). Incorrectly/excessively undermined tubal stumps (**C**). Note tubal and uterine blood vessels.

The distal occluded stump of the tube is then distended by gentle chromotubation, and the tip of the occluded isthmic stump grasped with a small Addison's (toothed) forceps and pulled outward. Using iris scissors placed perpendicular to the long axis of the tube, the occluded portion of the tube is resected, in one single stroke if possible (**Figure 23.5A**). Care should be taken not to try and create a flat end. In fact, if the transection has been done correctly the cut end of the tube will extrude in a conical fashion, as muscularis expands outward (**see Figure 23.6C**). Trimming the endosalpinx should be avoided; rather the surgeon should push the mucosal folds into the lumen when later performing the anastomosis.

Chromotubation is gently continued and if no obvious tubal patency is observed, the tubal stump is regrasped at its tip, over the site of the putative lumen, and another transaction performed. This process is repeated

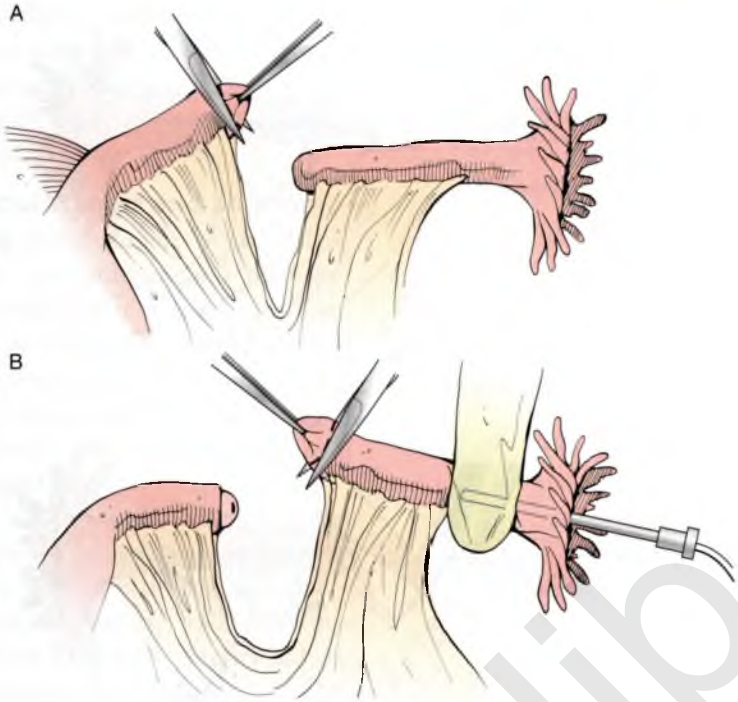

FIGURE 23.5 Transection of occluded portion of tube, including proximal isthmic stump (A) and distal ampullary stump (B). This latter transection is facilitated if the surgeon distends the occluded distal ampullary segment by inserting an IV catheter sleeve through the tubal fimbria and gently occluding the surrounding ostia using digital pressure.

until a patent and healthy (nonfibrotic) tubal lumen is observed. Small bleeding encountered is managed expectantly, unless persistent, in which case irrigation is used to uncover the exact bleeding sites, which are then cauterized with wire-tip or micro-bipolar electrosurgery. Care should be taken to continuously irrigate the tissues.

ii. **Proximal ampullary segment:** If the proximal stump is ampullary (meaning the tube has been interrupted in the ampullary region, the diameter of the lumen will be larger than if it were isthmic. As the distal stump that the proximal ampullary stump will be reanastomosed to will also be ampullary (see below), it may be best to await for exposure and preparation of the distal segment before opening the proximal lumen, to maximize the chances that the tubal lumen will be as close in diameter as possible. In either case, a perpendicular transection using iris scissors of the occluded portion of the proximal ampullary stump will likely be the best approach to prepare this tubal segment for anastomosis.

However, we should remember that the ampulla is less rigid (has less muscularis), and has a larger and more convoluted lumen due to more extensive mucosal folds, than the isthmus. Thus, continued gentle chromotubation to expand the occluded ampullary segment while transecting it is critical to ensure that only the minimum amount of tissue required to open the lumen is removed. In fact, it generally is best not to open the full tubal lumen, but only enough for the lumen to be visible and patent to chromotubation. The lumen can always be opened further if necessary.

b. **Exposure and preparation of the distal stump:** Attention is then paid to the distal tubal stump. The occluded tip of the tube is covered by adhesions and mesosalpinx, and the tube is grasped atraumatically, and freed using the wire-tip electrosurgery. Care not to excessively undermine the tube and to minimize damage to the inferior tubal vessels, should be made. At this point the occluded portion of the distal stump must be opened, and there are various approaches to do so, depending on what the proximal and distal segments of tubal stumps are, whether isthmic or ampullary.

i. **Isthmic–isthmic segments:** If both the proximal and distal tubal segments are

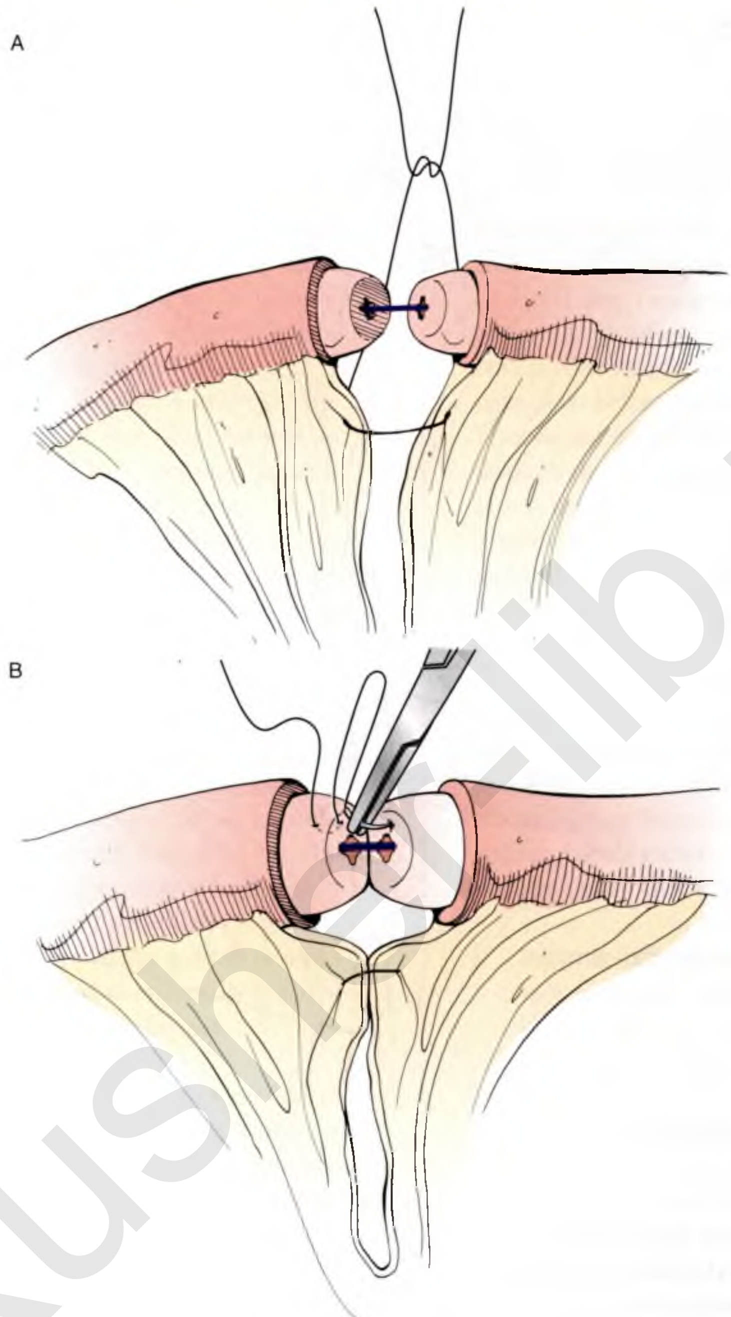

FIGURE 23.6 Isthmic–isthmic anastomosis, including anchor stitch placement (A); anastomosis of the tubal muscularis (B and C); and tubal serosa and mesosalpinx closure (D). *(Continued)*

isthmic, then the distal stump should be prepared and opened in the same manner as the proximal isthmic stump (see above). The surgeon should test the tension on freed stumps, by pulling the tubal ends to be anastomosed together. There should be no tension. At this point, some surgeons elect to thread a stent through the tubal ostia (see below) into the isthmic lumen to facilitate the subsequent reanastomosis.

ii. **Ampullary–ampullary segments:** The occluded ampullary stump is freed from overlying adhesions and mesosalpinx, and the tension between the two stumps tested. If the distal segment of the tube is ampullary, the approach taken to open the lumen will depend on the size of the lumen on the proximal tubal segment. If the proximal segment is also ampullary then a simple, single stroke perpendicular transection may be appropriate.

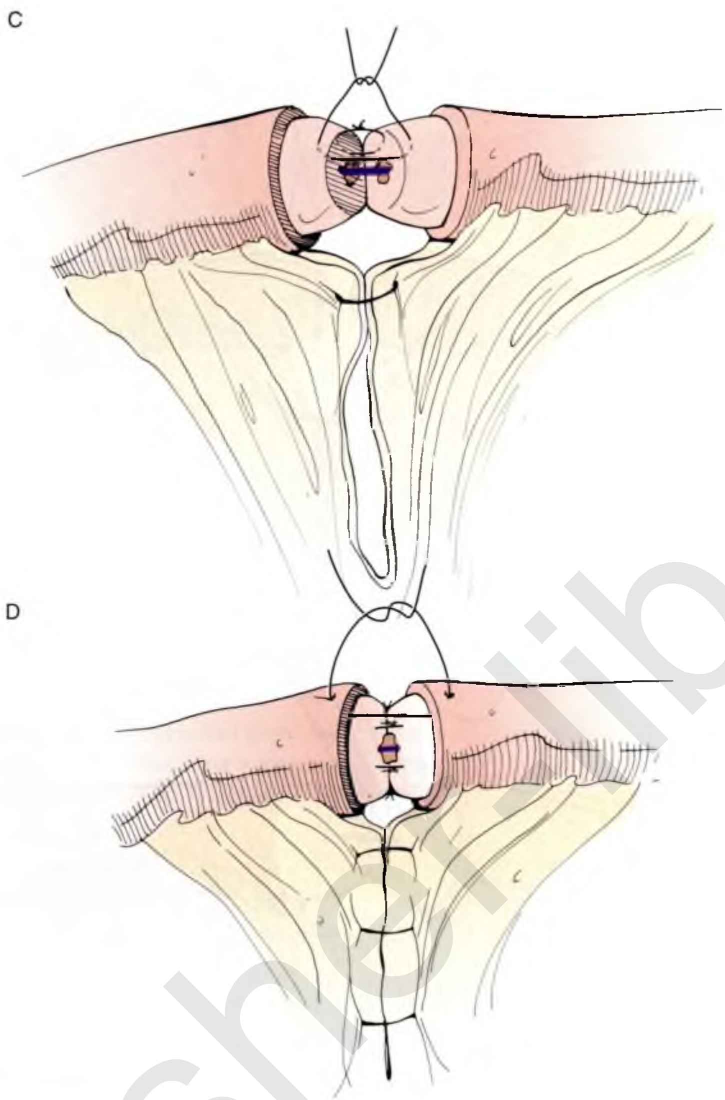

FIGURE 23.6 (*Continued*)

However, before doing so the surgeon should recognize that the distal ampullary lumen will be larger than that of the proximal segment.

Thus, care should be taken to only open a section sufficient in size to match that of the proximal segment. One way to visualize and control for the size of the proximal lumen is to distend the tube by chromotubation (see above). Similarly, the surgeon can distend the occluded distal ampullary segment by inserting an IV catheter sleeve through the tubal fimbria and gently occluding the surrounding ostia using digital pressure (**Figure 23.5B**). The IV catheter is connected via an IV connector to a syringe containing indigo carmine, which the assistant gently injects. In this manner the outline of the tubal lumen can be clearly visualized, and a more controlled transection can be performed.

iii **Ampullary–isthmic segments:** If the distal segment is ampullary and the proximal segment is isthmus, again the occluded ampullary stump is freed from overlying adhesions and mesosalpinx, and the tension between the two stumps tested. In this situation, the lumen of the ampullary segment needs to be opened in such a way as to match as closely as possible the size of the isthmic lumen (see below).

4. **Performing the reanastomosis:** Once both occluded ends of the tubal segments are mobilized and lumens open, the surgeon is ready to perform the reanastomosis.

a. **Anchor stitch:** The next step is to place the anchor stitch so as to position both lumens to be reanastomosed facing each other as close as possible, without unduly distorting the normal anatomy. Much will depend on how well the tubal stumps were undermined. Generally, and as noted above, it is best to leave sufficient mesosalpinx beneath the transected portions of the tubes so as to allow proper positioning of the lumens (**Figure 23.6A**). This step can be performed by direct visualization or using magnifying loupes.

The anchor stitch is placed through the mesosalpinx as closely to the tubal lumens as possible, ensuring that the apposing lumens touch each other at the same height without tension. Alternatively, the anchor stitch placement should also allow sufficient tubal segment mobility for the anastomotic sutures to be placed through tubal muscularis (see below). The stitch may have to be replaced more than once before tying down, to ensure correct placement. The suture is placed through and through the mesosalpinx, generally beginning and ending on the lateral aspect of the tube, so as to place the knot away from the ovary and minimize the risk of tubo-ovarian adhesions, which could compromise the free mobility of these organs at the time of ovulation. Generally, a 3-0G or 4-0G absorbable or nonabsorbable minimally reactive suture on a noncutting needle is used.

b. **Reanastomosis:** The reanastomosis portion of the tube involves the reconnection of the muscularis and the serosal layers of the tubal segments. While an operating microscope is not necessary when performing an ampullary–ampullary reanastomosis, which can be easily performed using loupes, an operating microscope will be useful when performing isthmic–isthmic and isthmic–ampullary reanastomoses.

We prefer to use 8-0 to 10-0 non-absorbable monofilament suture on a cutting needle for the inner (muscularis) layers of the anastomosis. The handling and control of sutures this size requires skill and training, and there are a few nuances that should be kept in mind. First, a demagnetizer should be available on the field, since the microsurgical instruments (e.g., needle holder) often become magnetized making it difficult to control the needle.

Second, care should be taken to keep the needle under direct visualization at all times, to ensure it is not accidentally pulled off and misplaced. If a needle of this size is lost in the patient it generally cannot be detected by x-ray, and in fact, may be left behind, as it often cannot be located and the risk of organ damage is minimal. To minimize the risk of loss, it is best to continuously stick the needle back into the foam pad of the suture package when not in use.

Third, the needle should be grasped at its midpoint to insert, and the surgeon should ensure the needle is directed in the correct direction before advancing into the tissue. The suture should be advanced progressively through the muscularis following the curvature of the needle. We should note that the needle is quite fragile and easily bent or broken if an attempt to redirect the path of the suture is made by trying to redirect the needle once it is lodged in the tissue. Finally, the surgeon should avoid anything that could worsen hand tremor, including excessively strenuous exercise, nicotine, and caffeine, in the hours prior to surgery.

Finally, approximation of the overlying tubal serosa is generally accomplished with interrupted stitches, using either a 7-0 or 8-0 absorbable or nonabsorbable suture on a noncutting needle.

i. **Isthmic–isthmic reanastomosis:** With the two apposing isthmic lumens are touching without tension, isthmic–isthmic anastomosis is accomplished in two layers (the inner muscularis and outer serosal layers). The surgeon should push the endosalpinx into the lumen while performing the anastomosis, rather than trimming the mucosal folds.

To anastomose the inner layer, sutures are placed through the tubal muscularis, beginning and ending on the outer aspect of the layer ("out-to-out"), so keep the knots away from the lumen (**Figure 23.6B and C**). In general, placing the suture through the tubal lumen should be avoided. Some surgeons find that a previously placed stent is helpful to visualize the lumen fully. Sutures are placed in order, beginning at 6 o'clock (lower part of lumen), then 3 o'clock (inner lateral aspect), 9 o'clock (outer lateral aspect), and 12 o'clock (upper aspect).

The muscularis sutures are tied using an instrument tie, using the curved needle driver to wrap the longer end of the suture three times around a straight or curved jeweler's forceps, then using the forceps to grasp the shorter end of the suture and pulling the throw through. Three throws of the knot are placed, taking care to lay each throw down in apposing direction to the one below. Some surgeons prefer to not tie the sutures as they are being placed, and tag them instead with rubber-shod hemostats until they are all placed. They are then tied at the same time. Other surgeons find it easier to maintain a clearer surgical field and tie the sutures as they are placed.

Once the muscularis sutures have been placed, gentle chromotubation is attempted and spillage of dye through the tubal ostia (i.e., tubal patency) should be observed. It is normal to have a small amount of leakage around the anastomosis site.

The overlying tubal serosa is then approximated using three or four interrupted stitches (**Figure 23.6D**). Care should be taken not to place the sutures too deeply, risking occluding or distorting the anastomosed lumen. Overzealous peritoneal suturing should be avoided, and if larger areas of peritoneum are missing they should be left as is, rather than place sutures under tension that may distort the tubal course and cause a greater degree of tissue strangulation.

At this point, the peritoneal window underlying the anastomosis site is closed with two or three interrupted stitches (**Figure 23.6D**), beginning and ending on the lateral aspect of the mesosalpinx, so as to leave the knot away from the ovary.

ii. **Ampullary–ampullary anastomosis:** Like the isthmic–isthmic anastomosis (see above), the ampullary–ampullary anastomosis can also be accomplished in two layers. However, the walls of the ampulla proper are thinner and contain relatively less muscularis than that of the isthmus, and it may be easiest to perform the anastomosis using a single-layer closure technique (**Figure 23.7**). Four to five interrupted 8-0 to 10-0 nonabsorbable stitches on a cutting needle are placed through the full thickness of the ampulla wall, "out-to-out." The surgeon should try to minimize placing the sutures within the lumen, although may not always be possible when ensuring a solid anastomosis.

iii. **Isthmic–ampullary anastomosis:** One of the difficulties with this type of procedure is the difference in the lumen sizes of the isthmus and the ampulla. The easiest way to ensure relatively similar lumen sizes is to thread the tip of an IV catheter (18G) through the fimbriated opening of the tube. The catheter is connected to a syringe containing indigo carmine

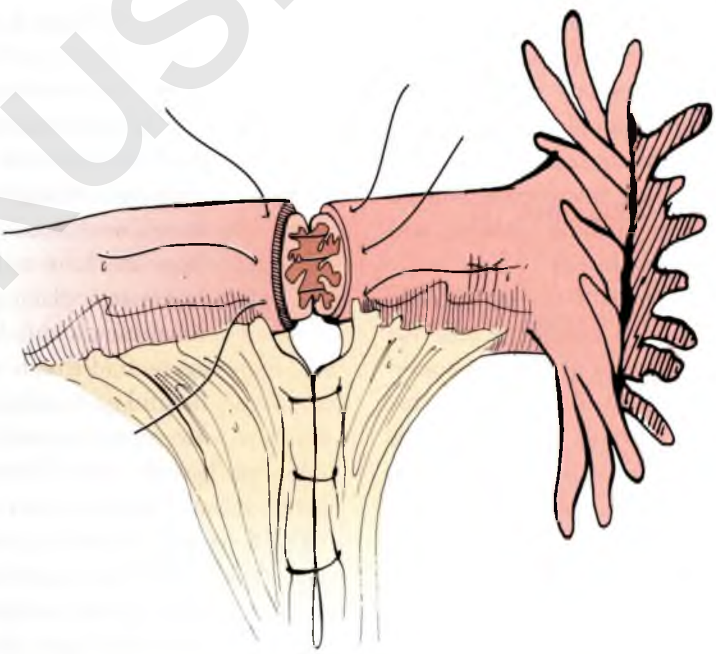

FIGURE 23.7 Ampullary–ampullary anastomosis by single-layer anastomosis.

(see above), with the needle removed (**Figure 23.8A**). The IV catheter should be advanced so as to push the occluded end of the tube outward, using periodic chromotubation to help delineate the lumen and guide the progress of the IV catheter.

When the IV catheter is tenting the occluded section of the ampulla and is as straight as possible, the catheter needle is threaded through the sleeve, taking care not to cut through the wall of the catheter, and pushed through the occluded wall of the ampulla. The entire IV catheter is then advanced and surrounding serosa resected back using microscissors to expose a sufficient amount of the lumen so as to match the size of the proximal isthmic lumen diameter.

Once both the proximal and distal lumens are open, some surgeons elect to thread a stent (generally a colored nonabsorbable flexible

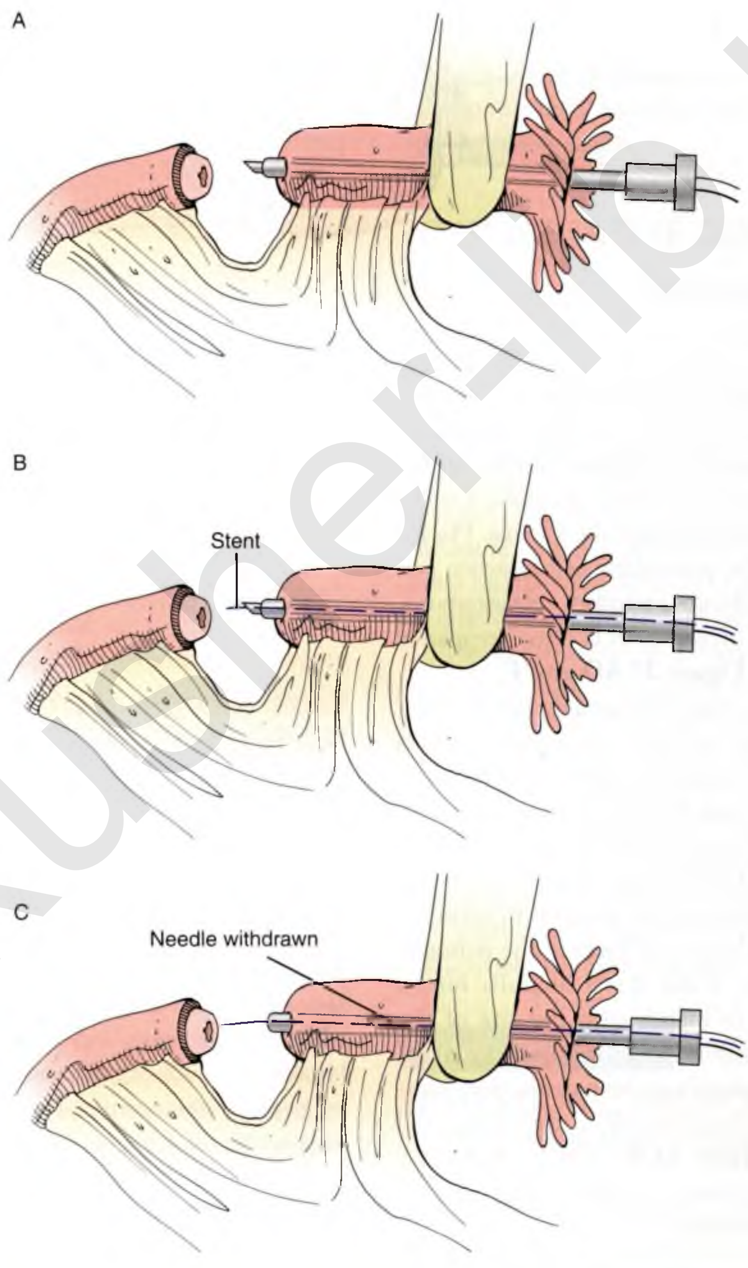

FIGURE 23.8 Isthmic–ampullary anastomosis by (A) making small opening through the occluded portion of the proximal ampullary segment using an IV catheter needle often guided by the placement of a stent, using a 0 gauge dyed monofilamentous suture (B and C). The anastomosis is typically accomplished using simple interrupted sutures with 8-0 or 10-0 suture on a cutting needle (D and E). ***(Continued)***

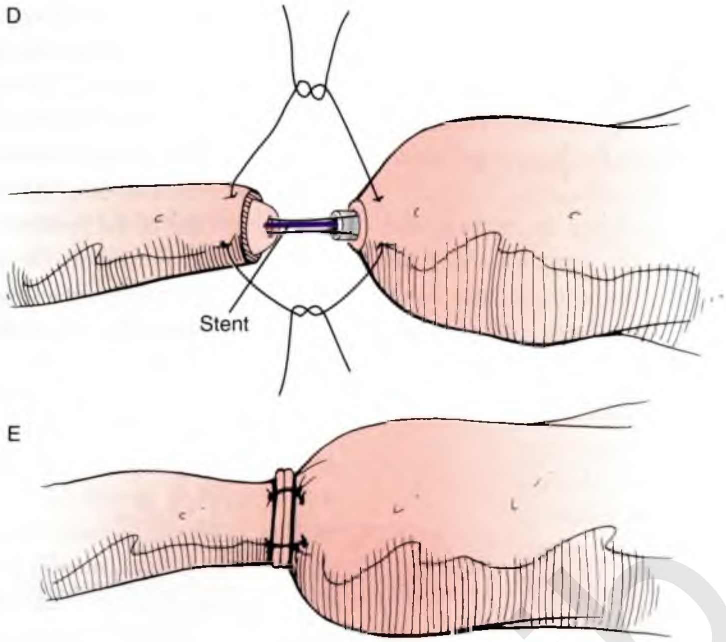

FIGURE 23.8 *(Continued)*

0G suture, such as 0-nylon) through the catheter into the isthmic to facilitate the subsequent reanastomosis (**Figure 23.8B and C**). Stretching the suture first will make it easier to pass the stent through the lumens. Placing a stent may be particularly helpful when performing a isthmic–ampullary reanastomosis. This type of anastomosis is often completed in one layer (**Figure 23.8D and E**).

Assuming that the lumens are of similar size, four or five interrupted sutures "out-to-out" (again using 8-0 to 10-0 non-absorbable monofilament suture on a cutting needle) are placed. Some degree of dissection of the serosa overlying the tip of the ampulla may be needed to allow its suturing to the serosal layer of the isthmus. Alternatively, if the distal ampulla lumen is too large to match with the size of the proximal isthmus opening, then the distal ampullary lumen can be narrowed by closing the opening partially using interrupted sutures (**Figure 23.9**). Once completed, any stent placed to guide the suturing should be removed.

5. **Completing the procedure:** Once both tubes have been reanastomosed and patency has been confirmed, all instruments and packs are removed from the pelvis, and the pelvis and abdomen are thoroughly irrigated and suctioned. The anastomosed tubes and ovaries are carefully allowed to fall into the cul-de-sac freely, checking for tension and misplacement. Some surgeons elect to also place an absorbable anti-adhesive barrier (e.g., Interceed®) over the anastomoses. The pelvis is then closed in the usual fashion.

Laparoscopic microsurgical tubal reanastomosis

Laparoscopic microsurgical tubal reversal, particularly if robot-assisted, provides the ability to mimic the open approach while maintaining a closed environment. Like open microsurgery, the robot-assisted surgical approach allows for two-layer closure of the muscularis and serosa with fine absorbable (or non-absorbable) sutures. It also minimizes tissue desiccation, potentially reducing adhesion formation and improving surgical outcomes. However, in general, similar intrauterine and ectopic pregnancy rates occur following traditional laparoscopic surgery and minilaparotomy.

Compared to traditional laparoscopy, robot-assistance affords greater ease of tissue manipulation and less physical stress for the surgeons performing the procedure. Compared outpatient minilaparotomy the robot-assisted laparoscopic tubal reanastomosis requires greater surgical and anesthesia times, although return to normal -activity was shorter with the robotic

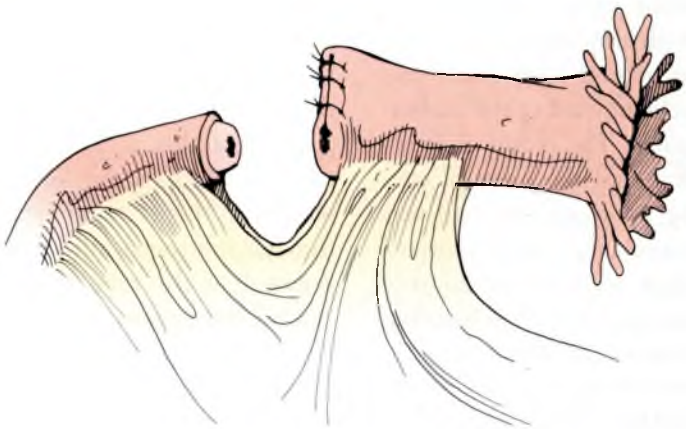

FIGURE 23.9 In an isthmic–ampullary reanastomosis, if the distal ampulla lumen is too large to match with the size of the proximal isthmus opening, then the distal ampullary lumen can be narrowed by closing the opening partially using interrupted sutures.

technique. (see also video: *Robot Assisted Laparoscopic Microsurgical Tubal Reanastomosis*).

Procedure in brief

1. The mesosalpinx is dissected from the underlying segments of fallopian tube to generate sufficient mobility in order to reduce subsequent tension on the muscularis at the anastomosis site.
2. Transection of the muscularis/mucosal layers exposing the tubal lumina is performed sharply with scissors and bleeding vessels are cauterized. Electrosurgical energy is not applied to the mucosal or muscularis layers. Tubal patency can be confirmed by use of a stent and/or chromopertubation of the proximal segment. A stent may also be placed to align the juxtaposed tubal lumina as a guide for approximating the muscularis. Some surgeons have advocated the use of a "suture-less" approach, basically entailing the use of a transuterine placed tubal stent and the use of two external metallic clips to approximate the anastomosis site.
3. The mesosalpinx is approximated with at least one interrupted absorbable suture to reduce tension at the tubal anastomosis site and align the tubal lumina, which are approximated by circumferential interrupted absorbable suture. In general, the 6 o'clock suture is placed first, and the subsequent sutures are placed based on difficulty of positioning and visualization, with the simplest sutures placed last.
4. A second layer of similarly sized interrupted or running absorbable suture may be placed approximating the serosa. Easy passage of a stent and/or chromopertubation confirms tubal patency.

POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see **Complications** box on page 207). Postoperative management should follow the general principals determined by the type of abdominal incision, including rapid ambulation. Care should be given to watching for any signs of incipient infection, including low grade temperatures, and white count elevations. As even a small amount of infection around the anastomoses can significantly reduce the success of the procedure, any sign of developing infection should be treated aggressively.

Patients should be instructed to use barrier contraception when having coitus in the first 60 postoperative days. Pregnancy can then be attempted. They should also be counseled regarding a higher rate of ectopic pregnancy, which can be as high as 10% of all pregnancies following MTR. An HSG is performed three to four months postoperatively to further determine anastomosis success. If the patient has not conceived within 12 months of surgery, consideration may be given to performing a laparoscopy, and possible salpingo-ovariolysis if necessary.

Operative Note

PROCEDURE: MICROSURGICAL TUBAL REANASTOMOSIS

The patient was placed supine upon the operating room table, and was prepped and draped in the usual sterile fashion. A Foley was placed to straight drain in the bladder. Time out was called and information reviewed. Gloves were washed in sterile water. At this point, a small transverse incision was made in the lower abdomen, about 2 cm above the pubic area. The incision was carried down through the subcutaneous fat to the fascia. The fascia was incised transversely and dissected off the rectus muscle, upward to the umbilicus and downward to the pubis. The rectus muscles were separated in the midline and the perineal cavity was entered digitally. The peritoneal incision was then extended upward to the umbilicus and downward toward the bladder. The edges of the incision were then wrapped with laparotomy packs to avoid bleeding from the incision into the abdomen; a Balfour retractor was placed into the abdomen. At this point, the uterus and adnexa were examined and the above findings were noted.

A Buxton uterine manipulator was placed over the uterus and the cervix was compressed. A 20G angiocath was placed through the fundus of the uterus and felt to have popped into the uterine cavity. The angiocath was now connected through an IV tubing to a syringe containing dilute indigo carmine dye. Gentle pressure was applied to the syringe which distended the uterus uniformly suggesting that the angiocath was placed correctly into the uterine cavity. At this point, the bowel was packed away from the pelvis using a lap packs placed in sterile plastic bags. Furthermore, lap packs in sterile plastic bags were placed into the cul-de-sac, elevating both adnexa including the ovaries.

Continuous irrigation using Lactate Ringer's was performed throughout the entirety of the procedure, using an 18G angiocath connected to a 20-cc syringe. Attention was given to the right adnexa. The isthmic stump was identified and grasped with Micro Adson forceps with teeth and using wire-tip electrocautery, the occluded portion of the tube was freed of overlying adhesions and mesosalpinx, attempting to preserve the underlying vessels. Likewise, the distal portion of the isthmic stump was also elevated with Adsons and freed from peritubal adhesions. The intervening Yoon ring was also dissected free and removed from the field.

At this point, using gentle pressure from the chromotubation syringe the proximal isthmic segment was slightly distended. Using a Micro-Adson forceps with teeth the tip of the occluded portion of the tube was grasped and the tube was transected perpendicular to its long axis with straight iris scissors. Chromotubation indicated tubal patency with extrusion of indigo carmine dye. Small areas of bleeding on the isthmus were irrigated, identified, and cauterized using microbipolar forceps.

Attention was then placed to the distal isthmic segment. Using Micro-Adson forceps with teeth, the occluded tip of the distal isthmus was grasped, pulled upward, and using straight iris scissors, the tube was transected in its entirety. At this point, using loupes, the tubal lumen appeared to be evident. To confirm patency of this area of the tube, an angiocath was threaded through the fimbriated portion of the tube which was them compressed digitally. Chromotubation through this angiocath reviewed patency of the distal segment of the tube. Again small areas of bleeding around the isthmus were identified by irrigation and cauterized with microbipolar.

At this point an anchor stitch using 7-0 Vicryl were placed at the base of the mesosalpinx in order to ensure that both tubal segments were brought together closely. This allowed the tubal stump to be approximated and also allowed sufficient mobility to perform the anastomosis.

Attention was paid to the left adnexa where a similar process was performed. Both tubal stumps were freed, opened, and approximated using an anchor stitch with 4-0 Vicryl. At this point, the operating microscope was now brought into the field. The focal length of the microscope had been set prior to surgery to ensure that the operating plane of the patient was visualized clearly at all times.

Under microscopic magnification the anastomosis was then performed. Four 8-0 nylon sutures were placed, from out to in and then out again, taking care to not enter the lumen. The sutures were placed at 6, 9, 3, and 12 o'clock. Chromotubation revealed tubal patency with a small amount of leakage around the anastomotic site. At this point the serosa of the tube was closed using interrupted sutures with 7-0 Vicryl. Chromotubation once again revealed tubal patency with minimal to no leakage. The peritoneal window was now closed with three interrupted sutures using 4-0 Vicryl, taking care not to injure the broad ligament or mesosalpinx vessels and to leave the knot away from the ovary. A similar procedure was performed on the contralateral side.

Once the tubes were anastomosed, chromotubation revealed them to be patent. No excessive bleeding was noted. At this point, all lap packs were removed from the pelvis after the adnexa were allowed to fall freely to the cul-de-sac. The pelvis was gently and thoroughly irrigated. At this point the sponge count was correct and the peritoneal incision was closed using a running suture using 2-0 Vicryl. The rectus fascia was closed using interrupted sutures with 0 Vicryl. The subcutaneous fat was approximated using three interrupted sutures using 2-0 Plain. The skin incision was enclosed in a subcuticular fashion using 4-0 Vicryl. At this point, the patient went to the recovery room in good condition without any complications. The estimated blood loss was approximately 50 cc.

COMPLICATIONS

- De novo pelvic adhesion formation—*Infrequent (less than 5%)*
- Postoperative infection (myometritis and adnexitis)—*Infrequent (less than 5%)*
- Hemorrhage and major vessel perforation—*Rare (less than 1%)*

Suggested Reading

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CHAPTER 24

Laparoscopic Salpingo-ovariolysis

M. Jonathon Solnik

INTRODUCTION

Abdominal and pelvic adhesion formation remains a common phenomenon, affecting up to 90% of those individuals who have undergone previous abdominal surgery. Adhesions have also been documented in those patients with no apparent risk factors. Adhesions occur following peritoneal injury, fibrin production, and dysfunctional repair of a process that would otherwise not result in adhesion formation (see Chapter 22). Risk factors include traumatic or inflammatory exposures that impede normal healing including thermal injury (e.g. electrosurgical applications), infection, foreign body (e.g., suture), tissue ischemia (e.g., exposure to ambient air), blood, and radiation.

The global impact of adhesions is significant, resulting in gastrointestinal obstruction, implicated as a potential contributor to chronic pain syndromes, and complicating subsequent operations. Of most interest to gynecologists and reproductive surgeons is the effect of adhesive disease on fertility. In fact, adhesions may be to blame for approximately 20% of female-specific infertility cases. This chapter focuses not only on the laparoscopic techniques to treat, remove, and minimize the recurrence of periadnexal adhesions, but also on those surgical techniques that may reduce the risk of de novo adhesion formation, in an effort to best preserve tubal function. Finally, the advent of in vitro fertilization (IVF) has significantly changed our approach to reproductive failure secondary to pelvic adhesions; this section will discuss those procedures that are current in light of these developments.

PREOPERATIVE CONSIDERATIONS

The ability to predict which patient will have preexisting pelvic adhesions is difficult, as the process of formation seems to be variable, depending on the host. Risk factors, such as previous abdominal surgery, should be thoroughly reviewed with patients when being counseled about a planned operation. Perioperative risks, such as visceral injury or need to convert to laparotomy, need to be clearly outlined.

A full understanding of the uterine and tubal anatomy is critical prior to undertaking surgical repair of the adnexa. While transvaginal sonography, with or without sonohysterography, will provide a three-dimensional assessment of the uterus and adnexa, hysterosalpingography (HSG), particularly using water-based contrast, gives the most accurate assessment of internal tubal anatomy, including the intramural portion. It is the opinion of this surgeon that a preoperative HSG is essential prior to undertaking salpingo-ovariolysis.

Consideration to the primary entry point, especially when performing a laparoscopic procedure, is often the first and possibly the most "at-risk" step, whether it be at Palmer's point (left upper quadrant), or open (Hasson technique), or closed access through the umbilicus. The use of preoperative mechanical bowel preparation in gynecologic surgery to reduce surgical risks in patients with suspected adhesions remains an unanswered debate. However, it seems reasonable to offer a bowel prep to patients who may be at high risk for bowel adhesions, particularly those involving the large intestine to the uterus or adnexa. We feel that a clear diet the day preceding surgery followed by a single Fleet® enema at night sufficiently empties the distal colon, facilitating access to the deep pelvis. Ultimately, however, it should be the surgeon's intent to safely complete the procedure, whether adhesiolysis is considered the primary procedure, or whether, adhesions represent an obstacle to the intended procedure.

SURGICAL TECHNIQUE

Restoration of the anatomy and minimization of adhesion reformation with the aim of preserving reproductive function remains the ultimate goal, and so meticulous dissection without the excessive use of electrosurgery is often required.

1. **General principles of adhesiolysis:** Surgeons should utilize all possible external factors that may facilitate the dissection, such as fairly steep Trendelenburg positioning and an articulating uterine manipulator that reproduces the function of an extra hand. Use of a microsurgical approach such as gentle tissue handling, minimizing desiccation, and limiting foreign body exposure have been well described (see Chapter 22) as a means of reducing subsequent risk of adhesion formation, particularly to prevent the de novo formation of adhesions in patients initially adhesion free.

   Adhesiolysis is facilitated using traction–countertraction, placing stretch on the adhesion, and more clearly presenting the intervening tissue planes. The organ to be preserved (e.g., tube) should be grasped with atraumatic graspers, which should hold the organ sufficiently loosely to allow it to escape without injury if excessive traction is applied (**Figure 24.1**). Alternatively, the adhesion to be removed can and should be grasped firmly, perhaps using a toothed forceps. Often adhesions can be broken apart using blunt dissection. However, thicker more fibrotic adhesions should not be divided bluntly as this may predispose to unintended trauma; sharp dissection with scissors is recommended in this situation.

   Adhesions can either be incised or they can be excised, depending on its structure and location. When possible adhesions should be excised at each insertion and the scar tissue removed, rather than simply divided. Hemostasis during dissection should be achieved by expectant management to the extent possible. The vast majority of bleeding during adhesion dissection will be capillary in nature and will stop spontaneously in short order without the need for energy. However, bipolar energy used sparsely is often sufficient to stop more significant bleeding. Monopolar energy should be avoided.

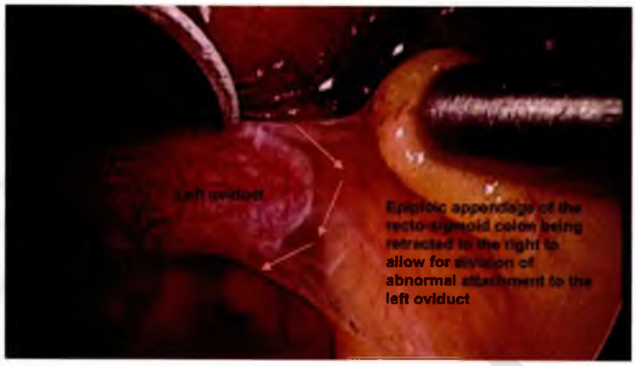

FIGURE 24.1 Adhesiolysis can be facilitated using traction–countertraction, placing stretch on the adhesion, and more clearly presenting the intervening tissue planes.

2. **Gaining pelvic exposure:** The first objective of adhesiolysis is to gain adequate exposure to all reproductive organs, and to do so by destroying as few surgical planes as possible. Hence, dissection should proceed with patience, and it is best performed using traction–countertraction and incising with cold scissors, not electrosurgery. Furthermore, a careful understanding and mental visualization of the underlying anatomy is critical, which requires that the surgeon start his/her dissection high up in the pelvis, where the anatomy may be adhesion free. When adequate exposure has been obtained, the surgeon can then focus on the task of unencapsulating adhesions from the ovaries and tubes.

3. **Dissection of adnexa–bowel adhesions:** If bowel or bowel appendages are adherent to the adnexa, the approach to the dissection should be to free as much of bowel adherences as is necessary, but not more. While we generally prefer to excise adhesions, when operating on bowel it is best to incise the adhesive bands, erring on the side of leaving some of the adherence on the bowel serosa rather than incising too close to the bowel serosa/muscularis and risking subsequent perforation (**Figure 24.2**).

   In general, when dissecting around bowel it is best to mobilize adhesions beginning in areas that are less risky. For example, a blunt probe can be sweeped along the anterior and posterior surface of the uterus, pressing towards the uterine body,

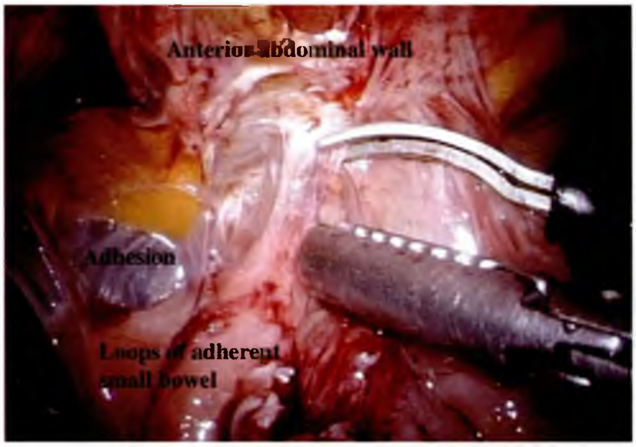

FIGURE 24.2 To remove bowel or bowel appendages adherences it is best to incise the adhesive bands, rather than excise the adhesions; the surgeon should aim to err on the side of leaving some of the adherence on the bowel serosa rather than incising too close to the bowel serosa/muscularis and risking subsequent perforation.

to identify and stretch adhesions that can then be incised/excised (**Figure 24.3**). The use of blunt dissection and electric energy in these areas should be avoided and, instead, gentle traction–countertraction and cold scissors should be used to expose and incise the adhesions, minimizing the risk of injury. Surgeons should recognize that excessive traction–countertraction can result in the bowel wall tears, a defect that is not always apparent until later perforation.

Before completing the surgery, surgeons should develop the habit of running the bowel laparoscopically to the extent possible to ensure that there are no adhered circular loops of bowel that may entrap, obstruct, and even strangulate another section of bowel at a later time.

FIGURE 24.3 In general, when dissecting around bowel it is best to mobilize adhesions beginning in areas that are less risky.

4. **Dissection of periovarian adhesions:** Mobilizing the ovary from adherences to the pelvic sidewall requires access to the posterior aspect of the ovary. This can be facilitated by placing a blunt probe at the infundibulopelvic (IP) ligament reflection above the ovary (**Figure 24.4**). The blunt probe is used to begin the dissection, advancing forward and downward, using a sweeping downward motion to break posterior ovarian adhesions. Eventually, any adhesions remaining on the posterior aspect of the ovary should be incised approaching the ovary laterally. In addition, often the tubomesosalpingeal reflection above the utero-ovarian ligament is relatively adhesion free, allowing the operator to pass a blunt probe into this area sweeping behind the ovary and so breaking up filmy adhesions. Finally, it is critical that the surgeon at all times during the dissection of the ovary from the sidewall be aware of the course of the ureter; the ureter is best located initially at the pelvic brim, where it crosses over the IP ligament (**Figure 24.4**).

Once the ovary is freed and mobile, it will be important to remove as many superficial adhesions overlying the ovarian cortex as possible. Periovarian adhesions will impede ovulation and release of the ovum and follicular fluid during ovulation, decreasing fertility and potentially leading to the development of persistent ovarian cysts. Superficial ovarian cortex adhesions should be handled by grasping the adhesive bands firmly (e.g., using a biopsy forceps with a central tooth or pin, and then peeling these by pulling them along the ovarian surface until freed (**Figure 24.5**). Some surgeons recommend lightly desiccating the adherent areas to facilitate removal of the adhesions, but we prefer not to do so, as radiated heat could destroy underlying ovi.

5. **Dissection of peritubal adhesions:** After the ovaries have been mobilized, attention can then be given to mobilizing up the tubes of peritubal adherences. Care should be taken when doing so as to use atraumatic tubal graspers and to not place excessive traction on such a delicate organ. We usually inject dilute indigo carmine through the uterine manipulator (chromotubate) to first confirm filling and patency of the oviducts. This maneuver may not only allow the surgeon to decide how aggressive he/she must be in restoring normal tubal anatomy, but will provide documentation of occlusion or patency for future reproductive planning.

Tubes that are obstructed at multiple internal sites and that also demonstrate periadnexal adherences

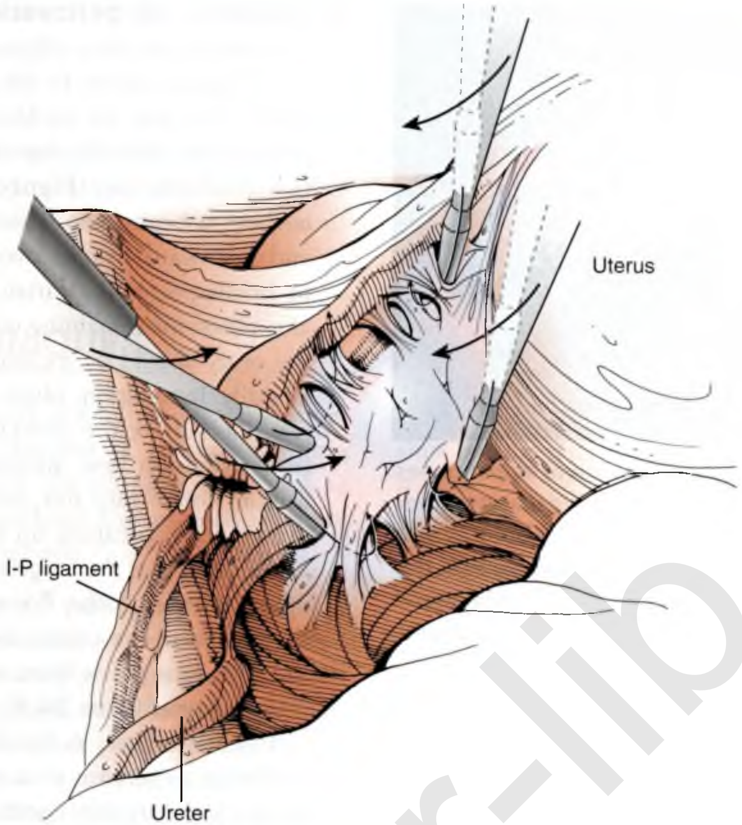

FIGURE 24.4 Freeing the ovary from sidewall adherences maybe made easier if the operator uses a blunt probe to begin the dissection at the infundibulopelvic (I-P) ligament reflection above the ovary at this point, advancing forward and downward, using a sweeping downward motion to free the ovary from sidewall adhesions.

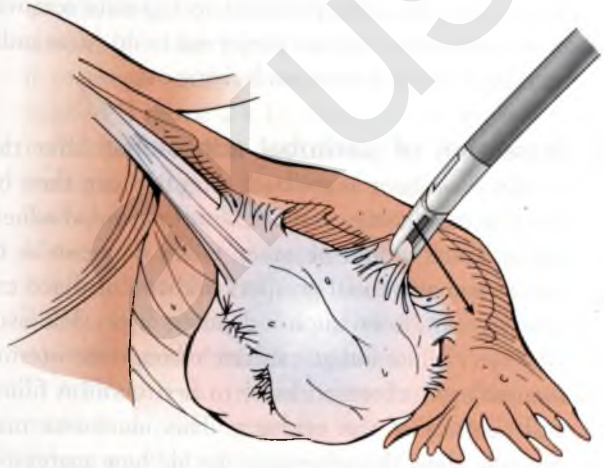

FIGURE 24.5 Superficial ovarian cortex adhesions should be handled by grasping the adhesive bands firmly, for example by using a biopsy forceps with a central tooth or pin, and then peeling these by pulling them along the ovarian surface until freed.

are usually not amenable to surgical repair. In these cases, consideration should be given to removal (salpingectomy) of the affected tube and subsequent IVF for fertility. Furthermore, care should be taken to avoid dissection of the very vascular fimbria, unless adhesive bridges between fimbria amenable to incising can be identified using a conical-tip probe. A discussion of reconstructive procedures of the tubal ostia, such as neosalpingostomy, is beyond the scope of this section as these procedures have become less relevant for the treatment of infertility in the face of IVF.

When lysing adhesions between the tube and the ovary, it is preferable to firmly grasp and put gentle traction on the ovary to stretch the adhesions and identify the dissection plane, placing less traction on the tube (**Figure 24.6**). However, care should be taken to not excessively incise into the mesosalpinx, as bleeding from mesosalpingeal vessels can be difficult to control. Again, dissection should be initiated in an area that is not adhered.

6. **Antiadhesives:** Adhesion formation/reformation occurs in 55% to 90% of patients after reproductive pelvic surgery. Compared to laparotomy, laparoscopy has been shown to reduce the risk of *de novo* adhesions, but represents no clear advantage in reducing adhesion reformation. Although beyond the context of this section the use of postoperative antiadhesive adjuvants should be considered. To date those that have received the most attention, and provide the most data in randomized trials, are the adhesion barriers. Some of these can be placed laparoscopically as needed (Interceed® and Prevens®) (**Figure 24.7**), although none of the barriers is specifically approved by the US FDA for laparoscopic use. Overall, meticulous surgical technique remains the gold standard for adhesion prevention.

POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see **Complications** box on page 215), the most frequent of which is adhesion formation or more commonly reformation. While patients should be followed in standard fashion, surgeons should be vigilant for any evidence of bowel perforation following surgery, and which can occur as late as 2 weeks after the procedure. On occasion the wall of an adherent bowel may be injured during adhesiolysis, which can weaken and eventually rupture under distention or pressure. Prompt recognition and action is required to avoid a catastrophic complication.

Second-look laparoscopy and repeat adhesiolysis, although advocated by some surgeons as a means of improving the condition of the pelvis by permitting the breaking up of developing adhesions, has not been shown to improve conception rates.

Operative Note

PROCEDURE: LAPAROSCOPIC SALPINGO-OVARIOLYSIS

The patient was taken to the operating room after proper informed consent had been obtained. She was placed in the dorsal supine position, legs in Allen-type stirrups. Her arms were then tucked appropriately at her side and she was prepped and draped in sterile fashion. A time out was then completed. Attention was turned to the pelvis, where a Foley catheter was placed

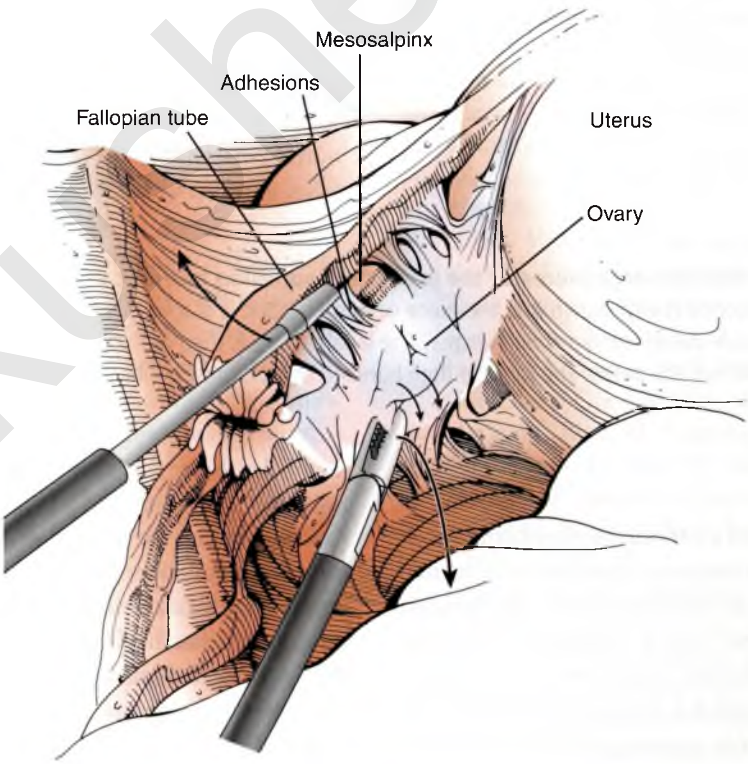

FIGURE 24.6 When lysing adhesions between the tube and the ovary, it is preferable to firmly grasp and put gentle traction on the ovary to stretch the adhesions and identity the dissection plane, placing less traction on the tube.

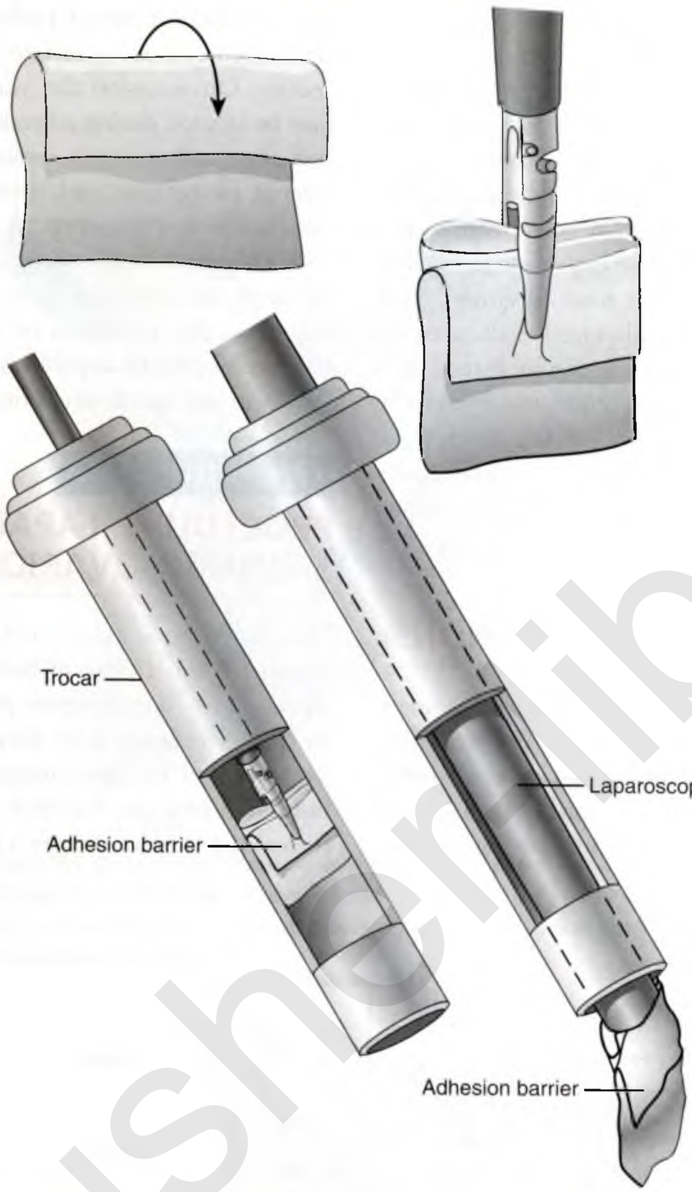

FIGURE 24.7 Relatively large pieces of the Interceed® adhesion barrier can be placed laparoscopically: The laparoscope is withdrawn and the piece of barrier fabric is placed directly into the umbilical port, beyond the pressure valve, using a small grasper. The laparoscope is then replaced into the umbilical sleeve, pushing the fabric into the pelvis. The fabric is then handled using a grasper placed through an ancillary port.

in the urinary bladder and a uterine manipulator placed to allow for chromopertubation. Attention was turned to the abdomen where an intraumbilical skin incision was made with a scalpel and a insufflation needle placed in that site. Negative aspiration test was performed, however, we could not confirm placement into the peritoneal cavity with opening pressures, and so direct trocar placement with a 5 mm optical trocar was performed with a 5 mm telescope. Pneumoperitoneum was achieved with carbon dioxide to a pressure of 15 mmHg. Inspection of the trocar entry site was thoroughly conducted and no evidence of insertional injury was noted. Ancillary trocars were placed with two in the lower lateral quadrants, both 5 mm in diameter, lateral to the inferior epigastric vessels. These were placed under direct visualization without incident. Another trocar 5 mm in diameter was placed between the pubic symphysis and umbilicus.

Chromopertubation was performed upon initial inspection, prior to manipulating adnexal structures to confirm the presence of preoperative spill. Prompt fill and spill of the left oviduct was noted; however, spill of the right oviduct was incomplete and no spillage was noted to occur despite normal appearing fimbria, consistent with her preoperative HSG.

At this point, we focused our attention on the left adnexa, where approximately 1 hour was required to perform ovariolysis and tubolysis to allow for normal and adequate visualization and mobilization of this adnexa. With extensive division of adhesions, we were able to properly view the posterior cul-de-sac and then begin our way to mobilize the right ovary, which was noted to have an adnexal mass prior to surgery. Our approach to the left adnexal dissection was to follow any available surgical planes using traction and countertraction techniques, cutting the more filmy adhesions with cold scissors. Small capillary bleeding was noted, but stopped without intervention. Sigmoid epiploicae were initially noted to be adherent to the distal oviduct. Upon dividing these adhesions, we traced the oviduct, which was noted to be normal in caliber, more distal until we reached the fimbriated edges, realizing that this tube was currently patent. Blunt dissection was also used when adhesions were filmy and without vessels. Thicker adhesions of the tube to the ipsilateral sidewall were also divided sharply and short bursts of focused bipolar energy were used to stop more brisk bleeding. No subsequent eschar was noted as a result of energy application. The course of the left ureter was identified prior to the dissection as was the mesocolon and sigmoid. No injuries were noted during dissection.

We then addressed the right adnexa by lysing adhesions and performing a salpingectomy using bipolar energy, then transecting the desiccated portions with scissors. At the completion of the procedure the pelvis was then observed for approximately 2 to 3 minutes under low intra-abdominal pressures to ensure hemostasis. The left adnexa was then wrapped in an adhesion barrier (Interceed®) once hemostasis was confirmed. Lateral trocar sites were observed after removal to make certain no abdominal wall vessels were lacerated. The remaining pneumoperitoneum was released and the primary trocar removed. The uterine manipulator was removed and the Foley catheter replaced to drain the bladder in the early postoperative period. All skin incisions were reapproximated using 4-0 Vicryl in a subcuticular fashion. The patient was then extubated and taken to recovery in stable condition.

COMPLICATIONS

- De novo pelvic adhesion formation and adhesion reformation—*Frequent (greater than 10% de novo adhesion formation, and as high as 90% adhesion reformation if severe re-existing adhesions)*
- Postoperative infection (myometritis, adenexitis)—*Infrequent (less than 5%)*
- Hemorrhage and major vessel perforation—*Rare (less than 1%)*
- Major organ perforation or injury (bowel, bladder, or ureter most frequently)—*Rare (less than 1%)*
- Postoperative bowel entrapment—*Rare (less than 1%)*
- Nerve injury (generally positional)—*Rare (less than 1%)*

Suggested Reading

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CHAPTER 25

Laparoscopic Ovarian Wedge Resection or Diathermy (Drilling)

M. Jonathon Solnik

INTRODUCTION

Oligo-anovulatory state and infertility often accompany the polycystic ovary syndrome (PCOS), due in large part to increased androgen production from the stromal component of the ovary. Bilateral ovarian wedge resection (BOWR) by laparotomy as treatment for PCOS was first described by Stein-Leventhal in 1935, who noted restoration of menses and occasional spontaneous conceptions subsequent to the procedure. However, given the risk of postsurgical adnexal adhesions and ovarian failure, and in light of the introduction of pharmacotherapeutic agents used to induce ovulation, the procedure has generally fallen into disuse. Gonadotropin administration, however, poses increased risks for ovarian hyperstimulation syndrome (OHSS) and multiple gestations for patients with PCOS. A potential indication for surgical intervention, then, may be therapeutic failure to standard ovarian stimulation cycles.

Unlike BOWR performed via laparotomy, laparoscopic ovarian diathermy (i.e., "ovarian drilling") results in fewer postoperative adverse outcomes such as ovarian failure, trauma, surgical dead space, hematoma formation, and adhesions. Furthermore, an effective alternative to ovarian drilling, which may unduly compromise healthy ovarian cortex, is the laparoscopic BOWR, which has a lesser risk of postoperative periovarian adhesions than classic BOWR via laparotomy.

The exact mechanisms of action of this procedure on ovulatory function are unclear. Laparoscopically performed ovarian wedge resection focuses on debulking the hyperplastic theca-stromal portion of the ovarian mass, generally sparing the ovarian cortex. Alternatively, bilateral ovarian diathermy focuses on destroying discrete and relatively limited areas of the ovarian cortex. Nonetheless, studies evaluating the success of either procedure have reported similar success with either ovarian wedge resection or ovarian diathermy, with spontaneously occurring ovulatory cycles in up to 90% of women treated. The endocrine changes found after ovarian surgery in PCOS women seem to be governed by the ovaries themselves, and simply put, seem to stem from any type of ovarian damage.

A recent Cochrane analysis indicated that laparoscopic ovarian diathermy is as successful as and more cost effective than gonadotropin therapy for ovulation induction, without the added risk of OHSS and multiple gestations. An economic evaluation demonstrated that treating women with laparoscopic ovarian diathermy results in a significant reduction in both direct and indirect costs. Overall, for women with PCOS-related anovulatory infertility and who cannot tolerate the risks or costs of gonadotropin ovulation induction, laparoscopic ovarian wedge resection or diathermy (drilling) may represent a viable option.

PREOPERATIVE CONSIDERATIONS

Patients who are candidates for bilateral ovarian diathermy are typically young and healthy, although some may be glucose intolerant or overtly diabetic and may require preoperative assessment by their internist. Not uncommonly do patients have lipid disorders or fatty liver disease, but these typically do not preclude an outpatient surgical procedure.

Commonly accepted surgical indications include patients who have normal pelvic anatomy, normal male factor, and have either not responded to clomiphene citrate or gonadotropin ovulation induction, or have not conceived after three to six ovulation induction cycles with either medication. Patients should also be counseled concerning the potential of postoperative periadnexal adhesions affecting fertility and the concept that the procedure itself will not generally be curative.

SURGICAL TECHNIQUE

Laparoscopic wedge resection

1. **Port and instrument placement:** As per routine, laparoscopic ports and instruments are placed so as to access and manipulate each ovary separately. This operator prefers to place two 5-mm ports lateral to the epigastric vessels, one each in the RLQ and LLQ, and a single 10- to 12-mm suprapubic port.
2. **Ovarian stromal resection:** Once the pelvis and abdomen are examined, and the cul-de-sac cleared of bowel, an ovary is grasped at its distal pole, away from the utero-ovarian ligament, with a grasping forceps placed through the contralateral port. The grasper preferably should fix the ovary with limited slippage and tearing (e.g., a grasper with a single central fixation pin), exposing the antimesenteric aspect of the ovary (**Figure 25.1**). Maintaining the fallopian tube away from the surgical site, behind and lateral to the ovary, an incision is made longitudinally along the long axis of the ovary using needle monopolar cautery, laser, ultrasonic scalpel, or cold laparoscopic scissors or scalpel (**Figure 25.2**).

Once the cortical incision is made, the grasper holding the ovarian pole is released and then used to grasp the ovarian stroma (**Figure 25.3**), which is placed on traction through the ovarian incision. A monopolar needle, laser, or scissors is then used to progressively dissect out a wedge of approximately 5 g of tissue (about a half thumb size) (**Figure 25.4**). Once the tissue is removed, the distal ovarian pole is regrasped and hemostasis of the resection bed is attained by the use of energy delivered through the ovarian incision. However, with sufficient patience, little bleeding is generally encountered. The ovarian incision does not need to be closed. The specimen is then removed through the suprapubic port; a laparoscopic retrieval bag is usually unnecessary.

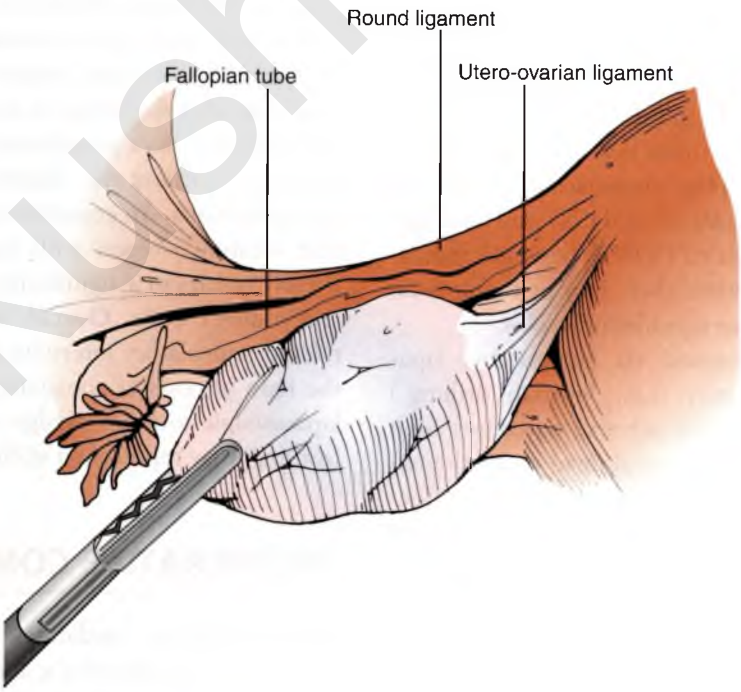

FIGURE 25.1 The proximal portion of the ovary is grasped and retracted cephalad so as to expose the antimesenteric border of the ovary on its longitudinal axis: The oviduct should be placed anterior to the ovary to prevent inadvertent injury.

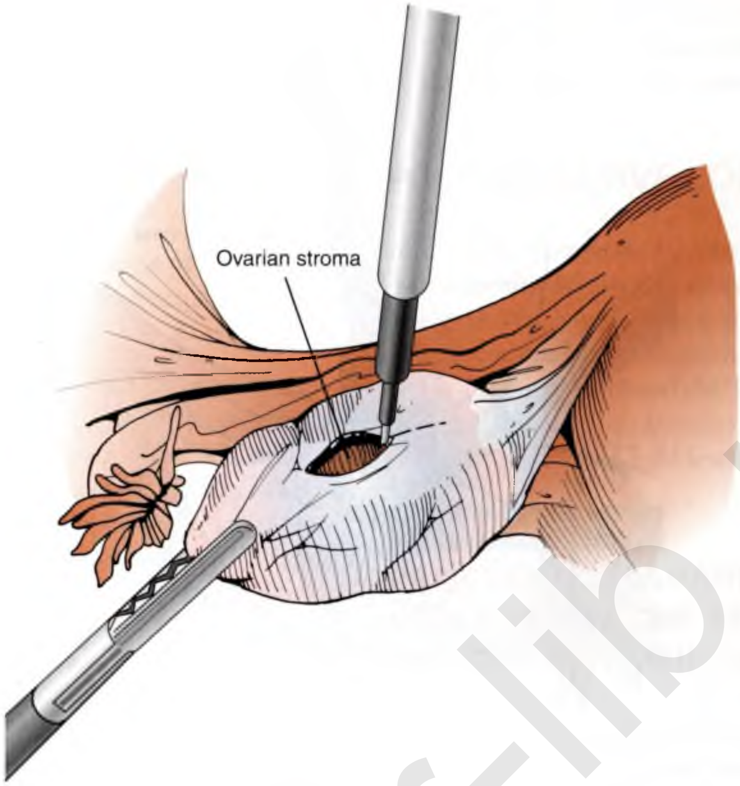

FIGURE 25.2 Once fixed in position, the ovarian cortex is incised longitudinally with a needle-tip electrosurgical instrument or laser.

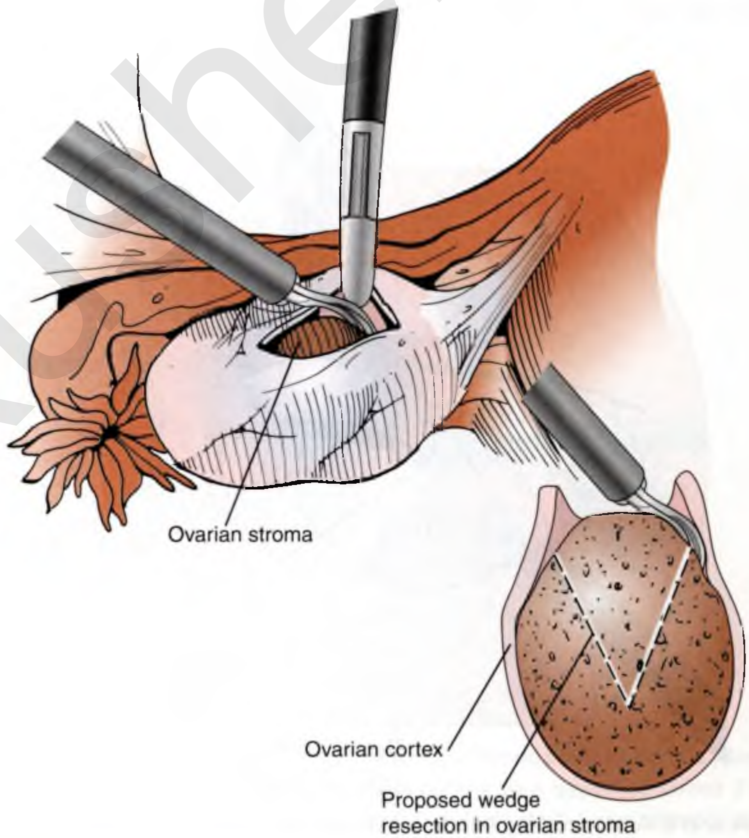

FIGURE 25.3 The initial grasper is replaced to place tension on the section to be excised, and a scissors, needle-tip electrode, or laser is used to create the wedge resection of ovarian stroma.

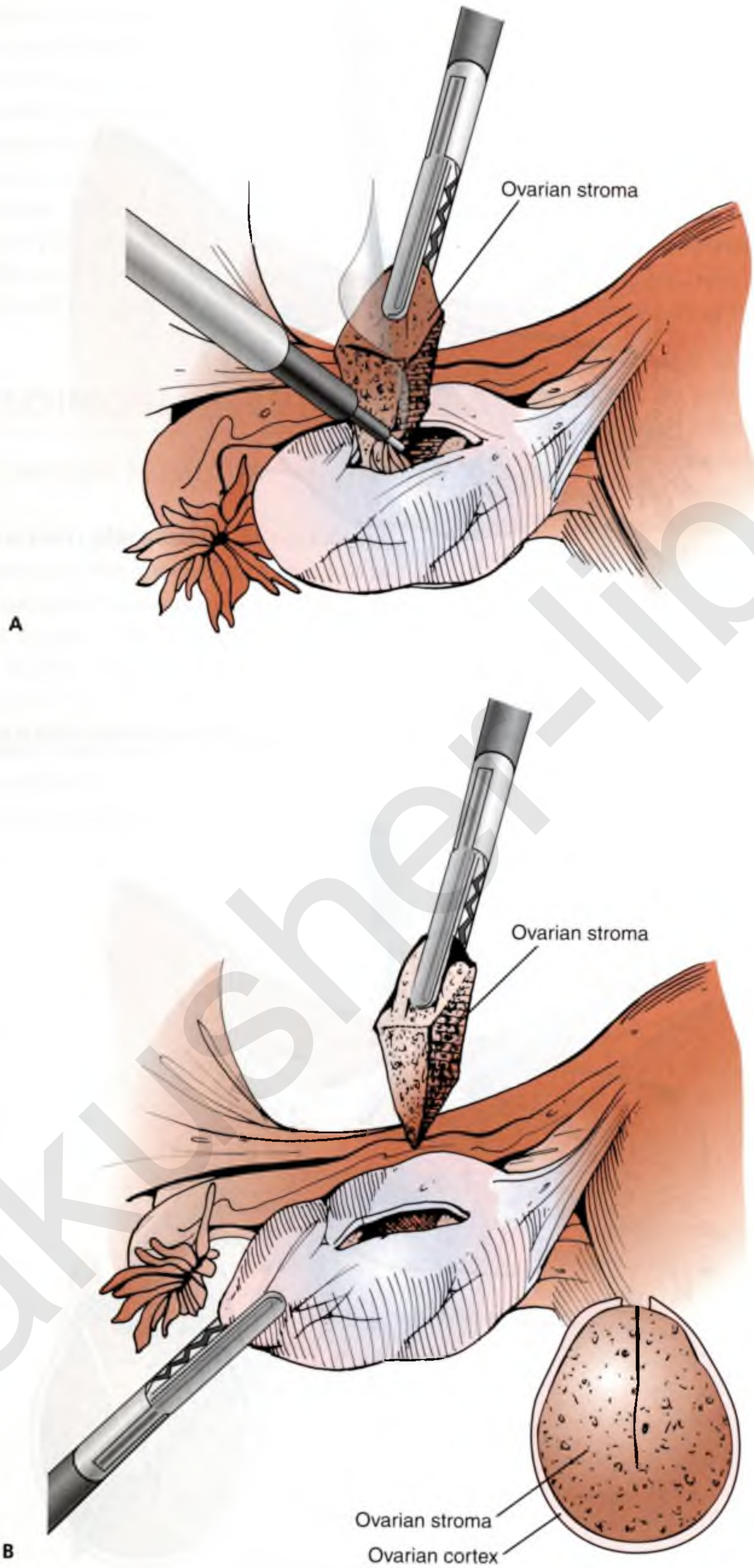

FIGURE 25.4A and B A monopolar needle, laser, or scissors is used to progressively dissect out a wedge of approximately 5 g of tissue (about a half thumb size).

The same procedure is then repeated on the contralateral side.

A laparoscopic diathermy (ovarian drilling)

1. **Port and instrument placement:** Placement of instrument ports is similar to that of the laparoscopic ovarian wedge resection (see above).
2. **Ovarian diathermy:** Once the pelvis and abdomen are examined, and the cul-de-sac cleared of bowel, the antimesenteric portion of the ovary is exposed by manipulation using a probe or suction tip placed through the contralateral port. A monopolar needle or laser is used to "drill" the ovarian cortex. If using the monopolar needle, the tip should be placed into the ovarian cortex to a depth of about 3 mm, before activating the current. Ten to fifteen sites are desiccated to a depth of 3 to 5 mm at a power of 30 W on CUT setting (**Figure 25.5**), although the number of sites may depend on the size of the ovary. There are no generally accepted application times, but the surgeon should look for visual clues to minimize significant thermal spread. Use of the CO_2 laser is another acceptable energy modality (40 to 80 W, 25 to 200 mJ; superpulse 25 to 40 W) for ovarian drilling. The same procedure is repeated on both ovaries.

POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see **Complications** box on page 222), the most frequent of which is adhesion formation. There are no special considerations other than the typical follow up for women being treated for PCOS, such as clinical symptomatology (hirsutism and acne), ovulatory function, and insulin and lipid levels.

Operative Note

PROCEDURE: LAPAROSCOPIC OVARIAN WEDGE RESECTION OR DIATHERMY (DRILLING)

The patient was taken to the operating room after proper informed consent had been obtained. She was placed in the dorsal supine position, legs in Allen-type stirrups. Her arms were then padded and tucked at her side, and she was prepped and draped in sterile fashion. A time out was then completed.

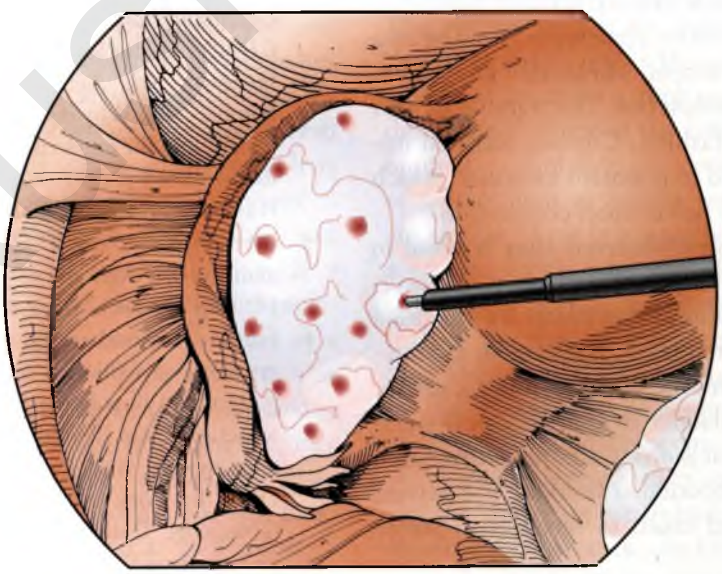

FIGURE 25.5 For laparoscopic ovarian diathermy (drilling), a monopolar needle is placed through a suprapubic port, and the tip placed into the ovarian cortex to a depth of about 3 mm, before activating the current: Ten to fifteen sites are desiccated to a depth of 3–5 mm at a power of 30 W on CUT setting generally suffices, although the number of sites may depend on the size of the ovary.

Attention was turned to the pelvis, where a Foley catheter was placed in the urinary bladder, and a uterine manipulator was placed to allow for adequate adnexal visualization.

An insufflation needle was placed within the umbilicus and low opening pressures were documented. Pneumoperitonium was achieved with carbon dioxide to a pressure of 15mmHg, at which point a 5mm bladeless trocar was placed. Confirmation of placement was done with a telescope. Inspection of the trocar entry site was thoroughly conducted and no evidence of insertional injury was noted. Ancillary trocars were placed with 2 in the lower lateral quadrants, both 5 mm in diameter, lateral to the inferior epigastric vessels. These were placed under direct visualization without incident. Another trocar 5 mm in diameter was placed in between the pubic symphysis and umbilicus.

The ovaries, which were otherwise mobile and nonadherent to their ipsilateral sidewalls, were enlarged with multiple peripheral follicles, consistent with preoperative assessment of polycystic ovarian syndrome. After thorough inspection of the abdomen and pelvis, a monopolar needle electrode was introduced from the right lower quadrant trocar to apply energy to the left ovary, which was elevated with an atraumatic grasper. The electrode was introduced into the ovarian cortex 10 times, approximately 3 to 5 mm beyond the epithelium, and monopolar current on low voltage setting (30 W) was applied for 5 seconds. Placement of the electrode was such that we avoided overlap of thermal insult. No excessive charring was noted as a result of the electrical current. Minimal, if any, bleeding was noted. After completion, the right ovary was addressed in a similar fashion. Copious warmed isotonic irrigation was used to maintain moisture, which was suctioned from the pelvis upon completion.

Lateral trocar sites were observed after removal to make certain no abdominal wall vessels were lacerated. The remaining pneumoperitoneum was released and the primary trocar removed. The uterine manipulator had then been removed and the Foley catheter replaced to drain the bladder in the early postoperative period. All skin incisions were reapproximated using 4-0 Vicryl in a subcuticular fashion. The patient was then extubated and taken to recovery in stable condition.

COMPLICATIONS

- De novo periovarian adhesion formation—*Infrequent (less than 5%, possibly higher with laparoscopic bilateral wedge resection)*
- Postoperative infection (oophoritis, adnexitis)—*Rare (less than 1%)*
- Hemorrhage or major vessel perforation—*Rare (less than 1%)*
- Major organ perforation or injury (bowel, bladder, or ureter most frequently)—*Rare (less than 1%)*
- Postoperative bowel entrapment—*Rare (less than 1%)*
- Nerve injury (generally positional)—*Rare (less than 1%)*

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CHAPTER 26

Hysteroscopic Metroplasty (Resection of Intrauterine Septum)

M. Jonathon Solnik

INTRODUCTION

Anomalies of the uterus occur in 3.8% to 4.3 % of the general population, depending on the actual indication for study; the mean incidence for women with subfertility falls in the range of 3.5% and increases significantly for those who have experience recurrent pregnancy loss (~10% to 15%). Although no classification system has been universally accepted, the American Society for Reproductive Medicine (ASRM) grouped these anomalies into seven types based on three main categories: a) agenesis/hypoplasia, c) lateral fusion defects, and c) vertical fusion defects. Although most anomalies observed fall into the ASRM classification (originally devised by Buttram and Gibbons), there are isolated anomalies that do not fit this system so easily, such as the complete (full) septum with duplicated cervices.

The uterine septum represents one of the most common müllerian anomalies encountered with a mean incidence of 1% to 3% in the general population. This particular anomaly most likely occurs as a result of varying degrees of incomplete resorption of the midline septum between the two laterally fusing müllerian ducts. Although the overwhelming majority of women with such anomalies are genotypic female (46, XX), the etiology of this disorder has not been clearly defined and it is felt to occur as a result of polygenetic and multifactorial processes.

A septate uterus is differentiated from other anomalies by its smooth fundal contour and two separate uterine cavities. The defect may range from a small midline septum to a larger defect resulting in a complete uterine septum and longitudinal vaginal septum. These anomalies are differentiated from the arcuate uterus based on the degree of intrauterine fundal defect (visualizing an imaginary line between the tubal ostia, the arcuate fundus does not generally protrude more than 2 cm into the intrauterine cavity, although there is no established distance that clearly differentiates arcuate uterus from a small septate uterus.

Continued debate exists over whether and when to proactively correct the septate uterus, since this defect may have a negative impact on reproductive outcome. The adverse impact on reproduction may arise from decreased vascularity of the septum itself, affecting the growth of an embryo implanted in the septum proper, diminished volume of the endometrial cavity, and suboptimal implantation site options. Since the incidence of septate uteri in women with and without infertility are similar, there is a large population of women with a septate uterus who will likely conceive and go on to deliver a healthy infant without complications and without the need for preconceptional surgical intervention. Overall, the negative impact of a uterine septum on the fecundability of asymptomatic women or those with primary infertility seems quite modest.

Alternatively, case series suggest that women with a septate uterus appear to have a higher rate of adverse obstetrical outcomes, including spontaneous pregnancy loss and preterm delivery. Thus, if a septum is found in a patient with untested fertility, consideration may be given to proactively correct those who have not yet demonstrated poor outcomes. Women with a septate uterus and who experience recurrent pregnancy loss are also likely candidates for metroplasty since posttreatment obstetrical outcomes are comparable to those of unaffected women. Finally, and although the effect of this müllerian anomaly on fecundability is not clear, the higher adverse pregnancy outcomes of women undergoing in vitro fertilization (IVF), such as preterm delivery, and the high cost of the treatment, suggest that patients who are scheduled for IVF and are found to have a septate uterus would be considered appropriate surgical candidates.

Metroplasty was first described in 1953 as a procedure that involved a wedge-like resection of the midline defect (Jones metroplasty) and so it had a wider range of application for various midline anomalies. It was performed by laparotomy, involved a fundal uterine incision, and removal of the defect. These procedures carried an increase risk for morbidity, intra- and postoperative hemorrhage, and reduced intra-cavitary volume, and necessitated cesarean delivery. Alternatively, hysteroscopic metroplasty is a relatively straightforward ambulatory procedure that obviates the majority of the aforementioned risks while providing excellent outcomes. Its risks are low enough that most surgeons feel comfortable offering this procedure prophylactically to asymptomatic women.

PREOPERATIVE CONSIDERATIONS

Establishing the correct preoperative diagnosis becomes pivotal in the evaluation and treatment of women with suspected müllerian anomalies, particularly in women with prior poor reproductive or obstetrical outcomes. Historically, a combination of hysteroscopy and laparoscopy were used for diagnostic means, but the role of transvaginal ultrasound, with or without saline infusion (i.e., sonohysterography) and magnetic resonance imaging (MRI) continue to be the studies of choice.

MRI provides a comprehensive picture of the abdomen and pelvis, allowing for a single modality to be used for the diagnosis of müllerian anomalies, especially since extra-uterine anomalies (e.g., isolated uterine remnant) are not uncommon in women with unilateral müllerian defects. An MRI can also differentiate a muscular from fibrous septum and may delineate cervical duplication and the septate uterus from uterine didelphys. In turn, the experienced ultrasonographer may also be able to differentiate many of the duplicative anomalies. While hysterosalpingography (HSG) represents the gold standard for evaluating the endometrial cavity and tubal patency, it lacks the ability to establish the presence of more complex anomalies that may require assessment of the external uterine contour or extrauterine phenomena. Finally, as with any other operative hysteroscopic procedure, the procedure should be timed to occur when the endometrium is at its thinnest, whether in the immediate postmenstrual period during a natural ovulatory cycle or achieved by hormonal (e.g., progestogenic) suppression. Following are brief descriptions of the surgical procedures used (see also videos: *Hysteroscopic Metroplasty (Resection of Intrauterine Septum)*).

SURGICAL TECHNIQUE

1. **Instrument selection:** The surgeon performing a metroplasty should be experienced in the performance of diagnostic and basic operative hysteroscopy, including understanding the instrumentation, distention media, energy sources, and risks and monitoring. The operator should use instruments with which he/she is most comfortable with, although using a hysteroscope with the smallest outer diameter is preferred in order to minimize the need for excessive cervical dilation. A 0° lens is helpful for on-axis visualization, especially when using an electrosurgical means of incising the septum; however, an angled lens (12° or 30°) may allow for greater total visualization of the uterine cavity (**Figure 26.1**).

   Preference should be given to the use of nonelectrosurgical means, such as a 3-mm rigid scissors placed through the operating channel of an operating hysteroscope with an angled offset ocular or an operative hysteroscope with a 5 to 7 French (~1.7 to 2.3 mm) semi-rigid scissors, in order to avoid thermal injury to the surrounding endomyometrium. An added benefit when using semi-rigid scissors is the ability to utilize a narrower hysteroscopic outer sheath, smaller than the larger electrosurgical resectoscopes, which are at least 9 mm in diameter (**Figure 26.1**).

   When the septum is quite large, projecting toward the level of the cervix, or when it is composed of more muscular fibers, an electrosurgical option may be more useful in minimizing blood loss and expediting the procedure. A number of electrosurgical instruments have been described including a simple resectoscopic loop, a specialized low-voltage forward facing tip, and a bipolar loop electrode. Also used are contact laser inserts (e.g., neodymium:yttrium–aluminum garnet [Nd:YAG]). Although there may be physiologic benefit when using an isotonic fluid distention media such as normal saline (which cannot be used with monopolar electrosurgical modalities), there is no clear distinction among the various energy modalities described with regards to efficacy or risk of postoperative intrauterine synechiae.

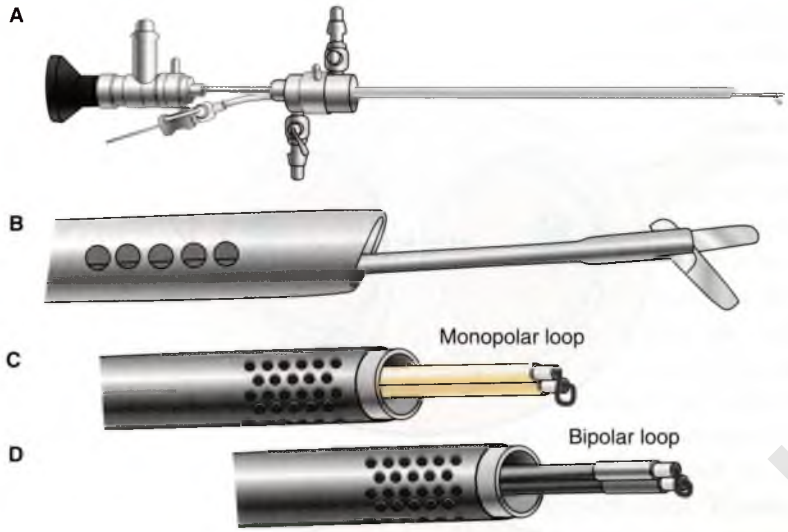


FIGURE 26.1 Equipment commonly used during hysteroscopic metroplasty, including (A) a 3-mm rigid scissors placed through the operating channel of an operating hysteroscope with an angled offset ocular, (B) an operative hysteroscope with a 5-7 French (~1.7 to 2.3 mm) semi-rigid scissors, (C) a simple resectoscopic loop with or without a forward facing tip, and (D) a bipolar loop electrode.

2. **Procedure:** After the patient is prepped and access to the uterine cavity is achieved, the operator should first visualize both tubal ostia, which may be in different chambers depending on the size of the septum (**Figure 26.2B**). Once the surgeon has been orientated to the cavity, the septum should be divided, using scissors, lasers, or electrosurgical means, at a point equidistant from the anterior and posterior walls of the uterine cavity (**Figure 26.3**). The fibromuscular component of the septum will retract into the surrounding wall once incised. The incision is progressively directed towards the uterine fundus. Adjusting the inflow and outflow channels of a continuous flow hysteroscopic sheath can be used to obtain the clearest view of the surgical site.

When the septum is relatively small and narrow, the incision should begin at the apex (lowest point) of the septum, gradually reaching the fundus with the previously described endpoint (**Figure 26.3**). Excessive incising to what appears to be a normal fundal contour should be avoided since the septum tissue will retract, and so the myometrium may have already been breached. Furthermore, if excessive bleeding or oozing is noted during the surgery, the procedure should be stopped. It is more prudent to

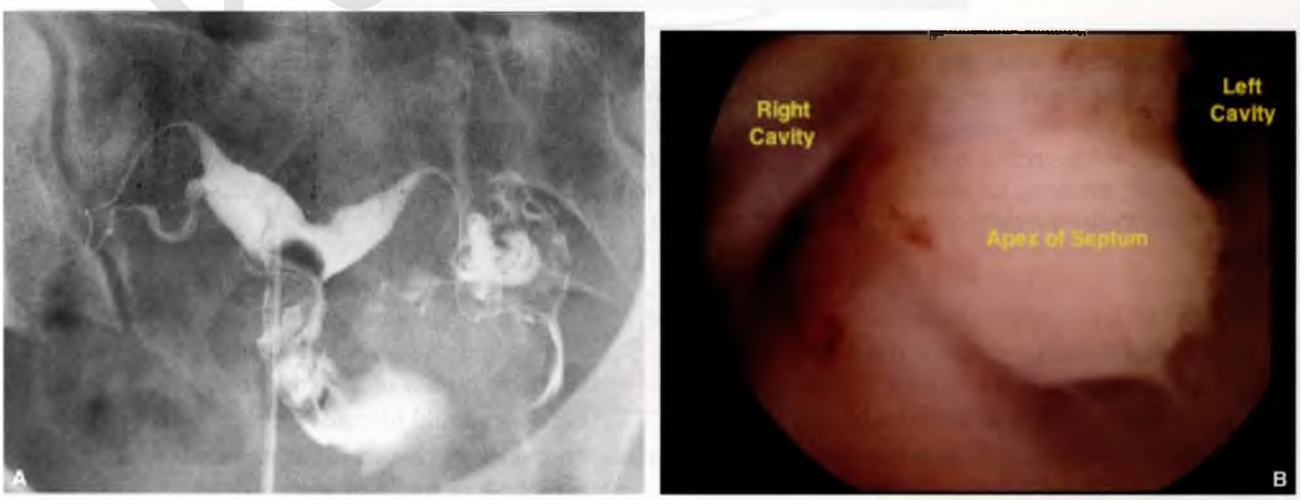


FIGURE 26.2 View of the unresected septum by hysterosalpingography (A) and hysteroscopically from the internal os (B).

A

B

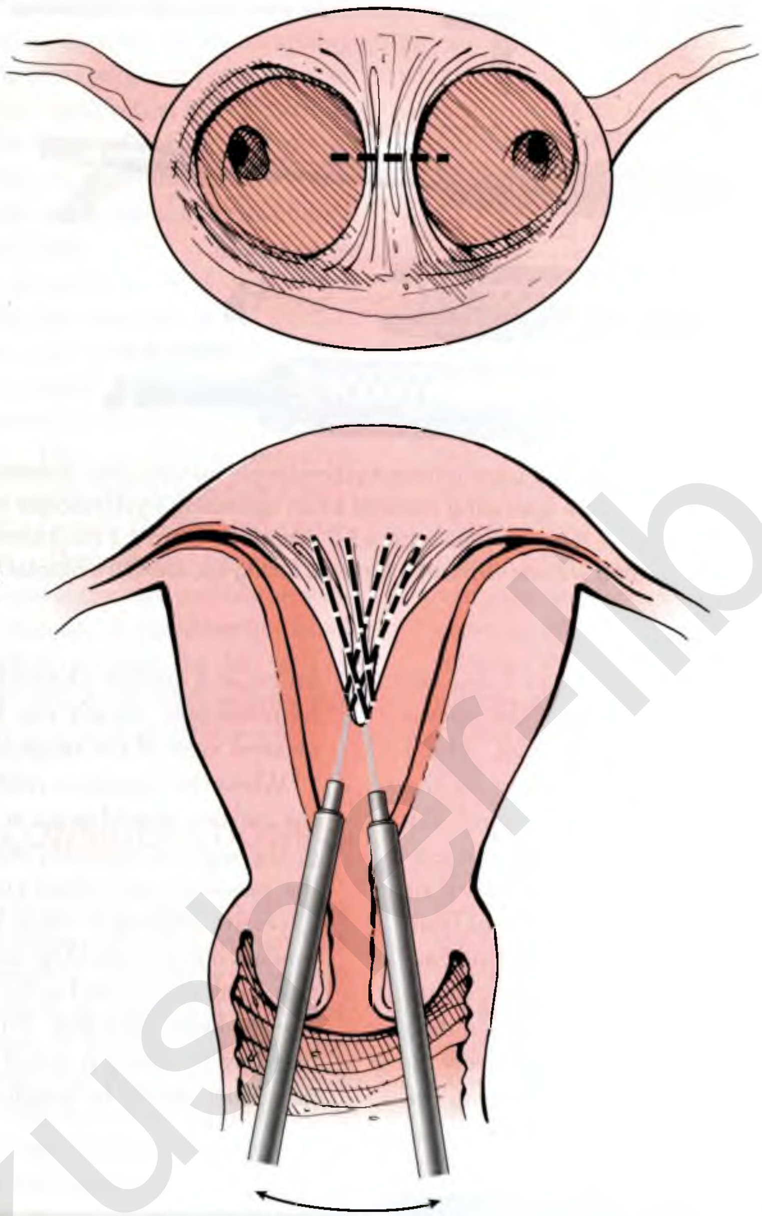


FIGURE 26.3 When the septum is relatively narrow, the incision should begin at the apex (lowest point) of the septum, at a point equidistant from the anterior and posterior walls of the uterine cavity (A): Both ostia should be kept in sight, perhaps requiring moving the hysteroscope from side to side, until the incision reaches the fundus (**B**). Care should be taken to ensure that the hysteroscope is either angled anteriorly, for anteverted uteri, or posteriorly, for retroverted uteri, to ensure that the dissection follows the transverse curvature of the uterine cavity (**C**). *(Continued)*

leave a small portion of the septum, up to 1 cm in length, rather than increasing risk by incising normal myometrium. The endpoint of the procedure, regardless of approach or technique used, should be to be able to visualize both tubal ostia simultaneously when viewed from the level of the internal os (**Figure 26.4A and B**).

Alternatively, when the septum is broader and the operator must sweep from side to side in order to maintain visualization of the surgical dissection, narrower incisions should be made on each side of the septum in gradual succession to the eventual endpoint, creating a narrow midline defect, which can then be traversed more readily (**Figure 26.5A and B**).

C

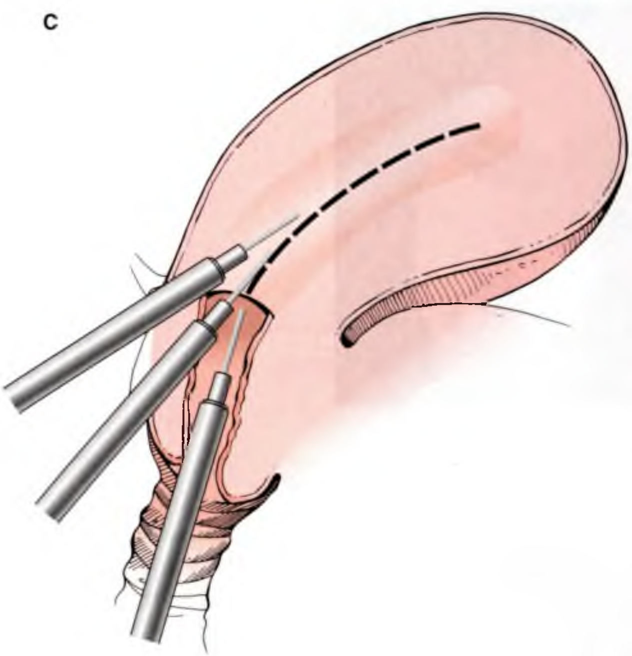


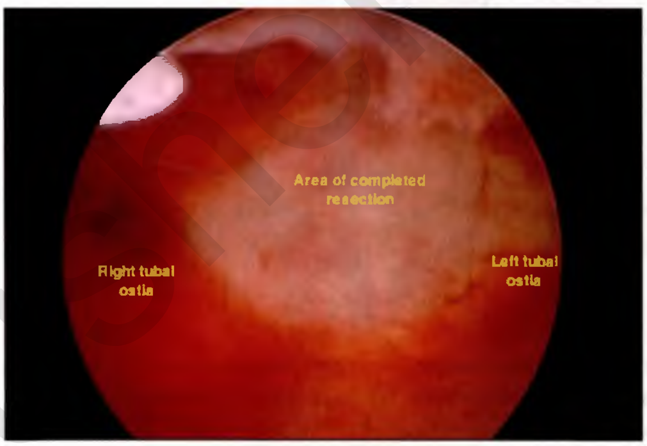
FIGURE 26.3 *(Continued)*

With long septa that end at or near the internal cervical os, it may be difficult to observe the lowermost portion of the septum to begin the hysteroscopic incision. In these cases it may be useful to begin the incision of the septum blindly, by transecting the lower-most portion of the septum using Mayo scissors placed into the uterine cavity transvaginally, with one blade in each horn and the curvature of the scissors matching that of the uterus (**Figure 26.6**).

In cases where the septum is complete and involves the cervix, a Foley catheter can be advanced into one cavity to aid in the dissection, with the surgeon creating a transverse incision to connect the two cavities, followed by cephalad dissection as is typically performed (**Figure 26.7**).

When the cervix appears to be involved, some surgeons have advocated sparing this portion of the septum to minimize the risk of future cervical incompetence. And although there is no substantive evidence to support this hypothesis, these patients should be advised of this potential complication. However, preserving the cervical portion of the septum makes the procedure more complicated.

A



B

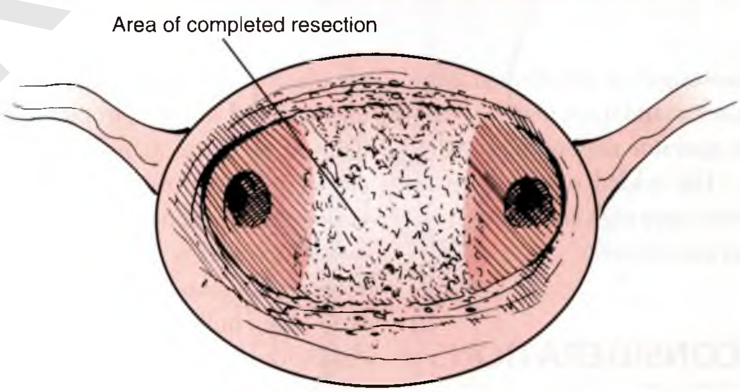


FIGURE 26.4 View of the resected septum from the internal os (A): The endpoint of the procedure, regardless of approach or technique used, should be to be able to visualize both tubal ostia simultaneously when viewed from the level of the internal os (**B**).

A

B

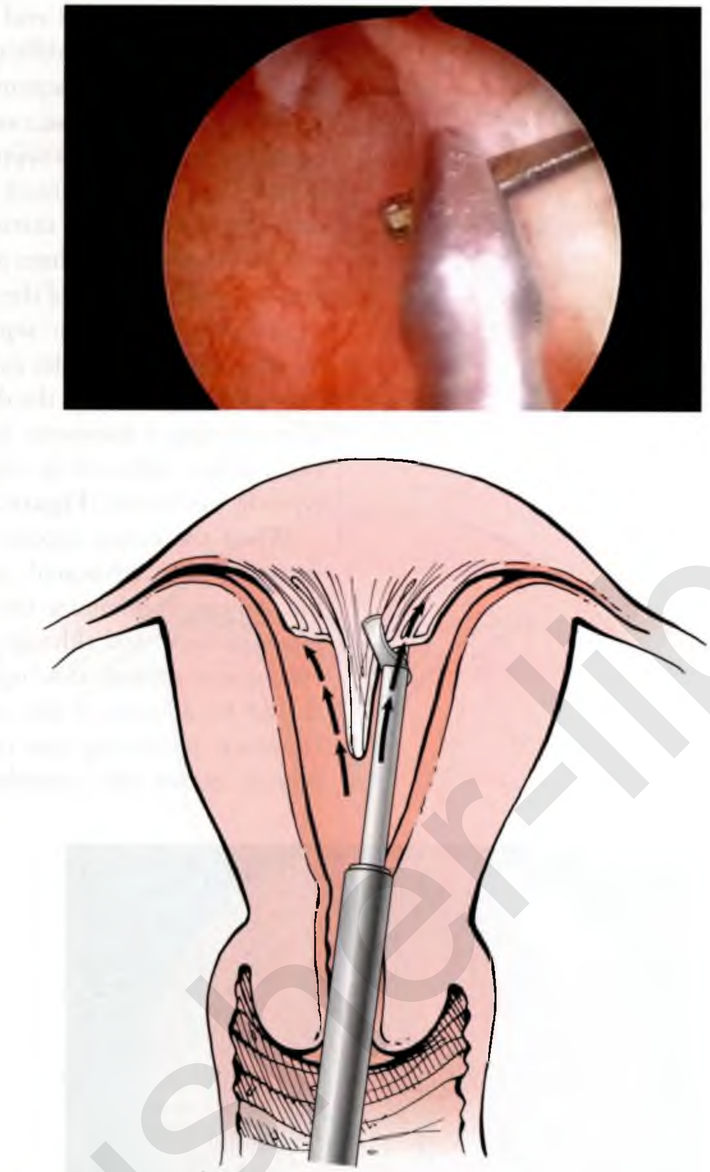


FIGURE 26.5 To incise broad-based septa, it may be necessary to incise the septum along one side and then the other as seen by incising the lateral aspect of the septum on the patients right, with the right tubal ostia in the background (A), thus progressively narrowing the defect, facilitating transection (B).

Concurrent use of laparoscopic or ultrasonography in this setting, although not mandatory, may be used at the discretion of the operator depending on the complexity of the case. The added risk of a laparoscopic intervention may outweigh its utility in a setting with no demonstrable benefit.

POSTOPERATIVE CONSIDERATIONS

In contrast to women being treated for intrauterine synechiae, there is no real benefit to placing an intrauterine device or inflated pediatric Foley balloon at the conclusion of the metroplasty. Adhesions are rarely encountered after metroplasty and are often filmy and likely of no consequence. In theory, herein lies the benefit of nonelectrosurgical means of metroplasty, since endometrial healing occurs more rapidly when less thermal injury occurs. If the scenario warrants and clinical acumen suggests using a means (e.g., distended pediatric Foley bulb) to maintain postoperative intrauterine distention or reduce intrauterine bleeding, the use of concomitant antibiotics is recommended. A postoperative HSG or hysteroscopy may be considered one to three cycles following the procedure to evaluate for cavitary distortion, with the potential operative benefit given

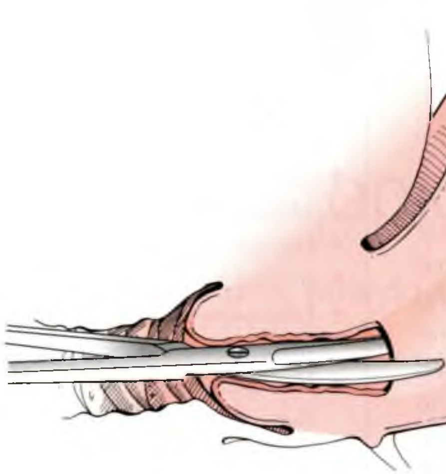


FIGURE 26.6 With long septa that end at or near the internal cervical os, it may be useful to begin the incision of the septum blindly, by transecting the lower-most portion of the septum using Mayo scissors placed into the uterine cavity transvaginally, with one blade in each horn and the curvature of the scissors matching that of the uterus.

to hysteroscopy should adhesions or significant remaining septum be encountered.

The risk of uterine rupture following hysteroscopic metroplasty is exceedingly low, although case reports do exist. If the procedure is otherwise uncomplicated and significant myometrial disruption is avoided, vaginal delivery should be attempted. A more significant complication, albeit rare, in the setting of an uncomplicated metroplasty, is abnormal placentation (e.g., placenta accreta or retained placenta).

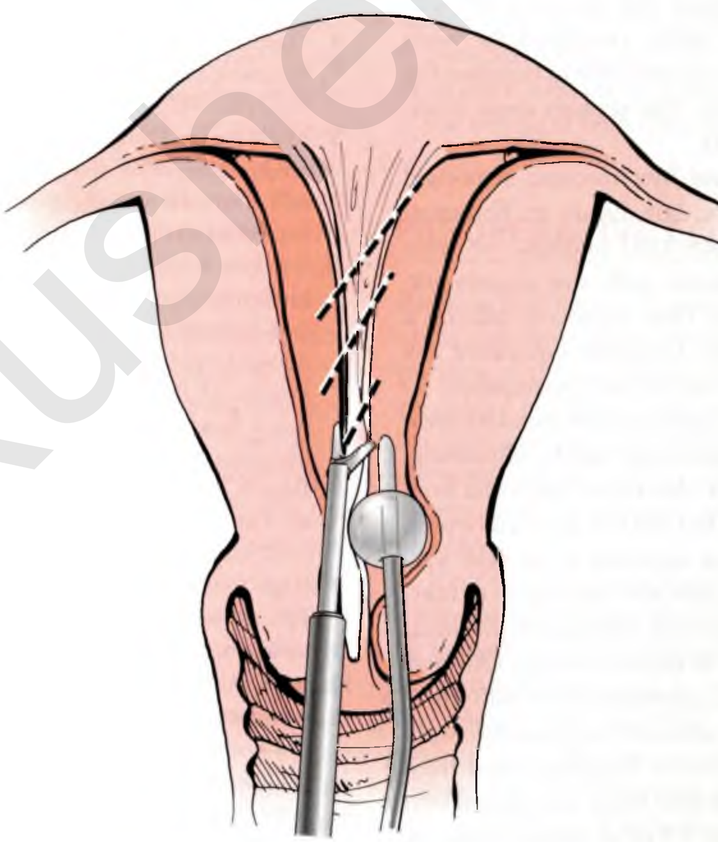


FIGURE 26.7 When the septum is complete and involves the endocervix, a Foley catheter can be advanced into one cavity to aid in the dissection, with the surgeon creating a transverse incision to connect the two cavities, followed by cephalad dissection as is typically performed.

Operative Note

PROCEDURE: HYSTEROSCOPIC METROPLASTY (RESECTION OF INTRAUTERINE SEPTUM)

The patient was taken to the operating room after proper informed consent was obtained. She was placed in dorsal supine position and underwent successful induction with general endotracheal anesthesia. Her legs were placed in Yellofin stirrups and her arms tucked appropriately at her side in the event that we had to perform a laparoscopy. She was prepped and draped in a sterile fashion. A time-out was then performed. An Ioban™ film was placed over her abdomen since the procedure was performed with ultrasound guidance, and was also draped in a sterile fashion.

Attention was turned to the pelvis where, after a Foley catheter was placed in her urinary bladder, a bivalve speculum was placed in her vagina and a single-tooth tenaculum was placed along the anterior lip of the cervix. A 5-mm operating continuous sheath hysteroscope was advanced through the cervical os under direct visualization using normal saline as a distention medium. We carefully passed the hysteroscope into the patient's left uterine cavity, visualized the ostia ,and withdrew slowly until we were able to visualize the patient's right uterine cavity. The septum came down to the level of the mid cervix.

We first attempted to use hysteroscopic semi-rigid shears to incise the septum, but due to its fibromuscular nature, consistent with MRI findings, we were unable to penetrate the tissue with this instrument. A bipolar resectoscope was then advanced, placing a twizzle device into the cavity. Using the equivalent low voltage setting, the septum was incised progressively up to the level of the fundus under continuous visualization, both through the hysteroscope and by ultrasonography. At this point, we were able to see both ostia from the level of the internal os, but did not proceed beyond the fibromuscular tissue that appeared to be more vascular. Once we felt comfortable with the degree of uterine resection, the procedure was terminated. Minimal eschar was noted from use of thermal energy. Our hysteroscopic fluid deficit was approximately 1,500 ml of normal saline. The patient tolerated the procedure well. Although there was no excessive bleeding noted from the cavity, a 10-French pediatric Foley was placed into the fundus and instilled with 3.5 ml of normal saline, to be left in place for 1 week. The patient was extubated and taken to recovery in stable condition.

COMPLICATIONS

- Incomplete septum resection—*Frequent* (*15% to 30%, depending on size of original septum*
- Fluid or electrolyte imbalance (see Table 27-1)—*Infrequent* (*less than 5%*)
- Uterine perforation—*Infrequent* (*less than 5%*)
- Intrauterine adhesions—*Infrequent* (*less than 5%*)
- Postoperative infection (endometritis, myometritis, and adnexitis)—*Rare* (*less than 1%*)
- Hemorrhage and major vessel perforation—*Rare* (*less than 1%*)

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CHAPTER 27

Hysteroscopic Myomectomy

M. Jonathon Solnik, Ricardo Azziz

INTRODUCTION

Submucosal myomas, through anatomic distortion of the uterine cavity, are implicated in the genesis of heavier menstrual bleeding, and as an independent risk factor for infertility and pregnancy loss. For more than 3 decades, gynecologic surgeons have been performing hysteroscopic resection of submucous myomas in order to avoid more substantial and morbid, yet traditional and effective approaches such as laparotomy and hysterotomy. As for most surgeries, one of the most critical considerations of this option remains patient selection.

Expert hysteroscopists have described well-established parameters to help guide surgeons in choosing which patient will experience a more favorable outcome, which include: older age, uterine size ≤ 6 cm, myoma size ≤ 3 cm, and projected operating time less than 20 minutes. Various classifications have been proposed to assess the feasibility of a hysteroscopic myomectomy (**Boxes 27.1 and 27.2**), although the classification originally proposed by Wamsteker and colleagues is the most commonly used. The hysteroscopic approach to myomectomy is primarily appropriate for submucous myomas with a majority, that is, >50% (types 0 or I), of their volume protruding into the uterine cavity, a ratio that can be increased somewhat by preoperative treatment with gonadotropin-releasing hormone agonist (GnRH-a) treatment (see below). To venture outside of these basic guidelines or beyond self-recognized hysteroscopic experience invites not only greater risk of perioperative complications, but reduced efficacy of the procedure itself.

Various methods of resecting submucosal fibroids have been described using different energy modalities (Nd:YAG, monopolar and bipolar electrosurgical techniques, hysteroscopic scissors, and mechanical resectoscopes) with accommodating fluid distention media. All have their inherent advantages and potential risks to patients. Ultimately, the surgeon's knowledge and experience with each of these should dictate their use in the setting of both basic and complex procedures.

PREOPERATIVE CONSIDERATIONS

Working in a confined space such as the endometrial cavity can pose many challenges, and a good understanding of these opposing forces will allow for a more successful outcome. Such variables include the number, size, and exact location of the fibroids as well as the parity of the patient and whether she has been instrumented in the past or suffered from infectious processes.

It is critical for the surgeon to have an accurate three-dimensional understanding of the uterine anatomy and its myomas prior to undertaking the surgery. Although transvaginal ultrasound is an effective assessment tool for women with abnormal uterine bleeding, further evaluation is often warranted prior to operative hysteroscopy. Sonohysterography has become an effective office-based tool, which can clearly delineate intracavitary lesions, although in recent years office hysteroscopy has become more commonplace, providing a clear view of the lesion that will facilitate operative planning.

BOX 27.1

European Society for Gynecological Endoscopy (ESGE) classification of intramural myomas in preparation to hysteroscopic myomectomy

Type 0: Pedunculated submucous fibroids without significant intramural extension
Type I: When the submucous fibroid is sessile and the intramural part is less than 50% of the myoma volume.
Type II: When the submucous myoma is sessile and the intramural portion is ≥50% of the myoma volume

(Reprinted with permission from Wamsteker K, Emanuel MH, de Kruif JH. Transcervical hysteroscopic resection of submucous fibroids for abnormal uterine bleeding: results regarding the degree of intramural extension. Obstet Gynecol 1993;82:736-740.)

A less obvious advantage of sonohysterography is the ability to detect the percentage of the fibroid that is intramural. Type II myomas (≥50% intramural) are not only more difficult to resect and should only to be approached by skilled surgeons, but also have a higher probability of requiring secondary procedures.

Magnetic resonance imaging, which provides high resolution of soft tissues, remains an alternative preoperative imaging modality, especially for evaluating for other fibroids that may affect the surgeon's surgical approach. Historically, the use of hysterosalpingography has been described for the preoperative assessment of the uterine cavity, although its value has lessened considerably, with the introduction of the above imaging techniques, which avoid radiation exposure and offer fewer risks, especially if tubal patency is not in question.

Timing of the procedure is another aspect that requires careful consideration, since a relatively atrophic endometrial lining with the least amount of shedding or bleeding makes for an easier procedure. The use of preprocedural suppression with oral contraceptive pills or continuous progestins is generally sufficient if it

BOX 27.2

STEPW (size, topography, extension of the base in relation to the uterine wall, and penetration into the myometrial wall) classification of intramural myomas in preparation to hysteroscopic myomectomy

	Size (cm)	Topography	Extension of the base	Penetration	Lateral Wall	Total
0	< 2	Low	< 1/3	0	+1	
1	> 2 a 5	Middle	>1/3 - 2/3	< 50%		
2	> 5	Upper	> 2/3	> 50%		
Score	+	+	+	+	+	

Score	Group	Complexity and therapeutic options
0 to 4	I	Low complexity hysteroscopic myomectomy.
5 to 6	II	High complexity hysteroscopic myomectomy. Consider GnRH use? Consider Two-step hysteroscopic myomectomy.
7 to 9	III	Consider alternatives to the hysteroscopic technique

(Reprinted with permission from Lasmar RB, Xinmei Z, Indman PD, Celeste RK, Di Spiezio Sardo A. Feasibility of a new system of classification of submucous myomas: a multicenter study. Fertil Steril 2011;95:2073-2077.)

is difficult to schedule the procedure in the early proliferative phase of the menstrual cycle, or the patient has unpredictable bleeding patterns.

GnRH analogue are effective in reducing the volume of the uterus and associated myomas, although less so for submucous myomas, in the short term. In the preoperative preparation of patients with submucous myomas, treatment with a GnRH analogue will assist in reducing the vascularity of the myometrium and the risk of intraoperative bleeding. In addition, because GnRH analogue treatment reduces normal myometrial volume to a greater degree than it reduces the volume of submucous myomas, assisting in extruding these myomas more clearly into the uterine cavity and facilitating resection. Two to three months of preoperative therapy with GnRH analogue is typically required (e.g., leuprolide 3.75 mg/month). As these agents have a stimulatory effect on endometrial activity in the first 2 to 3 weeks after administration, hysteroscopy should be avoided during this period of time.

Preoperative cervical ripening with vaginal prostaglandins or laminaria may be useful in nulliparous women or those at risk for cervical stenosis, as evident on office examination. Most resectoscopes are at least 9 mm in diameter and require significant cervical dilation in most patients, which if made easier, reduce the potential risk of cervical injury and uterine perforation. Following is a brief description of the surgical procedure used (see also video: *Hysteroscopic Myomectomy*).

SURGICAL TECHNIQUE

1. **Patient positioning and preparation, and instrument selection and placement:** Patients are placed in lithotomy position; Trendelenburg positioning should be avoided. Lingual mask airways are frequently selected by anesthesiologists, but in morbidly obese patients, in whom airway occlusion is a concern, endotracheal intubation should be considered. After examination under anesthesia, a side-opening bivalve speculum is placed in the vagina and the cervix identified. After placing a single tooth tenaculum along the anterior lip of the cervix, the cervix is infiltrated with 10 cc dilute vasopressin (20 U diluted in 50 cc normal saline) with a 22G spinal needle at the 4 o'clock and 8 o'clock positions, to reduce the risk of bleeding, and moreover, distention fluid intravasation. The needle is advanced approximately 1 cm into the cervical stroma and the solution slowly injected. The anesthesiologist should be informed whenever using vasoactive agents, which carry well-described cardiovascular risks.

The cervix is then dilated with a series of Hanks or Pratt dilators up to a diameter sufficient to accommodate the 9-mm outer sheath of a standard resectoscope. We prefer those longer dilators that have a gradually tapered tip, minimizing the need for forceful advancement and the risk of perforation. Most continuous-flow resectoscopes use endoscopes with a 12° lens, providing a more in-line view of the operation. The surgeon should be familiar with the specific resectoscope being used, be able to assemble it, select the power settings, and problem solve issues that may arise.

Large caliber inflow (cystoscopy tubing) and outflow tubing are connected to a fluid-management system that regulates intracavitary pressures and monitors fluid deficits (**Figure 27.1**). Pressures are selected based on the mean arterial pressure of the patient as a first line barrier to fluid intravasation, and should typically be no greater than 75 mmHg. The outflow tubing should be connected to both the under buttocks drape/collection bag as well as to the outflow adapter of the hysteroscope itself, using a Y-shaped connector. This allows for continuous suction of debris-laden fluid from the endometrial cavity and an accurate count of fluid lost. When continuous-flow sheaths are used, the outflow port should always remain open to minimize the risk of intravasation while resecting tissue and opening potential vascular channels. Adjusting the degree to which the outflow remains open may be helpful when the surgeon needs more relative cavitary expansion or if bloody fluid needs to be purged.

If a hysteroscopic myomectomy is to be performed without concomitant endometrial ablation, we prefer to use a monopolar or bipolar loop electrode (**Figure 27.2**). When using a monopolar setup, nonelectrolyte-rich, nonconductive fluid media (3% sorbitol, 5% mannitol, or 1.5% glycine) should be used to allow for transmission of current from the electrode to the tissue for the desired response. These solutions have much higher impedance than does tissue, allowing electrons to flow from the loop, through the media, into the tissue and back to the dispersive electrode (see **Table 27.1**). Alternatively, when using a bipolar energy system, isotonic solutions such as normal saline or lactated ringers can be used, since they have lower a impedance than does tissue. Since the active and return electrodes are in close proximity to one another, electrons travel between them,

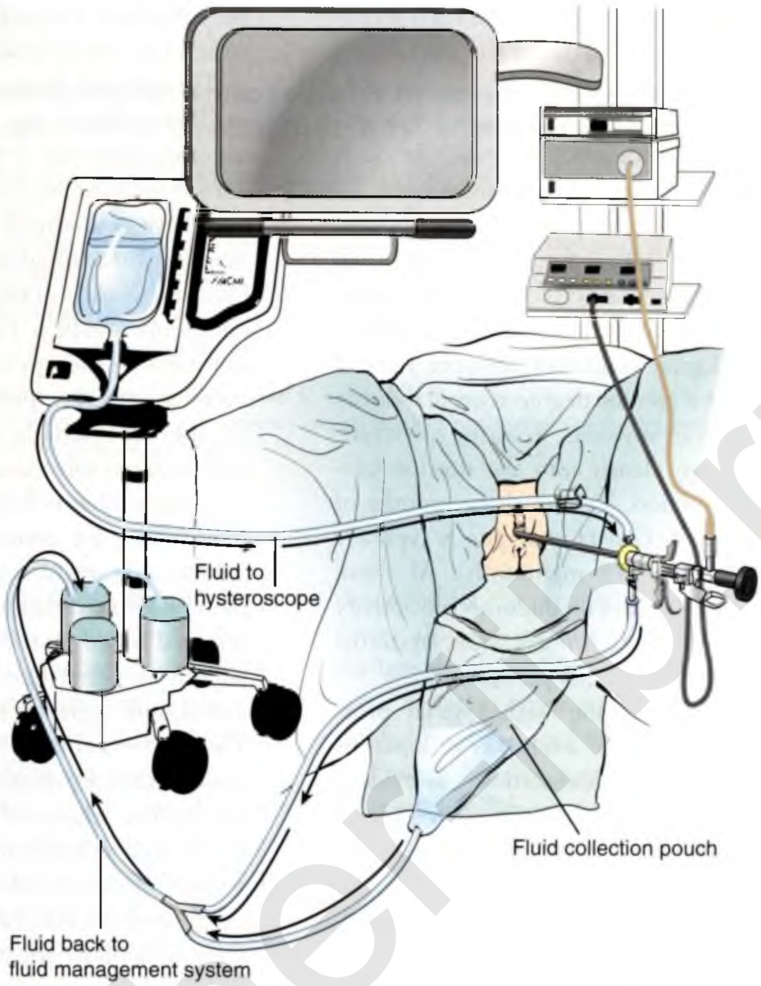

FIGURE 27.1 Continuous-flow resectoscope setup: The surgeon should be familiar with the specific resectoscope being used, be able to assemble it, select the power settings, and problem solve issues that may arise. Most continuous-flow resectoscopes use endoscopes with a 12° lens, providing a more in-line view of the operation. Large caliber inflow (cystoscopy tubing) and outflow tubing are connected to a fluid-management system that regulates intracavitary pressures and monitors fluid deficits. The outflow tubing should be connected to both the underbuttocks drape/collection bag and the outflow adapter of the hysteroscope itself, using a Y-shaped connector. When continuous-flow sheaths are used, the outflow port should always remain open to minimize risk of intravasation while resecting tissue and opening potential vascular channels.

passing through the media and not the tissue. The resultant active energy pocket allows for thermal destruction. The risk of volume overload and electrolyte disturbances is significantly reduced when using isotonic solutions.

Depending on which electrosurgical unit (ESU) or generator is available, specific high voltage (former term CUT) and low voltage (former term COAG) settings are selected. Current ESUs require lower power settings (Watts) to achieve the same response (80 to 90 W, CUT setting; 50 to 60 W, COAG setting) for loop electrodes. The cutting setting is preferred for hysteroscopic myomectomies due to its ability to penetrate deeper into tissue while using a fine electrode. When using a bipolar system, the ESU automatically detects which electrode is connected and automatically sets the power level. The surgeon should still confirm settings as these may occasionally reset to zero.

2. **Procedure:** The hysteroscope is advanced through the dilated cervix under direct visualization, being aware of the somewhat distorted view an angled lens provides, with the inflow and outflow channels wide open. Once the entire cavity is visualized and tubal ostia are identified, the attachment

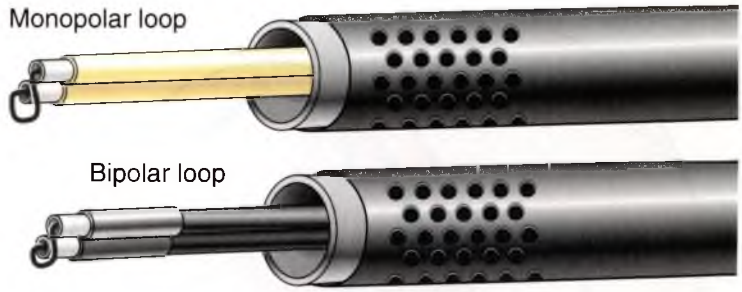

FIGURE 27.2 Monopolar loop and bipolar tip electrodes used for hysteroscopic myomectomy.

or base of the fibroid should be identified and inspected. If relatively pedunculated, the surgeon may attempt detaching the fibroid at the stalk and retrieving the specimen with forceps. Otherwise, a loop electrode is advanced beyond the area to be resected (**Figure 27.3**). Only at this point should the generator be activated, while drawing back on the electrode toward the lens (but not allowing the endoscope to advance toward the loop). This avoids inadvertent injury beyond the fibroid and field of view. Sequential passes in an organized fashion, maintaining an even platform to resect is ideal.

The fibroid should be resected to its base, while minimizing thermal injury to nearby endometrium. If a mural component to the myoma is evident, then the tip of the electrode may be used as a blunt probe, dissecting the remaining portion of the fibroid from its pseudocapsular bed (**Figure 27.4**). However, if a significant portion of the myoma is within the myometrium, the surgeon should be aware of the distance between the underlying myometrium and serosa, especially if attached on a lateral wall. Entering a principal uterine vessel may be devastating, and if the myometrium is too thin after resection this could pose a risk for uterine rupture during subsequent pregnancies. This is why an accurate three-dimensional understanding of the uterus and its myomas is critical prior to undertaking the surgery.

Surgical complications and incomplete procedures arise when fibroids are larger than

Table 27.1

Hysteroscopic Fluid Distention Media

	CO_2 gas	Hyskon	Glycine 1.5%	Sorbitol 3%	Saline
Qualities	Wider field of view	Historical use Extremely viscous	Hypotonic Electrolyte poor	Hypotonic Electrolyte poor	Isotonic Electrolyte rich
Pros	Crystallizes [not in blood]	Immiscible Nonconductive No leaks	Monopolar only	Monopolar only	Inexpensive Higher deficits Bipolar only
Cons	100 mmHg pressures Expensive	Ruins scope's' Hard to push	Can't use bipolar	Can't use bipolar	False sense of security
Max fluid deficit	N/A	500 ml [100 ml becomes 640 ml]	1,000 ml	1,000 ml	2–2.5 L
Adverse events	Gas embolism	Coagulopathy Anaphylaxis	Hyperammonemia Transient blindness	Hyperglycemia	Volume L-heart failure

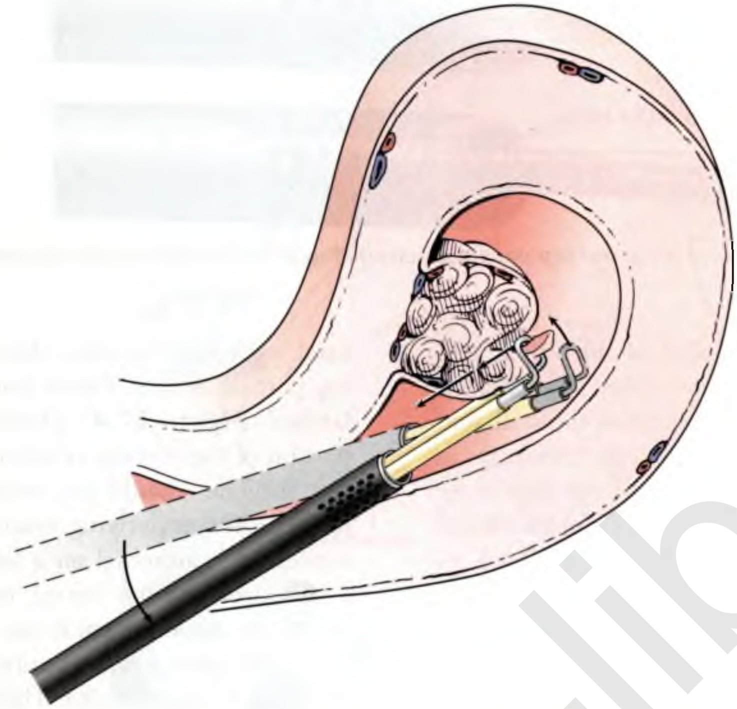

FIGURE 27.3 The attachment or base of the myoma should be identified and inspected, and a loop electrode advanced beyond the area to be resected: Sequential passes in an organized fashion, maintaining an even platform to resect is ideal.

3 cm and if concomitant endometrial ablation is performed. When resecting large fibroids, the surgeon should pay close attention to ongoing fluid deficit since time required to resect is typically increased. A VaporTrode®-type vaporizing electrode on low voltage setting may be first used to reduce the fibroid volume without producing fibroid debris that would otherwise require retrieval throughout the case. Once at a reasonable size, the loop can be placed to resect the remaining portion of the myoma.

3. **Removing the specimen:** Fragments of tissue that remain in the intrauterine cavity during the procedure can be removed by turning off the fluid inflow and withdrawing them through the outer resectoscope sheath. This technique has the advantage of minimizing the number of times the sheath is withdrawn from the uterus and cervix. Alternately, ovum forceps, myoma graspers, or suction curettage can be used to remove remaining pieces of myoma (**Figure 27.5**). When retrieving these myoma chips, both inflow and outflow channels should be closed to minimize influx of ambient air into the cavity. In uncommon cases, when the myoma cannot be removed in entirety, it may be left in place to degenerate within the uterus, or be expelled during the first menstruation following the procedure. If surface bleeding is encountered, any electrode may be used to achieve hemostasis using a high voltage current.

POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see **Complications** box on page 238). The overwhelming majority of hysteroscopic myomectomies are performed on an outpatient basis, and most patients are able to return to typical activities within a couple of days. They may experience some spotting, but heavy vaginal bleeding should prompt evaluation.

If large submucous myomas or multiple myomas that occupied large surface areas of the endometrial cavity were resected, patients are at risk for developing intrauterine synechiae. In these situations, consideration should be given to placing a 10-French pediatric Foley catheter into the uterine cavity, inflating the balloon to no more than 4 cc. In theory, this could prevent opposing

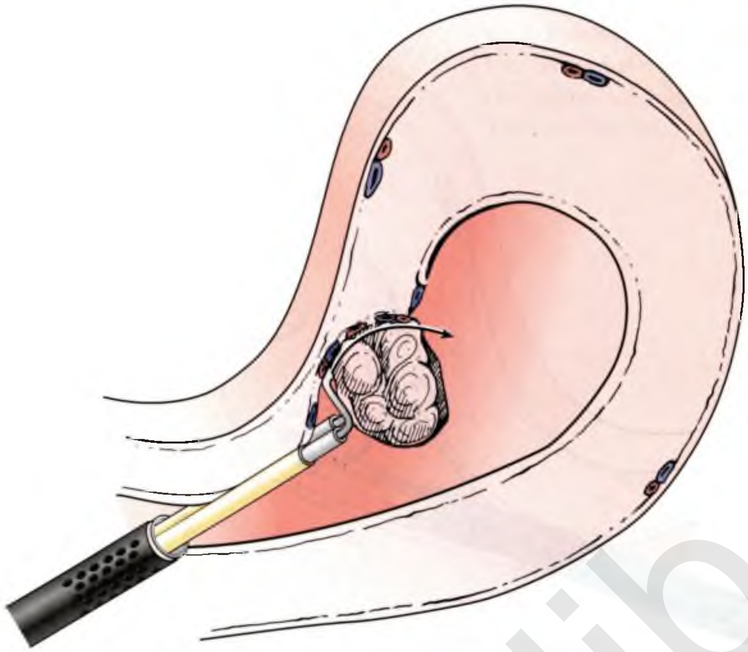

FIGURE 27.4 If a mural component to the myoma is evident, then the tip of the electrode may be used as a blunt probe, dissecting the remaining portion of the fibroid from its pseudocapsular bed: However, if a significant portion of the myoma is within the myometrium, the surgeon should be aware of the distance between the underlying myometrium and serosa, especially if attached on a lateral wall.

injured surfaces from adhering during the healing process. The catheter is maintained for approximately 7 days, during which a prophylactic antibiotic (e.g., doxycycline) should be given to prevent endometritis.

In anovulatory or hypoestrogenic patients, oral (e.g., 1.25 mg of conjugated equine estrogens) or transdermal (0.1 mg/day) short-term (3 to 4 weeks) estrogen therapy may also be given to help expedite the repair of the endometrial lining, potentially reducing adhesion formation. In general, the estrogen production of an anovulatory patient, particularly if the procedure was performed in the early follicular phase of the menstrual cycle, will be sufficient to stimulate healthy endometrial growth.

Recurrence rates are typically low, but patients at risk include those with multiple fibroids, those who have a larger tumor only able to be partially resected, and those who fail to conceive during the interval time frame.

Operative Note

PROCEDURE: HYSTEROSCOPIC MYOMECTOMY

The patient was taken to the operating room after proper informed consent was obtained, and was placed in the dorsal supine position and underwent successful induction of general anesthesia. After laryngeal mask airway placement, she was prepped and draped in a sterile fashion. A time-out was then performed. A catheter was used to drain her urinary bladder at which time a bivalve speculum was placed in her vagina and a single tooth tenaculum placed along the anterior lip of the cervix. Dilute vasopressin, 20 units in 50 ml of normal saline, 10 ml in total, was injected into the cervix to reduce the risk of fluid absorption. The cervix was dilated sufficient to accommodate a 9-mm resectoscope using normal saline as a fluid distention medium. At this point we were able to visualize a fundal, type 0 fibroid, which was resected using loop electrode in serial fashion to the level of the endomyometrium. The equivalent low voltage setting of 170 W was deployed. Fibroid chips were dispersed to allow for clear visualization of the operative field. Both tubal ostia were then easily identified. Following the dissection, a small 1.5-cm intramural fibroid along the posterior wall began to extrude at which point it was enucleated with loop electrode. Under low intracavitary pressures, we were able to see that there was a small perforating vessel that was pumping. We switched electrodes to the VaporTrode using 80 W to seal this vessel. Once the cavity was noted to be hemostatic, the procedure was completed. A 300-ml hysteroscopic fluid deficit was recorded. The

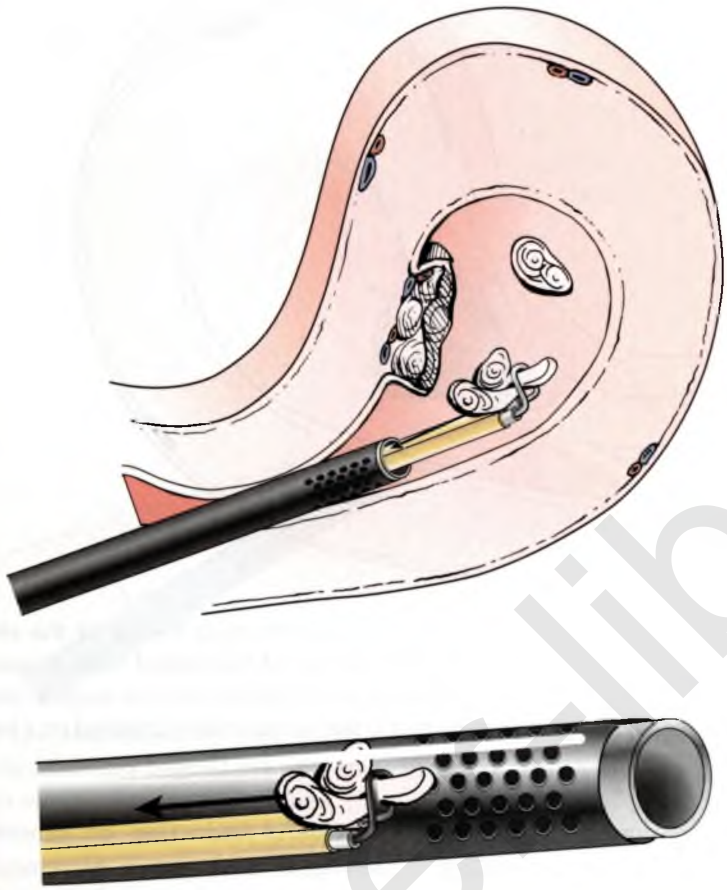

FIGURE 27.5 **Fragments of tissue that remain in the intrauterine cavity during the procedure can be removed by turning off the fluid inflow and withdrawing them through the outer resectoscope sheath.** Alternately, ovum forceps, myoma graspers, or suction curettage can be used to remove remaining pieces of myoma.

hysteroscope was withdrawn, visualizing the cervical canal upon exit, and the single-tooth tenaculum was removed. Silver nitrate application was required to stop a small amount of bleeding from the anterior lip of the cervix. The patient was awakened and taken to recovery in stable condition.

COMPLICATIONS

- Recurrence of myoma—*Infrequent (less than 5%, although may be higher if multiple fibroids removed)*
- Intrauterine adhesion reformation—*Infrequent (less than 5%, although may be higher if multiple fibroids removed)*
- Uterine perforation—*Infrequent (less than 5%)*
- Hemorrhage and major vessel perforation—*Infrequent (less than 5%)*
- Fluid or electrolyte imbalance (see **Table 27.1**)—*Infrequent (less than 5%)*
- Postoperative infection (endometritis, myometritis, and adnexitis)—*Rare (less than 1%)*

Suggested Reading

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CHAPTER 28

Abdominal Myomectomy and Uterine Reconstruction for Intramural Myomas

M. Jonathon Solnik, Ricardo Azziz

INTRODUCTION

In recent years, there has been a shift toward offering minimally invasive treatment options for women with reproductive disorders. Fibroid-specific therapies have likewise evolved to include uterine fibroid embolization and magnetic resonance imaging (MRI)-guided focused ultrasound. Although any form of therapy should only be directed toward women who are symptomatic, the prevalence of fibroids in reproductive-aged women and number of women treated annually remains high. Consequently, myomectomy remains the mainstay for women who wish to preserve their ability to conceive or are themselves experiencing subfertility. The objective of the clinician is to offer the approach that will best treat the patient's condition while minimizing the adverse surgical and reproductive outcomes that may follow myomectomy.

Women are often asymptomatic, and fibroids may be detected during routine gynecologic examination or are incidentally noted on imaging studies ordered for unrelated indications. Others will have mass-related complaints such as heaviness, urinary frequency, constipation, or low back pain. Diagnostic considerations then are reliant on the clinical acumen of the treating physician since functional complaints such as these may be visceral in origin, and surgery will less likely result in effective resolution of the patient's complaints. More reliable symptoms include abnormal uterine bleeding and dysmenorrhea, or cyclic cramping. If bleeding is irregular or unpredictable, however, causes of oligo-anovulation should first be considered since bleeding disorders related to fibroids tend to be ovulatory and heavy, representative of an anatomic, not endocrine, etiology. Other sources of pain should also be entertained since treatment may be options other than surgery. The role of fibroids in the setting of subfertility remains less clear, but there is sufficient evidence to support myomectomy when the fibroid is submucosal in location, or intramural and distorting the endometrial cavity.

Today there are a number of approaches that effectively destroy myomas more or less noninvasively (e.g., uterine artery embolization, high-intensity focused ultrasound, and cryomyolysis), although these are appropriate only for women who do not desire subsequent fertility. Myomectomy and uterine reconstruction continues to be the procedure of choice for women desiring fertility or the preservation of reproductive potential. Abdominal myomectomy remains the preferred surgical approach for women with multiple or larger tumors, and is the focus of this chapter.

Alternative approaches such as laparoscopic-assisted (see below) or minilaparotomy myomectomy provide effective treatment with well-described advantages with regard to postoperative recovery, but many women will not qualify as surgical candidates, and concerns regarding the potential for subsequent uterine rupture remain unanswered. Although abdominal myomectomy is often regarded as a single procedure, we need to understand that it also involves careful uterine reconstruction, perhaps the most important part of the surgery. In this chapter, we describe one method of performing an abdominal myomectomy, adhering to microsurgical principles (see **Chapter 22**) and restoring myometrial anatomy.

To ensure optimum surgical results, surgeons should clearly understand the anatomy of the myometrium and of myomas. Microscopically, leiomyomas are composed of dense whorls of smooth muscle cells with minimal intervening collagen. The smooth muscle cells of leiomyomata have increased nuclear size, more mitochondria, and increased free ribosomes. Anatomically, myomas are located throughout, and are classified as such, including submucosal (sessile and pedunculated), intramural, and subserosal (sessile, pedunculated, intraligamentous, and parasitic). Leiomyomas also degenerate, as they frequently outgrow their blood supply, since blood vessels do not grow into the mass (see below). Degeneration can be hyalinized, hemorrhagic, carneous, cystic, or caseous.

Most importantly, myomas are not truly encapsulated; rather they are surrounded by a layer of hypertrophied smooth cells of normal myometrium, forming a pseudocapsule, which contains flattened vessels (venous lacunae) (**Figure 28.1**). This web of flattened vessels surrounds the fibroid, which will often outstrip its blood supply and begin to degenerate. It is this latter anatomy that needs to be kept in mind when performing an abdominal myomectomy.

PREOPERATIVE CONSIDERATIONS

Unlike many other surgical procedures, preoperative counseling with regard to postoperative reproductive outcomes is requisite in patients undergoing myomectomy. Aside from the typical surgical risks, a thorough discussion should include the possibility of adnexal adhesions resulting in obstructive processes, possible hydrosalpinx formation, and tubal-factor infertility. In patients who are planning for advanced reproductive techniques whereby tubal transport is less of a concern, intrauterine synechiae (Asherman syndrome) remains a well-described phenomenon when the endometrial cavity is breached upon enucleation of a myoma. A discussion regarding when to conceive and how to deliver should the patient become pregnant should also take place, given the need for myometrial repair and risk of subsequent uterine rupture. Finally, patients should be counseled that, because of the nature of myomas, trying to safely create a "myoma-free" uterus may, in some patients, not be a realistic goal.

Preoperatively, it will be most important for the surgeon to obtain an accurate three-dimensional picture of the uterine anatomy. Transvaginal ultrasound is an effective assessment tool for women with abnormal uterine bleeding. However, further evaluation is often warranted, which may include sonohysterography. Sonohysterography can clearly delineate intracavitary

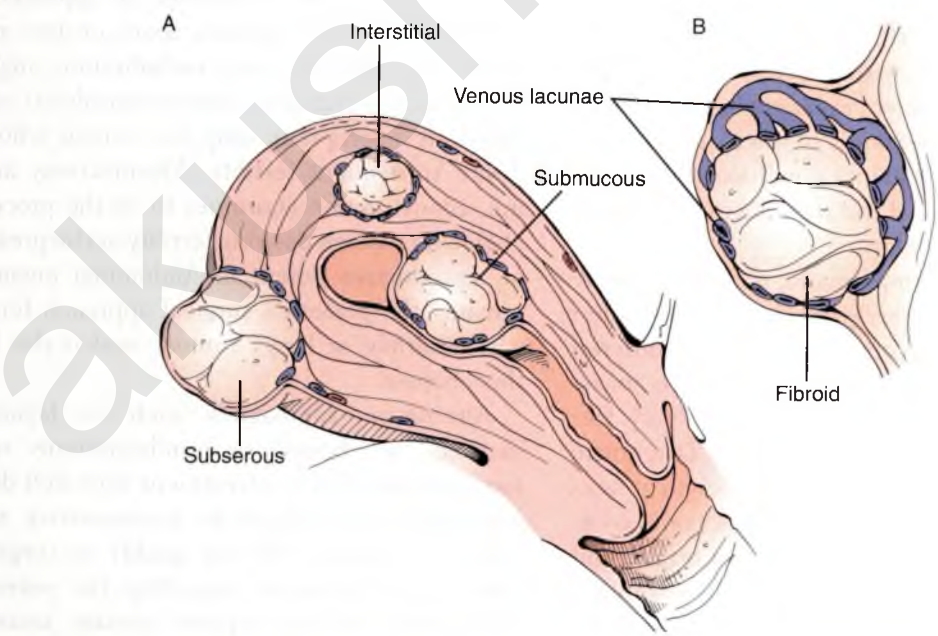

FIGURE 28.1 Myomas are not truly encapsulated; rather they are surrounded by a layer of hypertrophied smooth cells of normal myometrium, forming a pseudocapsule, which contains flattened vessels (venous lacunae) (A): This web of flattened vessels surrounds the fibroid (B), which will often outstrip its blood supply as it grows and begin to degenerate.

lesions, and has the ability to detect the percentage of the fibroid that is intramural. Historically, the use of hysterosalpingography (HSG) has been described for the preoperative assessment of the uterine cavity, although its value has lessened considerably, with the introduction of the above imaging techniques, which avoid radiation exposure and offer fewer risks, especially if tubal patency is not in question. MRI, although useful in planning for an operative hysteroscopic or laparoscopic myomectomy, provides less value in the planning of abdominal procedures. Images should be available in the operating room to guide the myomectomy.

Long-acting GnRH analogues (e.g., leuprolide 3.75 mg/month × 3 months) can be used to reduce the size of myomas and uterine vascularity prior to the procedure. However, this therapy also may make it more difficult to detect the plane between normal, albeit compressed myometrium, and myoma. In turn, since blood loss can be significant in cases with large and numerous fibroids, consideration toward use of cell-saver devices should be given and planned according to institutional policy. Following is a brief description of the surgical procedure (see also video: *Abdominal Myomectomy and Uterine Reconstruction for Intramural Myomas*).

SURGICAL TECHNIQUE

1. **Operative access and patient preparation:** The surgical approach typically begins with a transverse abdominal incision (Pfannenstiel or Maylard) unless exam under anesthesia reveals pathology more safely approached through a midline incision. Patients with deep posterior tumors, especially if large, may pose a formidable obstacle for the surgeon as these are not only difficult to visualize (bony pelvic inlet, sigmoid/colon/rectum), but even if successfully enucleated, may be exceedingly difficult to repair unless a lengthy fascial incision is made. Patient habitus, such as those with a longer distance between anterior superior iliac spines and shorter distance from the pubic symphysis to umbilicus may favor a transverse incision regardless of size or location of the fibroids. If a Pfannenstiel incision is first created, another option is to convert to a Cherney incision, rather than Maylard, in order to preserve the vascular supply to the anterior rectus sheath.

   Once the peritoneal cavity is entered, per reproductive surgery principles (**see Chapter 22**), the surgeon should wash his or her gloves with a moistened laparotomy sponge to remove any potential remaining irritants. The uterus, cul-de-sac, and adnexa are then gently palpated to obtain a clear picture of the uterine anatomy, complemented by reference to preoperative imaging results. This will allow the surgeon to plan the surgical approach. It may be useful to first deliver the myomatous uterus upward through the incision, not only for surgical ease but also to fully identify all potential tumors for resection. However, this may expose the uterus to a greater risk for peritoneal desiccation. Minimal use of laparotomy sponges to retract or grasp is recommended, as these are quite abrasive.

   Tactically, two issues should be considered. First, it is best to allow a readily accessible medium to a large-sized fibroid to remain until the end of the procedure, as these fibroids can be grasped to facilitate manipulation of the uterus. Alternatively, it may be necessary to remove those fibroids that are easiest to access initially, permitting access to myomas that are in more difficult-to-reach locations.

   A technique we have found useful to facilitate the identification of the endometrial layer at myomectomy, particularly when the myomas are suspected of abutting the uterine cavity or there is a possibility that the endometrial cavity will be entered, is to instill indigo carmine or methylene blue into the cavity. This will stain the endometrium a bluish tint and will make it easier to identify entry into the endometrial cavity and facilitates the identification of the incised endometrial edges for repair. Staining with dilute methylene blue (1%) lasts longer than with indigo carmine. Dye instillation can be performed transvaginally, through the cervix, or via an angiocath placed through the uterine fundus, although this may be difficult when the uterine cavity is significantly distorted by the myomas.

   Following, we initially describe the resection of an uncomplicated fundal or anterior myoma, followed by uterine reconstruction. Subsequently, we address the removal of myomas in more difficult locations (e.g., posterior, cervical, pedunculated, cornual, interligamentous, intracavitary, and multiple adjacent myomas).

2. **Myomectomy of a fundal/anterior myoma:** Once the uterus and tumors have been examined, and the approach established, the first incision is then planned. This incision should generally overlie the most pronounced area of the myoma, be directed transversely if well removed from the interstitial/cornual region of the uterus, as close to the midline as possible. Transverse incisions should not be used when operating close to the

uterine cornua, in order to prevent extension into the intramural portion of the tubes.

The incision size should be kept to the minimum necessary, and should not be made to accommodate the entire girth of the myoma, as morcellation of the tumor should be used if necessary. A vasoactive agent (we suggest vasopressin [Pitressin®] 20 U diluted in 50 cc of normal saline) is injected around the area of the planned incision, both superficially and deep into the myometrium. The anesthesiologist should be informed of the injection before it is administered. Some surgeons use a rubber tourniquet placed through the broad ligament compressing the uterine vasculature at the level of the internal os, although this surgeon views that approach as excessively risky.

A scalpel is used to incise the serosa and myometrium down to and into the fibroid itself. It is important that the surgeon understand that the incision must be carried deep into the myoma itself, preferably at least halfway the full width of the myoma. This technique allows the normal myometrium to retract from the less elastic fibroid (**Figure 28.2**), and allows the surgeon to better identify the true plane between the fibroid and normal (yet compressed) myometrium for atraumatic and relative bloodless enucleation. Alternatively, if the incision is not carried into the fibroid, then there is a high likelihood that the dissection will be started at the myometrial pseudocapsule, with all its flattened vessels, resulting in significant bleeding and damage to normal myometrium

Using a towel clamp or a Lahey traction forceps for external traction, a curved Kelly or Pean clamp can be used to dissect the fibroid in a multidirectional approach, following the avascular planes between the myoma and the myometrial pseudocapsule (**Figure 28.2**). In a stepwise fashion, most

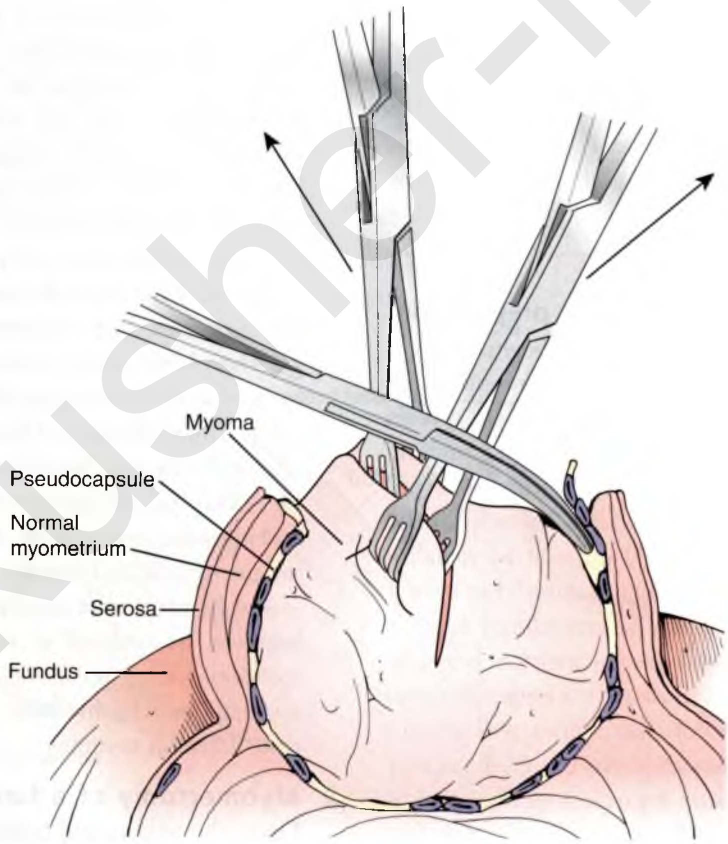

FIGURE 28.2 The incision must be carried deep into the myoma itself, preferably at least halfway the full width of the myoma, allowing the normal myometrium to retract from the less elastic fibroid: This will allow the surgeon to better identify the true plane between the fibroid and normal (yet compressed) myometrium for atraumatic and relative bloodless enucleation. A towel clamp or a Lahey traction forceps is used to grasp the fibroid for external traction, and a curved Kelly or Pean clamp can be used to dissect the fibroid in a multi-directional approach, following the avascular planes between the myoma and the myometrial pseudocapsule.

fibroids may be removed intact. However, if myomas are large, serial wedge-type morcellation with a scalpel should be considered (**Figure 28.3**). There is no need to take out fibroids "intact," and in fact, the serosal incision should not be made as large as the myoma; it should be made just sufficient to allow for dissection of the myoma from its bed and to permit wedge morcellation. We do not recommend the use of Allis clamps to grasp the serosa or myometrium for countertraction purposes as these only create more injured surfaces and potential nidus for adhesion formation.

The blood supply to the fibroid is peripheral and circumferential, rather than central (**Figure 28.1**). Myomas flatten and stretch the arcuate vessels of the uterus which run in a transverse pattern. If dissection through planes just exterior to the fibroid takes place, significant bleeding and oozing can occur. Accordingly, most incisions should be made in a transverse fashion to reduce bleeding and make for an easier closure. This is not always possible, and proximity to the interstitial portion of the oviduct and vascular supply should take precedence. Electrosurgery and electrocoagulation can be used in the deeper layers of the myometrium to achieve hemostasis of transected perimyomatous vessels. On occasion, a particularly large vessel may have to be isolated and tied off.

The operator should strive to minimize the number of incisions. To remove multiple fibroids, the serosal incisions should be planned strategically, in order to remove as many tumors through one incision as possible, although this may require on occasion that the operator transect normal vascular myometrium laterally, necessitating good hemostasis. Good palpation of the uterus during the procedure should be performed to ensure that no large tumors are missed, particularly those lower in the uterus. And surgeons should never forget to continuously irrigate the serosa with warmed isotonic solutions to maintain moisture throughout the procedure.

3. **Uterine reconstruction:** Closure, repair, and uterine reconstruction remain one of the most crucial aspects of the procedure. Once intended fibroids are removed, careful inspection of deeper tumor beds should take place before closing any defects to ensure hemostasis. We prefer to close the

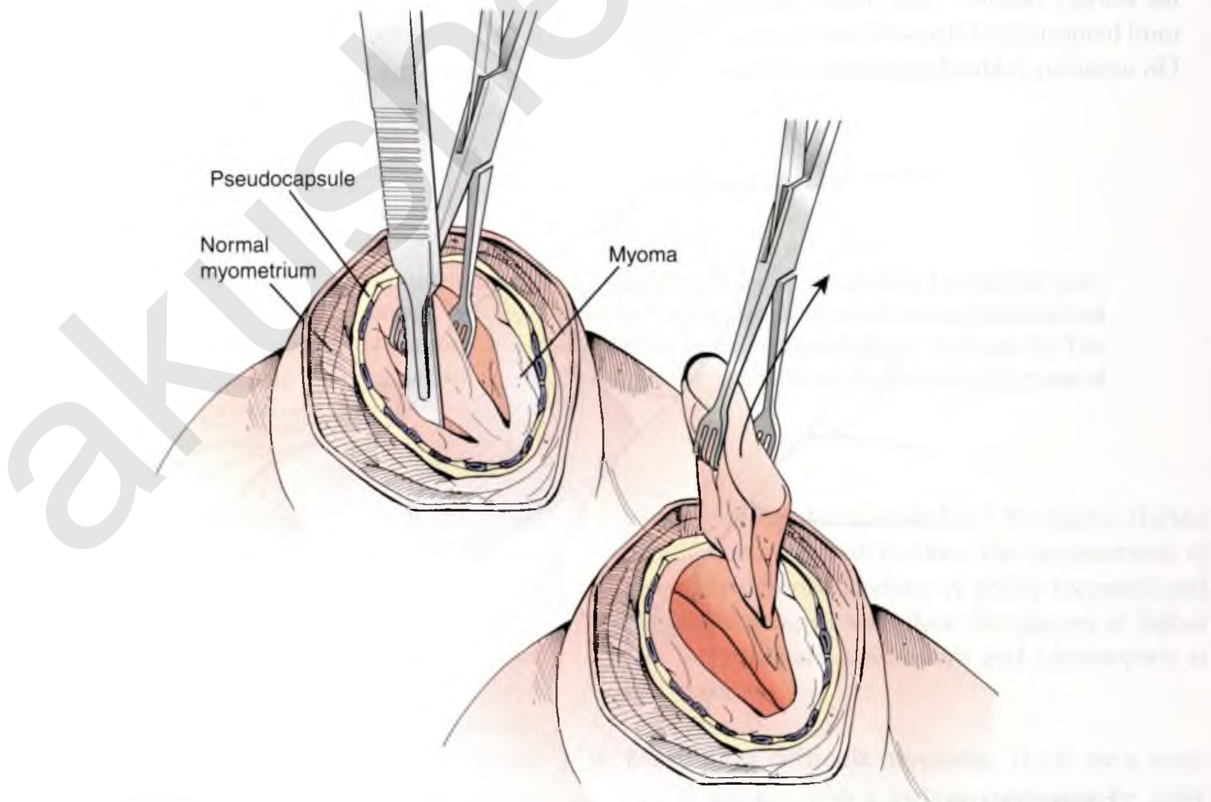

FIGURE 28.3 If myomas are large, serial wedge-type morcellation with the scalpel should be considered to aid extraction.

deep layers of myometrium using 0 gauge absorbable sutures on CT-1 or CT-2 needles. The defect is bridged in at least two layers of interrupted sutures (**Figure 28.4**). While generally the sutures are tied as they are placed, in more irregular defects it may be reasonable to tie them after all sutures are placed. External pressure should be applied manually to bring both sides of the incision together while the interrupted sutures are placed; this may require significant pressure as the operator is trying to bring together two parts of a strong muscle that have now contracted/retracted from the incision site. This is a critical step, and the principal reason why laparoscopic myomectomy, while effective for the removal of more superficial myomas, is less successful for the removal and subsequent reconstruction of deeper and intramural myomas.

Once the 2 to 3 deeper layers of sutures are placed and the uterus has regained its generally normal shape, the most superficial layer of myometrium (but not including serosa) may be best closed in a running horizontal mattress stitch (**Figure 28.5A**), which should aim to bring the edges of the myometrium together at equal heights. This technique occludes multiple parallel vessels with a single pass, and also reapproximates the tissues reading them for serosal closure. This suture should be placed until hemostasis of deeper layers has been achieved. On occasion, a bleeding perimyomatous vessel may be best occluded using a single interrupted horizontal mattress suture. At this point, after the uterus is fully hemostatic, the serosa should be reapproximated using 4-0 nonreactive absorbable suture in a "subcuticular (subperitoneal)-type" fashion (**Figure 28.5B**); the objective of this suture is to approximate the edges of the serosa without tension and without exposing foreign material to the peritoneal surface. This minimizes foreign body exposure that may occur with more typical running techniques, such as the baseball stitch closure.

4. **Pedunculated subserosal myomas:** It is relatively easy to remove subserosa, although the most difficult part of this removal is the repair of the serosa. Tying the base of a pedunculated myoma is not acceptable (**Figure 28.6A**), unless a sufficient flap of peritoneum has been dissected off the base first, to allow for subsequent subperitoneal reapproximation (**Figure 28.6B**). It will also allow for electrocoagulation without damaging the overlying serosa.

5. **Endometrial cavity entry during myomectomy:** Many surgeons fear entering the endometrial cavity, being concerned that this places the patient at greater risk of uterine rupture, mandating the need for a scheduled cesarean section. The reality is, however, that any deep injury or incision into the myometrium, whether there is endometrial

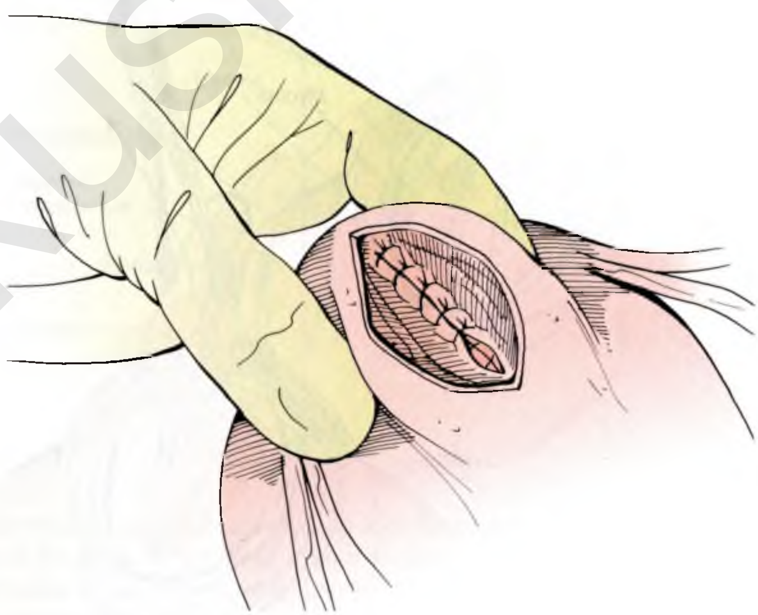

FIGURE 28.4 The deep layers of myometrium are closed using 0 gauge absorbable sutures and the defect bridged in one or two layers of interrupted sutures: External pressure should be applied manually to bring both sides of the incision together while the interrupted sutures are placed.

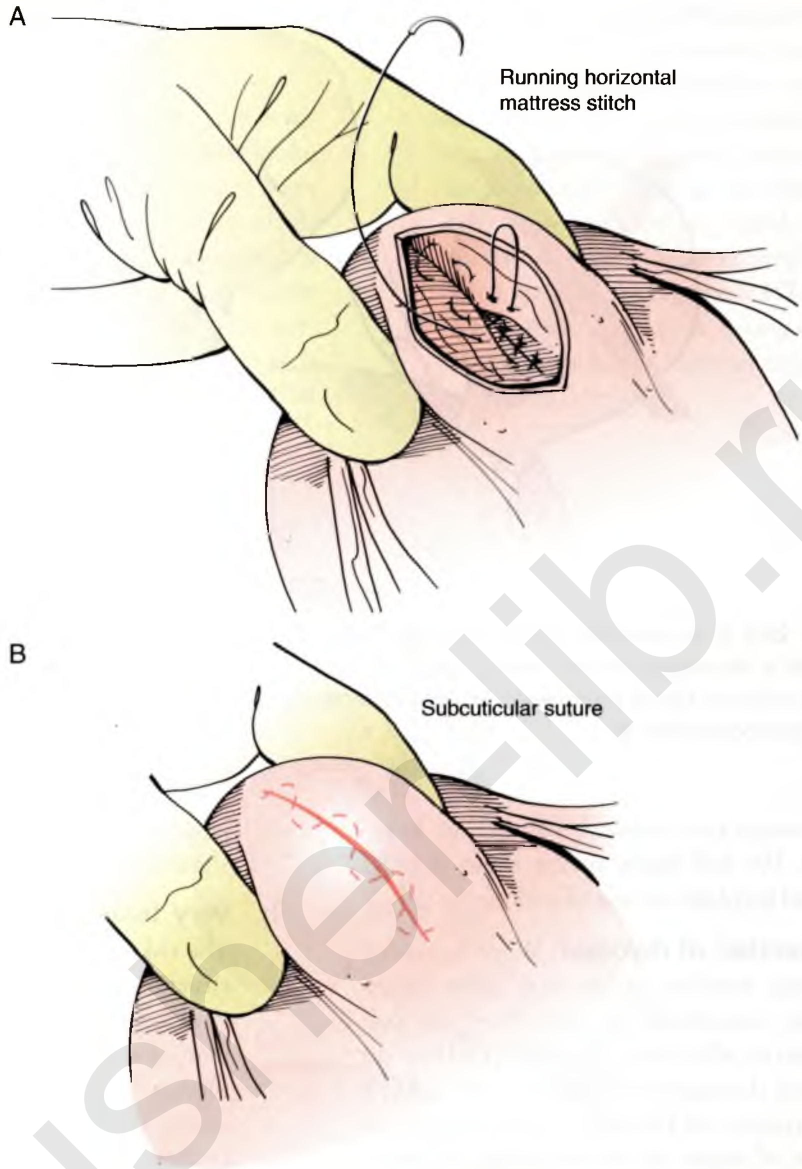

FIGURE 28.5 The superficial myometrium is closed, preferably using a running horizontal mattress stitch (A), and once the uterus is fully hemostatic, the serosa should be reapproximated using 4-0 nonreactive absorbable suture in a "subcuticular (subperitoneal)-type" fashion (B): This last stitch will approximate the edges of the serosa without tension and without exposing foreign material to the peritoneal surface.

entry or not, should be considered a risk factor for uterine rupture. As such it is much more important that the surgeon be alert to the possibility that entry into the endometrial cavity may/has occurred when removing deeply placed myomas, and strive to reconstruct the cavity appropriately. In fact (see below), a surgeon may intentionally breach the endometrium during removal of a posteriorly placed myoma. The surgeon should identify the endometrial edges and approximate them carefully using either interrupted (if the tear is irregularly shaped) or running (if regular) absorbable 2-0 sutures. He/she should then proceed to close the myometrium in layers, as described before. A poorly reconstructed endometrial repair will place the patient at higher risk for intrauterine adhesions and adenomyosis at the repair site.

6. **Managing difficult myomas:** There are a number of reasons why a myomectomy may be more difficult than described, including large number of myomas, large size myomas, and location of myomas

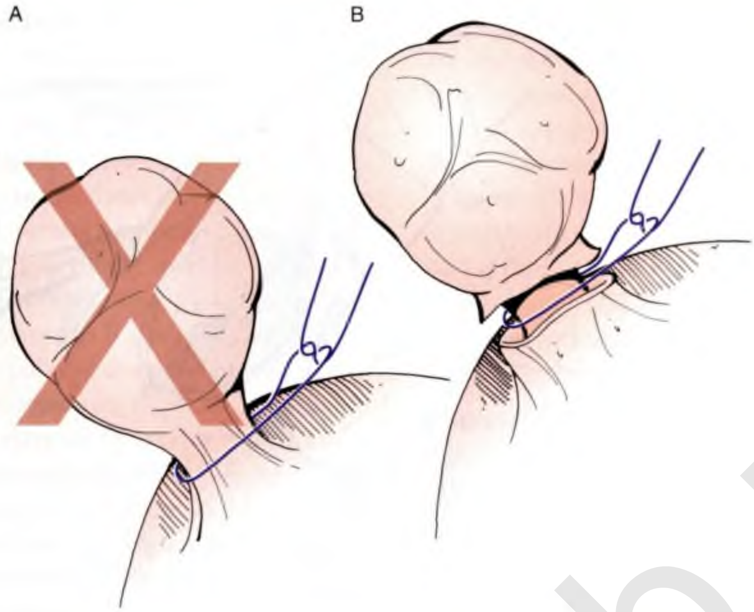

FIGURE 28.6 It is relatively easy to remove subserosa, although the most difficult part of this removal is the repair of the serosa. Tying the base of a pedunculated myoma is not acceptable (**A**), unless a sufficient flap of peritoneum has been dissected off the base first, to allow for subsequent subperitoneal reapproximation (**B**).

(posterior, intracavitary, cervical, cornual, or intraligamentous). We will briefly review these surgical situations, and highlight means of addressing.

a. **Large number of myomas:** When a patient has a large number of myomas three issues should be considered: a) How does the size of the uterus affect my approach? b) How do I minimize damage to the uterus? and c) Do I need to remove all fibroids? Below we address the issue of mass size in managing myomas. Previously we have described means of removing more than one myoma through one uterine incision, using lateral or sideway incisions to reach other fibroids. Most important, however, is the decision of how many fibroids should be removed and why.

   When addressing a large number of fibroids, an excessively zealous approach may risk bleeding, infection, malreconstruction, and hysterectomy. As such, the surgeon should approach this (and any other surgery) by understanding what the individual patient desires are. For example, if near-term fertility is desired, it may be possible to leave selected small tumors behind. If excessive abnormal uterine bleeding is a concern, then all fibroids around endometrial cavity should be removed. However, trying to create a "myoma-free" uterus may, in some patients, not be a realistic goal, and patients should be counseled in advance.

b. **Very large fibroids or myomatous mass:** The risk of bleeding is higher and uterine reconstruction more difficult with very large fibroids or myomatous masses; however, these are issues that simply require greater attention to dissection. Alternatively, large masses will make access and uterine mobilization more difficult. In these events, the uterine fibroids may need to be addressed sequentially, beginning at the top or front aspect. Pedunculated uterine fibroids should be palpated for, extracted, and removed, progressively allowing for greater uterine mobility.

   Large irregular masses also cause such a level of uterine distortion that it may be difficult for the operator to determine landmarks. For example, a large myomatous mass on the uterus may have rotated the uterus in such a way that exposes the uterine artery and vein directly anterior, heightening their chance of accidental or iatrogenic injury. Likewise, the location of tubal insertion may be difficult to ascertain, and encourage the transection of the tube at this site. Thus, in patients with a very large myomatous mass it will be critical that the surgeon begin by establishing (optimally visually, if not tactilely) insertion of adnexa, beginning with the origin and insertion of the infundibulopelvic and round ligaments, and so on.

c. **Posterior wall myomas:** Posterior wall myomas of any significance are unfortunately quite common. Obviously, easiest is to access them directly posteriorly. However, this carries a high chance that adhesions will form between the posterior uterine wall and the tubes and ovaries that rest normally in the cul-de-sac. This surgeon prefers, whenever possible, to approach posterior myomas anteriorly. That is to say, that the uterus is bivalved anteriorly using a longitudinal incision, preferably placed, at least in part, beneath the bladder reflection. Once the endometrial cavity is entered and the cavity walls retracted using army-navy retractors, an incision is made in the posterior wall into the posterior fibroid, which is enucleated/morcellated in a fashion similar to what has been described (**Figure 28.7**). The uterus is reconstructed in layers, taking care to bring the endometrial layers together separately from the myometrial repair.

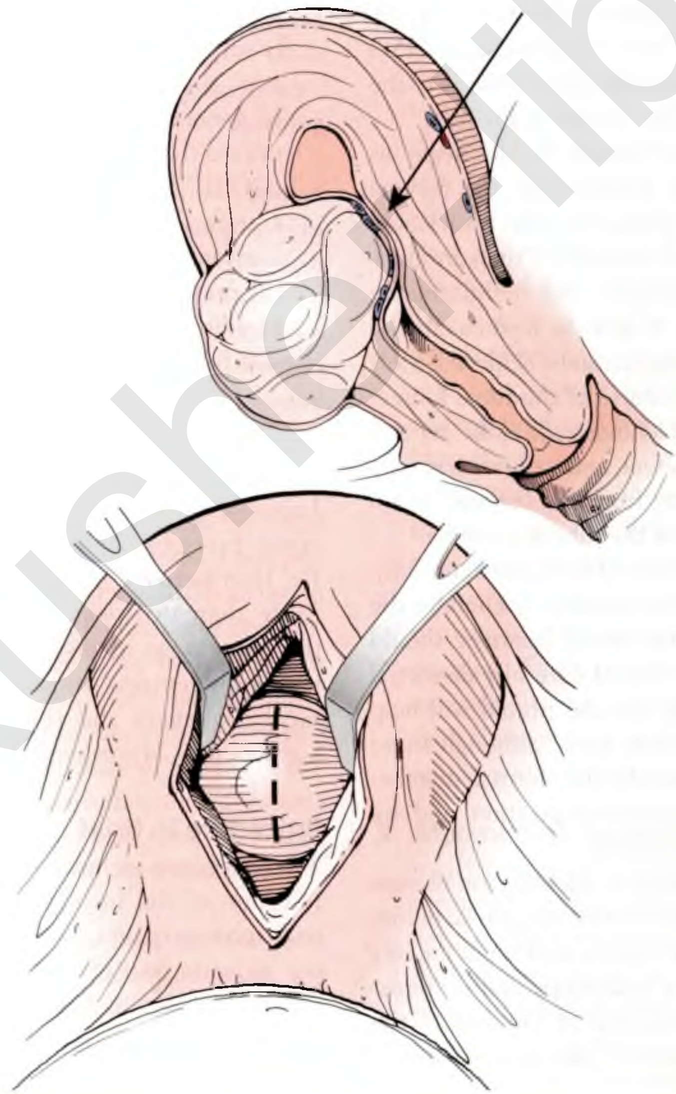

FIGURE 28.7 Whenever possible, a posterior-wall fibroid should be approached anteriorly: The uterus is bivalved anteriorly using a longitudinal incision. Once the endometrial cavity is entered and the cavity walls are retracted using army–navy retractors, an incision is made in the posterior wall into the posterior fibroid, which is then enucleated.

d. **Intracavitary myomas:** Intracavitary myomas can be handled in a manner similar to that described for anterior approaches to posterior myomas (see above). However, sole intracavitary myomas should be best handled by hysteroscopic resection (**see Chapter 27**).

e. **Cervical and cornual myomas:** The decision to remove myomas that are in close proximity to either the cervix or the uterine cornua should be made carefully, as their removal has significant risks for bleeding (cervical) or infertility (cornual). If a decision is made to proceed, a few strategies should be kept in mind. First, removal of fibroids from the cornual region should be made through an incision away from the intramural portion of the tubal lumen, as one does not want to transect the lumen while removing the fibroid. Examination of the preoperative HSG may prove helpful, as it may give a clue as to the direction the lumen has deviated away from.

   Dissection of the fibroid should begin as medially as possible, incising into the myoma body laterally. The fibroid is then enucleated taking care to protect as much of the surrounding myometrium as possible, and minimizing the use of electrosurgery. In general, myoma enucleation in the cornual region can be achieved safely without injuring the course of the tubal lumen. However, the lumen is most apt to be injured when repairing the defect, and so sutures should be placed as far away from the cornual region and from the course of the tube as possible.

   Cervical myomas should be tackled carefully, and from as medially as possible. Generally, the anterior portion of the broad ligament should be opened, and the fibroid carefully dissected away. Again, incising into the fibroid will help identify the true myoma mass, although these fibroids often lie outside the normal myometrium, in an intraligamentous position, and are generally clearly identifiable.

   Care should be taken to identify the uterine arteries and the ureter supervening these before fully enucleating the myoma and repairing any defect. If in doubt, a cystoscopy and ureteroscopy should be considered at the end of the procedure if the course of the ureter was not fully identified.

f. **Intraligamentous myomas:** Intraligamentous fibroids are rare, but occasionally masquerade as an adnexal mass. The surgical approach will depend on the size and amount of adnexal distortion. However, because these masses can lift, stretch, and flatten out large broad ligament vessels including the uterine artery and vein, the best approach is to open the broad ligament, using a small 1-cm incision over the uppermost aspect of the mass and as usual, incising deeper into the mass. Once this is done safely, further dissection of the mass should proceed through careful blunt dissection, ensuring all normal tissue (and vessels) are pushed off the fibroid.

7. **Final considerations and closure:** Once all tumors are removed and the uterus is reconstructed, all irrigation is suctioned using a pool adaptor, minimizing use of laparotomy sponges, which can abrade serosal linings. Before replacing the uterus, adhesion barriers may be placed. Although there is some evidence to support use of specific products, there is no definitive indication or selection. In general, the preponderance of evidence points toward the use of expanded polytetrafluoroethylene (GORE® PRECLUDE® Peritoneal Membrane) as an effect barrier against adhesion formation during a myomectomy. However, adhering to microsurgical principles (**see Chapter 22**) and minimizing bleeding remains the best means of reducing adhesion formation.

Laparoscopic myomectomy

Laparoscopic myomectomy represents a far from novel procedure, originally described in 1991 by Dr. Jean-Bernard Dubuisson after his first 43 cases. More than two decades following this publication, the percentage of myomectomies performed laparoscopically remains low, in large part due to the technical challenges and skills required (see also video: *Laparoscopic Myomectomy*).

Procedure in brief

The procedure includes patient selection, identification of the myoma, enucleation, myometrial reconstruction, and adhesion prevention. Since the ultimate goal of any laparoscopic procedure is to closely replicate its laparotomy counterpart, it is likely the reconstruction of the myometrium that represents the most difficult task for most surgeons. With the concern for uterine rupture during subsequent pregnancy, myometrial integrity has historically fallen under more scrutiny with a laparoscopic approach. For this reason, a multiple-layered closure, which can often be difficult and tedious to accomplish, should never be replaced with a single-layered bulk closure.

1. **Patient selection:** Although there exists no standard as to which patient is a good candidate for laparoscopic myomectomy, beginning with relatively easy cases will build skill sets and confidence. Transvaginal ultrasonography remains a good first step in evaluating women with fibroid uterus; however, pelvic MRI with contrast has clear advantages in that it will demonstrate more accurately the number, location, size, and 3D rendering that ultrasound cannot. Since the surgeon cannot "feel to find" the myoma during surgery, he or she becomes reliant on visual cues that comes best from MRI. This imaging modality also allows for enhanced surgical planning in the operating room and ensures retrieval of as many fibroids as is necessary for the intended outcome. Furthermore, MRI may help detect other myometrial pathology such as adenomyosis, which may redirect how a patient is counseled regarding treatment options.

   Many experts feel that some denomination of 15 cm is a good reference for selection purposes (an isolated 15-cm fibroid, three 5-cm fibroids, or five 3-cm fibroids). Ultimately, this range will vary based on surgeon experience. Location of the fibroid does not necessarily pose a limitation, but small fibroids (less than 2 cm) that are deeply intramural and in the background of several larger fibroids are often the most challenging to identify.

2. **Enucleation of the myoma:** Port placement is potentially one of the most limiting steps if not performed in relationship to the individuals' anatomy. As gynecologists, we become familiar and comfortable with the umbilicus, but if the uterus extends beyond the umbilicus, then ports should move cephalad, but still be able to reach the lower pelvis once the fibroids are enucleated. Surgeon preference should dictate where the ancillary ports are placed and depending on how they have been trained to suture (ipsilateral vs. contralateral suturing technique).

   Diluted vasopressin (we use 20 U in 100 ml of normal saline) is injected into the myometrium and serosa until adequate blanching can been seen. Typically, a monopolar scissors or hook, using a low voltage current (CUT) on 60-W power setting is used to incise the serosa and myometrium to and into the fibroid, similar to an open procedure. Smoke evacuation, which can be performed using a suction irrigator in a pulsatile manner, can be helpful during this portion of the procedure since resultant smoke from cellular combustion can impede visualization. Alternatively, suction tubing can be connected from an ancillary trocar to a tightly sealed bottle of warmed solution. This can help since it creates a passive outlet for smoke. If the surgeon is to avoid electrosurgical instruments altogether, a laparoscopic scalpel is also available. High-voltage current should be avoided as it is less precise and causes more lateral thermal injury that could impact healing and eventual integrity. No other energy source is typically required since hemostasis is ultimately accomplished by suture material. For pedunculated fibroids specifically, we do not recommend bipolar dessication of the stalk for two reasons. First, this results in significant thermal injury to serosa and possibly myometrium in the uterine corpus given the proximity of the stalk. The eventual defect is then quite small with virtually no redundant tissue to reapproximate for either hemostasis or strength of closure. Second, the stalk may contain large vessels and may bleed if not desiccated well prior to amputating. To improve all surgical aspects, we perform a circumferential incision along the base of the fibroid itself, resembling a wine cup and neck. The fibroid is shelled from its avascular planes, which results in less blood loss and leaves more serosa for closure. All other fibroids are enucleated and repaired as if the procedure were performed by laparotomy.

   A laparoscopic tenaculum or corkscrew is used to enucleate the fibroid in a similar manner to abdominal myomectomy. Anterior fibroids tend to be more difficult to enucleate since laparoscopic instruments are linear and come from a cephalad position. There is less room for torque between an anterior fibroid and the anterior abdominal wall than there is from a posterior fibroid and the origination point of the trocar.

3. **Myometrial reconstruction:** Historically, myometrial beds are repaired in multiple layers of interrupted sutures, often using 0-caliber absorbable sutures. Two commercially available barbed sutures have recently been introduced, making the uterine repair much easier since the beds can be reapproximated in a continuous fashion without the need of tying knots. The small barbs also constrict the myometrium while being placed, allowing for a very hemostatic repair (V-loc and Quill). Morcellation is performed with one of several available mechanical devices. It is critical that a fibroid count is

maintained and that if multiple, each fibroid is tagged for later retrieval to avoid retained material.

The da Vinci robotic platform, introduced in 2003, has also enabled surgeons to perform more complex procedures laparoscopically. The ability to suture with traditional instrumentation has been replicated by the advanced pulley system deployed by this platform, allowing the surgeon to suture multiple and deep defects and anterior fibroids comparably as if sewn by laparotomy. Surgical outcomes have demonstrated feasibility of this device, but long-term reproductive outcomes are not yet well established. Anecdotal findings have been promising in that adhesion formation at time of cesarean delivery seems to be significantly reduced compared to abdominal myomectomy.

POSTOPERATIVE CONSIDERATIONS

Serious complications are infrequent (see **Complications** box on page 253), although adhesion formation at the site of the myomectomy is very frequent, and blood loss sufficient to significantly decrease the hematocrit is frequent. The mainstay of postoperative care revolves around analgesia. Unless significant bleeding is encountered, we typically utilize nonsteroidal anti-inflammatory drugs such as IV/IM ketorolac, but narcotic administration is almost inevitably required. If selected, patient-controlled analgesic pumps are requested. Depending on the degree of myometrial dissection, which can result in hematoma formation and resultant pain, most patients will remain in-house for 2 to 4 days. It is not uncommon for patients to experience low-grade fevers in the early postoperative course, but concurrent evaluation for an infectious source is nonetheless warranted, especially if they appear toxic.

Venous thromboembolic prophylaxis with sequential compression devices are maintained until the patient is ambulatory, which is encouraged on postoperative day 1. Routine use of prophylactic antibiotics is not recommended. Foley catheters are typically maintained overnight unless the patient is ambulating early. Postoperative care is otherwise conducted in an individualized manner.

Upon discharge, a discussion about the procedure, recommendations for postoperative assessments (such as HSG), and modes of delivery should they conceive routinely take place. In general, if there have been significant breaches of the myometrial wall, a scheduled cesarean section should be considered for subsequent delivery.

Operative Note

PROCEDURE: ABDOMINAL MYOMECTOMY AND UTERINE RECONSTRUCTION FOR INTRAMURAL MYOMAS

The patient was placed supine upon the operating room table, and was prepped and draped in the usual sterile fashion. A Foley was placed to straight drain in the bladder. Time out was called and information reviewed. A speculum was placed into the vagina and the cervix exposed. A pediatric Foley was placed into the uterine cavity and the bulb was insufflated with air. The uterine cavity was insufflated with dilute 1% methylene blue dye. After instillation of the dye, the Foley was decompressed and removed.

At this point, gloves were washed in sterile water and a transverse incision was made in the lower abdomen, about 2 cm above the pubic area. The incision was carried down through the subcutaneous fat to the fascia. The fascia was incised transversely and dissected off the rectus muscle, upward to the umbilicus and downward to the pubis. The rectus muscles were separated in the midline and the perineal cavity was entered digitally. The peritoneal incision was then extended upward to the umbilicus and downward toward the bladder. The edges of the incision were then wrapped with laparotomy packs to avoid bleeding from the incision into the abdomen; a Balfour retractor was placed into the abdomen. At this point, the uterus and adnexa were examined and the above findings were noted. The bowel was then packed away from the pelvis using a lap pack placed in sterile plastic bags. Copious irrigation was maintained throughout the procedure using warm lactated Ringer's solution, instilled through an 18G angiocath connected to a 20-cc. syringe.

Attention was placed to the anterior uterine surface. Dilute Pitressin (20 U diluted in 50 cc of normal saline) was injected into the myometrium over the bulging myoma, along the planned incision line; blanching of the myometrium at the injection site was noted. Using a No. 15 scalpel, a small 3-cm transverse incision was made over the myoma, and the incision was carried deep into the body of the myoma. Applying pressure on both sides of the uterus manually, the edge of the bivalved myoma was clearly seen separate from the overlying myometrium. Using Lahey clamps to grasp each edge of the cut myoma, traction was applied and the myoma was dissected away from its myometrial bed using dissection with a curved Kelly clamp. Bleeding was minimal. The myoma was morcellated into halves using the scalpel in order to remove the tissue without extending the myometrial incision. Care was taken to not enter the uterine cavity.

At this point, attention was placed on removing the posterior wall myoma. After lysing the filmy posterior wall adhesions, a decision was made to remove the myoma through the anterior wall incision. At this time the anterior uterine incision was extended using the scalpel to 4 cm, taking care to avoid excessive extension into the lateral uterine vessels. The uterine cavity was then exposed using bilateral retraction with army–navy retractors, and the endometrial cavity was entered transversely incising the endometrial lining, identified by its bluish tint.

The cavity was exposed through retraction and then a transverse incision was made in the posterior wall of the endometrial cavity with a long-handled scalpel and the incision was carried into the body of the myoma. Again the edges of the bivalved myoma were grasped with a single-tooth tenaculum, and the myoma was morcellated and fragments extracted through the anterior uterine wall. Care was taken not to transect the posterior serosal wall, protecting the underlying bowel by placing a wide flat malleable retractor into the space.

Once the myoma had been removed in toto using the tip of a curved Kelly for dissection, closure of the posterior wall was begun, first using two layers of interrupted horizontal mattress stitches using 0-chromic. With the myometrium closed, care was then taken to approximate the posterior endometrial layer using interrupted using 2-0 plain catgut sutures, taking care to leave the knots on the myometrial side of the layer.

Attention was placed to the anterior intramural cornual fibroid. Careful inspection noted that the fallopian tube inserted posterior to the myoma. A 1 cm longitudinal incision was made with scalpel over the medial edge of the myoma and carried laterally into the body of the myoma. Once the myoma was bivalved, the cut edges were grasped using a single-tooth tenaculum, and the myoma was carefully dissected from its myometrial bed, taking care to not extend the dissection beyond the surface of the myoma. Once removed, the myometrial incision was closed using two interrupted vertical mattress sutures with 2-0 chromic, staying away from the cornual area. The superficial layer of the myometrium was now approximated using two 2-0 chromic interrupted superficial horizontal mattress sutures. The serosa was closed using a subserosal running stitch with 4-0 Vicryl®. No excess bleeding was noted.

Attention was now placed to the anterior wall incision. Palpation revealed additional smaller anterior wall fibroids, which were removed by making lateral incisions through the principal anterior wall incision. The beds of the fibroids were closed with single interrupted sutures using 0-chromic.

The anterior wall incision was now closed in layers. First, the anterior endometrial layer was approximated using interrupted sutures of 2-0 plain catgut, ensuring that the knot was placed away from the endometrial cavity. The myometrium was then closed in two layers, the first using vertical interrupted sutures with 0-chromic, and the second using interrupted horizontal mattress sutures with 0-chromic. Manual pressure was applied to the sides of the uterus through the repair in order to ensure exact approximation of the incision. A final running horizontal mattress layer using 2-0 chromic was placed through the superficial layer of the myometrium. The serosa was then closed using a subserosal running stitch with 4-0 Vicryl®. No excess bleeding was noted. A decision was made not to use an adhesion barrier at the sites of the anterior incisions.

At this point, after the pelvis was carefully inspected, irrigated copiously, and all blood products washed, all lap packs were removed from the pelvis after the adnexa were allowed to fall freely to the cul-de-sac. The pelvis was gently and thoroughly irrigated. At this point the sponge count was correct and the peritoneal incision was closed using a running suture using 2-0 Vicryl. The rectus fascia was closed using interrupted sutures with 0 Vicryl. The subcutaneous fat was approximated using three interrupted sutures using 2-0 Plain. The skin incision was enclosed in a subcuticular fashion using 4-0 Vicryl. The patient went to the recovery room in good condition without any complications. The estimated blood loss was approximately 150 cc.

COMPLICATIONS

- De novo pelvic adhesion formation and adhesion reformation—*Very frequent* (*greater than 50% de novo adhesion formation, and as high as 90% adhesion reformation if severe reexisting adhesions*)
- Hemorrhage or major vessel perforation requiring transfusion—*Infrequent* (*less than 5%*)
- Postoperative infection (myometritis, adnexitis)—*Infrequent* (*less than 5%*)
- Major organ injury—*Rare* (*less than 1%*)

Suggested Reading

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CHAPTER 29

Hysteroscopic Adhesiolysis of Intrauterine Synechiae

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INTRODUCTION

Intrauterine synechiae, albeit uncommon, affecting approximately 1.5% of women undergoing hysterosalpingography (HSG), and possibly more in at-risk patients, may present a challenging anatomical dilemma for women who wish to have children. For any type of adhesion, or synechiae to form in the body, two opposing surfaces must be injured at some level. Typically, within any body cavity, these surfaces are comprised of single-cell layers, such as peritoneum or serosa, but in the case of intrauterine synechiae, the injury occurs within the endometrium. It has been suggested that the probability of synechiae increases if the associated injury or trauma is accompanied by an inflammatory response, such as in the setting of a postabortal curettage for the indication of a septic abortion.

Women at increased risk for intrauterine adhesions include those who undergo postpartum or postabortal curettage who subsequently experience menstrual complaints. According to Friedler, the incidence of adhesions rose from 14% to 32% for curettage performed in the second versus the third abortion. As such, it is our recommendation to avoid vigorous curettage in any setting whether postabortal or for the indication of a menstrual complaint. The basalis layer of the endometrium is the most regenerative; however, during pregnancy, the uterine wall is quite compliant and the basalis layer is more predisposed to significant injury during this time period. Furthermore, after delivery, there may be more of an exaggerated healing response within the endometrium, also predisposing to adhesion formation. For these reasons, early diagnosis and surgical correction is warranted since it is ideal to treat less mature adhesions with less muscular component in order to preserve viable endometrium. Other women at risk for intrauterine synechiae are those with opposing submucosal myomas who undergo concurrent hysteroscopic resection, and those who undergo abdominal myomectomy with breach into the endometrial cavity and inappropriate cavitary repair.

Women with intrauterine adhesions appear to be more at risk for subsequent infertility and pregnancy loss. The mechanism for these process likely stems around the finding that impaired endometrial perfusion has been documented with less available surface area for implantation and subsequent embryonic development. Based on these anatomic and physiologic distortions, reproductive capacity becomes our primary interest. Categorizing the extent of disease has not been uniform throughout the literature; however, the American Society of Reproductive Medicine (ASRM) classification system published in 1988 describes not only the extent and type of adhesions, but also the impact on menstrual pattern since the more significant the burden, the more likely it is to affect bleeding (see **Table 29.1**). Nevertheless, several such systems have been described, one not more predictive of pregnancy outcome than the other.

PREOPERATIVE CONSIDERATIONS

Prompt detection followed by surgical management continues to be the mainstay for treating both symptomatic patients and those with infertility or recurrent

Table 29.1

ASRM Classification of Intrauterine Adhesions, 1988

Extent of cavity involved	<1/3	1/3–2/3	>2/3
	1	2	4
Type of adhesions	Filmy	Filmy & dense	Dense
	1	2	4
Menstrual pattern	Normal	Hypomenorrhea	Amenorrhea
	0	2	4
Prognostic classification		**HSG[a] score**	**Hysteroscopy score**
Stage I		(Mild)	1–4
Stage II		(Moderate)	5–8
Stage III		(Severe)	9–12

Source: The American Fertility Society classifications of adnexal adhesions, distal tubal occlusion, tubal occlusion secondary to tubal ligation, tubal pregnancies, mullerian anomalies and intrauterine adhesions. Fertil Steril 1988;49:944-55.
[a]All adhesions should be considered dense.

pregnancy loss. Historically, an HSG was used to diagnose synechiae, although this study suffers from higher false positive rates and does not necessarily quantify the extent of disease. In experienced hands, a transvaginal ultrasound may also serve to detect adhesions, but diagnostic accuracy is enhanced with the use of sonohysterography (with specificity and positive predictive values as high as 100% reported). Overall, however, operative hysteroscopy allows for the most accurate and descriptive means of diagnosis and provides the physician with the ability to concomitantly divide adhesions.

SURGICAL TECHNIQUE

The decision to surgically manage patients with intrauterine synechiae ultimately depends on symptoms (amenorrhea, poor reproductive outcomes). We prefer to use a 5.5-mm operative hysteroscope with semi-rigid cold scissors. Typically, we proceed to the operating room and use general anesthesia; however, specific centers have successfully implemented office-based treatment.

Early stage disease is frequently easy to manage by simply incising the synechiae in their horizontal plane with cold scissors (**Figure 29.1A**). Lower segment adhesions and more filmy adhesions are divided first (**Figure 29.1B**), and dissection is continued in a cephalad direction, dividing more dense adhesions later. The objective is to normalize the endometrial cavity while preserving or restoring as much viable endometrium as can be accomplished (**Figure 29.2**).

More advanced disease to include an obliterated cavity poses a more significant surgical challenge and should only be undertaken by skilled surgeons since the risk of uterine perforation and the inability to complete the procedure is relatively high. Lateral perforation toward the uterine vasculature poses significant risk. Surgical options include the initial use of a Pratt dilator to help establish a lateral channel from which to begin working (**Figure 29.3**). Ideally, two passages are created laterally, toward the tubal ostia. As a result of this quick maneuver, the resulting cavity resembles that of a uterine septum. At this point, the surgeon may use scissors or an electrosurgical electrode to incise the midline obstacle toward the fundus. Movement from lateral to medial remains the safest approach regardless of instrumentation selected. However, there is also a significant risk of creating a false passage with dilation. There will be times when the ostia cannot be visualized, and if more muscular adhesions are encountered, the likelihood of resuming normal menstrual function becomes lower.

The decision to terminate the procedure is similar to that of a uterine septum in that it is always safer to be less aggressive and lessen the risk of uterine perforation or thinning and weakening the myometrium, which may not be easy to identify in difficult cases. If brisk bleeding is encountered, the procedure should come to an end. Occasional visualization under low intrauterine pressures may help identify an appropriate bleeding point. Some surgeons have described the use of concurrent ultrasonographic imaging, whether by transabdominal ultrasound or by a laparoscopically deployed ultrasound probe to help move safely within such a small cavity. The literature lacks supportive evidence,

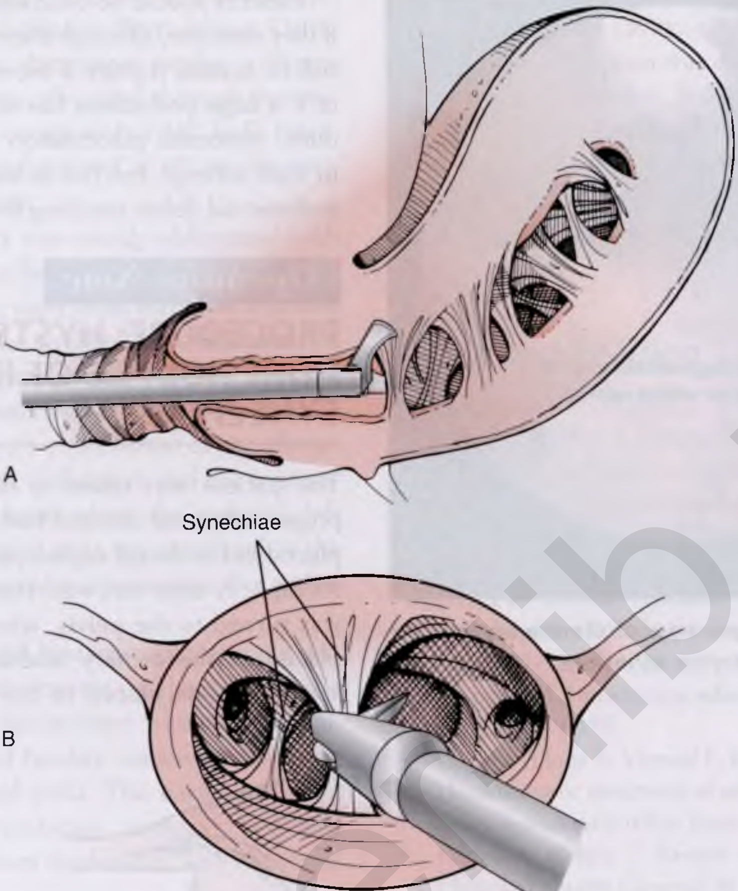

FIGURE 29.1 Transverse (A) and hysteroscopic view (B) of moderate intrauterine adhesions.

but in difficult cases, we typically use a transabdominal probe to help visualize the fundus in a coronal plane.

POSTOPERATIVE CONSIDERATIONS

Intraoperative and postoperative complications are infrequent (see **Complications** box on page 259). The highest risk is that of recurrent intrauterine adhesions, which can range from 2% to 20% in all patients, and even higher in patients with severe adhesions (20% to 60%). The most commonly described methods for reducing the risk of recurrent adhesions are the postoperative placement of an intrauterine device (IUD) or a pediatric Foley balloon. Currently, the most widely used technique is the placement of a 10-French Foley balloon, inflated to 3 to 3.5 ml saline to keep opposing surfaces separated for at least 1 week following surgery. However, overinflating the balloon may compromise the regenerative process by excessively increasing intrauterine pressure and reducing blood flow to the endometrium. If using a standard pediatric Foley, the tip of the catheter should be trimmed, taking care not to breach the lumen of the catheter. This is performed with the balloon inflated so not to cut the air reservoir and inadvertently deflate the balloon. While the balloon remains in place, we administer Doxycycline 100 mg by mouth twice daily to minimize the risk of endometritis.

Depending on the patient's estrogenic status, continuous estrogen (e.g., conjugated estrogen 1.25 mg by mouth once to twice daily) may also be given for the first 30 to 60 days following surgery to help promote endometrial growth, followed by progestin withdrawal. However, surgeons should note that oral estrogen in this dose may increase the risk of thrombi, and consideration should be given to treating patients with 81 mg (baby) aspirin daily. Furthermore, in patients who are younger, not hypoestrogenemic, and regularly ovulating, the addition of oral estrogen may not add little to their estrogen.

All stated, none of the above postoperative recommendations have been studied in a well-designed fashion. Given the relatively low risk profile of these recommendations, and the potential for improved outcomes, they are still often implemented.

FIGURE 29.2 Hysteroscopic view of uterine cavity after lysis of moderate intrauterine adhesions.

Patients should be counseled toward vaginal delivery if they conceive, although there may be a slight increased risk for uterine rupture if excessive electrosurgical injury or if a large perforation has occurred during the procedure. Abnormal placentation has also been described in such settings, but this is likely due to the preexisting endometrial defect resulting from the primary process.

Operative Note

PROCEDURE: HYSTEROSCOPIC ADHESIOLYSIS OF INTRAUTERINE SYNECHIAE

The patient was taken to the operating room after proper informed consent had been obtained. She was placed in the dorsal supine position, legs in Allen-type stirrups. A time-out was then completed. Attention was turned to the pelvis, where a Foley catheter was placed in the urinary bladder and a sterile bivalve speculum was placed in her vagina. The cervix was

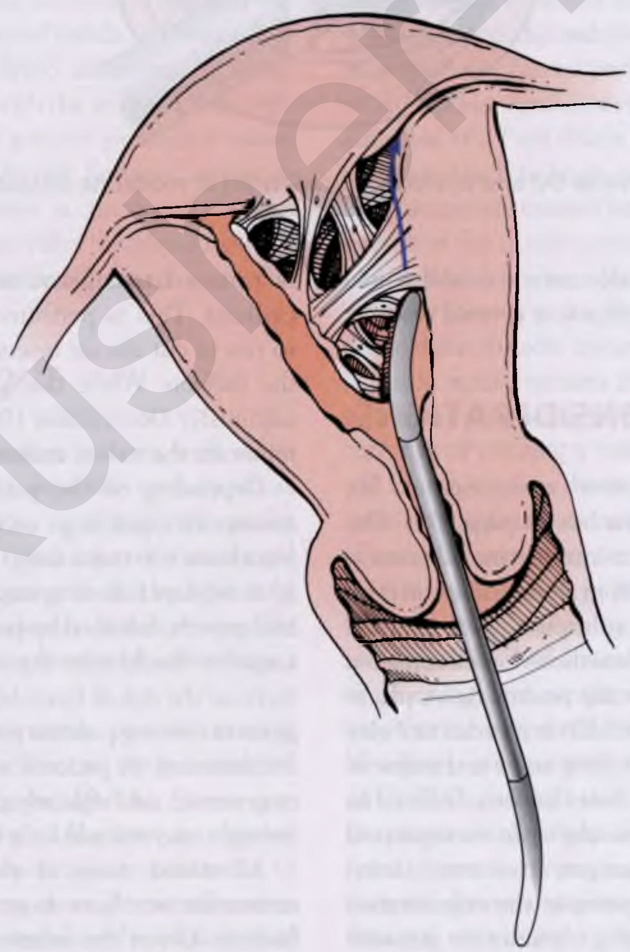

FIGURE 29.3 Transverse view depicting the use of a Pratt dilator to create lateral passages to facilitate lysis of intrauterine adhesions in uteri with severe intrauterine adhesions. However, there is also a significant risk of creating a false passage with dilation.

grasped with a single-tooth tenaculum and the cervix was dilated up to a 16-French Pratt dilator. Using normal saline as a fluid distention media, a 5-mm operative hysteroscope was advanced through the cervix into the endometrial cavity with a 30° lens. Intrauterine pressures were maintained at 60 mmHg with a fluid management system.

The endometrial cavity was mostly obliterated with filmy and fibromuscular adhesions except for the right, where a channel up to the right tubal ostia was followed and normal-appearing late proliferative endometrium was documented. The hysteroscope was then removed and a 14-French Pratt dilator was advanced through the endocervix into the patient's endometrial cavity, directing to her left. It was then withdrawn and the hysteroscope readvanced. A channel along the patient's left was then seen, but the tubal ostia not visualized as the endometrium was not normal in appearance, but rather shaggy in texture.

A 5.5-French semi-rigid hysteroscopic scissors was then advanced through the operating channel and the remaining synechiae in the midline was incised midplane up to the perceived fundus, somewhat less than flush with the right tubal ostia. The cavity was then viewed under lower intrauterine pressures and only scant oozing was noted from the fundus. The view from the internal os demonstrated a mostly normal volume to the endometrial cavity, although only little normal appearing endometrium was documented.

A 10-French pediatric Foley was then advanced into the cavity after trimming the tip of the catheter, and the balloon filled with 3.5 ml of sterile saline. The tail of the catheter was tucked into the vagina.

The patient was extubated and taken to recovery in stable condition.

COMPLICATIONS

- Intrauterine adhesion reformation—*Frequent (2% to 60%, depending on severity of original adhesions)*
- Uterine perforation—*Infrequent (less than 5%, although up to 10% in patients with severe adhesions)*
- Hemorrhage and major vessel perforation—*Infrequent (less than 5%, may be higher in patients with severe adhesions)*
- Fluid or electrolyte imbalance (see Table 1, Chapter 27)—*Infrequent (less than 5%)*
- Postoperative infection (endometritis, myometritis, adnexitis)—*Rare (less than 1%)*

Suggested Reading

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CHAPTER 30

Laparoscopic Resection of Ovarian Endometrioma

M. Jonathon Solnik, Ricardo Azziz

INTRODUCTION

Surgical management of endometriosis ultimately depends on the desired therapeutic goals. It becomes important to establish whether relief of pain, treatment of subfertility, or both are patient priorities. Preservation of fertility would lead one to avoid overly aggressive excisional treatment, which may result in decreased ovarian reserve or increased postoperative adhesion formation. Likewise, patients with pain due to fibrotic endometriosis may require more aggressive treatment with resection of all palpable and visible disease regardless of fertility.

Resection of ovarian endometriomas represents another aspect of surgical care, and often presents itself in the setting of subfertility. Historically, most women noted to have lesions suspicious for endometrioma on transvaginal ultrasound were offered ovarian cystectomy as a part of the treatment paradigm for subfertility. Most recent findings suggest that aggressive surgical management, particularly for smaller cysts (<5 cm), may be deferred in patients undergoing in vitro fertilization.

Studies which have addressed postoperative ovarian reserve, whether resulting from the endometrioma itself or from the resulting ovarian injury following surgery, and response to gonadotropin stimulation, do not necessarily favor surgery. That said, for larger lesions, in symptomatic patients, or if a malignancy cannot be excluded, surgical intervention remains the standard of care. It has been well established that complete enucleation and cystectomy rather than ablation of cyst wall, results in significantly fewer recurrences and is the procedure of choice. Hence simple drainage of endometriomas should be avoided because the recurrence rate is high.

PREOPERATIVE CONSIDERATIONS

As with any woman who has a documented pelvic mass, differential scenarios should be considered. The likelihood of uncovering a reproductive cancer in a young woman is relatively low, and hallmark ultrasonographic characteristics of an endometrioma are fairly consistent. Nevertheless, if there is any suspicion of a malignancy, the possibility that an oophorectomy may be required needs to be discussed during preoperative counseling. In fact, during any procedure that involves adnexal structures, especially when fertility is a primary objective, we find it equally important to review this possibility, as well as the possibility of decreased ovarian reserve even if the ovary is salvaged.

SURGICAL TECHNIQUE

1. **Port and instrument placement:** Initial port placement depends on the location and size of the endometrioma. For example, if there is a larger (>10 cm) lesion on the right, one could consider a left upper quadrant entry point in order to avoid inadvertent penetration of the lesion. We typically use a modified Hasson technique to gain peritoneal access through the umbilicus. This allows

for a larger fascial defect not provided by current fiber-spreading bladeless trocars to allow for easier retrieval of larger specimen.

2. **Mobilization of endometrioma:** The resection of an endometrioma may be complicated by longstanding inflammation and resultant fibrosis, predisposing to ovarian injury and bleeding, which may require use of energy modalities to establish hemostasis, resulting in further damage to ovarian epithelium. Likely due to the pathogenesis of endometrioma, these cysts are often densely adherent to their ipsilateral sidewalls, where the peritoneal lesion infiltrated the developing follicle on the medial aspect of the ovary.

Reestablishing the normal anatomic orientation and landmarks should be the initial step in the dissection of endometriomas, particularly if sigmoid colon or other adhesions are present. The first step is often to elevate the ovary and cyst anteriorly while hugging the peritoneum of the ovarian fossa with a blunt grasper, suction irrigator, or blunt-tip scissor tips (**Figures 30.1** and **30.2**).

If remaining in the proper surgical planes, the surgeon will avoid entry to retroperitoneal spaces and injury to the ureter or larger vessels. Use of blunt-tip scissors to divide more dense adhesions may be required. Small bleeding and oozing may be encountered, but often stops without additional effort. Extra-ovarian adhesions are often due to endometriosis-associated inflammation. Copious irrigation, ideally with warmed isotonic irrigant, helps visualize the

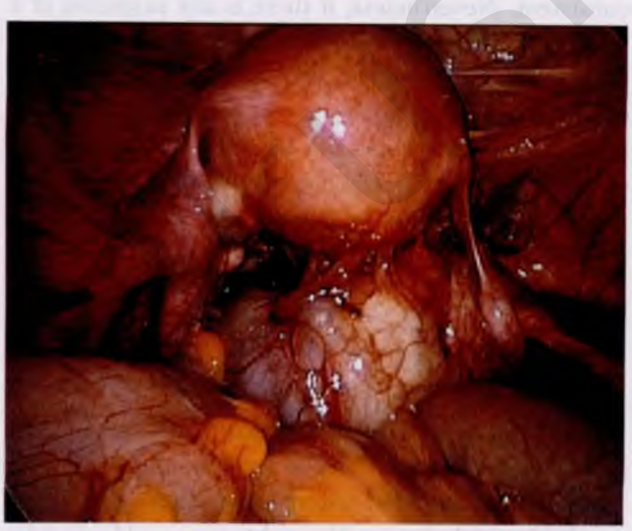

FIGURE 30.1 Laparoscopic view of a frozen pelvis resulting from advanced endometriosis with associated endometrioma seen posterior to the uterus originating from the right ovary: Loops of small intestine as well as colon are intimately adherent to the right ovarian endometrioma.

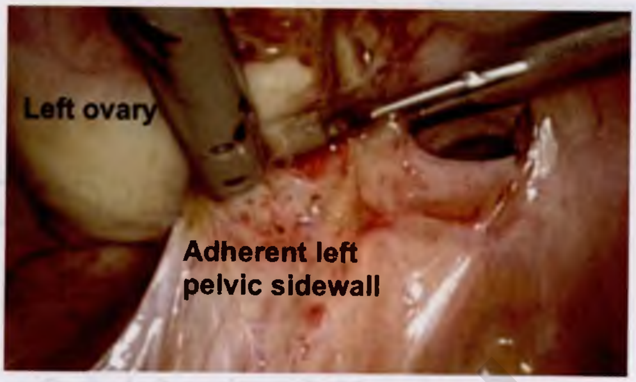

FIGURE 30.2 A left-sided endometrioma is adherent to its ipsilateral sidewall: A suction irrigator is used to elevate the ovary anteriorly while a blunt-tip scissors is used to dissect the ovary from sidewall attachments.

planes of dissection. Incidental cyst rupture often occurs during these efforts to expose the ovary in full.

3. **Removal of the endometrioma:** Once the ovaries have been carefully inspected and visualized, small surface endometriomas (<1 cm) can be "decapitated" at the ovarian endometrioma junction and the base coagulated or vaporized. The resulting defect does not need to be reapproximated. Alternatively, larger endometriomas are resected in a manner similar to that used at laparotomy. However, when they become particularly large (>10 cm), managing them at laparoscopy may prove difficult and should only be approached by those who have specific surgical expertise.

Once adequately mobilized, the cyst, if it has not already spontaneously drained, may be opened, drained, and lavaged. The lining is inspected. With larger or more chronic cysts, the cyst wall and ovarian cortex are often fused extensively by fibrosis and significant resection of the fused pseudocapsule may be required in order to clearly expose the plane between the normal ovarian cortex and the cyst wall. In order to identify the proper plane of dissection, the edge of the cyst wall opening is circumferentially (**Figure 30.3A**) cut back to fully and clearly expose "the cyst wall-ovarian cortex interphase." This is preferably done with cold scissors since electrosurgery, ultrasonic energy, or lasers may tend to fuse the cortex and ovarian cyst wall. If the dissection plane is not developed well, attempted cyst enucleation may result in unwanted bleeding during the enucleation of the cyst.

Once identified, the plane between endometrioma wall and normal ovarian cortex is developed further by grasping the edge of the ovarian cortex

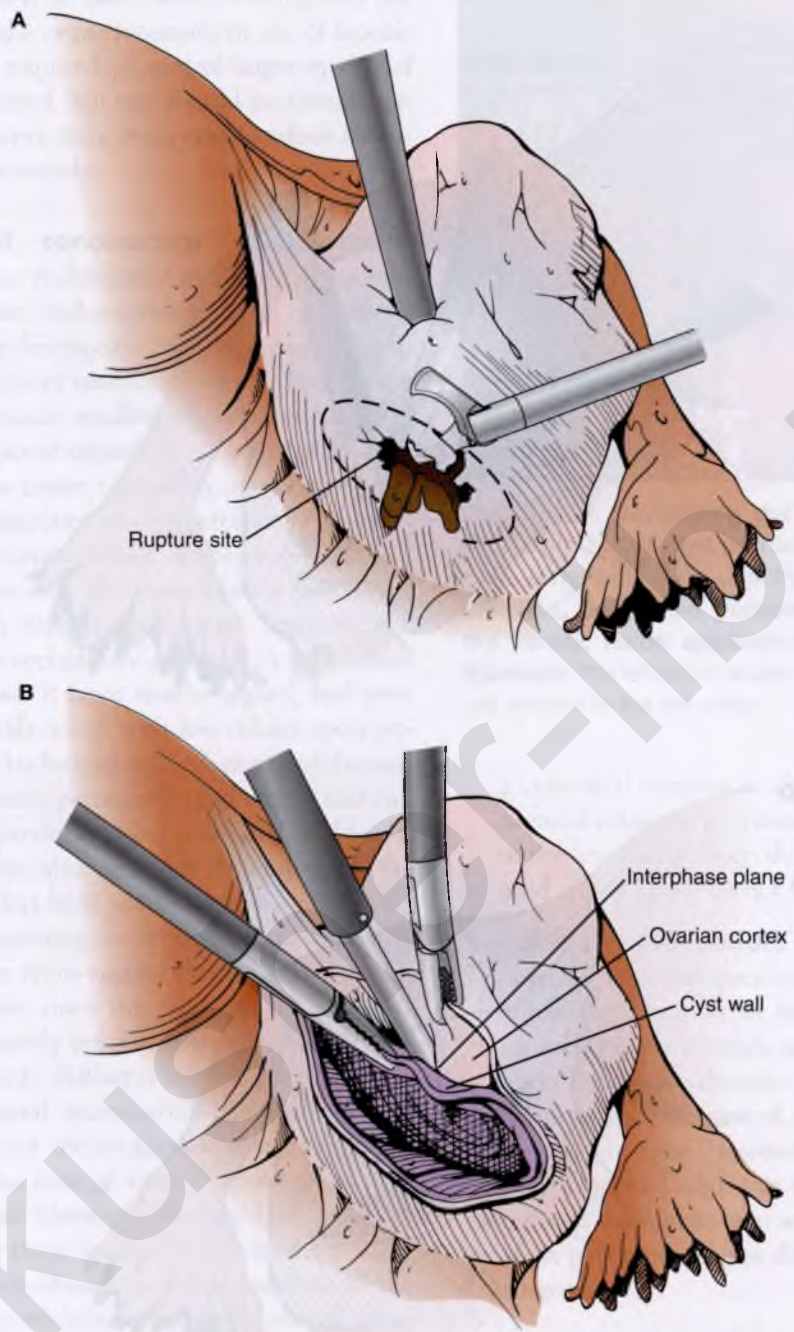

FIGURE 30.3 Excising endometrioma: Once opened, the cyst lining is inspected, and the edge of the cyst wall cut back circumferentially around the opening to fully and clearly expose the cyst wall-ovarian cortex interphase (**A**). Once identified, the interphase plane is dissected further by grasping the edge of the ovarian cortex and the cyst wall separately and progressively pealing the cyst wall away from the underlying ovarian bed using traction-countertraction and blunt dissection (**B**), generally allowing removal of the cyst in toto (**C**). The ovarian cortical incision remaining (**D**) rarely needs closing; rather the ovary will collapse bringing the cyst walls together, effectively closing the opening, and allowing healing of the incision. *(Continued)*

and the cyst wall separately, and progressively pealing the cyst wall away from the underlying ovarian bed using traction-countertraction and blunt dissection (**Figure 30.3B**). To do so, the transected ovarian cortex should be first grasped with an atraumatic grasper, although often a forceps with a single grasping pin may be used to fix the tissue firmly in the jaws of the forceps, avoiding tissue slippage and tearing.

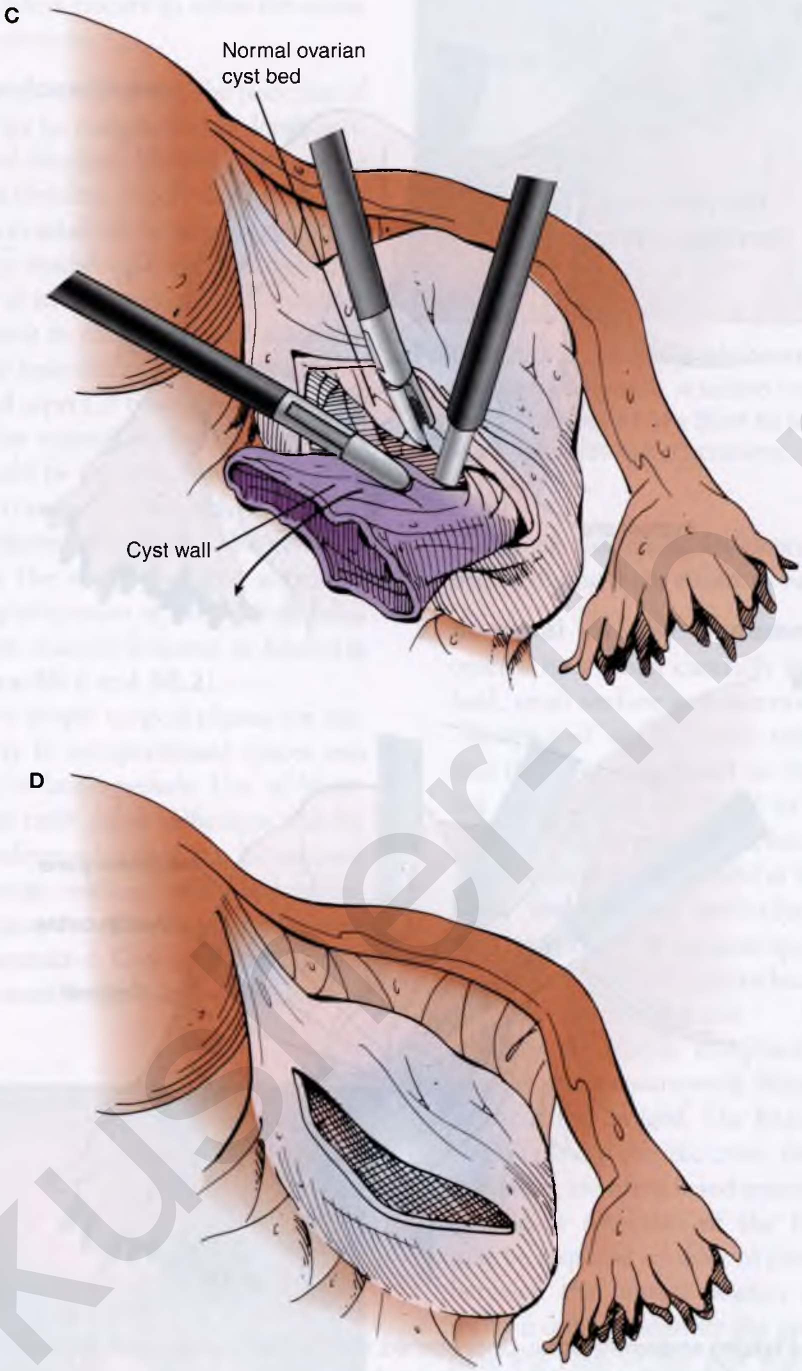

FIGURE 30.3 *(Continued)*

Once the cyst wall has been freed sufficiently, enucleation may proceed by grasping the *inside* of the normal ovarian cyst bed rather than the edge of the transected ovarian cortex, which is more prone to tearing. As enucleation proceeds, the ovarian cortex or cyst bed, and cyst wall should be progressively grasped, released, and regrasped, ensuring that the tissues are grasped as close to the dissection plane as possible to minimize tearing of the tissues (**Figure 30.3C**). The remaining incision in the ovarian cortex (**Figure 30.3D**) rarely needs closing; rather the ovary will collapse bringing the cyst walls together, effectively closing the opening, and allowing healing of the incision.

Although more frequent in smaller cysts, incompletely resected areas, often found at the base of these lesions, may be further coagulated or vaporized.

Extreme care must be taken when working near the hilar vessels of the ovary. Intermittent use of bipolar energy may be required to control larger epithelial vessels encountered, but use should be focused on these specific areas since most small surface bleeding stops spontaneously.

4. **Treatment of concomitant endometriotic lesions:** Ovarian endometriomas are often accompanied by pelvic endometriosis. More superficial implants may be destroyed with electrosurgical application (fulguration or resection). Bipolar energy may be used to desiccate smaller implants, especially if not close to adjacent organs, but if larger or in close proximity to the ureter or rectum, resection is recommended. Fulguration and vaporization techniques cause tissue distortion, which can be confusing.

Deep lesions may be incompletely destroyed, especially with bipolar technique. Traction and countertraction techniques are used to first isolate the lesion, retract it from nearby organs, and then excise it more effectively with low voltage monopolar energy. This technique minimizes risk of thermal injury to unaffected peritoneum and organs that can occur from dispersion of heat generated. Cold scissors or laser may also be used, depending on the lesion and comfort level of the surgeon.

Patients presenting with endometriomas may also suffer from recto-vaginal disease that may not be readily visible, since this form of endometriosis does not necessarily present with superficially recognizable implants. Rather it is more often palpable upon recto-vaginal examination. In women with pain, concomitant recto-vaginal disease should be addressed at the time of endometrioma resection. If retroperitoneal fibrosis is identified, we typically begin resecting these lesions by developing avascular planes, which allows for better isolation of the areas of interest while minimizing the risk of injury to surrounding viscera. The rectum is often adherent to the retrocervical region, and to fully resect this area, the rectovaginal space must be developed. If the planes are obscured, attention is turned cephalad, up to the pelvic brim, where anatomy is often unaffected by endometriosis.

The pararectal spaces can then be developed progressively with a caudal and medial approach, the rectum can then be mobilized caudally and lesions better targeted (**Figure 30.4**). When more aggressive lesions are identified, such as endometriosis that infiltrates the ureter or rectum, consultation with another surgical specialist, such as a colorectal surgeon is often indicated. The use of ureteral catheters as a means to reduce surgical risk to the ureters has been debated and may be considered, although we do not favor their use.

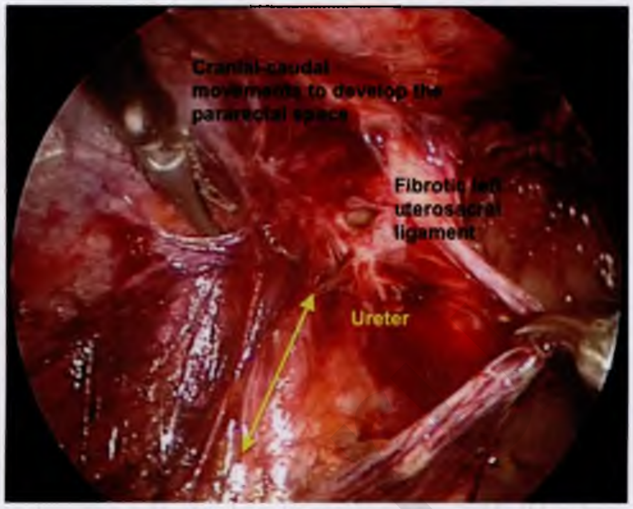

FIGURE 30.4 Developing the left pararectal space by retracting the affected peritoneum medially after making a longitudinal incision that begins from the more cephalad, unaffected peritoneum and moves toward the fibrotic lesion approximating the left uterosacral ligament: The left proximal uterine artery can be seen medial and anterior to the left ureter.

5. **Adhesion prevention:** Although the use of microsurgical techniques can minimize the risk of adhesion formation in patients with endometriosis and endometriomas, a risk already amplified by an inflammatory disorder that predisposes to such phenomenon, the use of adhesion barriers may reduce such risks. However, there are no currently FDA-approved adjuvants for the laparoscopic treatment of endometrioma, and so use of such materials is performed at the discretion of the individual surgeon.

POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see **Complications** box on page 266), the most frequent of which is adhesion formation or more commonly reformation. As a result of the release of inflammatory factors after treating advanced stages of endometriosis, patients often feel quite sore postoperatively, despite their ability to be discharged home the same day of surgery. Perioperative and postoperative use of nonsteroidal anti-inflammatory drugs provide the most effective relief of such discomfort.

Operative Note

PROCEDURE: LAPAROSCOPIC RESECTION OF OVARIAN ENDOMETRIOMA

The patient was taken to the operating room where she was placed in the dorsal supine position and underwent successful induction of general endotracheal anesthesia. Her legs were placed in the Allen-type stirrups and her arms tucked appropriately at her side. She was prepped and draped in a sterile fashion. A time-out was then performed. At this time, attention was turned to the pelvis where a Foley catheter was placed in her urinary bladder and a HUMI® manipulator placed into the cervical os under direct visualization for chromopertubation.

Attention was then turned to the umbilicus where the open Hasson technique was used to enter the peritoneal cavity, at which point a blunt trocar was placed in that site. A balloon was then inflated to secure the sheath, and 2-0 Vicryl sutures were used to tag the lateral aspect of the fascia for later closure. Pneumoperitoneum was then created with carbon dioxide to 15 mmHg of pressure and a laparoscope was then advanced under direct visualization. No evidence of insertional injuries was noted. Ancillary trocars were then placed in both lower quadrants, lateral to the inferior epigastric vessels, as well as another between the pubic symphysis and umbilicus, all 5 mm in diameter and placed under direct visualization without incident.

At this point, chromopertubation was performed to evaluate for tubal patency, and prompt fill and spill of diluted indigo carmine was noted from both fimbriated ends. We then proceeded to restore the normal anatomy by dividing adhesions between the right ovary and at the ipsilateral sidewall and deep posterior cul-de-sac, but most of the adhesions and inflammation was encountered from the left endometrioma to sigmoid colon and ipsilateral sidewall. The oviducts were not involved in any of these adhesions. Using sharp dissection with scissors, as well as blunt retraction and countertraction, both ovaries were mobilized and relatively normal anatomy restored. The right ovary had a simple cyst noted previously, and it was simply drained to minimize trauma to the normal adnexa. During the mobilization of the left ovary, entry into the endometrioma cyst occurred and all the chocolate fluid was suctioned from the pelvis. After the left ovary was completely mobilized off its ipsilateral sidewall, complete ovarian cystectomy was performed using traction and countertraction techniques. Small amounts of oozing was noted throughout this dissection, especially on the posterior aspect of the cervix as well as the ovarian cortex. Minimal bipolar energy was needed to achieve hemostasis.

The left uterosacral ligament was somewhat firm and rubbery, and using scissors, the involved section was resected. This was lateral to the colon and medial to the left ureter. Copious irrigation was used throughout to maintain moisture and remove all blood products from previous dissection. Once it was noted to be hemostatic, GYNECARE INTERCEED® was laid throughout the deep pelvis and overlying both ovaries.

At this point the abdomen was partially deflated and the surgical sites were noted to be hemostatic. The umbilical port site was reapproximated with two interrupted 0-Vicryl sutures. After the pneumoperitoneum was released, all other ports were removed and the skin incisions were reapproximated with 5-0 Monocryl in a subcuticular fashion. The Foley catheter was removed at the end of the procedure. The patient was then extubated and taken to recovery in stable condition.

COMPLICATIONS

- De novo pelvic adhesion formation and adhesion reformation—*Frequent* (*greater than 10% de novo adhesion formation, and as high as 90% adhesion reformation if severe reexisting adhesions*)
- Postoperative infection (myometritis and adenexitis)—*Infrequent* (*less than 5%*)
- Hemorrhage and major vessel perforation—*Rare* (*less than 1%*)
- Major organ perforation or injury (bowel, bladder, or ureter most frequently)—*Rare* (*less than 1%*)
- Postoperative bowel entrapment—*Rare* (*less than 1%*)
- Nerve injury (generally positional)—*Rare* (*less than 1%*)

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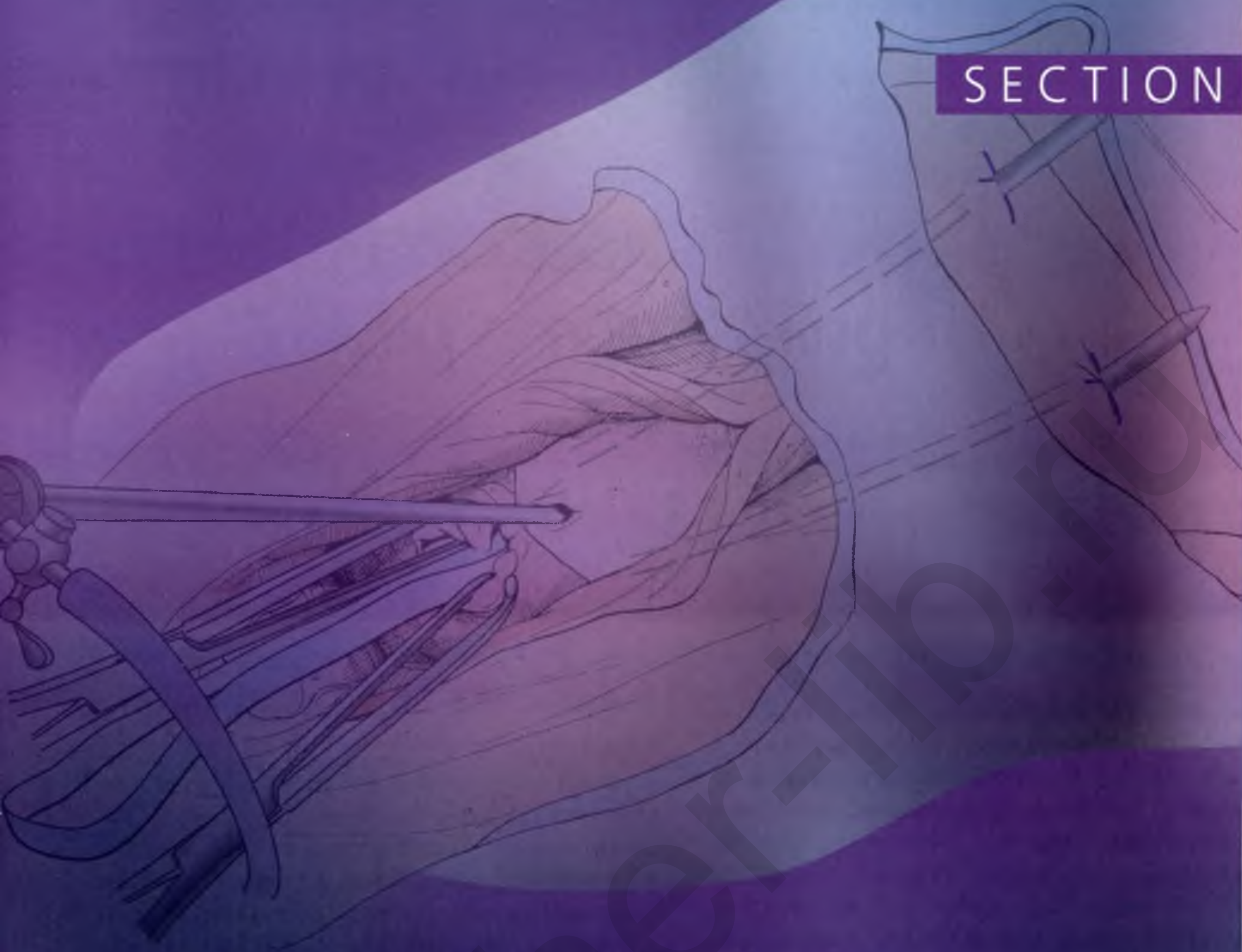
SECTION IV



Urogynecology

CHAPTER 31

Retropubic Mid-urethral Sling

Geoffrey W. Cundiff

INTRODUCTION

The mid-urethral sling has revolutionized the treatment of stress urinary incontinence in women by offering an easy-to-learn, minimally invasive procedure that provides excellent and reproducible results. Given the prevalence of stress urinary incontinence and associated burden of disease, the mid-urethral sling is an important procedure for the gynaecologic surgeon to master.

The retropubic approach was the original description of the mid-urethral sling but was soon followed by the transobturator approach. There is ample level-I evidence demonstrating similar efficacy for the two approaches, but with different complication profiles. Based on these differences, the retropubic approach may provide lower complication risks for younger and older patients.

PREOPERATIVE CONSIDERATIONS

The most important preoperative preparation for a mid-urethral sling is to insure the proper diagnosis. There are several guidelines available that define the necessary diagnostic criteria (1,2). This does not routinely require urodynamics, provided that the symptoms of urinary loss with an increase in intraabdominal pressure is present and leakage can be demonstrated with a stress test (3).

In postmenopausal patients with atrophic vaginal epithelium, preoperative estrogen cream can be used to promote a healthier mucosal epithelium. A preoperative bowel prep is not indicated. While there is no evidence to support it, most surgeons utilize intraoperative antibiotic prophylaxis with a second generation cephalosporin or clindamycin in penicillin-allergic patients. There is level II data comparing a single dose of perioperative antibiotic prophylaxis to continued postoperative prophylaxis (4). This study suggests that a single dose is preferable, as the multiple dose regime had higher adverse events without an improvement in preventing surgical site infections. In the absence of patient-specific risks, deep venous thromboembolism prophylaxis is not necessary as the surgery usually takes less than 45 minutes, making it a low risk for development of deep vein thrombosis. It should be considered, however, in patients with other risk factors that increase their overall risk for development of deep vein thrombosis.

The patient should be positioned in lithotomy or modified lithotomy position with both a vaginal and lower abdominal fields. Either regional anesthesia or general anesthesia is appropriate, although level II data suggests an association between regional anesthesia and acute postoperative urinary retention that could prolong the postoperative stay (5). The mid-urethral sling procedure can also be accomplished with local anesthesia, and some surgeons prefer this approach as it allows the surgeon to adjust tension based on feedback of whether leakage occurs when the patient is asked to cough. Submucosal infiltration with injectable 1% lidocaine with epinephrine simplifies postoperative pain management and assists with dissection and hemostasis. A Foley catheter should be placed during the surgery to drain the bladder and define the course of the urethra. Following is a brief description of the surgical procedure used (see also video: *Retropubic Mid-urethral Sling*)

SURGICAL TECHNIQUE

The surgical approach begins in the suprapubic field with identification of the exit incisions for the sling. (**Figure 31.1**). The incisions are approximately 2 cm lateral to the midline in a transverse line that is 1.5 cm above the superior symphysis pubis. Once the sites are identified, they should be infiltrated with local anesthetic, and two small stab incisions made. (**Figure 31.1**) Some surgeons follow the original technique described by Ulmsten that included hydrodissection of the Retzius space using a dilute solution of Lidocaine, although experience suggests that this does not improve the safety of the procedure.

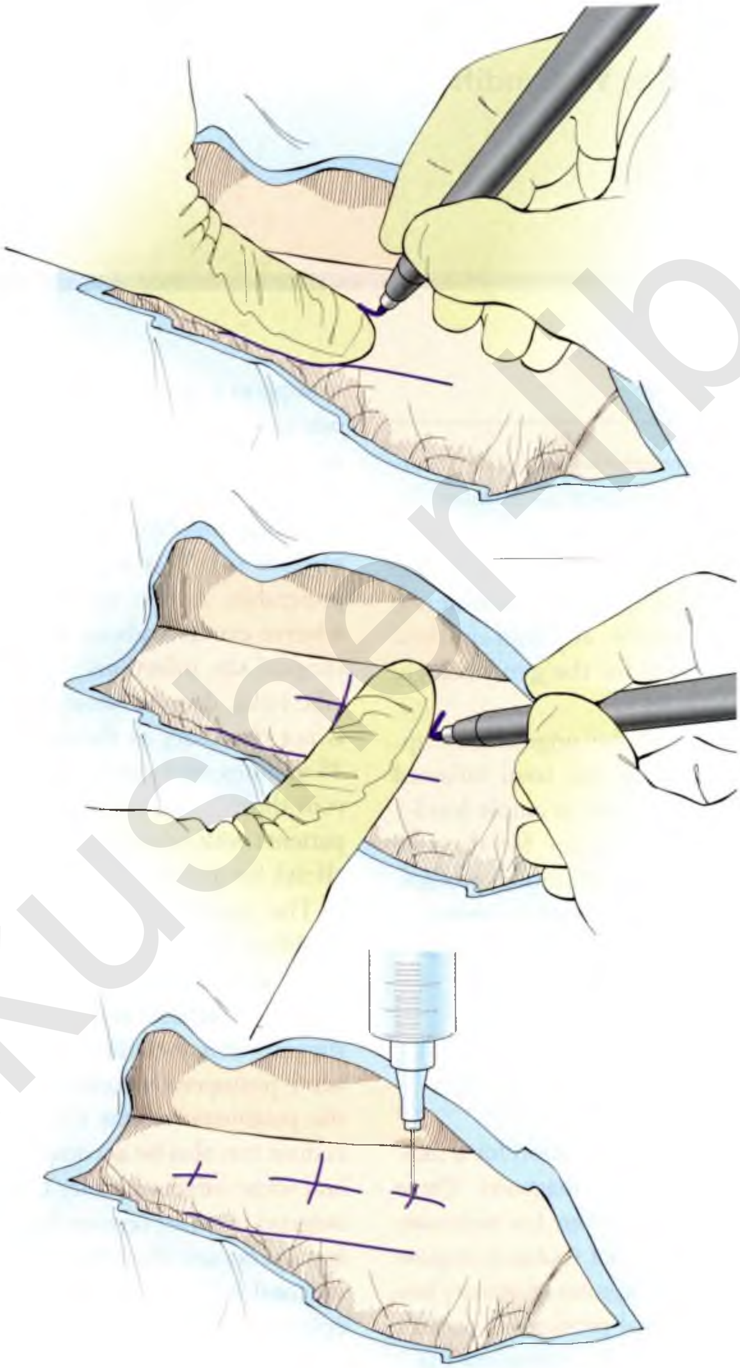


FIGURE 31.1 The sites of the exit incisions are marked at the intersection of a line 1 cm above the superior symphysis pubis and two longitudinal lines 1.5 cm lateral to the midline: After infusion with local anesthesia, two longitudinal stab incisions are made.

The surgery now moves to the vaginal field. The vaginal incision is made longitudinally in the midline, over the mid-urethra. A 1–2 cm incision is adequate, and is usually just proximal to the urethral meatus (**Figure 31.2**). Infiltration with local anesthetic in the line of intended dissection facilitates the dissection. The dissection is done sharply with Metzenbaum scissors and is carried laterally to the white line (arcus tendineus fasciae pelvis) (**Figure 31.2**). A rough indication of adequate dissection is when the screw joining the two scissor blades reaches the margin of the surgical incision. It is important not to buttonhole the vaginal epithelium, so countertraction with an Allis clamp on the margin of the incision, as well as a vaginal finger against the epithelium is useful. (**Figure 31.2**)

Once the dissection is complete, the sling is placed using the sling trocar. The trocar provides a minimally invasive means of placing the sling, but the blind nature of the passage makes this the most dangerous part of the procedure. To maximize the safety of the trocar passage, the surgeon should have a clear understanding of the retropubic anatomy, and the intended path of the trocar with respect to surrounding anatomical structures. The final goal is for the sling to lay beneath the mid-urethra, then pierce the pubocervical fascia just medial to the white line, traversing the space of Retzius, before piercing the rectus fascia and exiting the abdominal incisions. Proper handling of the trocars will allow the surgeon to accomplish this.

The original description of the procedure advocated the use of a catheter guide that is intended to move the urethra laterally to minimize injury during trocar placement. We do not use this catheter guide as it has not been shown to improve safety and increases operating time.

Starting on the left, the first step is to bring the tip of the trocar to the most lateral portion of the vaginal dissection. This is safely accomplished by maintaining the trocar in a horizontal plane as the tip is introduced into the vaginal incision and advanced (**Figure 31.3A**). Once the tip is at the white line, the trocar handle is

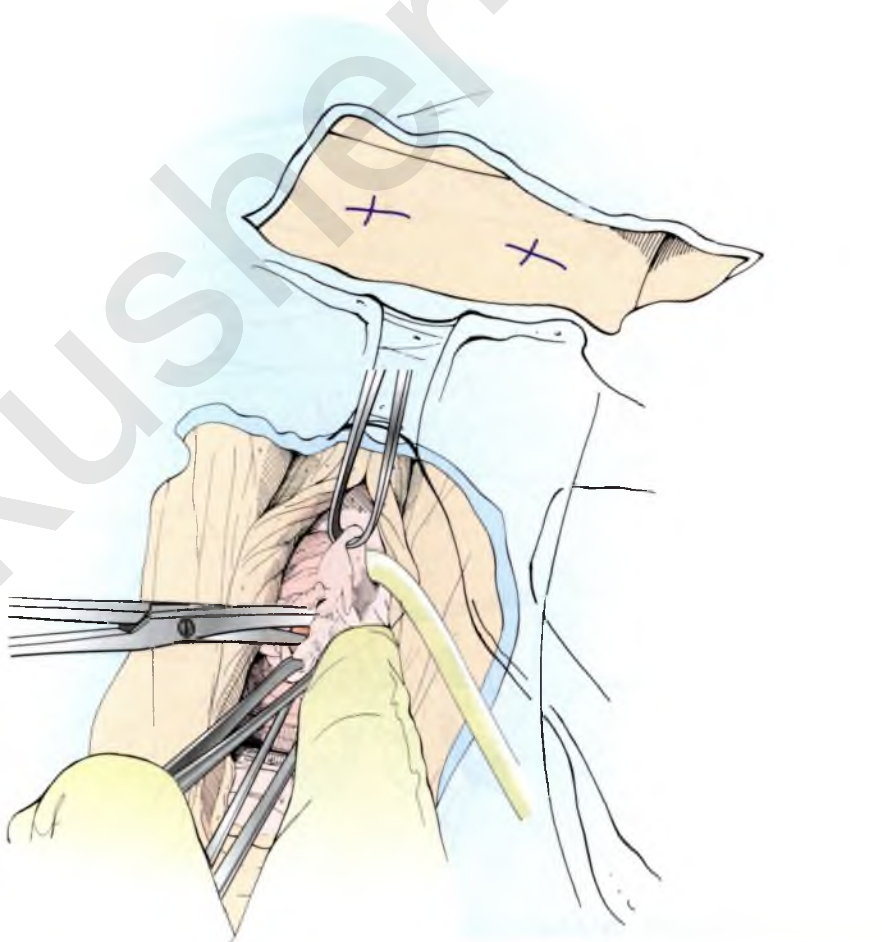


FIGURE 31.2 A midline incision is made in the distal anterior vaginal wall just proximal to the external urethral meatus.

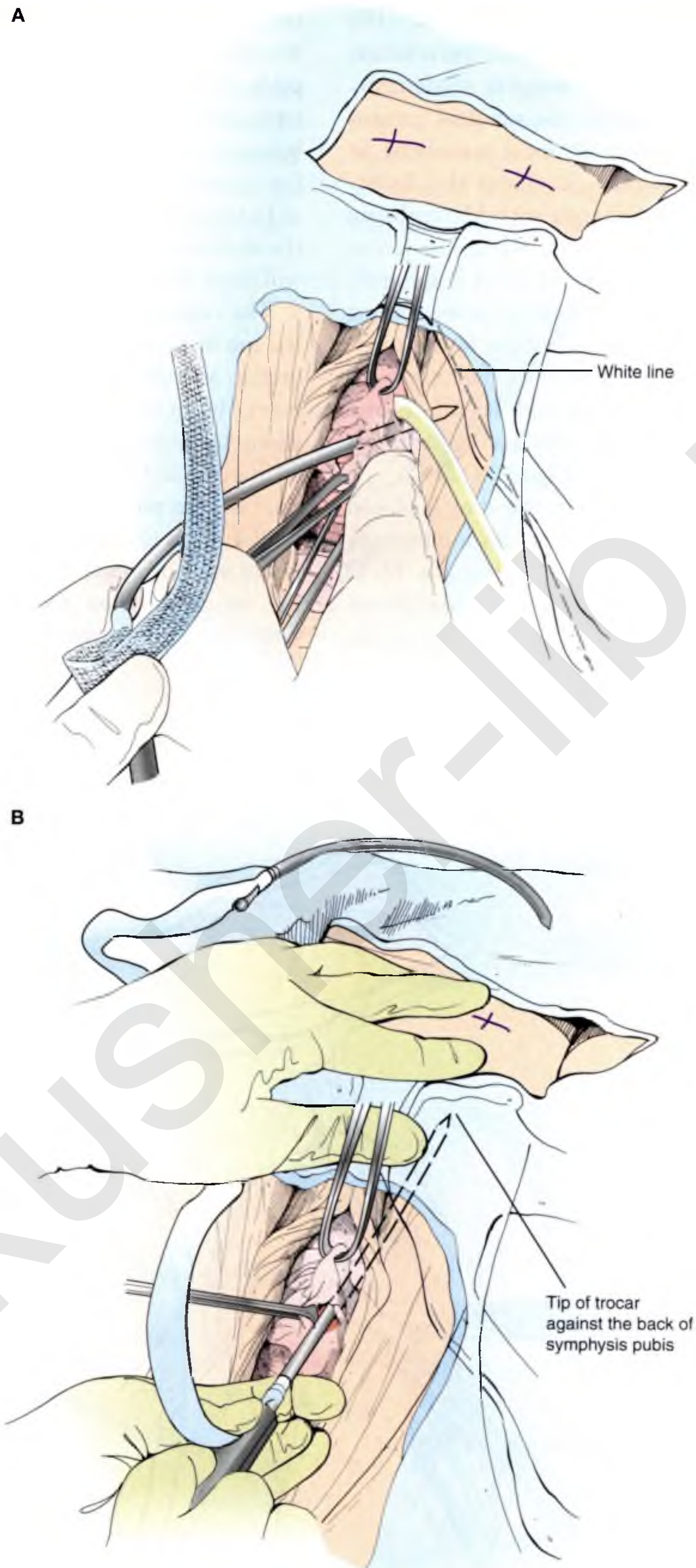
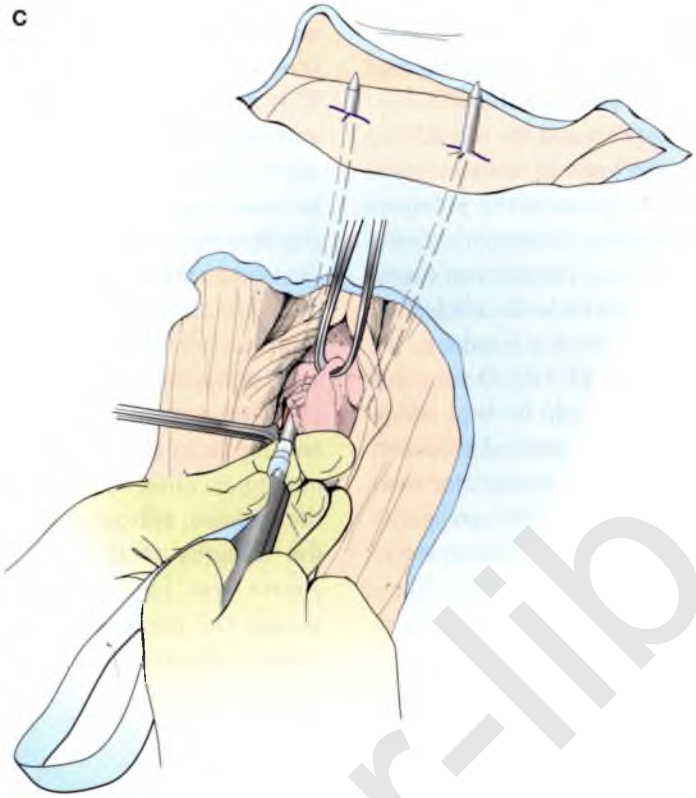


FIGURE 31.3 Sling trocar placement: (**A**) Advance the trocar tip to the lateral extent of the vaginal dissection with the trocar in a horizontal plane. (**B**) Rotate the trocar handle to orient the tip at 90° to the plane of the pubocervical fascia and pierce the pubocervical fascia by pushing down on the handle and using a finger as a fulcrum. The axis of the trocar should be kept inside a longitudinal line drawn from the ipsilateral shoulder.

C



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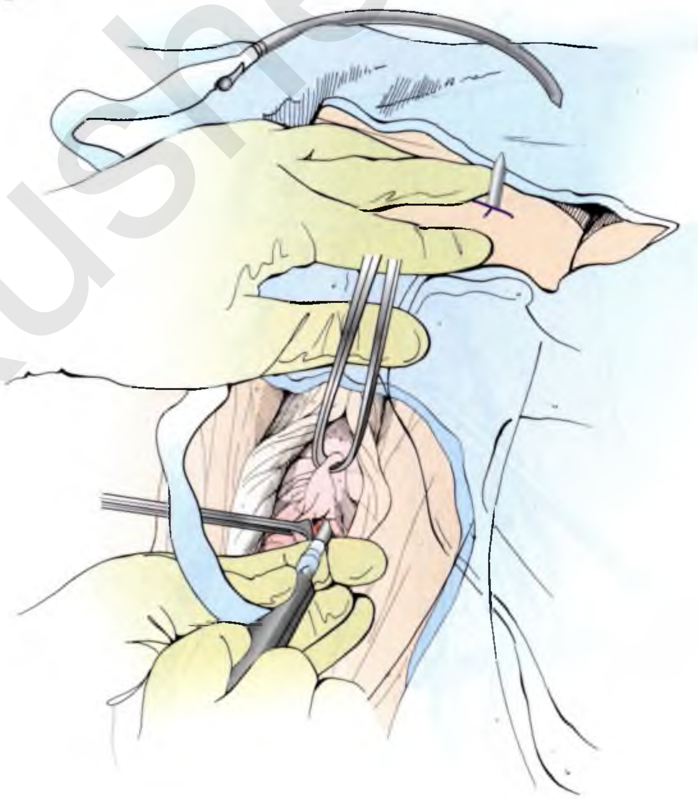

FIGURE 31.3 (*Continued*) (**C**) The trocar tip is then brought through the abdominal wall incision on the ipsilateral side. (**D**) Placement of the contralateral trocar.

rotated counterclockwise until the tip of the trocar is at a right angle to the pubocervical fascia with the tip just medial to the white line. The surgeon must be cognizant of the orientation of the plane of the pubocervical fascia, which can be appreciated by identifying the ischial spines and inferior portion of the symphysis pubis that define the edge of the plane of the pubocervical fascia. The goal is to pierce the pubocervical fascia at a right angle. To accomplish this, the surgeon's right index finger is placed under the trocar as a fulcrum, while the left hand pushes down on the handle to lift the tip through the fascia (**Figure 31.3B**). During this maneuver, the axis of the trocar should be kept inside a longitudinal line drawn from the ipsilateral shoulder, as this avoids inadvertent injury to the obturator neurovascular trunk in the lateral aspect of the retropubic space. If there is significant resistance while trying to pierce the pubocervical fascia, the trocar tip is likely against the bladder wall and should be redirected more laterally.

Once the trocar tip is in the retropubic space, it is advanced through the space with the tip against the posterior aspect of the symphysis pubis (**Figure 31.3B**). This helps to avoid inadvertent injury to the bladder and other structures within the retropubic space. Once the tip is against the rectus fascia, the right hand can be used against the skin of the suprapubic region to stabilize the trocar tip as it pierces the rectus fascia and direct it to the skin incision. (**Figure 31.3C**)

Cystotomy is a recognized complication occurring in up to 14% of cases (7). Known risk factors include a prior hysterectomy and a BMI of greater than 26 (7). Recognition of the bladder injury with removal and replacement has no long-term sequelae in terms of surgical cure, so before the trocar is pulled through the incision, cystoscopy should be performed to insure the integrity of the bladder and that the intended course was followed (**Figure 31.4**). A diagnostic sheath (17 French) with a 70° lens is optimal, as it allows a thorough evaluation and identification of the

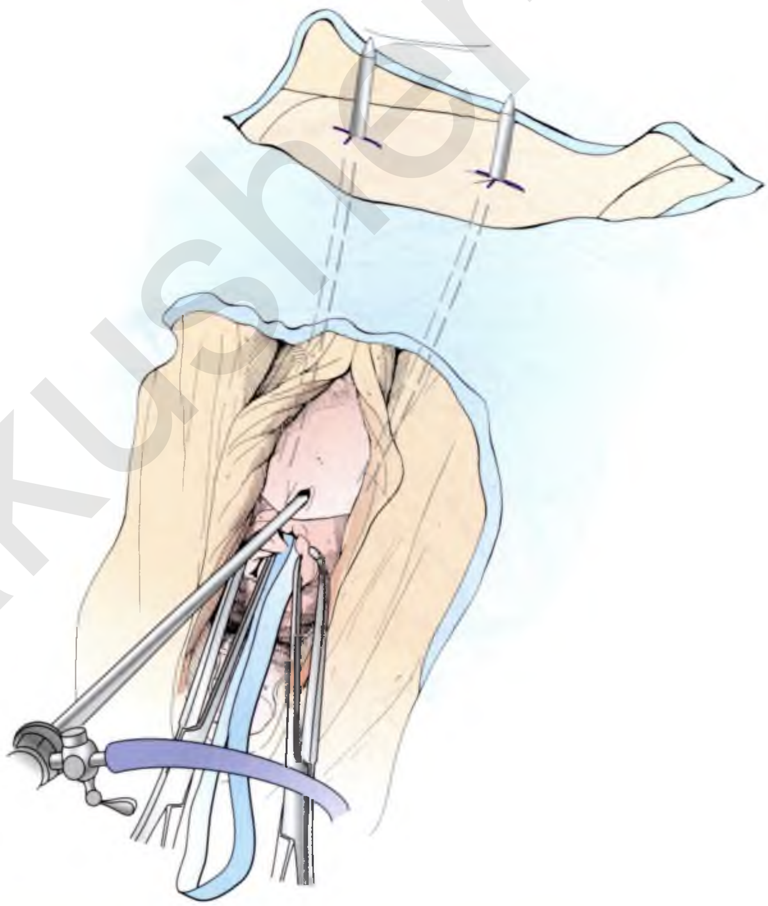

FIGURE 31.4 Cystoscopy is performed to insure bladder integrity: Placement of sling is achieved by pulling the trocars through the abdominal incision.

trocar course just lateral to the urethrovesical junction. Because a cystotomy can occur anywhere along the course of this trocar, the cystoscopic exam should visualize its entire length. Performing cystoscopy with the trocar in place allows the trocar to be removed and replaced if cystoscopy reveals a cystotomy. Many surgeons perform cystoscopy after each pass of the trocar. Alternatively, both trocars are passed and left in place until cystoscopy confirms bladder and urethral integrity. If a cystotomy is recognized, the cystoscope should be removed, and the trocar passed a second time, with a second cystoscopy to insure that the final path is outside the bladder. After completing cystoscopy, replace the Foley catheter prior to tensioning the sling.

The right trocar is passed using the same technique as described for the left (**Figure 31.3D**). To save time, some surgeons prefer to pass both the left and right trocar before performing cystoscopy. Regardless, once both trocars are in place, and the integrity of the bladder assured, (**Figure 31.4**) the trocars are pulled through the abdominal incision with the protective sheaths in place (**Figure 31.5**). The sheaths allow temporary adjustment of the sling, but once they are removed it sticks to the surrounding tissue and can no longer be adjusted.

The sheathed sling arms should be pulled up until the appropriate tension is achieved. This step is perhaps the most important to achieving optimal results, as the tension of the sling beneath the urethra has a major impact on results. Too loose can result in persistent stress incontinence, while too tight can result in voiding dysfunction or even obstruction. One of the major innovations of the original Tension-free Vaginal

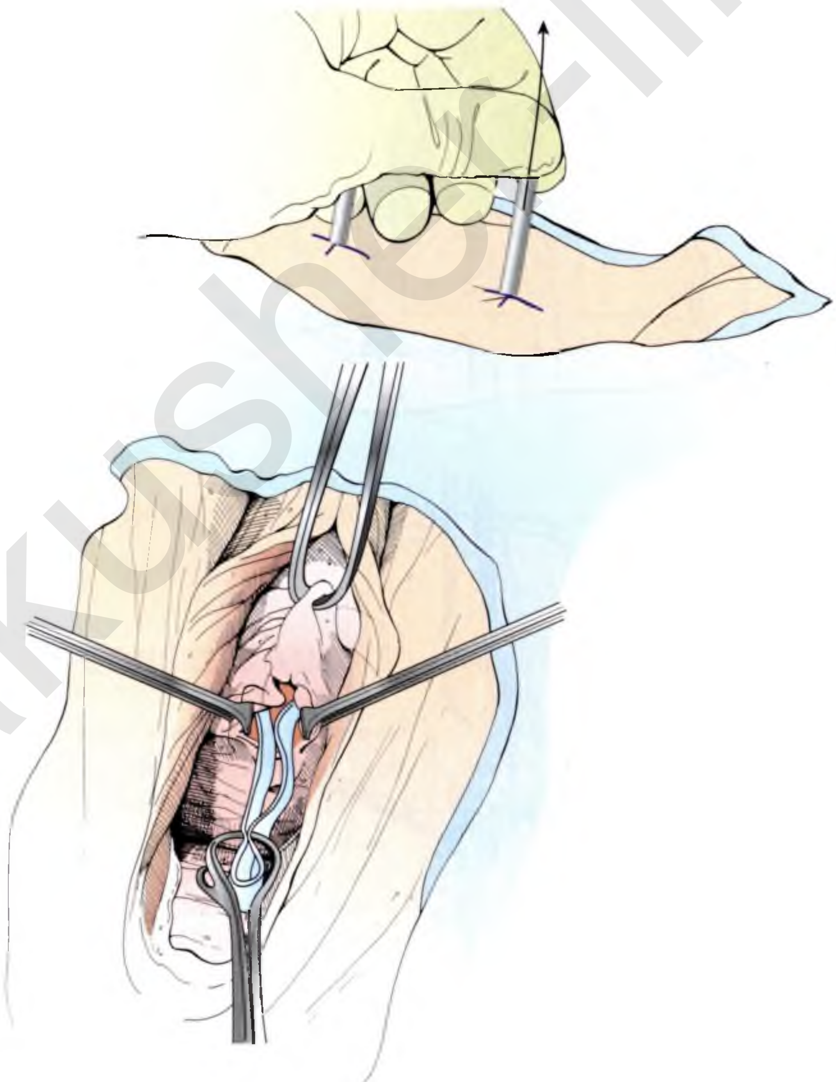

FIGURE 31.5 Tensioning of the sling.

Tape (TVT), mid-urethral sling was the recognition that it is much easier to get the sling too tight then too loose, hence the reference to tension free. Different techniques are described to achieve a tension free placement, including placing the closed blades of a suture scissor or a #7 Hegar dilator between the sling and the urethra. Our preferred approach is to use a Babcock clamp to grasp a 1.5 cm fold of the middle portion of the sling (**Figure 31.5**), and pull the Babcock clamp snug against the urethra (**Figure 31.5**). The protective sheaths are then removed, (**Figure 31.6**) anchoring the sling in place, and the Babcock clamp is then released.

With the sling in place, the excess sling arms can be cut at the abdominal skin, and the incisions closed with steri-strips. The vaginal incision should be sutured using a 3-0 Polyglactin 910 or similar absorbable suture (**Figure 31.7**). Erosion of the polypropylene sling into the vaginal wall is rare, but we generally place a deep box stitch followed by a simple running closure to minimize this complication.

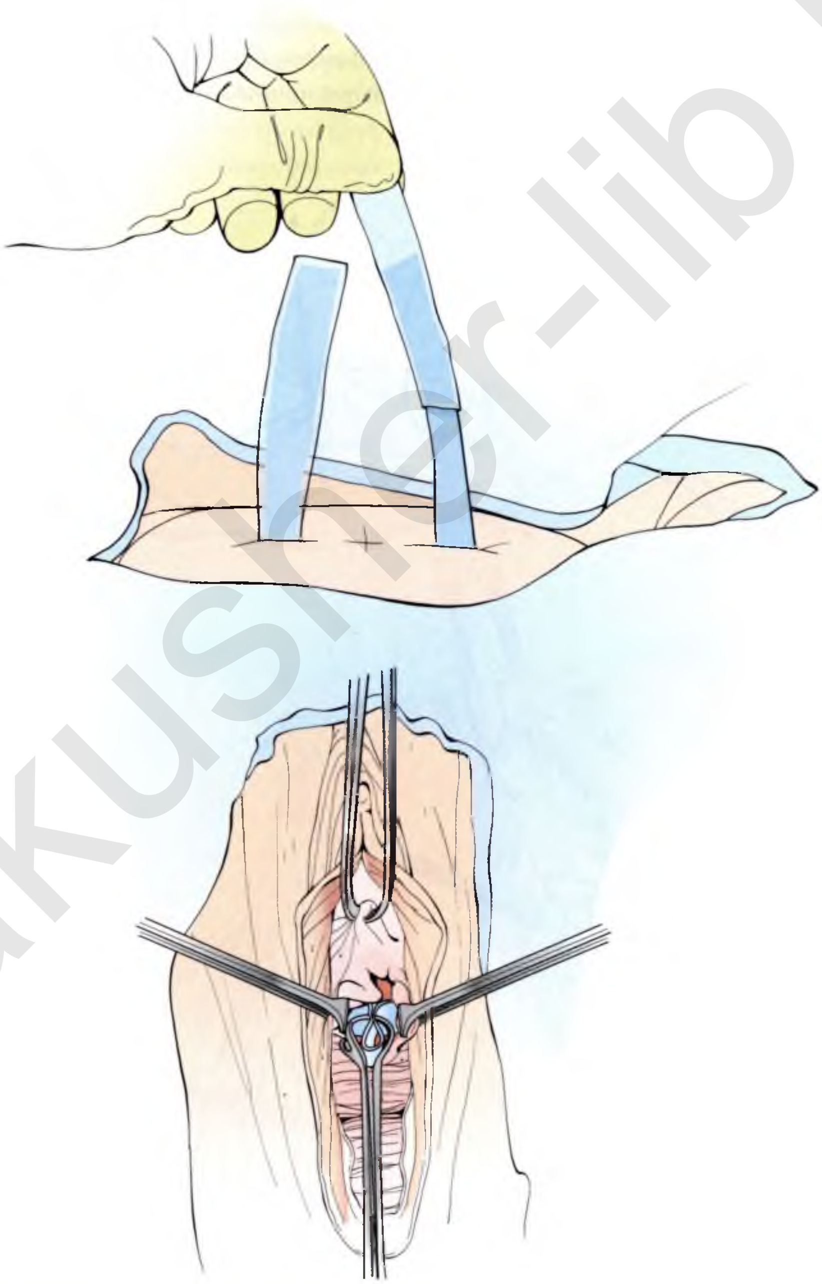

FIGURE 31.6 Removal of the sling sheathes.

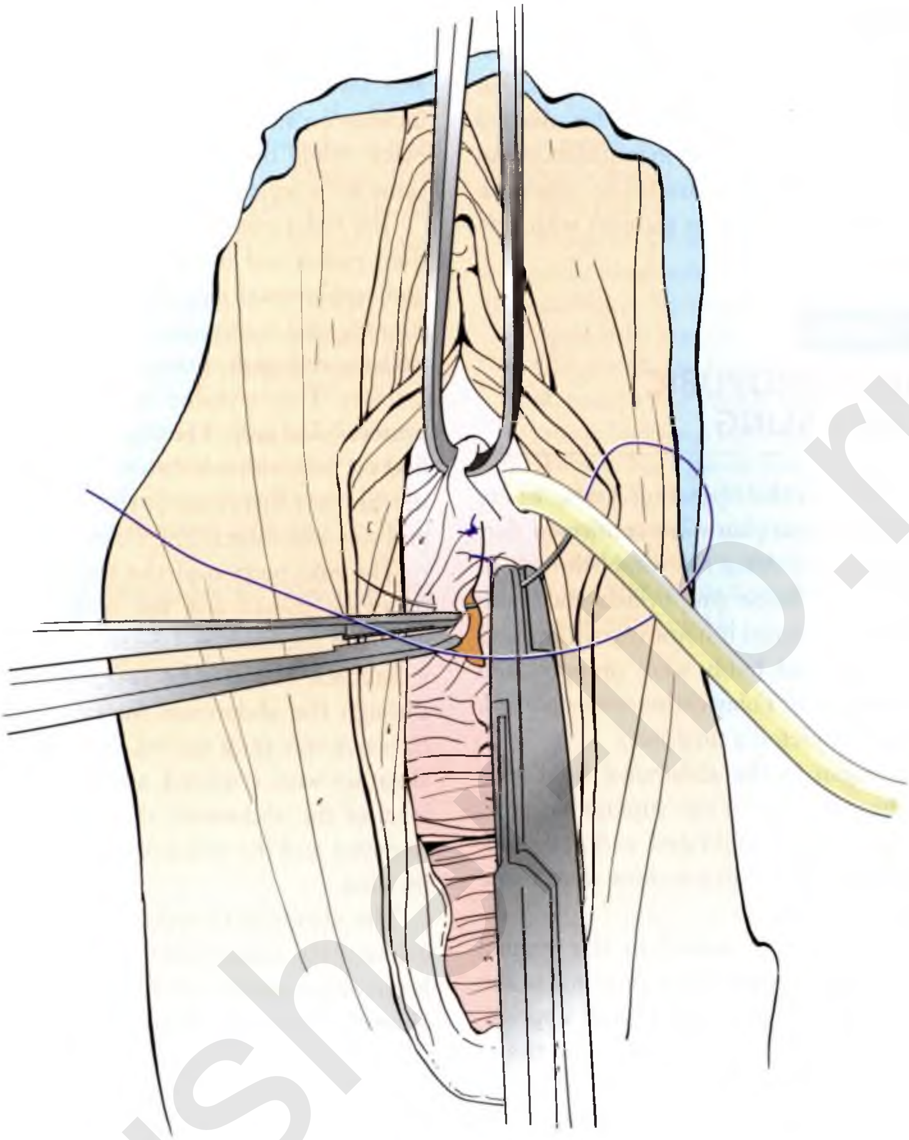

FIGURE 31.7 Closure of the vaginal incision.

POSTOPERATIVE CONSIDERATIONS

For most patients, mid-urethral sling can be performed in a day surgery setting as an outpatient. If it is combined with other prolapse repairs, then an overnight stay may be indicated.

Prolonged bladder drainage in not generally necessary for patients with normal bladder function and no injury to the bladder urothelium. Urinary retention is rare, but can occur if the sling is too tight. Confirmation of normal voiding through the measurement of the post-void residual is, therefore, important to insure that the sling is properly tensioned. Our usual practice is to remove the catheter prior to leaving the operating theater. The resultant empty bladder provides enough of an interval for the patient to recover before needing to void. We then measure two post-void residuals, either with an ultrasound device or straight catheterization, and confirm two voids with residuals of less than 100 ml prior to discharge. When a cystotomy is noted, the Foley is left in place for 1 to 2 days. When it is removed, voiding trials should be pursued.

Postoperative pain management is usually adequately managed with nonsteroidal anti-inflammatory drugs. A regular schedule of oral medication helps to minimize postoperative pain needs, by providing a baseline analgesia. Oral narcotics can then be used on an as-needed basis for pain spikes.

Patients should be instructed to avoid sexual relations and use of tampons for 6 weeks until the incisions are fully healed. During the first 6 weeks, activities that increase intraabdominal pressure should be avoided as they may predispose to recurrent incontinence. An over-the-counter stool softener is useful to minimize straining at defecation, especially in patients with preoperative constipation.

Operative Note

PROCEDURE: RETROPUBIC MID-URETHRAL SLING

The patient was taken to the operating room, where her identity and the surgical plan were confirmed during a preoperative briefing. After the establishment of adequate anesthesia, antibiotic prophylaxis was initiated. She was placed in a dorsal lithotomy position, and the suprapubic and vaginal fields were prepped and draped. An indwelling 14 Fr Foley catheter was placed. The operative team completed a time-out.

The procedure began in the abdominal field with identification of the exit sites in the suprapubic area. The sites were marked and infiltrated with 1% lidocaine with epinephrine. Two stab incisions were made transversely using a #11 blade.

The surgeons' attention is turned to the vaginal field. Two Allis clamps were placed just proximal to the urethral meatus on the anterior vaginal wall approximately 1.5 cm apart. The intervening and lateral tissue was infiltrated with 1% lidocaine with epinephrine. A 1-cm longitudinal incision was made between the Allis clamps. The left epithelial margin was grasped with an Allis clamp to provide countertraction and Metzenbaum scissors were used to dissect the epithelium off the underlying tissue. This created a tunnel from the incision to the white line. The same dissection was performed on the patient's right side.

The insertion trocar was brought into the field and introduced into the left tunnel. In a horizontal orientation it was advanced to the most lateral aspect of the dissection with a vaginal finger in place to insure the integrity of the vaginal epithelium. Once the tip was against the white line, the trocar was rotated counterclockwise until the trocar was oriented at 90° with respect to the plane of the pubocervical fascia. A finger was used as a fulcrum at the handle and downward pressure was applied to the handle until the tip of the trocar pierced the pubocervical fascia. The tip was then held against the posterior aspect of the pubic bone while the trocar was advanced through the retropubic space to the recuts fascia. Downward pressure was also applied abdominally to pierce the rectus fascia and advance the tip through the previously made stab incision on the patient's left. The left trocar was left in place, while the right trocar was placed following the same technique.

The Foley catheter was removed and cystoscopy was then performed using a 17 French sheath, 70° lens, and sterile water as a distending medium. With water running, the cystoscope was advanced to the bladder where a thorough survey was performed in a clockwise fashion. This revealed intact urothelium and patent ureters bilaterally. The course of the trocar was identified on both sides and the urothelium was intact. The urethra was inspected as the cystoscope was retracted and was also intact. The Foley catheter was replaced.

The mid portion of the sling was isolated from the overlying sheath and the middle portion was folded over and the middle 1.5-cm section was grasped with a Babcock clamp. The two trocars were then pulled through the abdominal incisions until the tip of the Babcock was snug against the urethra. The trocars and sheathes were removed, and the excess sling cut at the level of the abdominal skin. The Babcock clamp was removed and the redundant sling was pushed into the incision.

The skin was closed in two layers using 3-0 Polyglactin 910 suture. The first layer was a subepithelial horizontal mattress stitch followed by a simple running closure of the epithelium. The Foley was removed, the legs returned to a supine position, and the patient was prepared for transfer to the recovery room. She tolerated the procedure well and was in good condition.

COMPLICATIONS

Intraoperative	Postoperative
Cystotomy (4–10%)	Reoccurrence of incontinence (5–10%)
	Mesh erosion (2–4%)
	Dyspareunia (rare)

Suggested Reading

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CHAPTER 32

Transobturator Midurethral Sling

Roxana Geoffrion

INTRODUCTION

Transobturator midurethral slings (tapes or TOT) were introduced in 2001 as an alternative to retropubic midurethral slings for the treatment of stress urinary incontinence. The primary difference is that the TOT avoids the retropubic space by exiting the pelvis through the Obturator foramen onto the upper thigh. There are several types of transobturator slings that differ based on how the sling is placed. It can be placed with an inside-out or an outside-in technique, depending on whether the sling tunneler is passed starting through the vaginal incision or through the inner thigh incision, respectively. The TOT sling should not be confused with the second generation mini-slings, which do not penetrate the muscles of the thigh or the obturator foramen. Presently, there is minimal data defining the safety and efficacy of the mini slings and they are not covered in this book as they are currently under investigation.

There are many studies comparing TOT slings with other established surgical techniques for stress incontinence. The TOT supports the urethra like a hammock and avoids the retropubic space at insertion. This has resulted in clinical advantages of less voiding dysfunction and fewer irritative symptoms as well as fewer intraoperative complications of bladder and bowel perforation. On the other hand, the TOT is associated with increased groin/thigh pain and its location closer to the surface of the vaginal mucosa may cause more mesh erosions in the long term. Subjective efficacy of the TOT at correcting stress urinary incontinence is similar to retropubic slings, while objective efficacy is slightly inferior. Evidence of clinical efficacy is lacking beyond 5 years from the initial operation. The TOT also seems to be inferior to retropubic slings in selected groups of patients such as those suffering from intrinsic sphincteric deficiency (ISD).

Gynecologic surgeons performing TOT must familiarize themselves with the obturator space anatomy, as this is an area where gynecologic surgery is rarely performed (**Figure 32.1**). The TOT outside-in tunneler is inserted through and around adductor muscles of the thigh. After penetrating the skin, the tunneler next encounters the gracilis muscle and its broad attachment to the inferior pubic ramus. It then continues between attachments of adductor magnus to inferior pubic ramus and adductor longus to superior pubic ramus. Deep to magnus and longus lie the adductor brevis and obturator externus muscles, which are also penetrated by the tunneler. The tunneler then passes through the obturator foramen (and membrane) to pierce obturator internus and turn the corner around the inferior pubic ramus until it emerges through the vaginal incision. The innervation to the adductor muscles of the thigh is provided by the obturator nerve, which passes through the obturator canal at the superior edge of the obturator foramen. On the other hand, the obturator internus muscle is an abductor muscle and its innervation is supplied by the nerve to obturator internus which lies deep in the pelvis. The obturator canal, with its rich vasculature and nerves, is a structure to be avoided when a TOT is placed. On average, the distance between tunneler and canal is 2.3 cm.

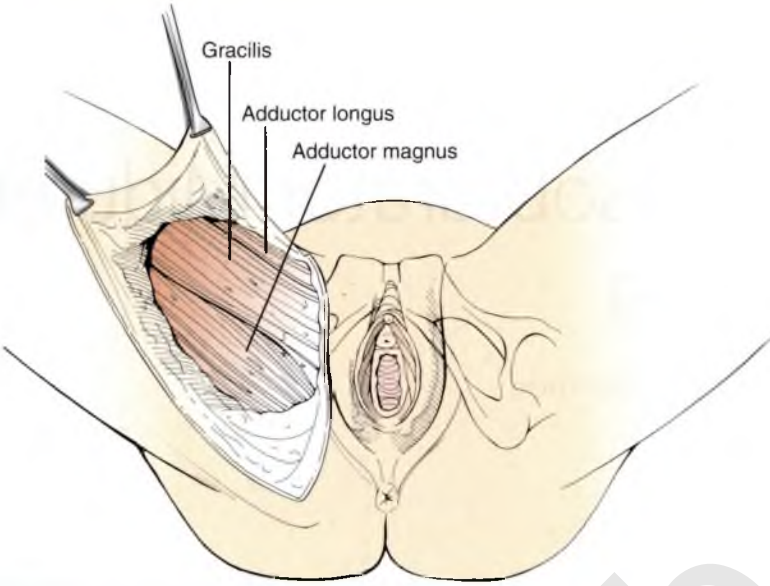

FIGURE 32.1 Anatomy of the obturator foramen: The TOT tunneler traverses the adductor muscles of the thigh; the gracilis muscle the adductor magnus, the adductor longus, the adductor brevis, and the obturator externus muscles. Next the tunneler traverses the obturator membrane overlying the foramen and pierces the obturator internus, passing medial to the inferior pubic ramus until it emerges through the vaginal incision. The vasculature and innervation of the thigh pass through the obturator foramen, which lies at the superior edge of the obturator foramen, approximately 2.3 cm from the course of the tunneler.

PREOPERATIVE CONSIDERATIONS

The most important preoperative preparation for a TOT sling is to ensure the proper diagnosis of stress urinary incontinence. There are several guidelines available that define the necessary diagnostic criteria, which do not routinely require urodynamics, provided that the symptoms of urinary loss with an increase in intra-abdominal pressure is present and leakage can be demonstrated with a stress test.

If ISD is suspected as an etiologic cause for the patient's stress urinary incontinence, urodynamics should be obtained, including valsalva leak point pressures and/or urethral pressure profilometry to assess the sphincteric function. If ISD is indeed present, the patient is best served by a retropubic sling. However, if hypermobility is the cause for the patient's stress incontinence, a TOT is a good treatment option.

Patients should be counseled that TOT placement is a day surgery and that a Foley catheter may be necessary in cases of postoperative voiding dysfunction. The need for a postoperative Foley catheter is usually transient and short-lived; however, in patients at high risk for voiding dysfunction, consideration should be given to self-catheterization teaching preoperatively.

Prophylactic antibiotics should be administered prior to incision. A first-generation cephalosporin is the first choice, but clindamycin, erythromycin, or metronidazole are also acceptable choices in patients allergic to penicillin or cephalosporins. An assessment of risk for deep venous thromboembolism is indicated. Sequential compression devices are necessary in patients at high risk for deep vein thrombosis. Due to the short case length, most patients do not require thromboembolic prophylaxis.

SURGICAL TECHNIQUE

In preparation for TOT, the patient is placed in comfortable dorsal lithotomy position, with the edge of her hips just over the edge of the operating table. Excessive hip flexion and knee extension are avoided to prevent injury to the femoral and sciatic nerves. However, some flexion of the hip is desirable, so that the thighs bend back over the abdomen, leaving an angle of >60° between the thigh and abdomen. The procedure is tolerated under general, regional, or local anesthesia with sedation. The patient's skin is prepared with a surgical scrub solution from the lower abdomen to the upper medial thighs, bilaterally; an internal vaginal scrub is also required. Surgical lights are directed onto the surgical field. The bladder is emptied.

Surgery begins with the incisions in the inner thigh. Palpation of anatomical landmarks helps to plan the thigh incisions. The adductor longus tendon is the most obvious landmark. The notch just below this tendon, just outside the labia majora and at the level of the clitoris can be marked using a sterile pen. Local anesthetic with a vasoconstrictive agent is injected beneath the skin down to the obturator foramen and small stab incisions are made with a scalpel at these previously landmarked inner thigh locations (**Figure 32.2**).

A posterior speculum (weighted or Jackson) is placed in the vagina and the middle third of the urethra is identified. Further local anesthetic with epinephrine is injected beneath the vaginal mucosa at the midurethra and laterally toward the obturator internus on each side. A 2-cm incision is made in the anterior vaginal mucosa at the level of the midurethra and the vaginal mucosa is dissected off the underlying tissue laterally using Metzenbaum scissors (**Figure 32.3**). The dissection is carried beneath the inferior pubic rami and toward the obturator internus muscle. The incision should allow palpation of the obturator internus muscle by the surgeon's index finger on each side. The lateral margin of the inferior pubic ramus is identified between an index finger placed in the periurethral vaginal incision and thumb placed over the thigh incision in front of the obturator foramen.

The original TOT tunnelers were curved; more recently, helical ones have also been used. The recommended tunneler orientation for insertion is slightly different based on its shape. For a curved tunneler, the straight tip is introduced vertical to the obturator membrane with the handle downward and perpendicular to the floor. For a helical tunneler, the handle is held parallel to the inferior pubic ramus and at the same angle as the ramus with respect to the floor. (**Figure 32.4A**) After a popping sensation through the obturator membrane, the handle is turned up more horizontal to the floor and the tunneler tip is directed toward the vaginal incision (**Figure 32.4B**). The index finger of the other hand is inserted through the vaginal incision to guide the tip of the tunneler around the inferior pubic ramus. The vaginal finger protects the urethra and bladder from the tunneler tip and also ensures that the lateral vaginal fornix has not been penetrated by the emerging tip. Cystoscopy is then performed to ensure the tunneler has not perforated the bladder (**Figure 32.5**). The TOT mesh is then attached to the tunneler and passed back through the tunneler as the latter is pulled out of the inner thigh incision (**Figure 32.6**). After introduction on both sides, the mesh is adjusted tension-free at the level of the midurethra by leaving a visible space a few millimeters wide between tape and midurethra. Adjusting sling tension with the patient in Trendelenburg position risks over-tightening the sling. The patient

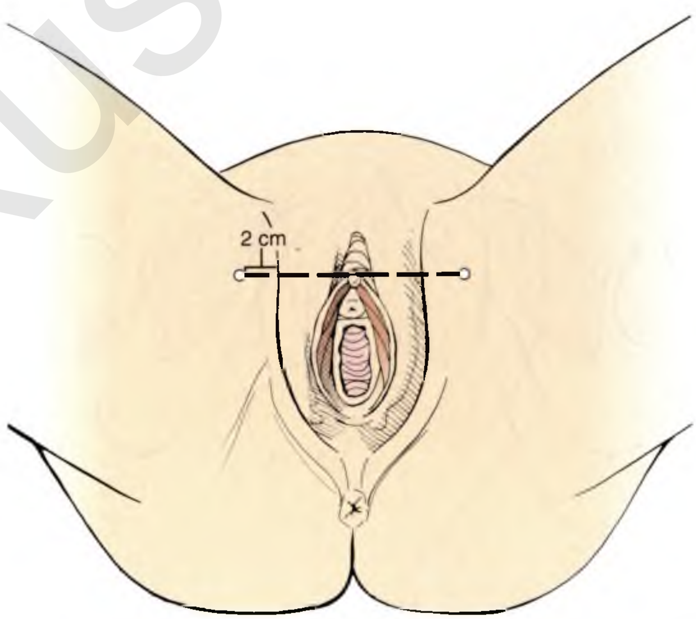

FIGURE 32.2 Thigh incisions are made over the medial aspect of the obturator foramen at the level of the clitoris.

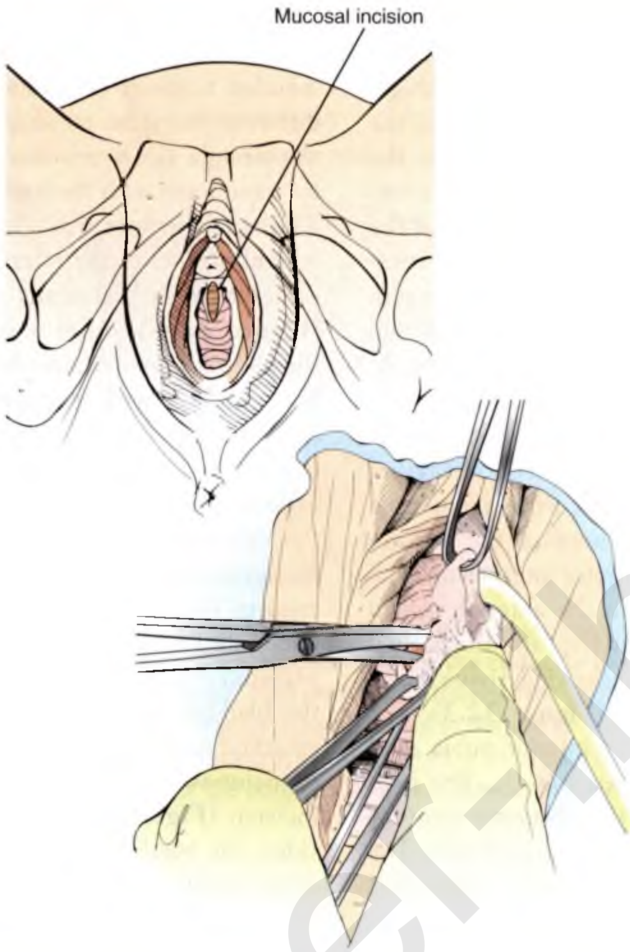

FIGURE 32.3 A midline incision is made in the distal anterior vaginal wall just proximal to the external urethral meatus, and the underlying tissue is dissected off the vaginal mucosa out to the Obturator internus muscle.

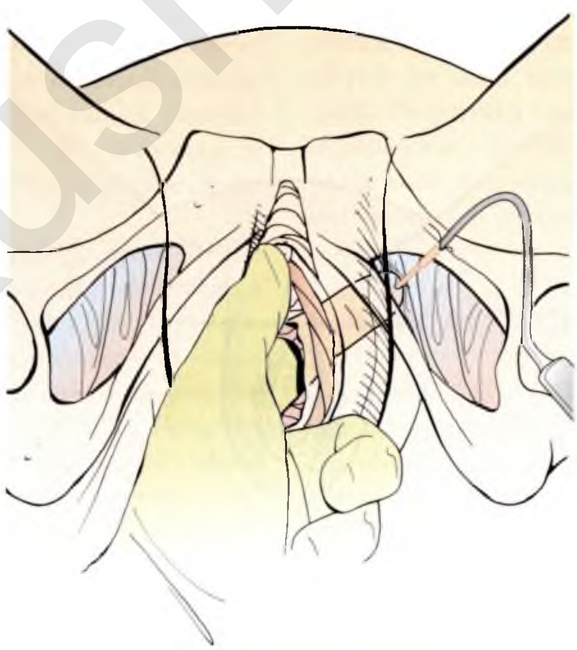

FIGURE 32.4 Insertion of a helical tunneler; the handle is held parallel to the inferior pubic ramus and at the same angle as the ramus with respect to the floor. After a popping sensation through the obturator membrane, the handle is turned up more horizontal to the floor and the tunneler tip is directed toward the vaginal incision.

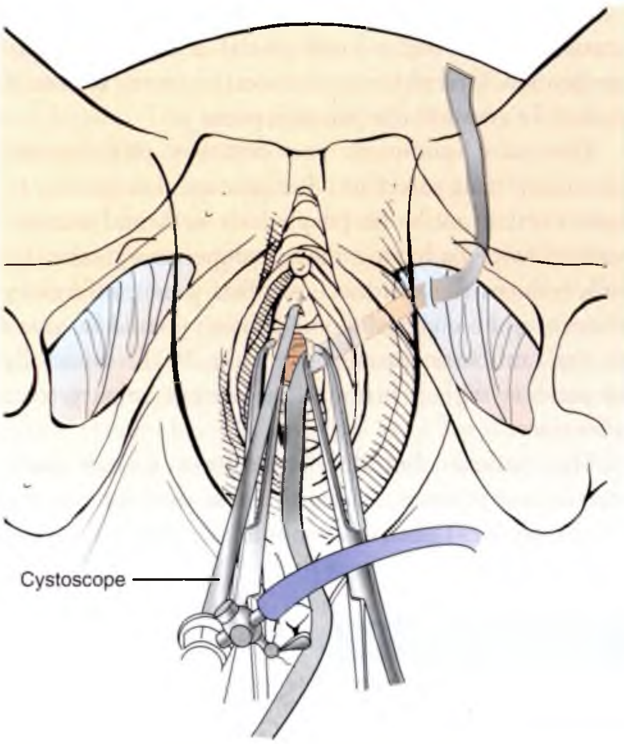

FIGURE 32.5 Cystoscopy is performed after each passage of the tunneler.

should be in neutral flat position for this surgical step. Curved Mayo scissors are inserted between sling and urethra to maintain the tension-free adjustment. With scissors in place, the tunnelers are removed, plastic sheaths covering the tape are pulled and excess mesh is trimmed (**Figure 32.7**). The scissors are then removed and the vaginal incision is closed with running or interrupted absorbable sutures (**Figure 32.8**). The skin around the inner thigh incisions is then pulled away from the end of the tape and sutured with a fine absorbable suture or closed with SteriStrips.

POSTOPERATIVE CONSIDERATIONS

After isolated TOT, the patient can be discharged the same day. Draining the bladder via indwelling Foley catheter is not necessary unless a bladder perforation has occurred or unless the patient cannot void. A trial of void should verify that at least one postvoid residual is in the normal range, less than 100 ml, prior to discharge. If the trial of void is not successful, an indwelling Foley can be placed until the next day. On postoperative day 1, the Foley can be removed and most patients void normally.

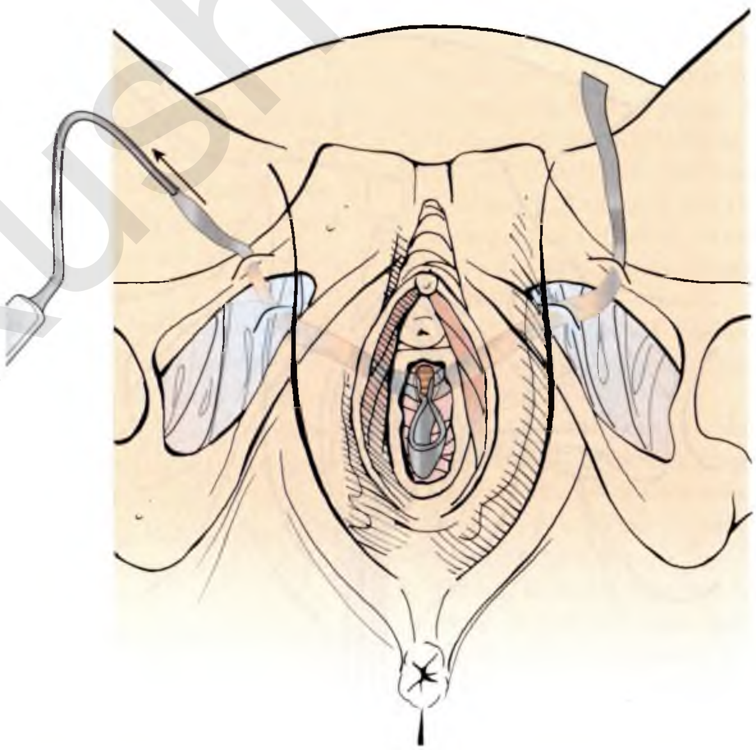

FIGURE 32.6 The mesh sling is pulled through the vaginal field and out the thigh incision after attaching it to the tunneler tip.

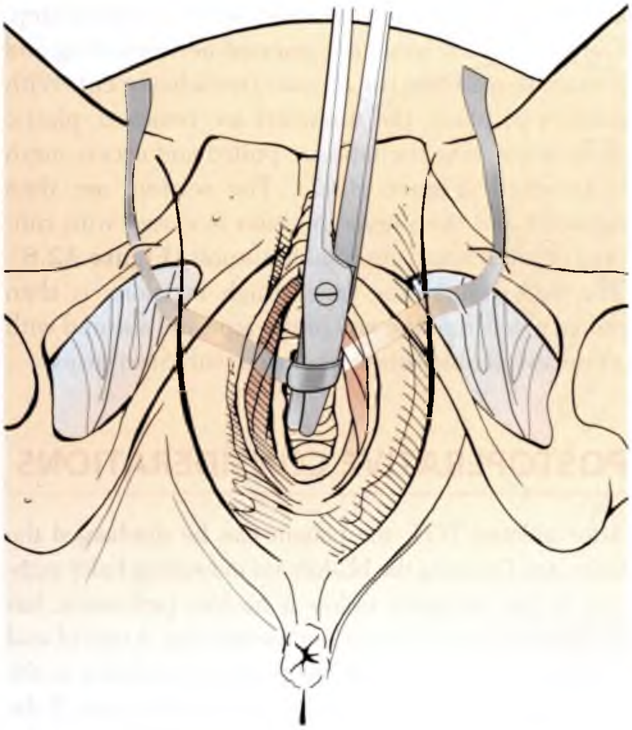

FIGURE 32.7 The tension on the sling is judged by using a set of Mayo scissors placed between the urethra and sling: This ensures a tension-free application. When properly tensioned, the sling sheathes are removed.

Postoperative pain is usually manageable with oral acetaminophen and a nonsteroidal anti-inflammatory medication. Oral narcotics are used on rare occasions if required to control the patient's pain.

The most common postoperative complication is urinary tract infection. Preliminary data seems to indicate that antibiotic prophylaxis with oral nitrofurantoin twice daily for 3 days postoperatively successfully reduces the incidence of urinary tract infections after retropubic slings. Consideration should be given to oral antibiotic prophylaxis after TOT, especially in patients with a history of recurrent urinary tract infections.

The patient should abstain from sexual intercourse and tampon use for 6 weeks postoperatively. Heavy physical activities should be avoided during this healing period.

Operative Note

PROCEDURE: TRANSOBTURATOR MIDURETHRAL SLING

The patient was taken to the operating room, where her identity and the surgical plan were confirmed during a preoperative briefing. After the

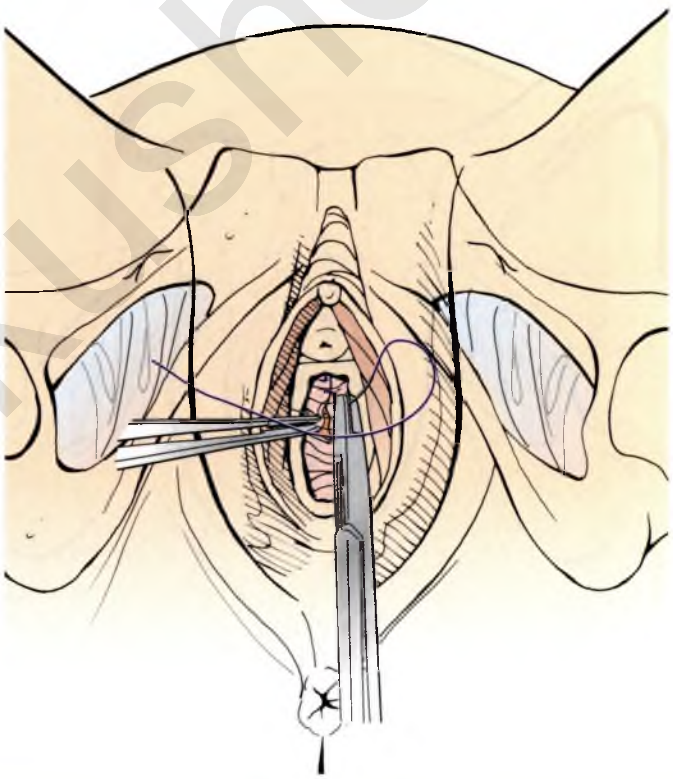

FIGURE 32.8 The vaginal mucosa is closed in a simple running stitch.

establishment of adequate anaesthesia, antibiotic prophylaxis was initiated. She was placed in a dorsal lithotomy position, and the vaginal field was prepped and draped. The bladder was drained using an Foley catheter. The operative team completed a time-out.

A sterile marker was used to landmark the site of the inner thigh incisions on both sides, at the base of the adductor longus tendon. Local anesthetic with epinephrine was infiltrated at this location down to the obturator membrane bilaterally. A posterior speculum was placed intra-vaginally and the vaginal mucosa overlying the midurethra was grasped using 2 Allis clamps laterally. Further local anesthetic with epinephrine was infiltrated into the anterior vaginal mucosa at this location as well as laterally toward the obturator internus muscles bilaterally. A 2-cm midline incision was made with scalpel at the level of the midurethra. The vaginal mucosa was undermined laterally using Metzenbaum scissors beneath the inferior pubic rami bilaterally.

With an examining finger against the left obturator internus muscle, the left-sided TOT tunneler was introduced through the inner thigh skin incision, adductor muscles, and obturator foramen, and was brought out around the inferior pubic ramus into the vaginal incision. Cystoscopy was performed and an intact bladder wall on the left was confirmed. The cystoscope was removed and the bladder was drained. The TOT mesh was attached to the left-sided tunneler vaginally and brought out through the left inner thigh incision. Tunneler insertion was repeated on the right side. Cystoscopy was again performed and confirmed an intact bladder wall on the right. The cystoscope was removed and the bladder was drained. Lateral vaginal fornices were carefully inspected and there was no evidence of penetration by the mesh on either side.

The mesh was adjusted tension-free at the level of the midurethra and the plastic sheaths covering the mesh were pulled through the inner thigh incisions bilaterally. The mesh was then cut flush with the skin. The skin was pulled away from the underlying mesh and was closed with SteriStrips. The vaginal incision was closed with a simple running Polygalactin 910 suture. Adequate hemostasis was noted at the end of the procedure.

The patient was then cleaned, repositioned, (extubated), and transported to the recovery room in stable condition. Sponge and instrument counts were correct. Estimated blood loss for this procedure was (surgeon to insert). There were no obvious complications.

COMPLICATIONS

Intraoperative	Postoperative
Bladder perforation —0.2–4%	Groin pain—12%
	Voiding dysfunction—4%
Pelvic hematoma (no reoperation)—1–2%	Bladder/urethral erosion —1–3%
Urethral perforation —0.1–0.9%	Vaginal erosion—3%
	De novo urgency—3%
	Reoperation rate for voiding dysfunction—2%

Suggested Reading

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CHAPTER 33

Cystocele Repair Using the Defect-directed Approach

Geoffrey W. Cundiff

INTRODUCTION

Providing optimal care for a cystocele, or prolapse of the anterior vaginal wall, begins with recognition of the heterogenous nature of pelvic organ prolapse, and a focus on the primary goal of intervention, relief of symptoms. Cystoceles frequently occur with concurrent prolapse of the posterior vaginal wall and/or the vaginal apex, and a durable repair requires attention to these support defects as well.

While prolapse is ubiquitous in parous women, it does not warrant treatment unless it is symptomatic. The symptoms commonly attributed to anterior prolapse include pelvic pressure, a sensation or visualization of protrusion, urinary dysfunction, and sexual dysfunction. While symptoms of protrusion are almost always due to prolapse, predicting which patients will have relief from urinary dysfunction and sexual dysfunction depends on a thorough understanding of the anatomy of support of the anterior wall as well as the differential diagnosis of these symptoms. Studies show that resolution of urinary symptoms is the most commonly stated goal for patients, regardless of stage of prolapse. The ability to perform daily activities, and sexual function goals are at least as important as resolution of prolapse symptoms and may be the reason for seeking care.

There are a variety of surgical techniques available to the surgeon treating cystocele, including the anterior colporrhaphy, anterior fascial reinforced repair (Chapter 35). Each of these approaches has strengths and limitations. The defect-directed repair, also known as the site-specific fascial repair, aims to maximize relief of symptoms without creating new functional symptoms, through recreating normal anatomy. The technique is based on Richardson's observations at the time of cystocele repair and during cadaveric dissections, of discrete tears or breaks in the pubocervical fascia or vaginal muscularis. He advocated an anatomical repair limited to repair of these fascial tears or defects in the pubocervical fascia without attempts to narrow the vaginal caliber. This approach appears to improve the relief of protrusion symptoms due to prolapse. However, its reliance on native tissues that may be compromised in women with pelvic organ prolapse, may have a negative impact on its durability. Nevertheless, it is a good choice for a patient that desires a repair using native tissue, especially if she has no risk factors for recurrence.

PREOPERATIVE CONSIDERATIONS

Some surgeons advocate preoperative estrogen cream to promote a healthier mucosal epithelium in atrophic postmenopausal patients although histological studies do not support this hypothesis. A bowel preparation is not generally indicated preoperatively. Antibiotic prophylaxis with a second generation cephalosporin or metronidazole is recommended, although there is minimal data to show its efficacy. A risk assessment for deep venous thromboembolism prophylaxis is also recommended. The patient should be positioned in lithotomy or modified lithotomy position. Either regional anesthesia or general anesthesia is appropriate. Submucosal infiltration with injectable lidocaine with epinephrine simplifies postoperative pain and assists dissection and hemostasis. A Foley catheter should be placed during the surgery to drain the bladder. Following is a brief description of the surgical procedure used (see also video: *Cystocele Repair Using the Defect-directed Approach*).

SURGICAL TECHNIQUE

Begin by defining the scope of the cystocele. Placement of a vagina retractor provides access to the anterior vaginal wall (**Figure 33.1**). The surgical approach begins with a longitudinal incision in the midline of the anterior vaginal wall (**Figure 33.2**). This incision begins just proximal to the external urethral meatus and is carried approximately to two-thirds of the vaginal length. The vaginal epithelium is then dissected off the underlying tissue in the plane between the mucosa and the vaginal muscularis or pubocervical fascia (**Figure 33.3A**). Finding this plane is essential to identifying the location of the rent in the pubocervical fascia. This dissection is facilitated by using sharp dissection combined with countertraction provided by Allis clamps, a self-retaining retractor, or by using a finger behind the vaginal mucosa (**Figure 33.3B**). Moreover, as the rent can occur in the midline of the pubocervical fascia or at its lateral attachments, the dissection should be carried laterally to the arcus tendineus fascia pelvis or white line, the normal attachment of the pubocervical fascia to the obturator internus muscle, and superiorly to the cervix or vaginal cuff (**Figure 33.3C**).

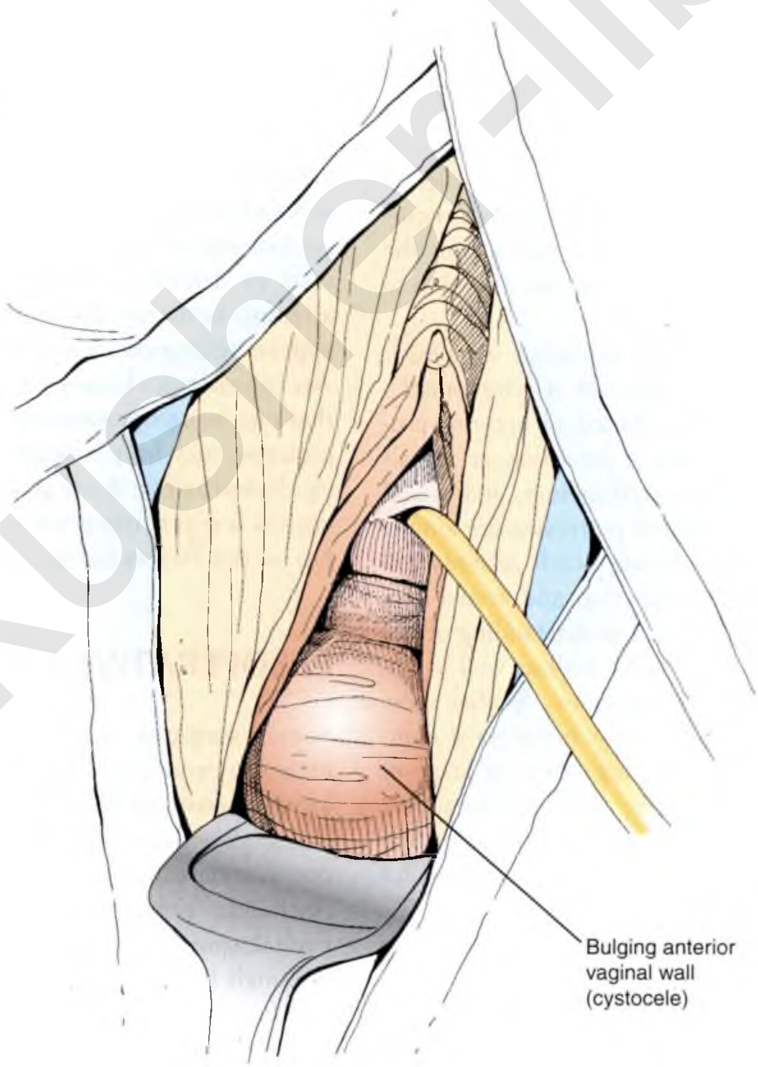

FIGURE 33.1 Preoperative exam; use a vaginal retractor to show the extent of the cystocele.

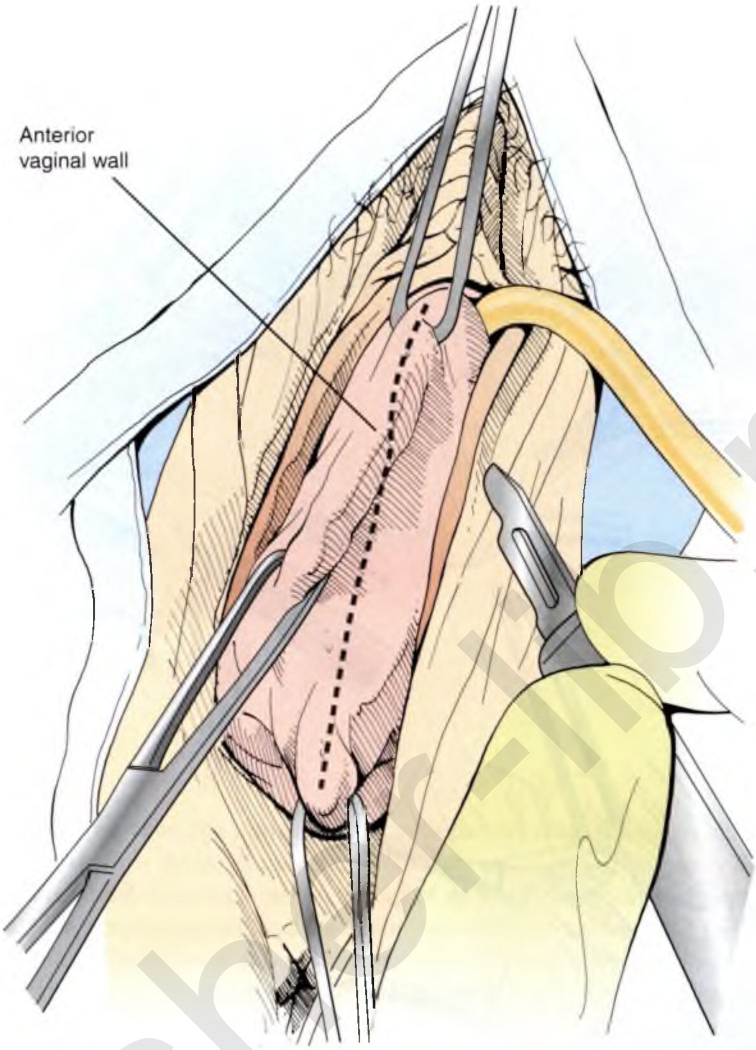

FIGURE 33.2 Mucosal incision; a longitudinal incision beginning just distal to the external urethral meatus.

Once the dissection is complete, the surgeon must identify the location of the rent in the pubocervical fascia. The defect in the pubocervical fascia can occur in the midline, or through a separation of the pubocervical fascia from the white line on either side (**Figure 33.4A**). Less commonly, the pubocervical fascia separates from the cervix. We begin by assessing the lateral attachment to the white line. Recognizing its end points, the ischial spine and the symphysis pubis help to identify the course of the white line. Place the tip of contralateral index finger on the ischial spine and the proximal phalangeal joint against the lower margin of the symphysis pubis, and the white line will course between the two, along the outer aspect of the index finger. Once the location of the white line is confirmed, an attempt to sweep the finger anteriorly should be blocked by the pubocervical fascia (**Figure 33.4A**). If the finger easily moves anteriorly into the retropubic space, then the lateral attachment of the pubocervical fascia is compromised (**Figure 33.4B**). This is often referred to as a paravaginal defect, and can be confirmed by visualizing retropubic space fat. If the pubocervical fascia's lateral attachment to the white line is intact, then this maneuver should be repeated on the other side to assess both lateral attachments. If both lateral attachments are intact, then the break is most likely in the midline.

Identifying the midline defect requires the ability to discriminate between the pubocervical fascia and the bladder muscularis. The bladder muscularis is ruddy red in color, bleeds easily and has poor tensile strength when grasped with forceps. In contrast, the pubocervical fascia is white in color, does not usually bleed, and has comparative tensile strength when grasped with a forceps. The bladder muscularis, which is the tissue that herniates through the rent, is distinguished by its elasticity and lack of tensile strength, ruddy color,

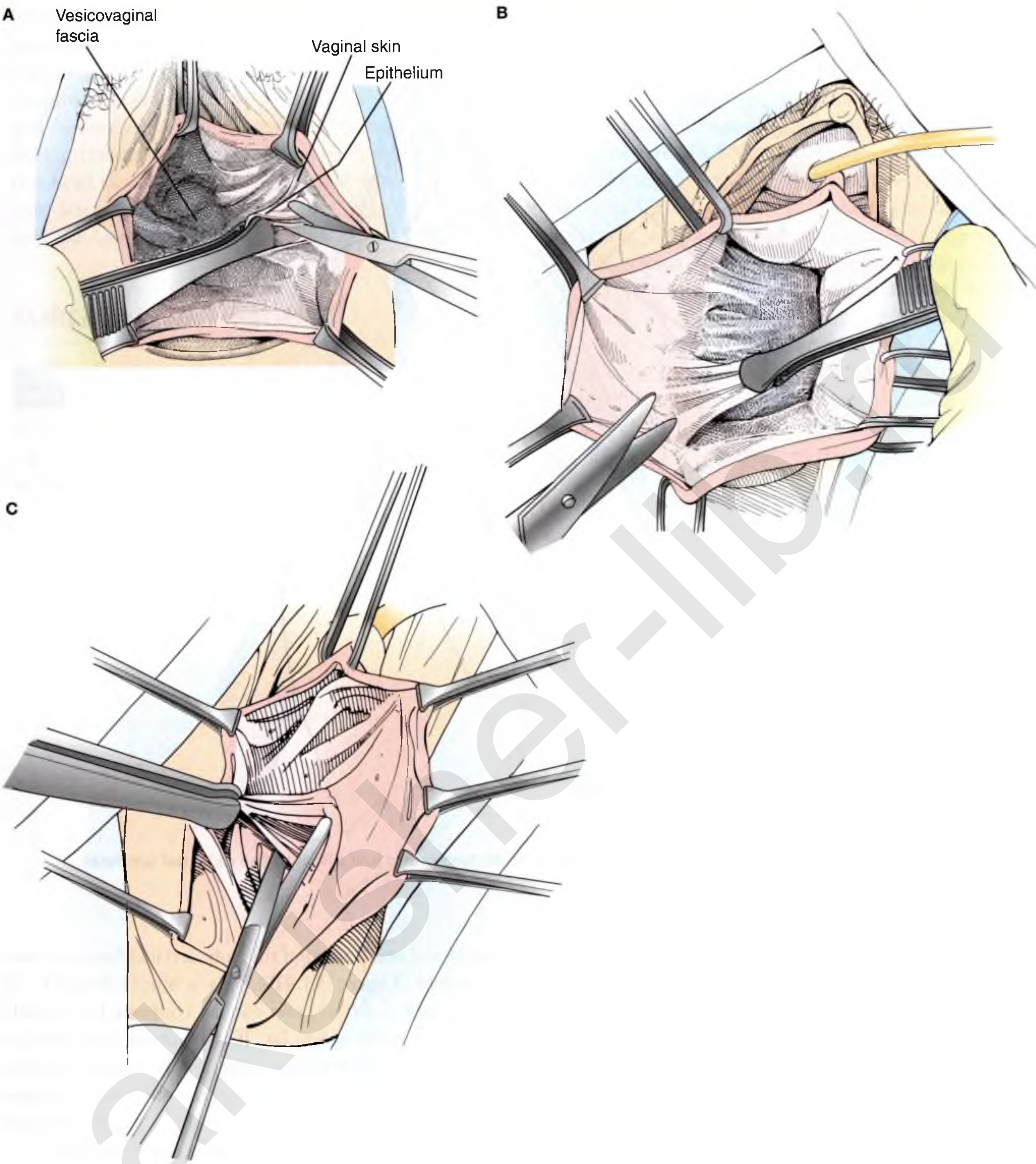

FIGURE 33.3 (A) Dissection of pubocervical fascia; use countertraction and sharp dissection to develop the plane on the left. The fibers should be cut at their insertion into the vaginal mucosa. (**B**) Dissection of pubocervical fascia; use the same technique to develop the plane on the right. (**C**) Dissection of pubocervical fascia; the dissection should be carried laterally to the white line on both sides, and superiorly to the cervix.

and more vascular nature (**Figure 33.4C**). The edges of the rent should be clearly delineated, keeping in mind that it is frequently separated from one lateral attachment, or both.

Once the rent is identified, the repair is limited to reapproximation of the edges in an interrupted fashion, burying the knots beneath the pubocervical fascia (**Figure 33.5A**). Some surgeons advocate a permanent

A

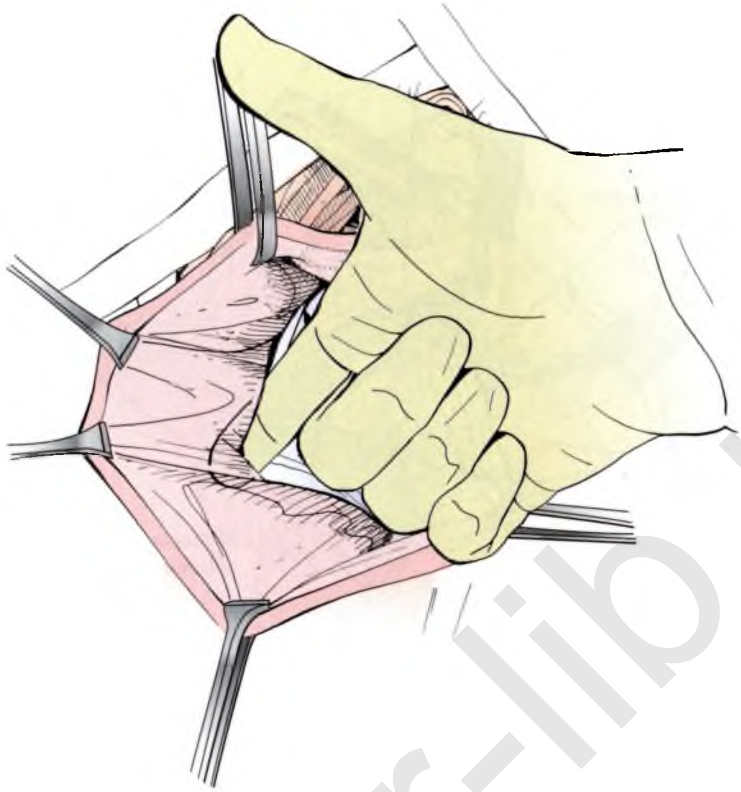

FIGURE 33.4 (A) Assess for rent; the pubocervical fascia can separate from the white line on either side, or have a midline rent: It can also separate from the cervix, creating a superior defect. Assess for Rent; place the tip of contralateral index finger on the ischial spine and the proximal phalangeal joint against the lower margin of the symphysis pubis, and the white line will course between the two, along the outer aspect of the index finger. Once the location of the white line is confirmed, an attempt to sweep the finger anteriorly should be blocked by the pubocervical fascia. (**B**) If the finger is not blocked from swinging anteriorly into the retropubic space, then there is a paravaginal defect. A right paravaginal defect is shown. (**C**) Alternatively, there may be a midline rent, in which case the bladder muscularis, which is the tissue that herniates through the rent, is distinguished by its elasticity and lack of tensile strength, ruddy color, and more vascular nature. The edges of the rent should be clearly delineated, keeping in mind that it is frequently separated from one lateral attachment, or both. *(Continued)*

suture, although a monofilament delayed absorbable suture provides similar results. A 2-0 caliber is sufficient. Plication is not a surgical goal as it tends to narrow the vaginal caliber. Closure of paravaginal defects is simpler if all sutures are passed through the white line first, while a retractor blade directed into the retropubic space holds the bladder medially. The first stitch is placed at the level of the spine with subsequent stitches placed sequentially at approximately 1 cm gaps (**Figure 33.5B**). This is much easier if the axis of the needle driver is kept parallel to the white line, although most novice surgeons usually try to place the stitches with the needle driver perpendicular to the white line. After placing all sutures in the white line, the ends are brought through the lateral edge of the pubocervical fascia and held (**Figure 33.5C**). Finally, all sutures are tied. When the defect in the pubocervical fascias is in the superior portion, it is important to determine whether Level I apical support is also compromised, as a successful repair in this circumstance will require repair of apical support as well, for example by uterosacral suspension (Chapter 38). Once the pubocervical fascia is repaired, the vaginal epithelium is closed in a simple running fashion with a 3-0 absorbable suture, such as Polygalactin 910 (**Figure 33.6**). This should leave a well-supported anterior vaginal wall directed toward the ischial spines (**Figure 33.7**).

Injury to the bladder and ureters are potential complications of the dissection and repair. Consequently, perioperative cystoscopy, including evaluation of the urethra, is always recommended. If ureteral patency is not confirmed on one side, following a paravaginal

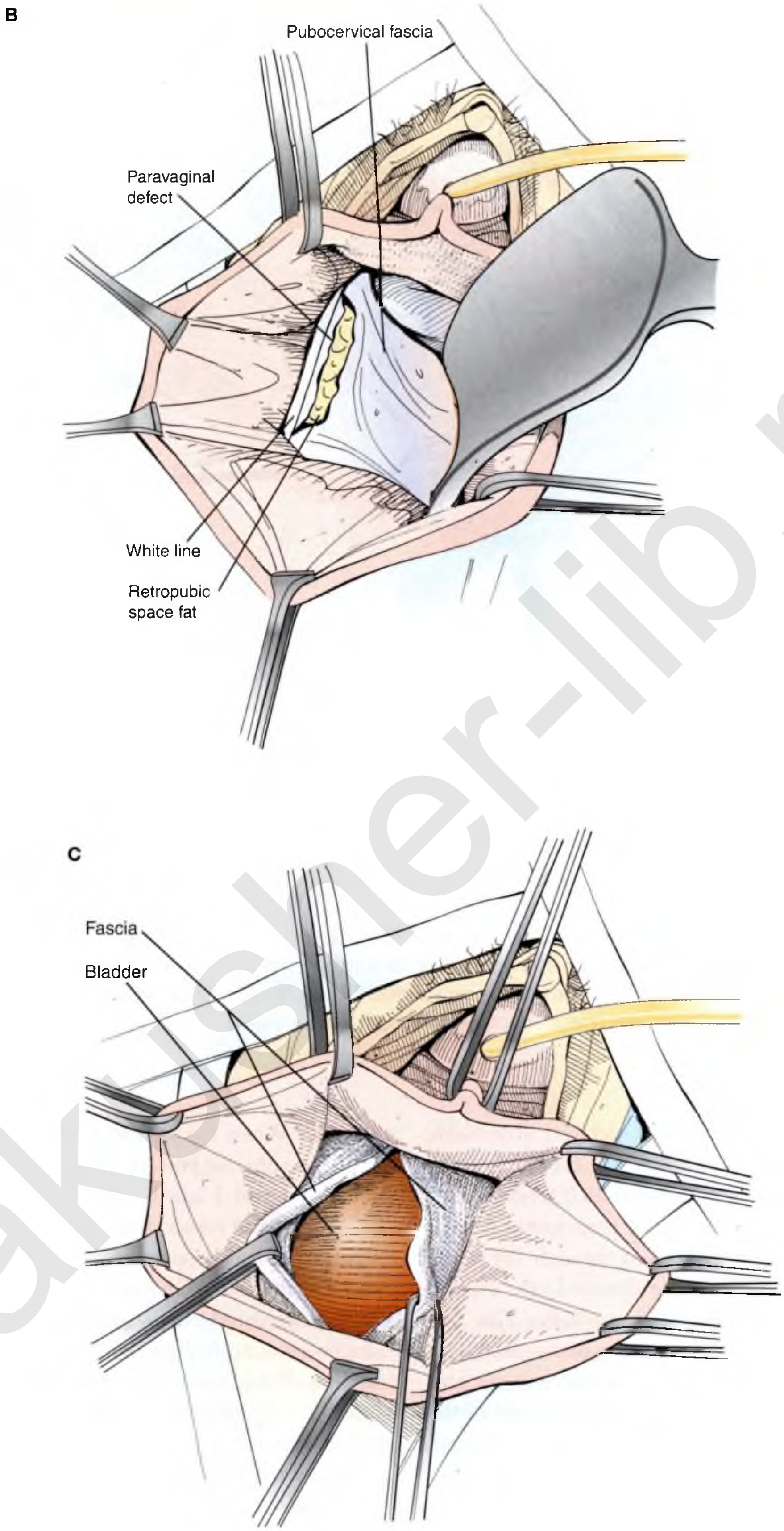

FIGURE 33.4 (*Continued*)

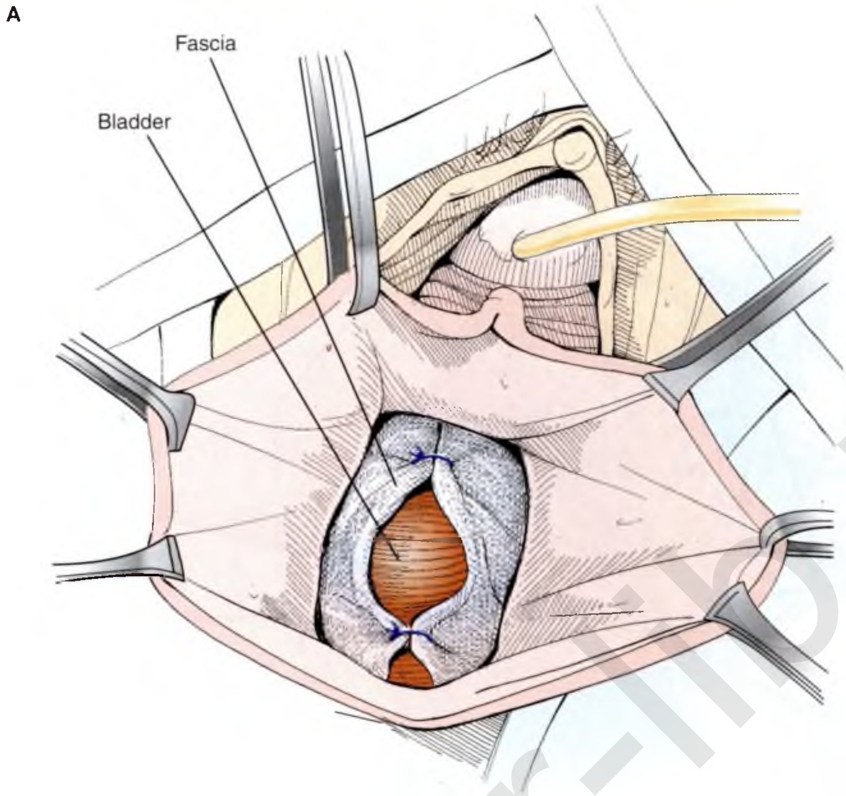

FIGURE 33.5(A) Closure of midline defect; reapproximate the edges in an interrupted fashion, burying the knots beneath the pubocervical fascia. (**B**) Closure of right paravaginal defect; place sutures in the white line, beginning at the level of the ischial spine. This is much easier if the needle driver is held so that the long axis of the instrument is parallel to the course of the white line. (**C**) Closure of right paravaginal defect; after placing the stitches in the white line, bring the ends through the medial edge of the pubocervical fascia. *(Continued)*

repair, then the most superior suture on that side should be removed. Vaginal narrowing is not a surgical goal, so excessive removal of skin should be avoided. For large cystoceles, it may be necessary to trim a minimal amount of the vaginal skin, but just to the point where the skin edges fall together. Closure of the vaginal epithelium is accomplished with a simple running approach using an absorbable suture. A vaginal pack can be placed for several hours to enhance hemostasis (See **Complications** box on page 300).

POSTOPERATIVE CONSIDERATIONS

For most patients, the defect-directed cystocele repair can be performed in a day surgery setting as an outpatient. If it is combined with other prolapse repairs, then an overnight stay is indicated.

Prolonged bladder drainage is not generally necessary for patients with normal bladder function, although an indwelling catheter is appropriate until the vaginal pack is removed, if a vaginal pack is used. Urinary retention is rare after an isolated cystocele repair, although postoperative spasm of the pelvic floor can cause a functional obstruction occasionally. Consequently, confirmation of normal voiding, including measurement of the post-void residual is a good practice. The post-void residual can be measured with an ultrasound device or straight catheterization and should be less than 100 ml.

Postoperative pain management is usually adequately managed with nonsteroidal anti-inflammatory drugs. A regular schedule of oral medication helps to minimize postoperative pain needs, by providing baseline analgesia. Oral narcotics can then be used on an as needed basis for pain spikes.

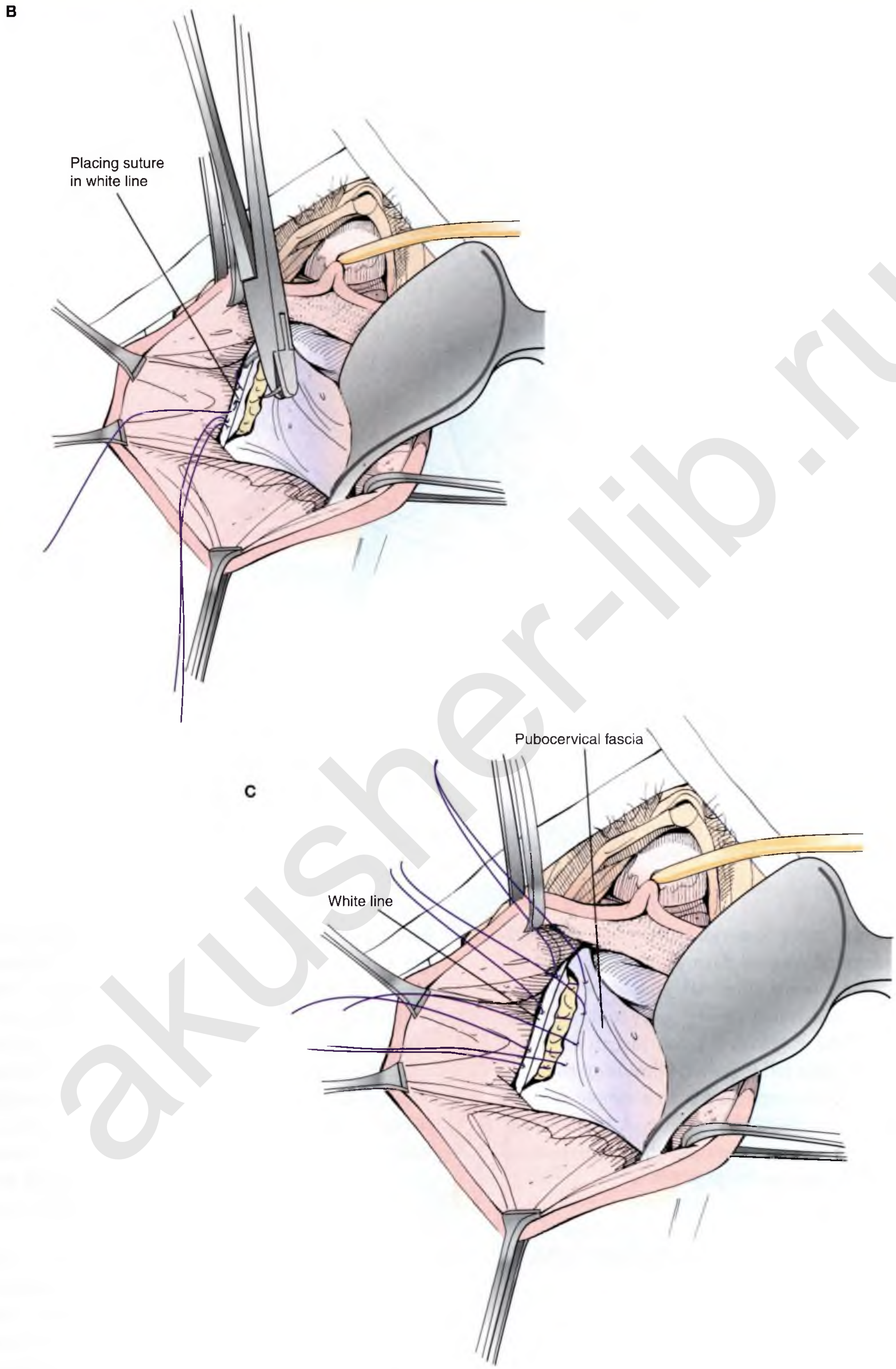

FIGURE 33.5 (*Continued*)

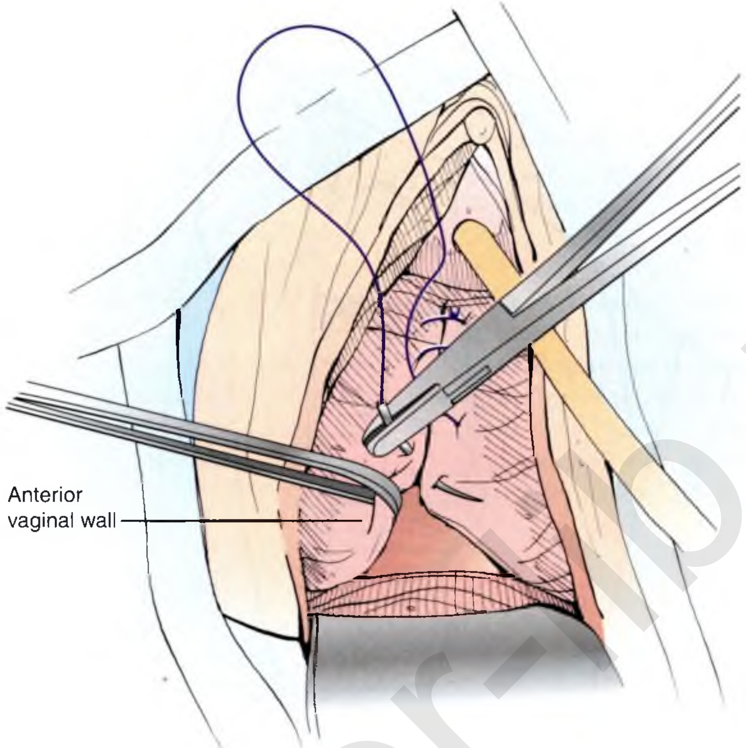

FIGURE 33.6 Closure of epithelium; simple running closure.

Patients should be instructed to avoid sexual relations and use of tampons for 6 weeks until the incisions are fully healed. During the first 6 weeks, activities that increase intra-abdominal pressure should be avoided as they predispose to recurrent prolapse. An over-the-counter stool softener is useful to minimize straining at defecation, especially in patients with preoperative constipation.

Operative Note

PROCEDURE: CYSTOCELE REPAIR USING THE DEFECT-DIRECTED APPROACH

The patient was taken to the operating room, where her identity and the surgical plan were confirmed during a preoperative briefing. After the establishment of adequate anesthesia, pneumatic compression devices were placed and antibiotic prophylaxis initiated. She was placed in a dorsal lithotomy position, and the vaginal field was prepped and draped. The operative team completed a time out.

The procedure began with infiltration of the anterior vaginal wall with 1% lidocaine with epinephrine. A longitudinal incision was made in the midline of the anterior vaginal wall. This incision was carried two-thirds of the vaginal length. Using countertraction, the vaginal mucosa was sharply dissected off the underlying tissue out to the white line. This dissection was then continued superiorly to the cervix, fully defining the pubocervical fascia. Palpation of the lateral attachments revealed a right paravaginal defect. Hemostasis was achieved using electrocautery.

A stitch of 2-0 PDS was brought through the right white line at its most superior level near the ischial

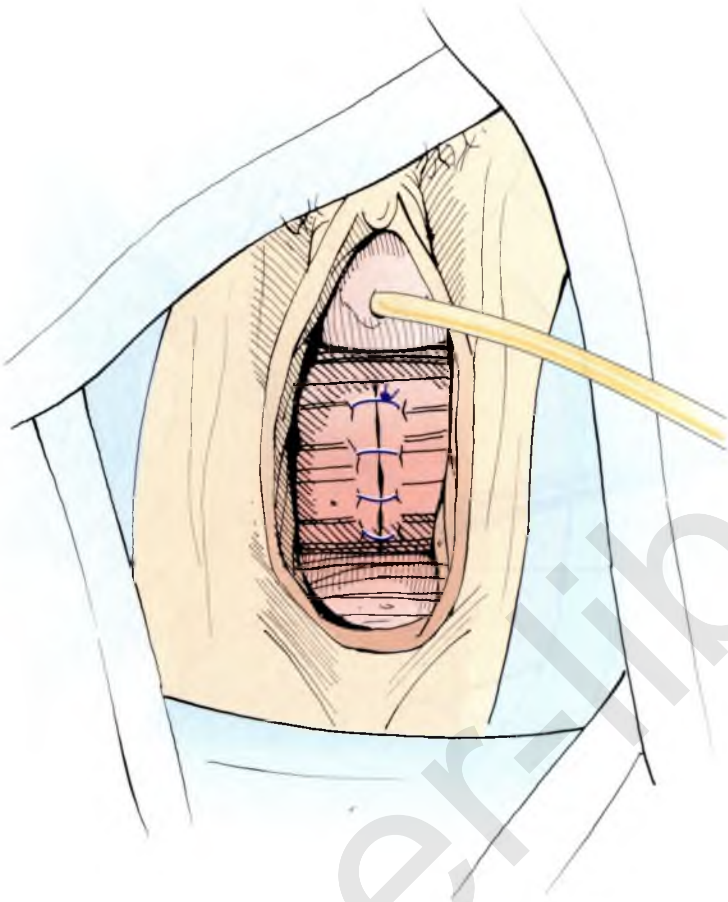

FIGURE 33.7 Final repair.

spine. Additional interrupted stitches of 2-0 PDS were placed in the same fashion moving distally along the white line. Once the stitches were in the white line, the sutures were individually brought through the lateral aspect of the pubocervical fascia at the same level. The mucosal incision was closed in a simple running fashion using 3-0 Vicryl.

Diagnostic cystoscopy was performed using a 17-French sheath and a 70° lens with sterile water as the distending media. With water running, the cystoscope was advanced into the urethral meatus and into the bladder. A thorough survey was made following the points of a clock. The ureteral orifices were noted to be patent bilaterally. The 70° lens was then exchanged for a 0° lens. With water running, the cystoscope was retracted, providing a view of the urethral lumen.

A sterile pack was placed. The patient was returned to a supine position and then was transferred to the recovery room in good condition. She tolerated the procedure well.

COMPLICATIONS

Intraoperative

- Hemorrhage (3%)
- Urinary tract injury (2%)

Postoperative

- Lower urinary tract symptoms (12%)
- Reoccurrence of prolapse (5%)
- Lower extremity neuropathy (2%)
- Dyspareunia (rare)

Suggested Readings

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CHAPTER 34

Cystocele Repair Using Anterior Fascial Reinforcement

Geoffrey W. Cundiff

INTRODUCTION

Providing optimal care for a cystocele, or prolapse of the anterior vaginal wall, begins with recognition of the heterogeneous nature of pelvic organ prolapse, and a focus on the primary goal of intervention, which is relief of symptoms. Cystoceles frequently occur with concurrent prolapse of the posterior vaginal wall and/or the vaginal apex, and a durable repair requires attention to these support defects as well.

While prolapse is ubiquitous in parous women, it does not warrant treatment unless it is symptomatic. The symptoms commonly attributed to anterior prolapse include pelvic pressure, a sensation or visualization of protrusion, urinary dysfunction, and sexual dysfunction. While symptoms of protrusion are almost always due to prolapse, predicting which patients will have relief from urinary dysfunction and sexual dysfunction depends on a thorough understanding of the anatomy of support of the anterior wall as well as the differential diagnosis of these symptoms. Studies show that resolution of urinary symptoms is the most commonly stated goal for patients, regardless of stage of prolapse. The ability to perform daily activities, and sexual function goals are at least as important as resolution of prolapse symptoms and may be the reason for seeking care.

There are a variety of surgical techniques available to the surgeon treating cystocele, including the anterior colporrhaphy and defect-directed cystocele repair (Chapter 33). Each of these approaches has strengths and limitations. The defect-directed repair, also known as the site-specific fascial repair, aims to maximize relief of symptoms without creating new functional symptoms, through recreating normal anatomy. This approach appears to improve the relief of protrusion symptoms due to prolapse; however, its reliance on native tissues that may be compromised in women with pelvic organ prolapse, may have a negative impact on its durability. The anterior fascial reinforced repair attempts to overcome the shortcomings of the defect-directed approach by adding a graft to reinforce the native tissue and thereby provide added durability.

The use of grafts in transvaginal prolapse repairs is a controversial topic in reconstructive pelvic surgery. The concept of a graft-reinforced repair was adopted from the management of hernias, where there is ample evidence that the addition of a graft significantly improves the durability of hernia repairs. The concept became popular during the late decade of the 20th century, and enthusiasm led to multiple approaches and the development of new technologies, including different grafts and different kits for placement of the grafts. However, this surge in interest was not initially accompanied by data on either safety or efficacy. As that data began to emerge, it became clear that placing grafts through a vaginal incision was associated with complications that might overcome any benefit from added durability. This culminated in two FDA warnings about the use of transvaginally placed grafts for prolapse repairs, the first in 2008 and the most recent in 2011. Based on several systematic reviews, the 2011 warning noted that the only use of transvaginal grafts in prolapse repairs that had evidence to support added durability was in the repair of cystoceles. Importantly, the added graft did not provide better results in terms of symptom relief, but only in anatomical outcomes. Moreover, there remain added complications related to graft use, including graft erosion, injury to surrounding organs related to instruments developed for placement, and postoperative pain and dyspareunia. Consequently, we reserve the anterior fascial reinforced cystocele repair for patients with recurrent anterior wall prolapse, so that the potential benefits outweigh the added risks. There remain many unanswered questions about the use of grafts for cystocele repairs in spite of the evidence of improved anatomical outcomes. These include the relative merits of surgical mesh versus biological grafts, the use of surgical kits that replace sutures for anchoring the graft, and whether the graft should reinforce a native tissue repair, or be placed without efforts to repair the native tissue. Prudence dictates an in-depth discussion of these issues for any patient that is considering an anterior fascial reinforced repair.

PREOPERATIVE CONSIDERATIONS

Some surgeons advocate preoperative estrogen cream to promote a healthier mucosal epithelium in atrophic postmenopausal patients although histological studies do not support this hypothesis. A bowel prep is not generally indicated preoperatively. Antibiotic prophylaxis with a second generation cephalosporin or metronidazole is recommended, although there is minimal data to show its efficacy. A risk assessment for deep venous thromboembolism prophylaxis is also recommended. Given the lithotomy position and the average length of surgery, most patients have at least a moderate risk of venous thromboembolism, and consequently, we routinely use prophylaxis. Either pharmacologic or mechanical prophylaxis is appropriate.

The patient should be positioned in lithotomy or modified lithotomy position. Either regional anesthesia or general anesthesia is appropriate. Submucosal infiltration with injectable lidocaine with epinephrine simplifies postoperative pain and assists dissection and hemostasis. A Foley catheter should be placed during the surgery to drain the bladder. Following is a brief description of the surgical procedure used (see also video: *Cystocele Repair Using Anterior Fascial Reinforcement*).

SURGICAL TECHNIQUE

Begin by defining the scope of the cystocele. Placement of a vaginal retractor provides access to the anterior vaginal wall (**Figure 34.1**). The surgical approach begins with a longitudinal incision in the midline of the anterior vaginal wall (**Figure 34.2**). This incision begins just proximal to the external urethral meatus and is carried approximately two-thirds of the vaginal length. The vaginal epithelium is then dissected off the underlying tissue in the plane between the mucosa and the vaginal muscularis or pubocervical fascia (**Figure 34.3A**). Finding this plane is essential to identifying the location of the rent in the pubocervical fascia. This dissection is facilitated by using sharp dissection combined with counter traction provided by Allis clamps, a self-retaining retractor, or by using a finger behind the vaginal mucosa. This dissection should be carried laterally to the white line and superiorly to the cervix or vaginal cuff (**Figure 34.3B**). Once the left side of the dissection is complete, the right side should be developed in the same fashion (**Figure 34.3C**).

Once the dissection is complete, the surgeon must identify the location of the rent in the pubocervical fascia. The defect in the pubocervical fascia can occur in the midline, or through a separation of the pubocervical fascia from the white line on either side. Less commonly, the pubocervical fascia separates from the cervix. We begin by assessing the lateral attachment to the white line. Recognizing its end points, the ischial spine and the symphysis pubis, helps to identify the course of the white line. Place the tip of contralateral index finger on the ischial spine and the proximal phalangeal joint against the lower margin of the symphysis pubis, and the white line will course between the two, along the outer aspect of the index finger. Once the location of the white line is confirmed, an attempt to sweep the finger anteriorly should be blocked by the pubocervical fascia. If the finger easily moves anteriorly into the space of Retzius, then the lateral attachment of the pubocervical fascia is compromised. This is often referred to as a paravaginal defect, and can be confirmed by visualizing Retropubic space fat. If the pubocervical fascia's lateral attachment to the white line is intact, then this maneuver should be repeated on the other side to assess both lateral attachments. If both lateral attachments are intact, then the break is most likely in the midline.

Identifying the midline defect requires the ability to discriminate between the pubocervical fascia and the

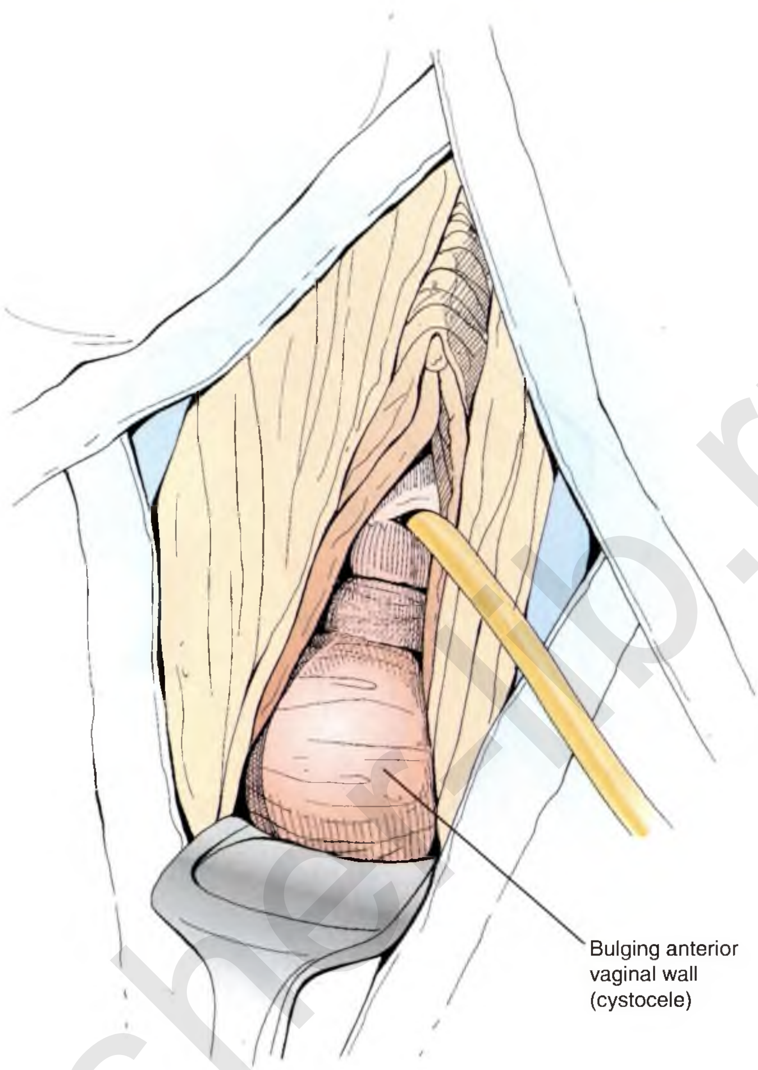

FIGURE 34.1 Preoperative exam: Use a vaginal retractor to show the extent of the cystocele.

bladder muscularis. The bladder muscularis is ruddy red in color, bleeds easily, and has poor tensile strength when grasped with forceps. In contrast, the pubocervical fascia is white in color, does not usually bleed and has comparative tensile strength when grasped with a forceps. The bladder muscularis, which is the tissue that herniates through the rent, is distinguished by its elasticity and lack of tensile strength, ruddy color, and more vascular nature (**Figure 34.4**). The edges of the rent should be clearly delineated, keeping in mind that it is frequently separated from one lateral attachment, or both.

Once the rent is identified, the repair begins with reapproximation of the edges in an interrupted fashion, burying the knots beneath the pubocervical fascia (**Figure 34.5A**). Some surgeons advocate a permanent suture, although a monofilament delayed absorbable suture provides similar results. A 2-0 caliber suture is sufficient. Plication is not a surgical goal as it tends to narrow the vaginal caliber. If there is a paravaginal defect, this should be closed as described in Chapter 34 and the sutures should be kept long after they are tied down.

Once the pubocervical fascia is closed, sutures should be placed in the white lines, bilaterally. This is simpler if a retractor blade is directed into the Retropubic space to hold the bladder medially. The first stitch is placed at the level of the spine with subsequent stitches placed sequentially at approximately 1 cm (**Figure 34.5B**). This is much easier if the axis of the needle driver is kept parallel to the white line, although most novice surgeons usually try to place the stitches with the needle driver perpendicular to the white line.

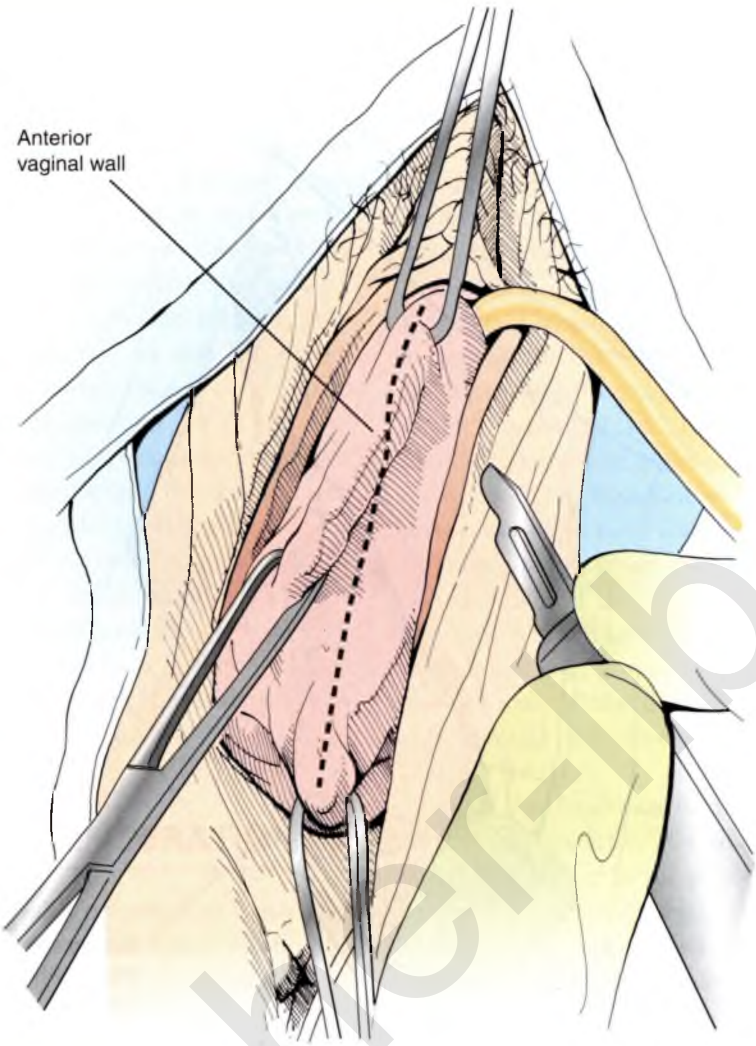

FIGURE 34.2 **Mucosal incision:** A longitudinal incision beginning just distal to the external urethral meatus.

After placing all sutures, the graft is brought into the field. We use a 8 × 10 cm graft with the 10 cm axis spanning the interspinous diameter. First, the most superior sutures in the white lines are brought through the superior corners of the graft (**Figure 34.6**). These sutures are then tied down. When the defect in the pubocervical fascia is in the superior portion, it is important to determine whether level I apical support is also compromised, as a successful repair in this circumstance will require repair of apical support as well, for example by uterosacral suspension (Chapter 38). Under this circumstance, the superior aspect of the graft should be attached to the arms of the uterosacral suspension sutures.

The graft is then trimmed along the sides to a size slight larger than the rhomboid shape of the pubocervical fascia (**Figure 34.7**). Healing can lead to shrinkage of the graft, so it is prudent to leave some redundancy. Next, the remaining sutures previously placed in the white line are brought through the edges of the graft at the appropriate location to allow it to lay flat (**Figure 34.8**). Finally all sutures are tied.

Injury to the bladder and ureters are potential complications of the dissection and repair. Consequently, perioperative cystoscopy, including evaluation of the urethra, is always recommended following completion of the repair. If ureteral patency is not confirmed on one side, then the most superior suture on that side should be removed.

Vaginal narrowing is not a surgical goal, so excessive removal of skin should be avoided. For large cystoceles, it may be necessary to trim a minimal amount

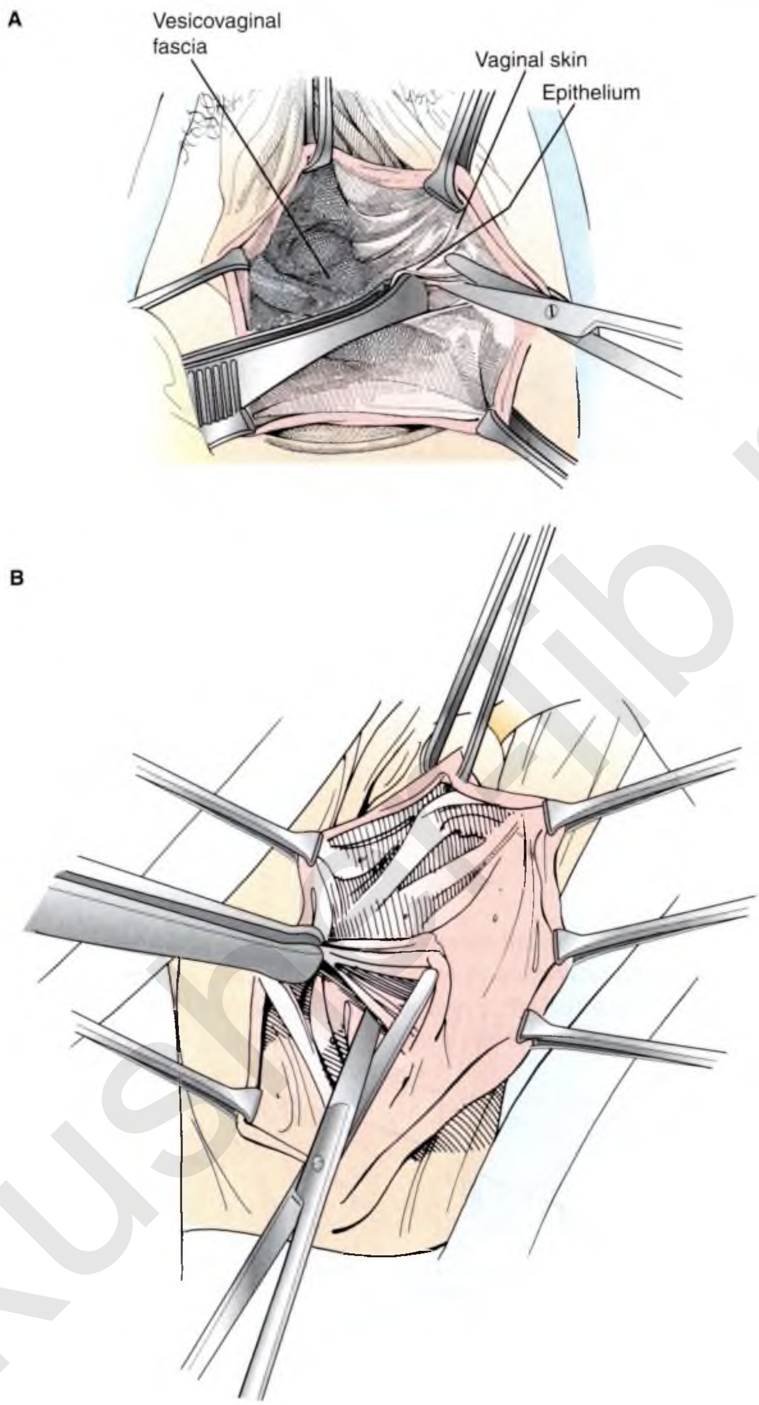

FIGURE 34.3 (A) Dissection of pubocervical fascia; Use countertraction and sharp dissection to develop the plane on the left: (**B**) Dissection of pubocervical fascia; The dissection should be carried laterally to the white line on both sides, and superiorly to the cervix. (**C**) Dissection of pubocervical fascia; Use the same technique to develop the plane on the right. *(Continued)*

of the vaginal skin, but just to the point where the skin edges fall together (**Figure 34.9**). Closure of the vaginal epithelium is accomplished with a simple running approach using an absorbable suture (**Figure 34.10**). At the conclusion of the repair, there should be a well-supported anterior vaginal wall directed toward the ischial spines (**Figure 34.11**). A vaginal pack can be placed for several hours to enhance hemostasis.

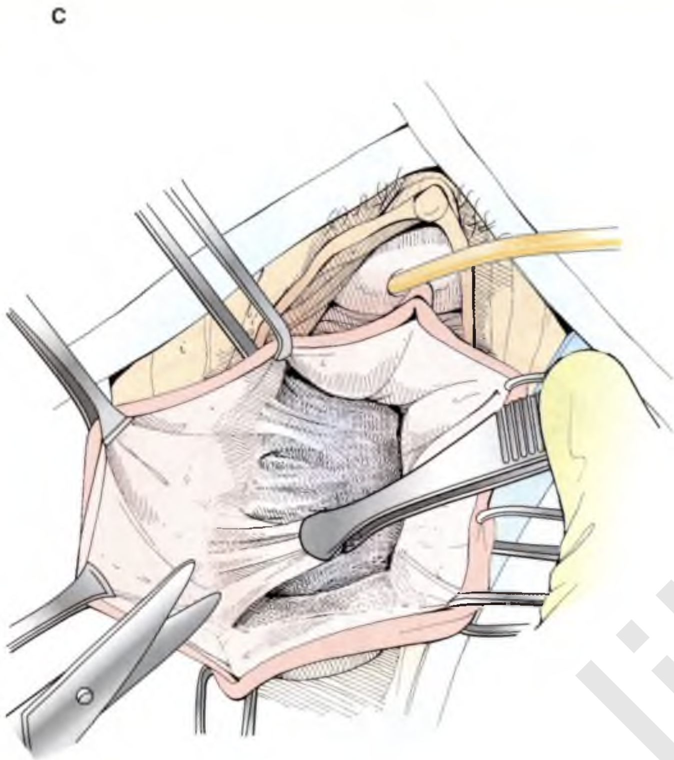

FIGURE 34.3 (*Continued*)

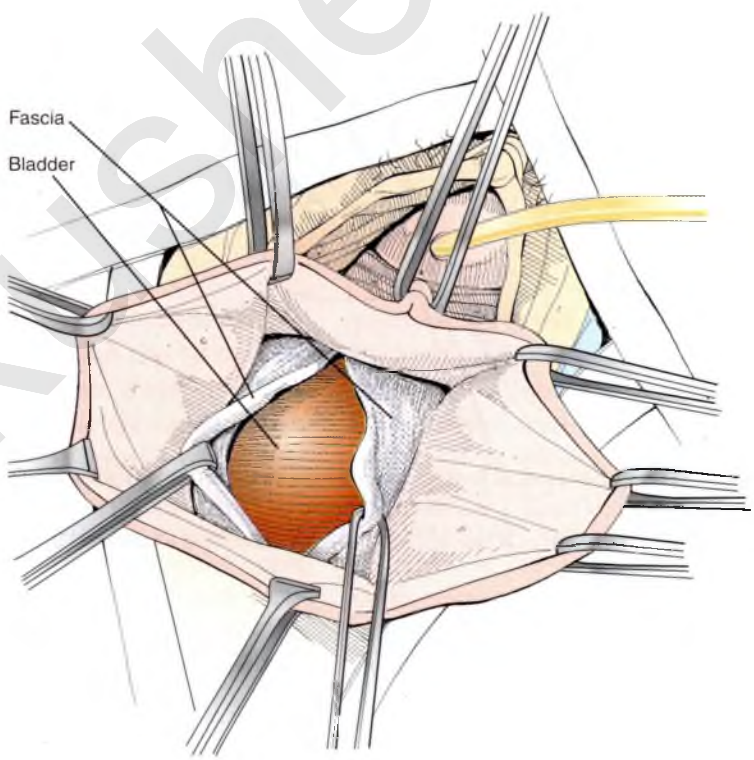

FIGURE 34.4 Assess for tent: The pubocervical fascia can separate from the white line on either side, or have a midline rent. It can also separate from the cervix, creating a superior defect. This figure shows a midline rent with Allis clamps on the edges.

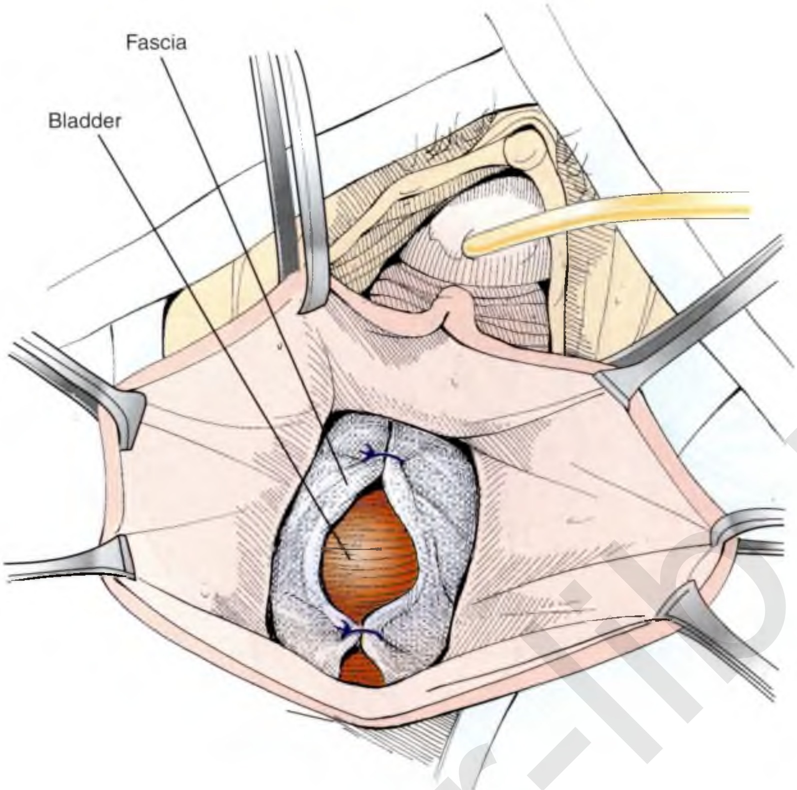

FIGURE 34.5 (A) Closure of midline defect: Reapproximate the edges of the pubocervical fascia in an interrupted fashion, burying the knots beneath the pubocervical fascia. (**B**) Placement of lateral sutures: Place sutures in the white line, beginning at the level of the ischial spine. This is much easier if the needle driver is held so that the long axis of the instrument is parallel to the course of the white line. Sutures should be placed at 1cm intervals bilaterally. *(Continued)*

POSTOPERATIVE CONSIDERATIONS

For most patients, the anterior fascial replacement cystocele repair can be performed in a day surgery setting as an outpatient. If it is combined with other prolapse repairs, then an overnight stay is indicated.

Prolonged bladder drainage is not generally necessary for patients with normal bladder function, although, if a vaginal pack is used an indwelling catheter is appropriate until the vaginal pack is removed. Urinary retention is rare after an isolated cystocele repair, although postoperative spasm of the pelvic floor can cause a functional obstruction occasionally. Consequently, confirmation of normal voiding, including measurement of the post-void residual is a good practice. The post-void residual can be measured with an ultrasound device or straight catheterization and should be less than 100 ml.

Postoperative pain management is usually adequately managed with nonsteroidal anti-inflammatory drugs. A regular schedule of oral medication helps to minimize postoperative pain needs, by providing baseline analgesia. Oral narcotics can then be used on an as-needed basis for pain spikes.

Patients should be instructed to avoid sexual relations and use of tampons for 6 weeks until the incisions are fully healed. During the first 6 to 12 weeks, activities that increase intraabdominal pressure should be avoided as they predispose to recurrent prolapse. An over-the-counter stool softener is useful to minimize straining at defecation, especially in patients with preoperative constipation.

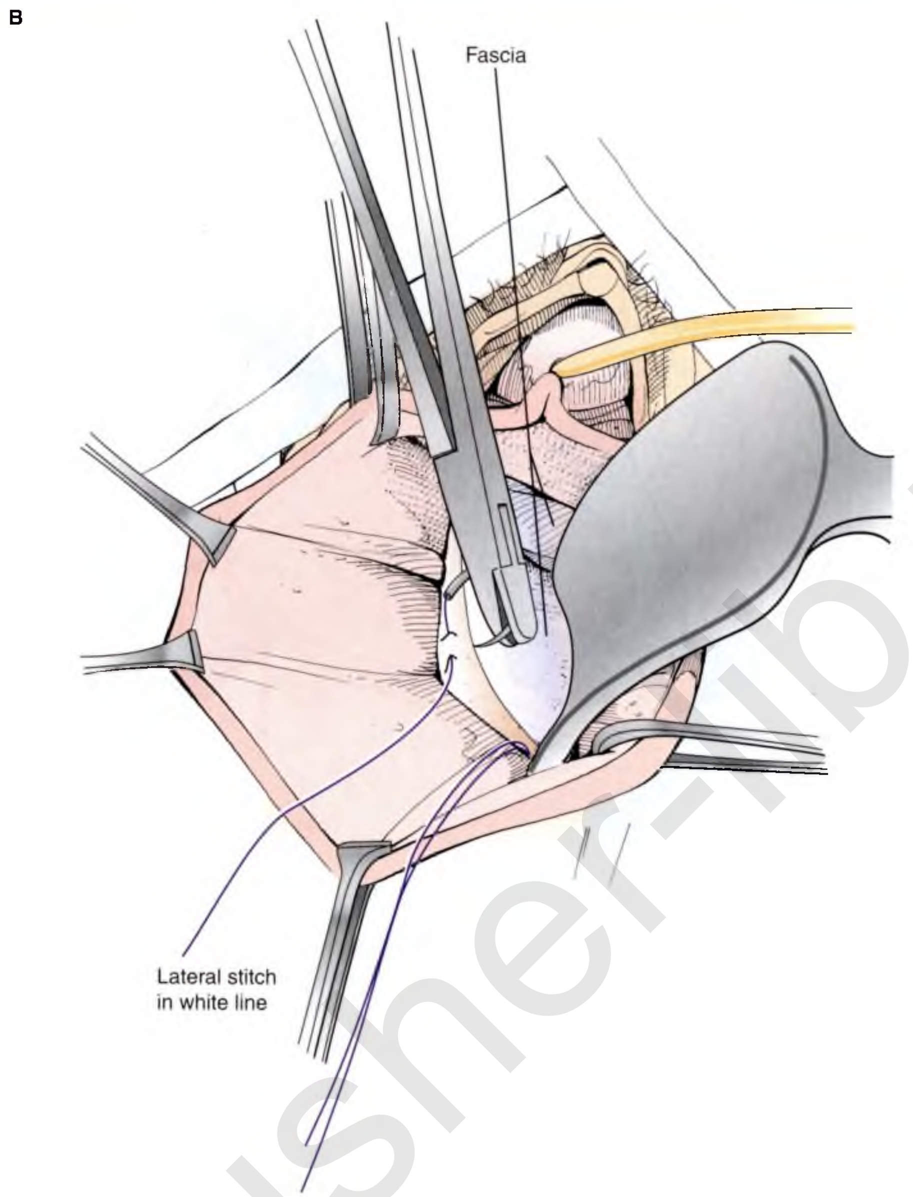

FIGURE 34.5 (*Continued*)

Operative Note

PROCEDURE: CYSTOCELE REPAIR USING ANTERIOR FASCIAL REINFORCEMENT

The patient was taken to the operating room, where her identity and the surgical plan were confirmed during a preoperative briefing. After the establishment of adequate anesthesia, pneumatic compression devices were placed and antibiotic prophylaxis initiated. She was placed in a dorsal lithotomy position, and the vaginal field was prepped and draped. The operative team completed a time-out.

The procedure began with infiltration of the anterior vaginal wall with 1% lidocaine with epinephrine. A longitudinal incision was made in the midline of the posterior vaginal wall. This incision was carried two-thirds of the vaginal length. Using countertraction, the vaginal mucosa was sharply dissected off the underlying tissue out to the white line. This dissection was then continued superiorly to the cervix, fully defining the pubocervical fascia. Palpation of the lateral attachments revealed intact attachments to the white line. The midline rent in the pubocervical fascia was then identified. Hemostasis was achieved using electrocautery.

A stitch of 2-0 PDS was brought through the right margin of the pubocervical rent, and then through the left side and was tied down burying the knot beneath

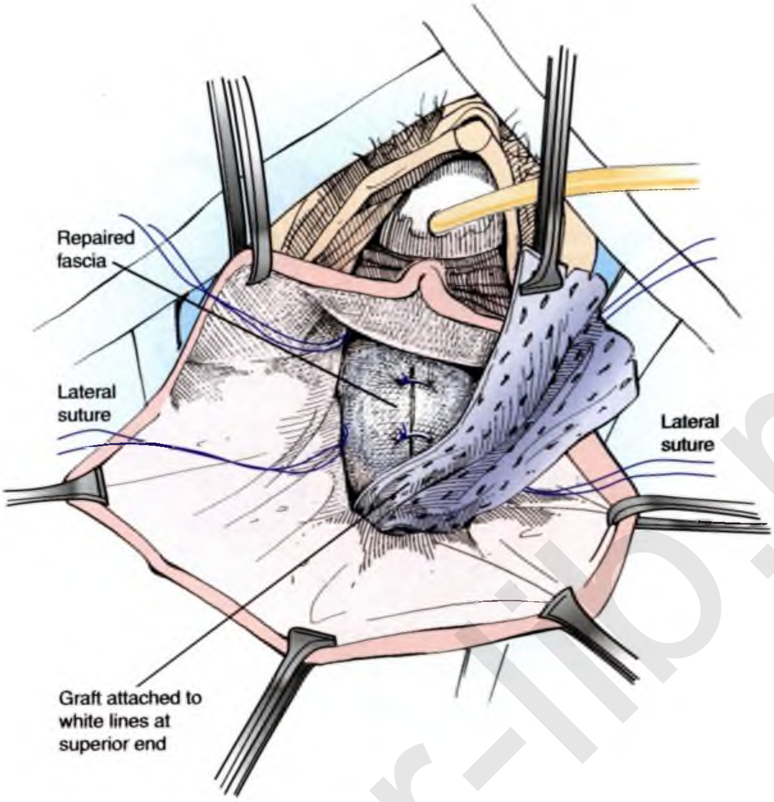

FIGURE 34.6 Attachment of the graft: Begin by attaching the graft superiorly. The most superior sutures in the white line are brought through the corners of the graft and tied down.

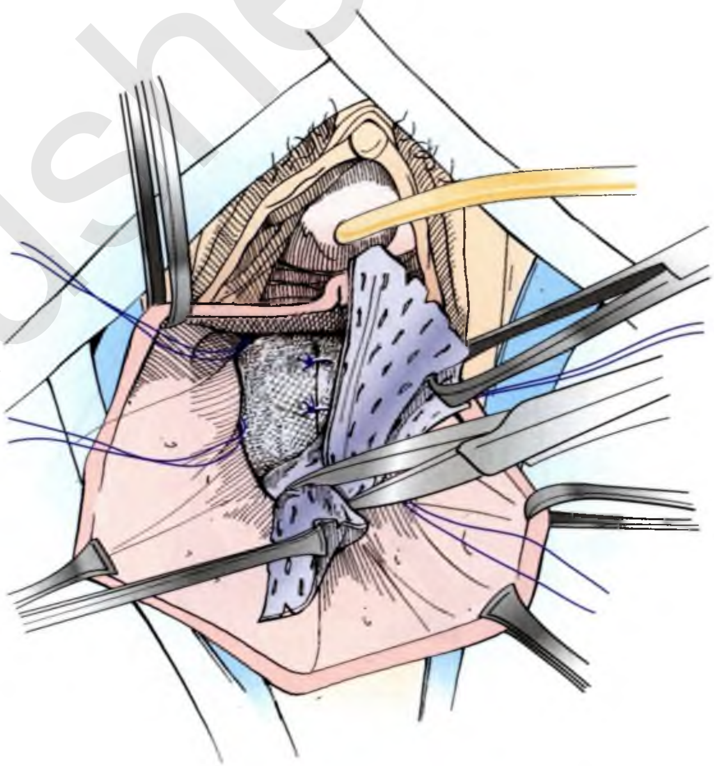

FIGURE 34.7 Trimming the graft: Remove a triangle of graft from the lateral edges to recreate the rhomboid shape of the pubocervical fascia. Given the shrinkage of the graft that can occur with healing, it is important to make sure the graft has some redundancy.

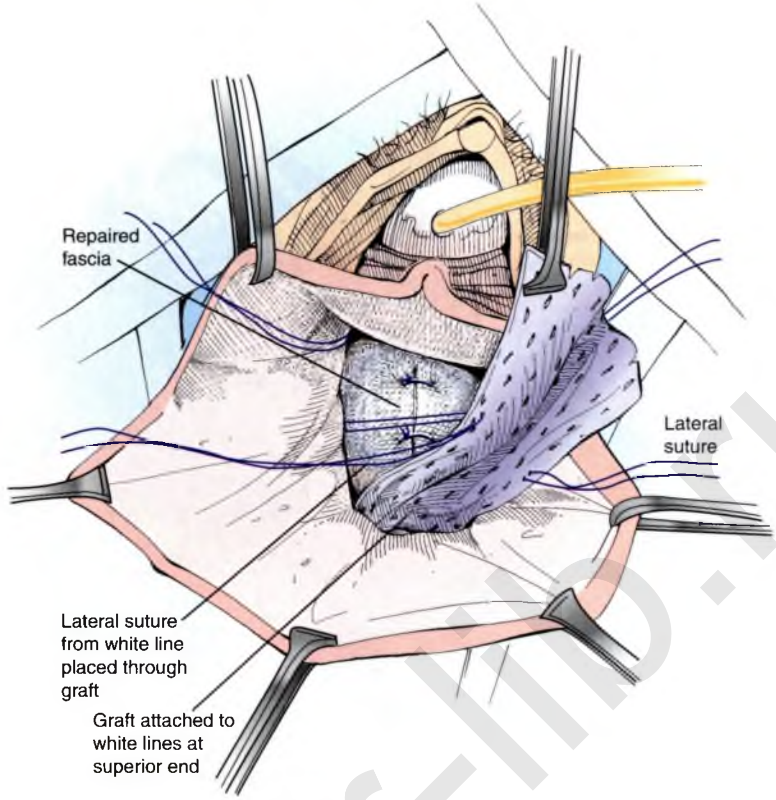

FIGURE 34.8 Attachment of the graft: Attach the graft laterally by bringing the sutures in the white line through the graft at the appropriate location.

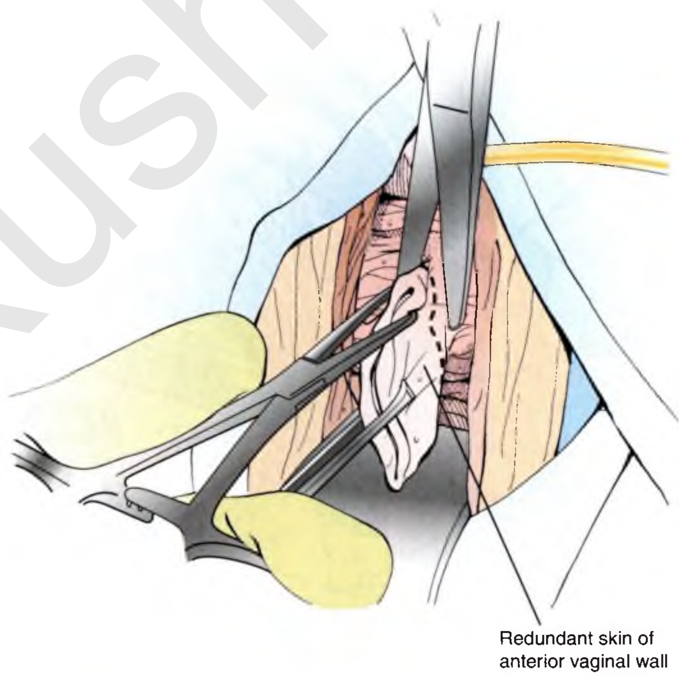

FIGURE 34.9 Trimming the mucosa: The edges of the incision should be trimmed to remove redundant skin, being careful not to narrow the vaginal caliber. Limit the excision to the amount that will allow the cut edges to fall together.

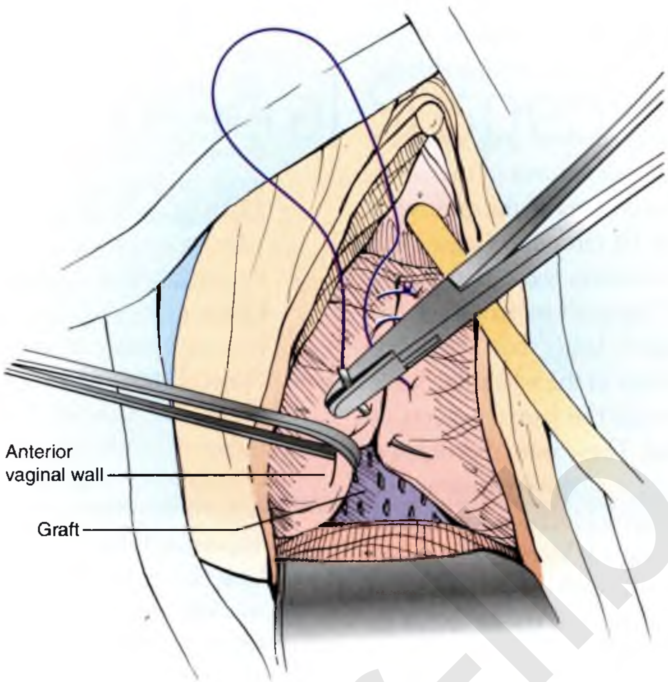

FIGURE 34.10 Closure of epithelium: Simple running closure.

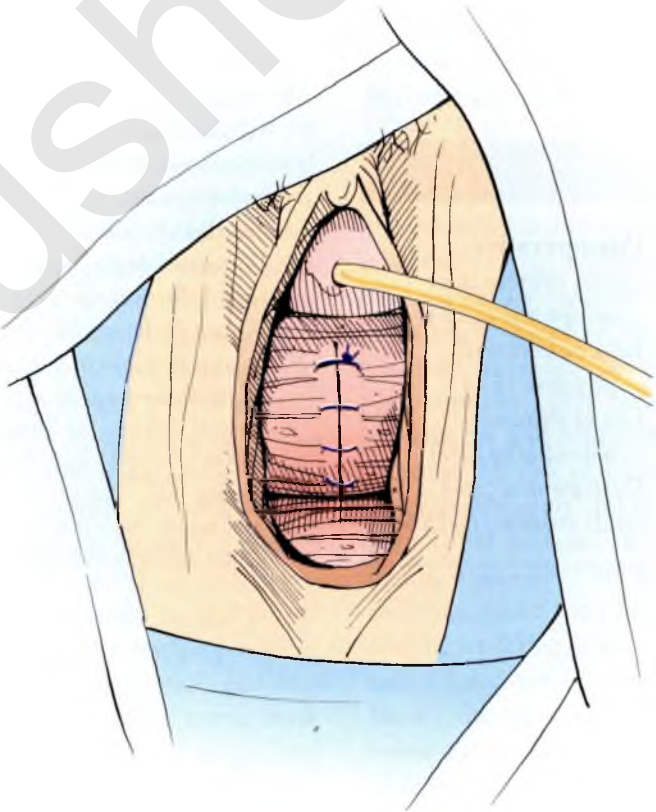

FIGURE 34.11 Final repair.

the pubocervical fascia. Additional sutures were placed in a similar interrupted fashion to close the pubocervical rent. Sequential sutures of 2-0 PDS were then placed in the white line beginning at its most superior level near the ischial spine and continuing distally along the white line on both sides.

An 8 × 10 cm meshed porcine dermal graft was then brought into the field. The superior sutures in the white lines were brought through the corners of the graft with the graft oriented so that the 10 cm edge gapped the interspinous diameter. These sutures were tied down, anchoring the graft superiorly. The graft was trimmed laterally so that the graft was slightly larger than the pubocervical fascia. The lateral sutures in the white line were then individually brought through the lateral aspects of the graft at the appropriate level. These were then all tied down. The edges of the vaginal incision were trimmed so that edges fell together. The mucosal incision was closed in a simple running fashion using 3-0 Vicryl.

Diagnostic cystoscopy was performed using a 17-French sheath and a 70° lens with sterile water as the distending media. With water running, the cystoscope was advanced into the urethral meatus and into the bladder. A thorough survey was made following the points of a clock. The ureteral orifices were noted to be patent bilaterally. The 70° lens was then exchanged for a 0° lens. With water running, the cystoscope was retracted, providing a view of the urethral lumen.

A sterile pack was placed. The patient was returned to a supine position and then was transferred to the recovery room in good condition. She tolerated the procedure well.

COMPLICATIONS

Intraoperative
Hemorrhage (3%)
Urinary tract injury (3%)

Postoperative
Lower urinary tract symptoms (12%)
Reoccurrence of prolapse (5%)
Lower extremity neuropathy (2%)
Dyspareunia (3%)
Graft erosion (6–15%)

Suggested Reading

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CHAPTER 35

Uterosacral Suspension

Geoffrey W. Cundiff

INTRODUCTION

Pelvic organ prolapse is common, as women have an 11% lifetime risk of undergoing surgery for prolapse or urinary incontinence, and the reoperation rate is estimated at 30%. Surgery is but one approach to pelvic organ prolapse treatment, with alternative treatment options including observation without intervention, or a pessary. When surgery is pursued, the surgeon should choose a repair that addresses all support deficits, as anatomical studies of vaginal support demonstrate different levels of support within the vagina. Support of the vaginal apex derives from the uterosacral and cardinal ligaments, while the lateral attachments of endopelvic fascia provide the support of the anterior and posterior vaginal walls. In any given patient, pelvic organ prolapse is a combination of support defects, and surgical repair should address all support defects. Unfortunately, studies show that many gynecologists do not follow this surgical principle, and the most neglected level of support is the apical support, provided by attachment of the uterosacral and cardinal ligaments to the cervix.

Choosing the appropriate surgery requires identification of the anatomical defects present, whether at the vaginal apex, rectovaginal fascia, or pubocervical fascia, and then combining repairs to address all identified support defects. Consequently, proper identification of all support defects is essential, and correction of apical support is frequently the cornerstone of many prolapse surgeries. This chapter is focused on the uterosacral suspension, an anatomical, vaginal approach to repairing apical support. We prefer the uterosacral suspension to other vaginal repairs, such as the sacrospinous suspension, McCall culdoplasty, or iliococcygeal suspension, because it provides more anatomical vaginal support. The major distinction between the McCall culdoplasty technique and uterosacral ligament suspension described here is that the latter does not plicate the uterosacral ligaments, instead attaching the vaginal apices to the ipsilateral uterosacral ligament bilaterally. The vaginal approach decreases postoperative pain and shortens recovery. It also provides flexibility, as it can be utilized at the time of vaginal hysterectomy or for post-hysterectomy prolapse.

The primary goal of prolapse surgery is to alleviate symptoms related to compromised pelvic support, while restoring normal bladder, bowel, and coital function. The patient's symptoms that can be attributed to prolapse must, therefore, be the primary basis of surgical planning, although choosing the best procedure should also consider other factors as well as the patients' preferences and expectations. Factors that potentially increase the risk of recurrent prolapse are an important consideration, and include the severity of prolapse, prior failed prolapse surgery, young age, wide genital hiatus, weakness of the levator ani muscles, and chronically increased intra-abdominal pressures associated with heavy lifting, chronic cough, tobacco use, obesity, and chronic constipation. In the presence of these risk factors, the sacral colpopexy (Chapter 36) may be a preferred approach to repairing apical prolapse due to the added support provided by the surgical mesh. However, in discussions with patients, the increased durability offered by the graft should be balanced by the potential complications associated with a foreign body, and the longer recovery associated with laparotomy.

The uterosacral suspension has been shown to provide excellent relief of prolapse symptoms as well as consistent anatomical outcomes that are durable over time. Intraoperative complications are similar to or better than alternative vaginal apical repairs. The possible exception is ureteral obstruction, which has been reported in up to 11% of patients undergoing the uterosacral suspension. However, this high rate is limited to one case series, and subsequent anatomical studies have provided preferential locations for anchoring sutures that decrease the risk of kinking the ureters. The surgical approach described in this chapter incorporates these surgical landmarks to minimize ureteral obstruction, yet perioperative cystoscopy should be used to insure ureteral patency at the conclusion. Studies also suggest that the uterosacral suspension tends to shorten vaginal length by 0.5 to 0.75 centimeters, although this is not physiologically important as the majority of women have normal vaginal length postoperatively.

PREOPERATIVE CONSIDERATIONS

Some surgeons advocate preoperative estrogen cream to promote a healthier mucosal epithelium in atrophic postmenopausal patients, although histological studies do not support this hypothesis. A bowel prep is not generally indicated preoperatively. Antibiotic prophylaxis with a second generation cephalosporin or metronidazole is recommended, although there is minimal data to show its efficacy. A risk assessment for deep venous thromboembolism prophylaxis is also indicated. Given the lithotomy position and average length of surgery, most patients have at least a moderate risk of venous thromboembolism, and consequently, we routinely use prophylaxis. Either pharmacologic or mechanical prophylaxis is appropriate.

The patient should be positioned in lithotomy or modified lithotomy position. Either regional anesthesia or general anesthesia can be used. Submucosal infiltration with injectable lidocaine with epinephrine simplifies postoperative pain and assists dissection and hemostasis. A Foley catheter should be placed during the surgery to drain the bladder. Following is a brief description of the surgical procedure used (see also video: *Uterosacral Suspension*).

SURGICAL TECHNIQUE

The uterosacral suspension can be performed at the time of vaginal hysterectomy in patients with uterine prolapse or independently in a patient with post-hysterectomy apical prolapse. In the latter case, the surgery begins with a posterior colpotomy. In most cases of post-hysterectomy prolapse, there is an apical enterocele caused by a discontinuity between the superior portion of the pubocervical fascia and the rectovaginal fascia. This results when the surgeon performing the hysterectomy neglects to close the cuff and support it at the conclusion of the hysterectomy (see Chapter 3 for discussion of apical support at the time of vaginal hysterectomy). In this circumstance, the reconstructive surgeon wants to incise the vaginal cuff and open the enterocele sac in a manner that will allow easy identification of the superior margin of the pubocervical fascia and rectovaginal fascia. If the enterocele sac is large, this may be best accomplished by removing some of the vaginal mucosa and enterocele sac at the time of colpotomy. We will usually try to identify the stumps of the uterosacral ligaments at the superior margins of the pubocervical fascia and rectovaginal fascia before making an incision as we use these landmarks in deciding how to make the colpotomy. Frequently, an elliptical or diamond shaped incision just proximal to the superior margins of the pubocervical fascia and rectovaginal fascia provide the easiest approach (**Figure 35.1**).

Following vaginal hysterectomy or post-hysterectomy cuff colpotomy, the patient is placed in Trendelenburg position and the small bowel is packed away using a moistened 6-inch Kerlix sponge (**Figure 35.2**). Because the Kerlix does not have a radiopaque tag, we attach a suture to the sponge and hold it outside the field. Breisky-Navratil retractors help deflect the rectum medially and the bowel and surgical pack cephalad. The remnants of the distal uterosacral ligaments are identified and grasped. When we perform this surgery with concurrent vaginal hysterectomy, we hold the sutures used to ligate the uterosacral ligaments and use them for traction. Otherwise, we place sutures through the distal ligaments and hold them. Caudal traction on the distal uterosacral ligament along with the use of a headlamp facilitates visualization of the uterosacral ligament.

The surgeon should be aware of the fanlike projection of the uterosacral ligament from the vaginal cuff toward the sacrum between S1 and S4, as the overlying peritoneum usually only allows visualization of the most anterior aspect of the uterosacral ligament (**Figure 35.3**). Anatomical studies show that the

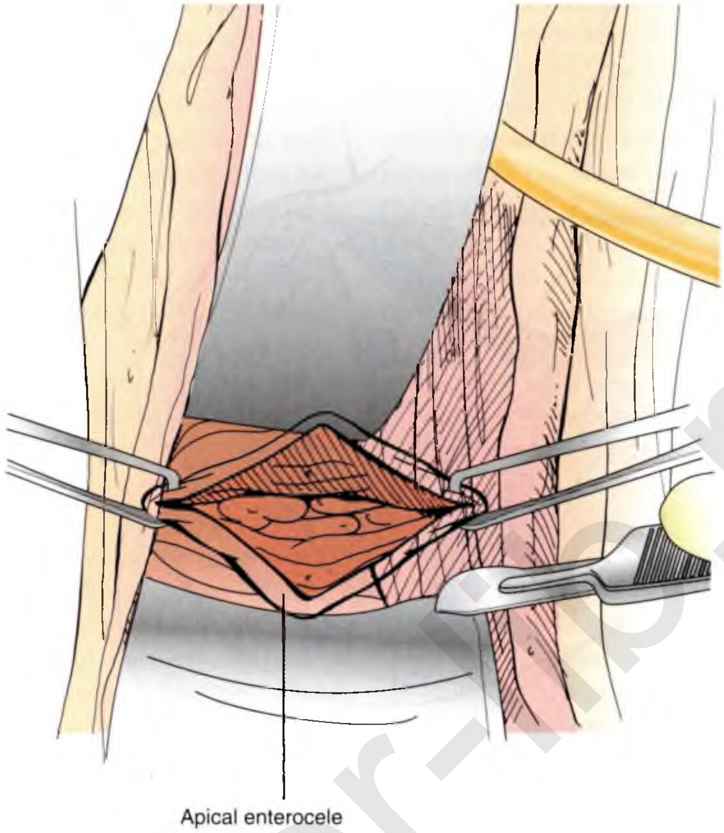

FIGURE 35.1 A diamond-shaped incision is made just proximal to the superior margins of the pubocervical fascia and rectovaginal fascia.

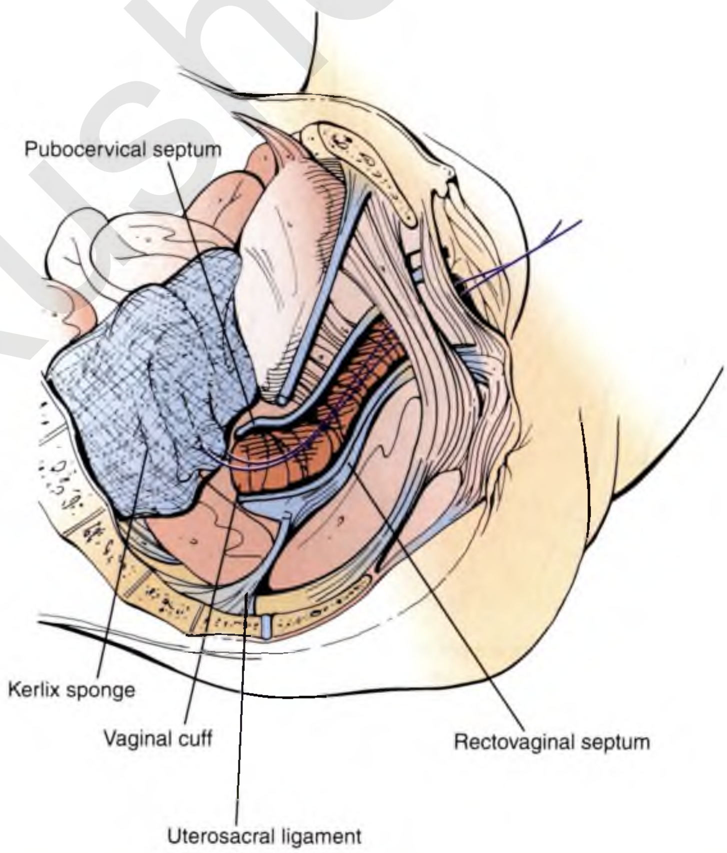

FIGURE 35.2 The small bowel is packed away using a moistened 6-inch Kerlix sponge.

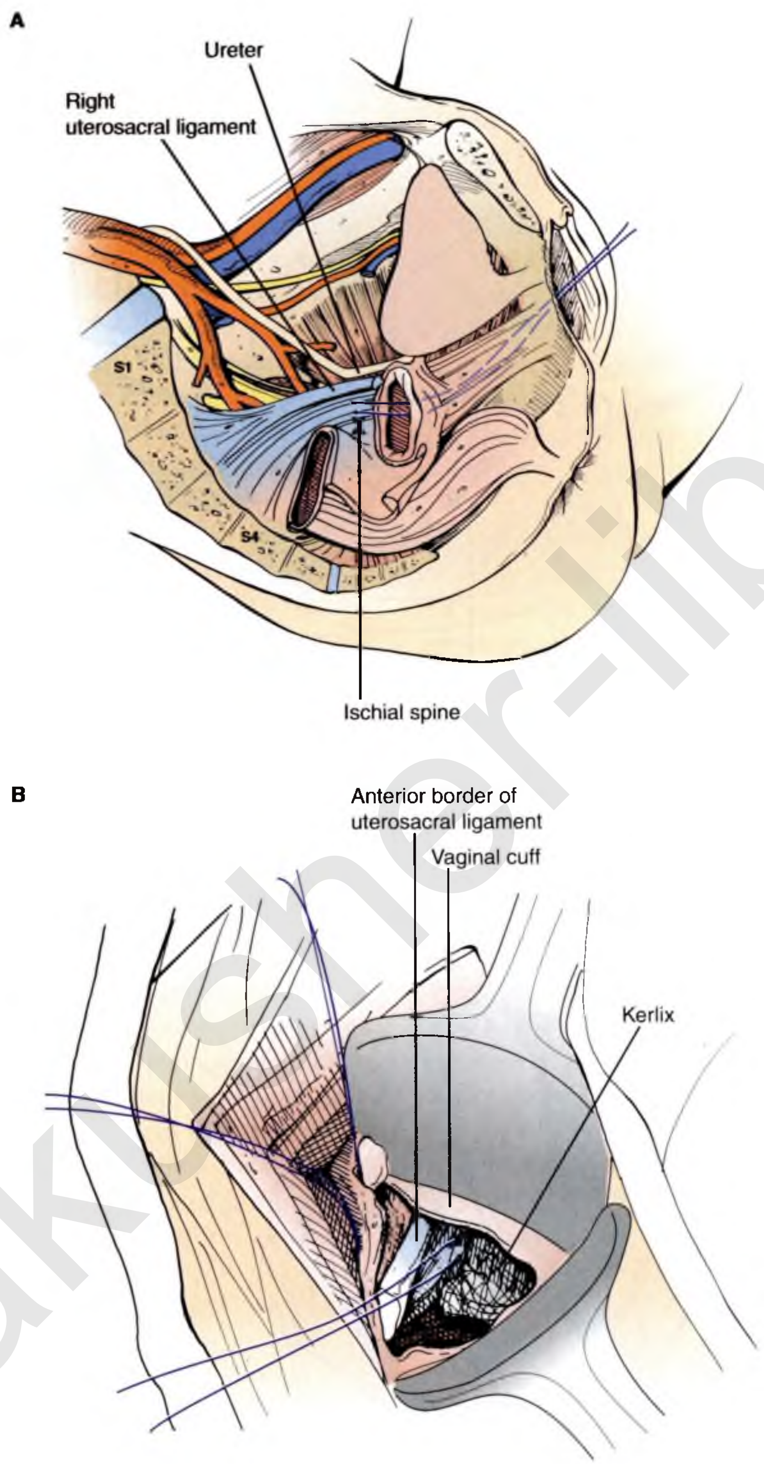

FIGURE 35.3 (A) The uterosacral ligament has a fanlike configuration with the narrow portion at the vaginal cuff and widening toward the sacrum between S1 and S4: The overlying peritoneum only allows visualization of the anterior-most aspect of the uterosacral ligament. The ureter courses along this anterior border along the distal uterosacral ligament and diverges as the uterosacral ligament approaches the sacrum. (**B**) The ischial spine is a good marker of the mid portion, where the anchoring sutures are placed. They should be at least 1 cm posterior to the anterior order of the ligament to prevent kinking of the ureter.

intermediate segment of the uterosacral ligament is the optimal site for suture placement as it balances strength and safety. The fiber matrix is denser closer to the cervix, but the intermediate segment has good strength and has fewer vital structures subjacent, such as vasculature and nerves. The ureter courses along the anterior border of the distal uterosacral ligament and diverges as the uterosacral ligament approaches the sacrum. Therefore, the distal uterosacral ligament, and more specifically, the anterior portion of the ligament are the areas to avoid as they are associated with ureteral obstruction. The ischial spine is a good marker of the intermediate segment, and can be used to judge the level of suture placement (**Figure 35.3**). The first nonabsorbable suture, such as braided polyester of at least 2-0 gauge is placed on the right at the level of the ischial spine with care taken to avoid locations within 1 cm of the anterior edge of the uterosacral ligament where the ureter is more vulnerable. Studies suggest a lower risk of entrapping the sacral nerve roots if sutures are passed in a dorsal-to-ventral direction. Once placed, traction on this suture demonstrating a firm attachment helps to verify a sufficiently deep purchase to get the ligament. A second suture is then placed on the left following the same approach. Each anchoring suture is then brought through the vaginal cuff ipsilaterally. One end of the right suture is brought through the right pubocervical fascia and anterior vaginal wall excluding the epithelium, and the other through the rectovaginal fascia and posterior vaginal wall excluding the epithelium (**Figure 35.4**). Similarly, the anterior arm of the left suture is brought through the left pubocervical fascia and anterior vaginal wall and the posterior arm through the rectovaginal fascia and posterior vaginal wall excluding the epithelium with both. An additional nonabsorbable mattress suture approximates the midline pubocervical and rectovaginal fascia preventing enterocele formation (**Figure 35.5**).

Some authors advocate placing additional sutures on each side; however, we have concerns about increased risk of sacral trunk nerve injury (especially S2 and S3) with multiple sutures placed closer to the sacrum, and studies of the single anchoring site show excellent outcomes. If two sutures are planned on each side, the proximal uterosacral suture is placed approximately 1 cm medial to distal uterosacral suture, which is secured near the angle of the vaginal cuff. A simpler approach is to take the suture arms on the

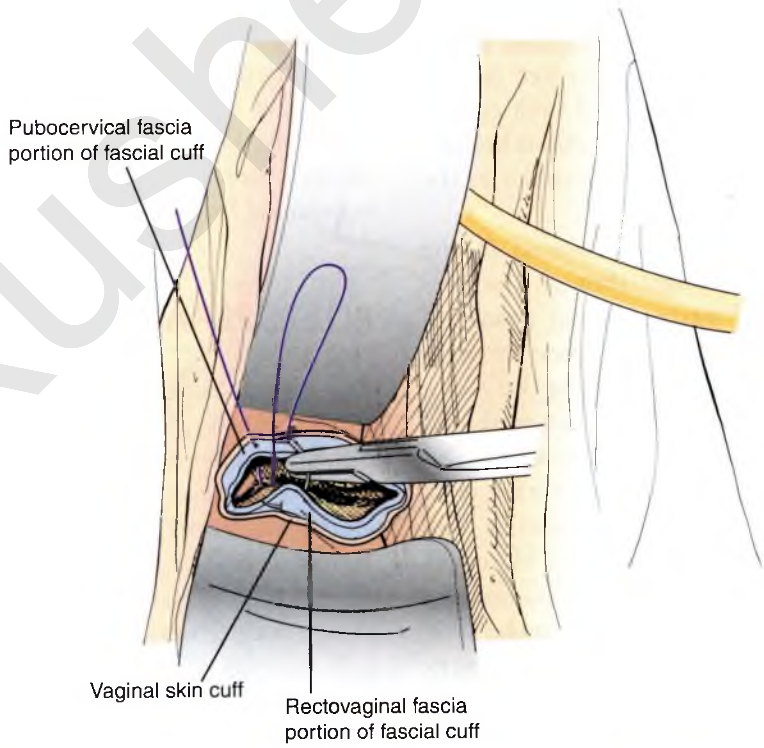

FIGURE 35.4 The anterior arm of the anchoring suture is brought through the pubocervical fascia and anterior vaginal wall excluding the epithelium at the ipsilateral vaginal angle: The posterior arm is brought through the rectovaginal fascia and posterior vaginal wall excluding the epithelium at the ipsilateral vaginal angle.

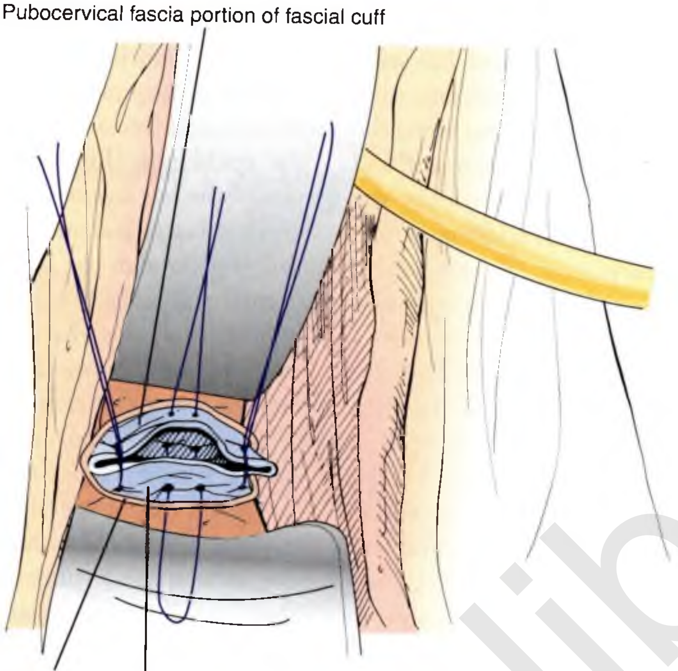

FIGURE 35.5 A mattress suture approximates the midline pubocervical and rectovaginal fascia preventing enterocele formation.

distal uterosacral pedicle back through the vaginal epithelium at the vault ipsilaterally using a free needle. One arm is brought through the vaginal vault epithelium anterior to the pedicle, while the other is brought through the vaginal vault epithelium posterior to the pedicle (**Figure 35.6**).

Once the anchoring sutures are placed in the uterosacral ligament and brought through the ipsilateral vaginal angle, the intraperitoneal sponge is removed and the sutures are tied into place, insuring the vaginal angle is elevated firmly against the uterosacral ligament (**Figure 35.7**). Cystoscopy should then be performed to insure bladder integrity and ureteral patency. We maintain the long suture ends held until cystoscopy confirms ureteral patency. The sutures are then trimmed and the cuff is closed. If distal uterosacral ligament sutures were also brought through the cuff angles, these sutures can be held to improve visualization while closing the intervening cuff. The vaginal vault can be closed with a simple running suture of an absorbable suture such as 3-0 Polyglactin 910 with a simple running stitch (**Figure 35.8**). In the absence of ureteral flow, ureteral stent placement can be used initially, and usually reveals an obstruction 4 to 5 cm form the ureteral orifice. However, as release of the uterosacral suture usually alleviates the obstruction caused by kinking of the ureter, ureteral stenting is not really necessary. Direct ureteral injury requiring reimplantation is rare. Nevertheless, postoperative cystoscopy is essential for a safe repair.

POSTOPERATIVE CONSIDERATIONS

After uterosacral suspension and additional repairs, the patient usually stays in hospital overnight. The Foley catheter is removed the next morning and voiding trials initiated. We discontinue voiding trials after 2 voids of more than 200 ml with a post-void residual of less than 100 ml. The post-void residual can be measured with an ultrasound device or straight catheterization. Sequential compression devices are maintained until the patient is fully ambulatory. Diet should be as tolerated, with early feeding preferable and left to the patient's discretion.

Initially, we usually provide intravenous narcotics immediately after surgery for postoperative pain management. Pain management thereafter is adequately managed with nonsteroidal anti-inflammatory drugs after postoperative day 1. A regular schedule of oral

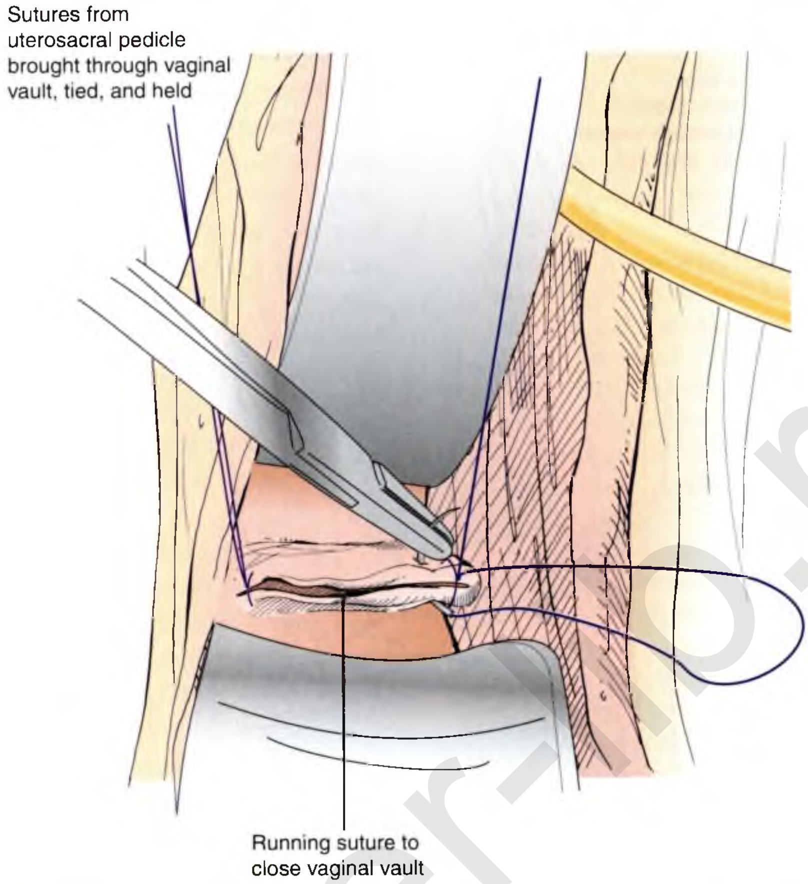

FIGURE 35.6 In patients undergoing a concurrent vaginal hysterectomy, one arm of the suture on the uterosacral pedicle is brought through the vaginal vault anterior to the pedicle, while the other is brought through the vaginal vault posterior to the pedicle.

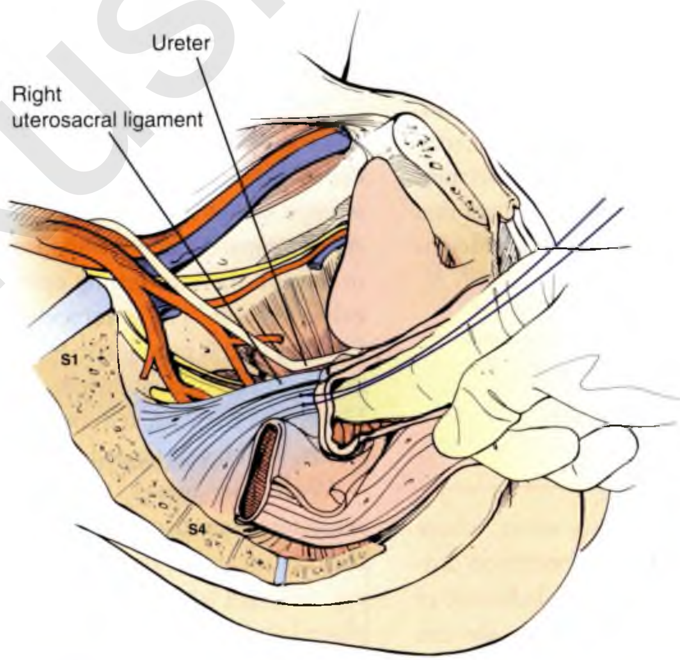

FIGURE 35.7 The anchoring sutures are tied into place, insuring the vaginal angle is elevated firmly against the uterosacral ligament.

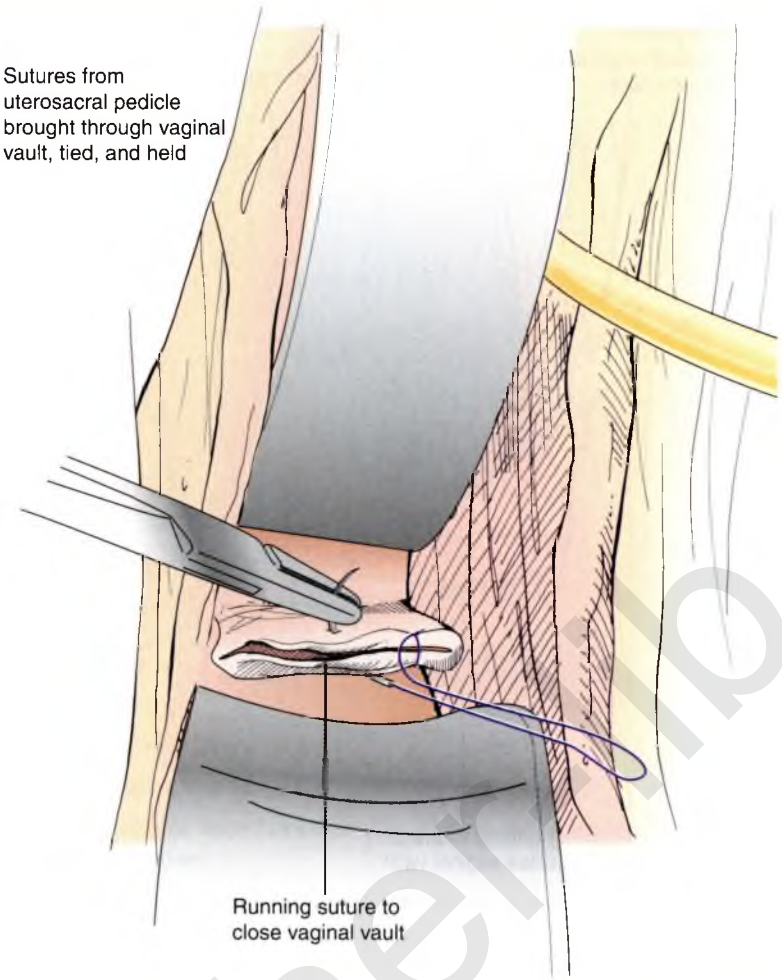

FIGURE 35.8 The vaginal vault is closed with a simple running suture in a simple running stitch.

medication helps to minimize postoperative pain needs, by providing baseline analgesia. Oral narcotics can then be used on an as-needed basis for pain spikes.

Patients should be instructed to avoid sexual relations and use of tampons for 6 weeks until the incisions are fully healed. During the first 6 weeks, activities that increase intra-abdominal pressure should be avoided as they predispose to recurrent prolapse.

Operative Note

PROCEDURE: UTEROSACRAL SUSPENSION

The patient was taken to the operating room, where her identity and the surgical plan were confirmed during a preoperative briefing. After the establishment of adequate anesthesia, pneumatic compression devices were placed and antibiotic prophylaxis initiated. She was placed in a dorsal lithotomy position, and the vaginal and perineal fields were prepped and draped. The operative team completed a time-out. A 14 French Foley catheter was placed to urimeter.

The procedure began with identification of the apical enterocele. The superior portion of the pubocervical fascia and the rectovaginal fascia were identified and the stumps of the uterosacral ligaments were grasped with Allis clamps. A diamond shaped incision was then made to remove the intervening epithelium overlying the apical enterocele. The enterocele sac was entered sharply. Stitches of 2-0 polyglactin 910 were placed through the distal stumps of the uterosacral ligaments and held. The bowel was then packed away using a 6-inch moistened Kerlix, which was tagged with a stitch.

With the bowel packed away, Breisky-Navertil retractors were used to retract the bowel anteriorly and the rectum and sigmoid colon to the left, thereby exposing the right uterosacral ligament. Distal traction was placed on the ligament using the suture placed through the stump, and the contour of the uterosacral ligament was revealed. The ischial spine was identified as a marker of the intermediate portion. The first anchoring stitch of 2-0 braided polyester was then placed deep into the substance of the uterosacral ligament, from a dorsal to ventral direction, but staying 1-centimeter posterior to the anterior border of the ligament. The anterior arm of the suture was then brought through the right angle of the superior pubocervical fascia, while the posterior arm was brought through the right angle of the superior rectovaginal fascia. This suture was held. The retractors were reoriented to visualize the left uterosacral ligament and the left anchoring stitch was placed in the same fashion. The Kerlix was removed and a horizontal mattress stitch of 2-0 braided polyester was used to approximate the medial aspect of the superior pubocervical fascia to the analogous portion of the rectovaginal fascia. The sutures on the distal uterosacral ligament were then brought through the vaginal epithelium using a free needle, with one arm anterior and the other posterior. These sutures were held. The anchoring sutures in the mid uterosacral ligament were tied down, insuring elevation of the vaginal cuff to the mid portion of the uterosacral ligament, and providing excellent support of the vaginal cuff. These sutures were held while cystoscopy was performed.

The Foley catheter was removed. Using a 17-French sheath, with a 70° lens a rigid cystoscope was introduced into the urethral meatus with sterile water flowing. The cystoscope was advanced to the bladder where a thorough survey was made in a clockwise fashion. The urothelium was intact and both ureters were patent. The cystoscope was removed and the Foley was replaced.

The surgeon's attention returned to the vaginal field, where the anchoring stitches were cut. The distal uterosacral ligament sutures were tied and held to facilitate closure of the cuff using 3-0 polyglactin 910 in a simple running fashion. All stitches were then trimmed. The patient was returned to a supine position, extubated, and transferred to the post-anesthesia unit in good condition.

COMPLICATIONS

Intraoperative	Postoperative
Transfusion 1–4%	Cuff cellulitis 2%
Cystotomy* 4%	Recurrent apical prolapse 5–6%
Ureteral injury 1–11%	Entrapment of sacral nerve root 1%

*In cases combined with vaginal hysterectomy.

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CHAPTER 36

Sacral Colpopexy

Darren M. Lazare

INTRODUCTION

Pelvic organ prolapse is a common problem reported in up to 50% of parous women.It may be associated with protrusion symptoms and complicit with voiding, defecatory, and sexual dysfunction. Together, these disorders negatively impact upon the quality of life of patients who have pelvic organ prolapse and informs their decision to seek conservative and surgical management solutions. The goal in surgically correcting prolapse defects is to restore normal anatomical support as a means to enhancing function with the end result of improving patient symptoms and quality of life.

Suspension of the vaginal apex to the anterior longitudinal ligament overlying the sacral promontory is widely considered the "gold standard" for surgical management of vaginal vault prolapse that occurs after hysterectomy. This surgical procedure may be approached abdominally, laparoscopically, or robotically with similar long-term efficacy. The long-term efficacy, safety, and durability of concurrent uterine sparing, total or subtotal hysterectomy represents an opportunity for further study and is not addressed in this chapter.

PREOPERATIVE CONSIDERATIONS

Many patients with apical prolapse also have other support defects that should be treated simultaneously. This should be considered in surgical planning. Additionally, some patients with apical prolapse also have symptoms of stress urinary incontinence. There is level 1 evidence to suggest that even those women who do not complain of stress urinary incontinence have a high risk of postoperative stress incontinence and benefit from a concurrent surgical procedure for stress incontinence. These issues, as well as the risks inherent with the use of surgical mesh should be discussed with the patient as part of surgical consent.

Preoperative topical estrogen restores vaginal mucosal health in postmenopausal patients and promotes healing. Bowel preparation is not indicated preoperatively in this setting; however, antibiotic prophylaxis with a second-generation cephalosporin is recommended. Thromboembolic prophylaxis is also recommended in the form of sequential decompression stockings or injectable anticoagulants. The patient should be situated in the dorsal lithotomy position with legs in stirrups. A transurethral Foley catheter should be placed during the surgery to drain the bladder. Following is a brief description of the surgical procedure used (see also video: *Sacral Colpopexy*).

SURGICAL TECHNIQUE

Access to the peritoneal cavity is possible through either a Pfannenstiel or longitudinal midline incision, although the Pfannenstiel offers some advantages for healing and usually provides adequate visualization (**Figure 36.1A**). The patient is placed in Trendelenberg position to allow placement of a self-retaining retractor to facilitate exposure of the sacral promontory and vaginal vault or

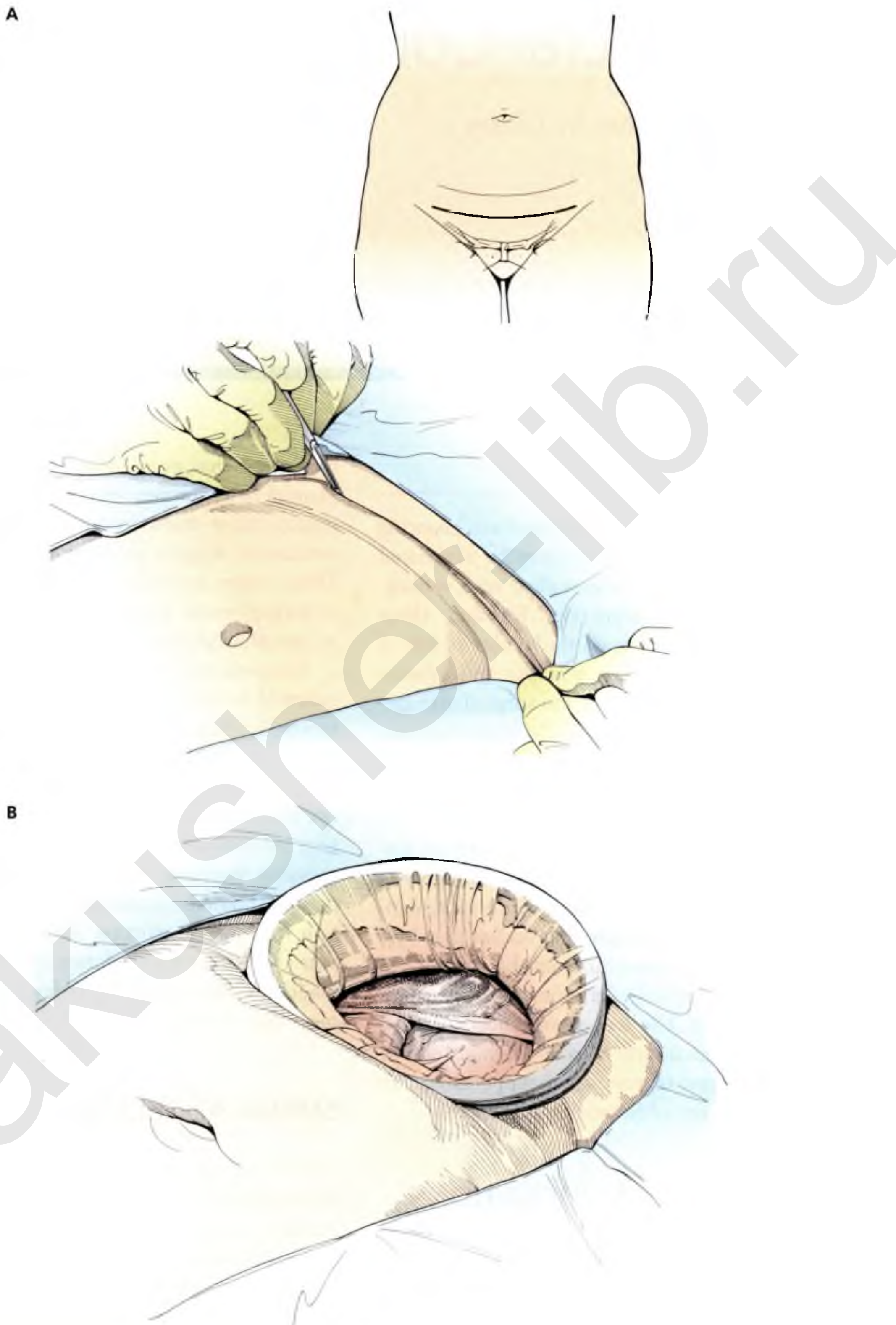

FIGURE 36.1 (A) Pfannenstiel incision. (**B**) Placement of a self-retaining retractor and packing away of the bowel.

uterus (**Figure 36.1B**). A rigid self retaining retractor is acceptable, although we prefer Alexis wound protector/retractor (Applied Medical, Rancho Santa Margarita, California) because it offers excellent visualization, is quick and simple to place, and eliminates the risk of neuropathy associated with rigid retractors. The bowel is packed away and the rectosigmoid is retracted to the patient's left so as to visualize the peritoneum overlying the sacrum.

Dissection of the vaginal vault

The vaginal apex must be isolated to allow attachment of the mesh. This requires opening of the vesicovaginal space and the rectovaginal space and dissection of the vaginal vault away from the bladder and rectum.

Once the bladder is catheterized some physicians prefer to instill 200 to 300 ml of dye (methylene blue or indigo carmine). This helps to identify the bladder as it is dissected from the anterior vaginal wall and makes an inadvertent cystotomy obvious. An end-to-end anastomosis sizer or Breisky-Navratil retractor is then placed in the vagina and directed toward the sacral promontory (**Figure 36.2A**). This vaginal stent stretches the vaginal walls taught and is the first aspect of traction-counter traction. Using atraumatic forceps, such as Russians, to pull the bladder in the opposite direction provides the counter traction (**Figure 36.2B**). Sharp or electrocautery dissection through the peritoneum and then between the bladder and the vaginal vault opens the vesicovaginal space (**Figure 36.3**). The dissection should extend nearly as far as the bladder trigone.

Dissection of the rectovaginal space proceeds in a similar fashion. The vaginal stent is directed more anteriorly but without compromising the cephalad pressure on the stent that stretches the vaginal

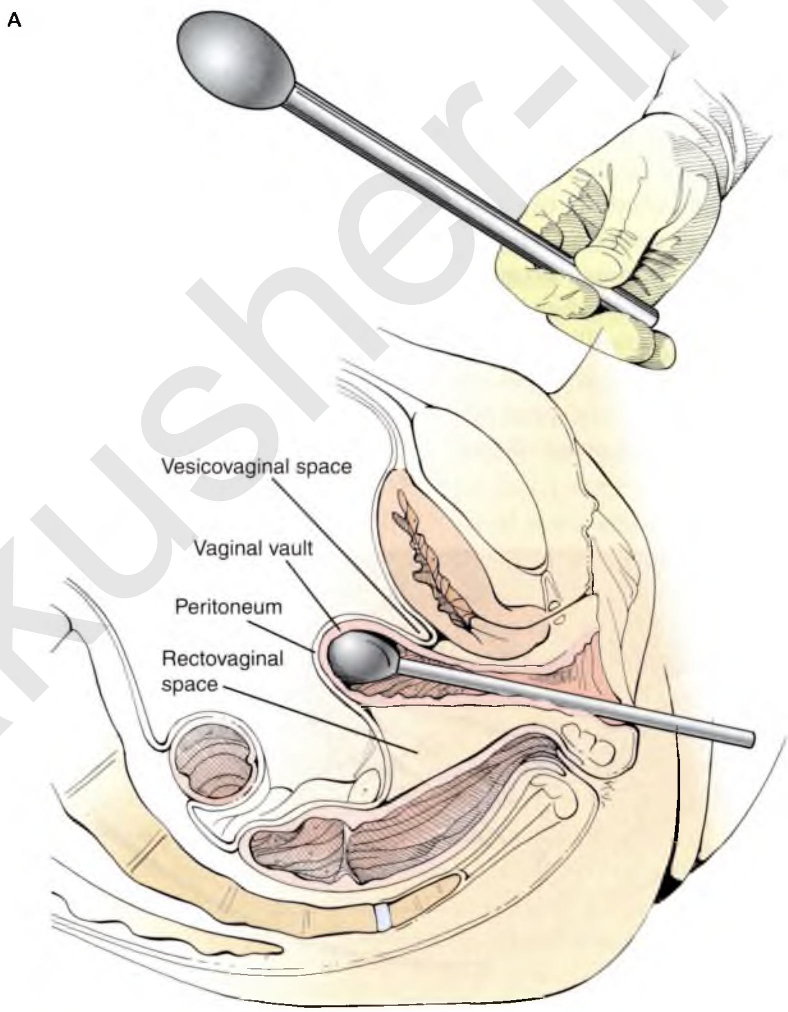

FIGURE 36.2 (A) Placement of an end-to-end anastomosis sizer as a vaginal stent to elevate the vaginal apex. (**B**) Elevation by the vaginal stent facilitates traction counter traction to safely dissect the vesicovaginal space. *(Continued)*

B

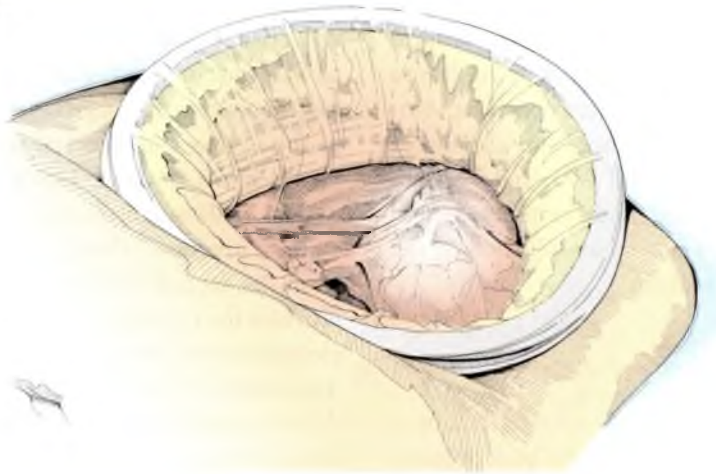

FIGURE 36.2 (*Continued*)

vault taught. Counter traction on the peritoneum between the uteroscaral ligaments insertion into the vaginal vault facilitates entry into the rectovaginal space (**Figure 36.4**). Once the peritoneum is cut, a malleable retractor can be used to develop the space bluntly, by pushing posteriorly on the rectum (**Figure 36.5A**). The distal extent of dissection is variable but should be far enough inferiorly to allow attachment of the mesh to the posterior vaginal wall (**Figure 36.5B**). The sacral colpoperineopexy is a modification of the sacral colpopexy developed to address apical perineal descent as well as apical prolapse. This modification includes attachment of the mesh to the posterior vaginal wall and perineal body has been described, requiring a more distal dissection.

Mesh attachment

The durability of the sacral colpopexy is generally attributed to the use of a graft to reinforce the apical support of the vagina. The graft also adds a foreign body with associated risks. While multiple types of grafts have been used, the literature suggests that the risk and benefits are most favorable for Amid type 3 grafts that are synthetic and composed of nonabsorbable, monofilament fibers woven into a macroporous mesh. Soft weave Polypropylene mesh is the most commonly used graft. Two leaves of mesh are required and should measure approximately 4 to 5 cm in width and 14 cm in length (**Figure 36.6**). The first graft is attached to the anterior vaginal wall with at least three interrupted transverse sutures (**Figure 36.7**). This is often easier

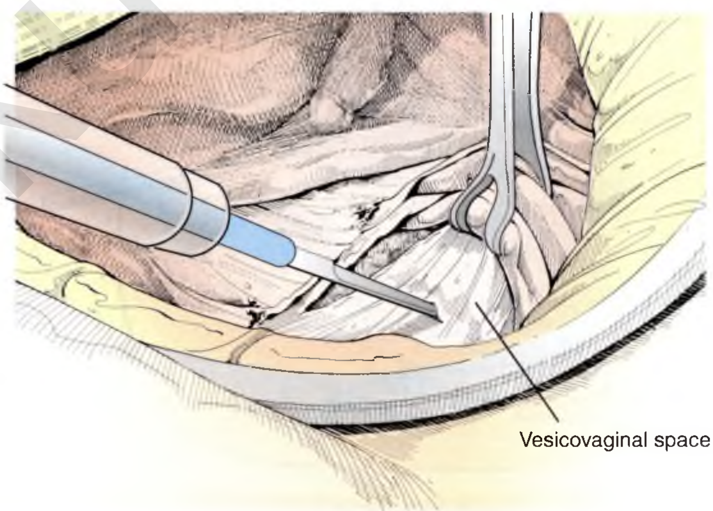

FIGURE 36.3 Dissect the vesicovaginal space using electrocautery: This should be carried to just above the trigone.

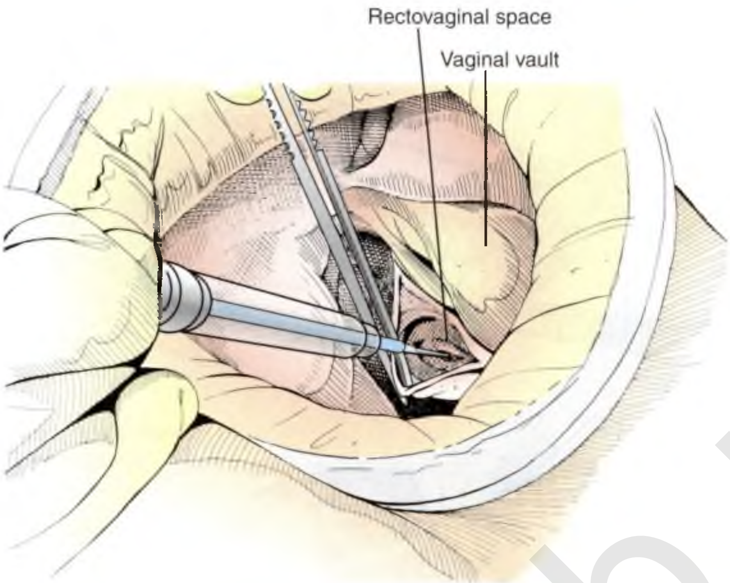

FIGURE 36.4 Dissection of the rectovaginal space also uses traction counter traction provided by the vaginal stent and downward traction on the rectum.

by placing all sutures into the vagina and mesh before tying them down. These sutures should be tied relatively loosely to avoid necrosis which could predispose postoperative mesh erosion. Many surgeons prefer non-absorbable monofilament suture, although we use a 2-0 delayed absorbable suture. Polytetrafluroethylene sutures should be avoided, as they are associated with a higher rate of erosion.

Similarly, the posterior leaf of mesh is attached to the posterior vaginal wall with at least three transverse interrupted sutures (**Figure 36.8**). The malleable retractor facilitates suture placement (**Figure 36.5B**). Placing all sutures into the posterior vaginal wall (rectovaginal fascia) and then through the mesh prior to tying simplifies placement. Ideally, the lateral sutures should incorporate the levator ani muscle as well as the rectovaginal fascia. These sutures should be tied relatively loosely to avoid necrosis, which could predispose postoperative mesh erosion. Upon suturing the posterior leaf of mesh to the posterior vaginal wall the two mesh arms may be attached to each other at the lateral aspects of the vaginal cuff, to create a Y configuration. It is important that the mesh bridge be tension-free so as to prevent over straightening of the urethrovesical angle and resulting de novo incontinence or worsen preexisting incontinence.

Dissection of the sacral promontory

Identification of key anatomical landmarks within close proximity of the sacral promontory fixation site is important in preventing injury to these structures. Important structures include the aortic bifurcation, common iliac vein, right ureter, middle sacral artery and vein, and lateral sacral venous plexus. The peritoneum overlying the sacral promontory is grasped and elevated with long Allis clamps or forceps and the overlying peritoneum is incised longitudinally (**Figure 36.9**). Incising the peritoneum facilitates entry into the retroperitoneum, where blunt dissection of loose alveolar tissue allows visualization of the anterior longitudinal ligament and middle sacral artery. Two non-absorbable 2-0 monofilament sutures are then secured to the anterior longitudinal ligament and held for later use (**Figure 36.10**). These sutures should be placed at the S1–S2 level, and can encircle the middle sacral artery embedded in the ligament. A taper needle is preferable to a cutting needle as the latter could injure the artery. Anchoring the mesh to the anterior longitudinal ligament at the level of S1–S2 has the advantage of allowing visualization of the middle sacral artery, avoiding significant hemorrhage seen with anchoring at the S3–S4 level while having no detectable negative effect on the vaginal axis. If hemorrhage occurs, the sacral sutures can be tied to accomplish hemostasis. Significant hemorrhage can arise from injury to the middles sacral artery, so it is advisable to have orthopedic bone thumbtacks, bone wax, or pledgets available in case suture ligation is insufficient.

Many surgeons will perform a culdoplasty to close the cul-de-sac before completing the sacral colpopexy to prevent small bowel from becoming trapped behind the graft. We use the Halban culdoplasty (**Figure 36.11**). The sacral sutures are then brought through the posterior and anterior mesh leaves at a level that provides vaginal apical

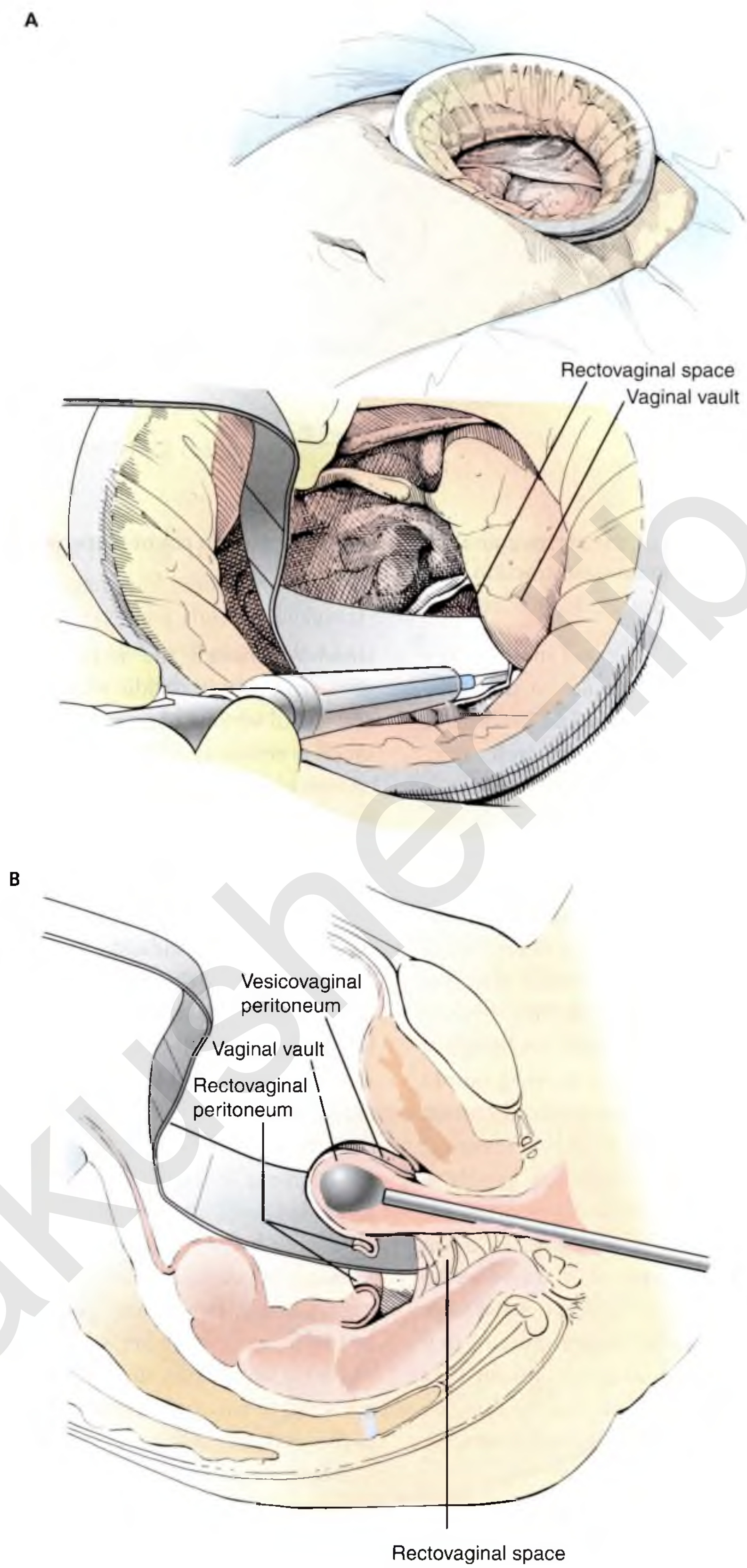

FIGURE 36.5 (A) Dissection of the rectovaginal space. (**B**) The rectovaginal space dissection is facilitated by the use of a malleable retractor to push the rectum posteriorly.

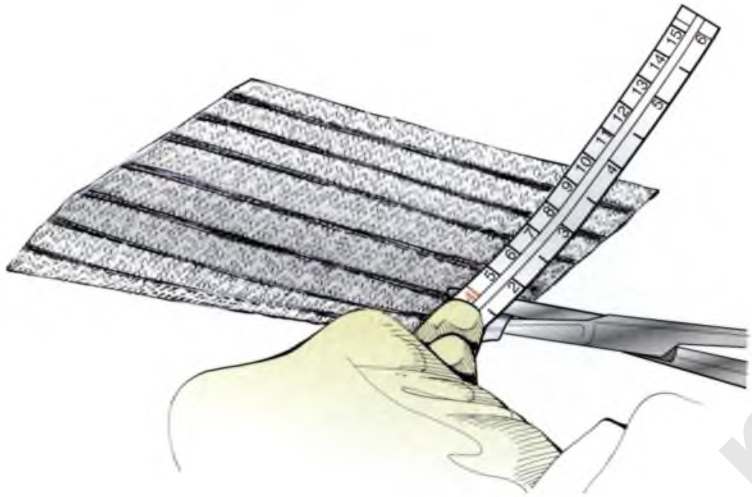

FIGURE 36.6 Cut 2 leaves of mesh approximately 4 cm × 14 cm.

support without tension. The mesh may shrink with healing, so undue tension should be avoided. Finally, these are tied down to the sacrum (**Figure 36.12**).

Most surgeons advocate closing the peritoneum over the mesh in order to decrease the risk of small bowel obstruction and mesh erosion. The may be accomplished with a running 3-0 absorbable suture. Injury to the bladder and ureters are potential complications of the dissection and repair. Consequently, perioperative cystoscopy, including evaluation of the urethra, is always recommended following completion of the repair.

POSTOPERATIVE CONSIDERATIONS

Most patients are hospitalized for 1 to 2 days following surgery. Prolonged bladder drainage in not generally necessary for patients with normal bladder function,

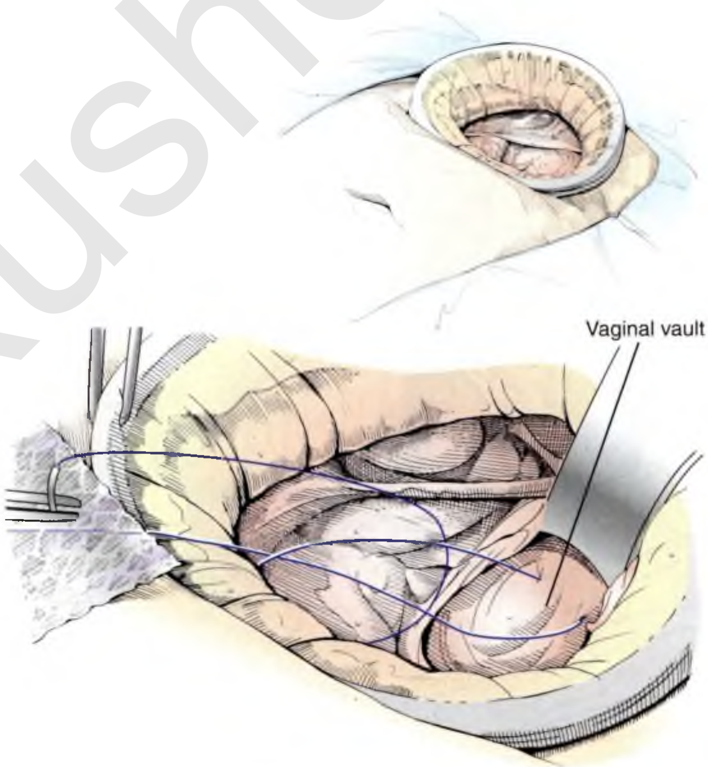

FIGURE 36.7 Attach one leaf of mesh to the superior aspect of the pubocervical fascia using three interrupted transverse stitches.

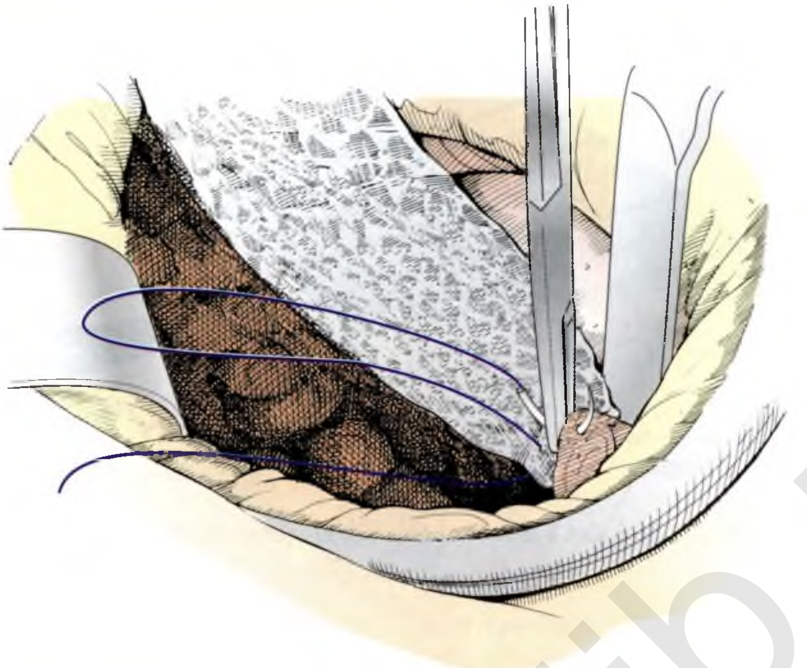

FIGURE 36.8 Attach one leaf of mesh to the rectovaginal fascia using three interrupted transverse stitches.

although an indwelling catheter is appropriate over night. Once the bladder catheter is removed a voiding trial is commenced to ensure normal bladder emptying. The post void residual can be measured with an ultrasound device or straight catheterization and should be less than 100 ml.

Postoperative pain management is usually managed with a regular schedule of rectal nonsteroidal anti-inflammatory drugs after ensuring that the patient has normal renal function. This helps to minimize postoperative pain needs, by providing baseline analgesia. Narcotics are administered parenterally on

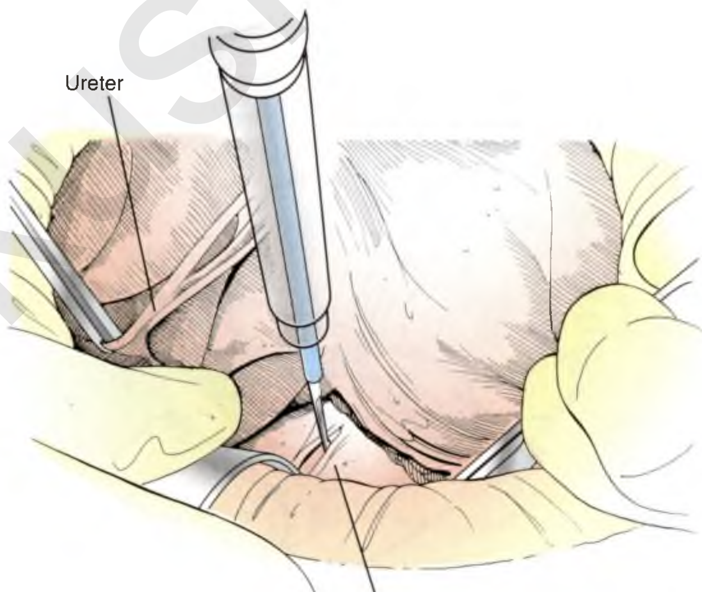

FIGURE 36.9 Dissection of the presacral space is done by elevating the peritoneum over the sacral promontory and incising the peritoneum longitudinally.

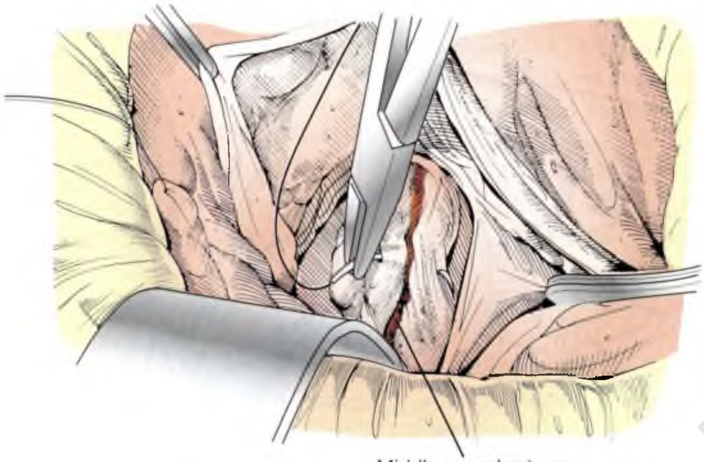

FIGURE 36.10 Place two sutures in the anterior longitudinal ligament, surrounding the middle sacral artery.

an as needed basis for exacerbation of pain either via patient controlled analgesic, or by a regular schedule. We generally wean patients to oral anti-inflammatories and narcotics on postoperative day 1.

Patients should be instructed to observe pelvic rest for 6 weeks until the incisions are fully healed. During the first 6 weeks, activities that increase intraabdominal pressure should be avoided as they predispose to recurrent prolapse. An over-the-counter stool softener is useful to minimize straining at defecation, especially in patients with preoperative constipation.

Operative Note

PROCEDURE: SACRAL COLPOPEXY

The patient was taken to the operating room, where her identity was confirmed and a preoperative briefing was completed. After the establishment of adequate anesthesia, pneumatic compression devices were placed and antibiotic prophylaxis initiated. She was placed in a dorsal lithotomy position using Allan stirrups, and the abdominal and vaginal fields were

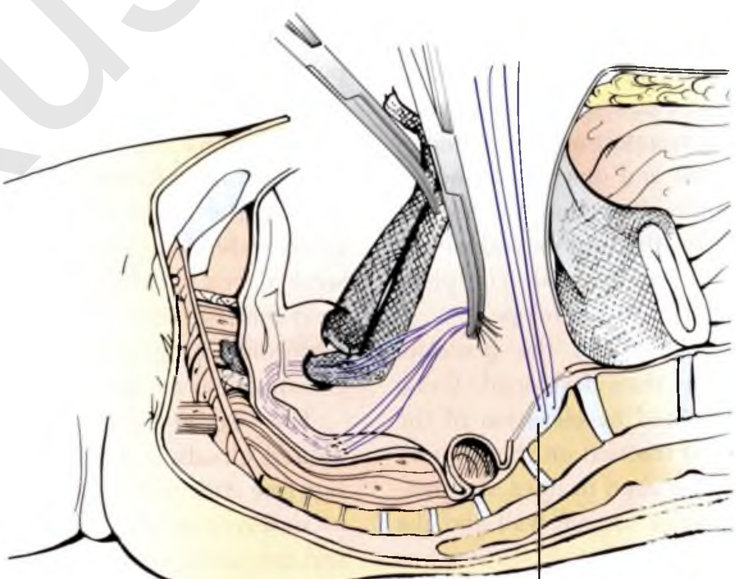

FIGURE 36.11 Halban culdoplasty.

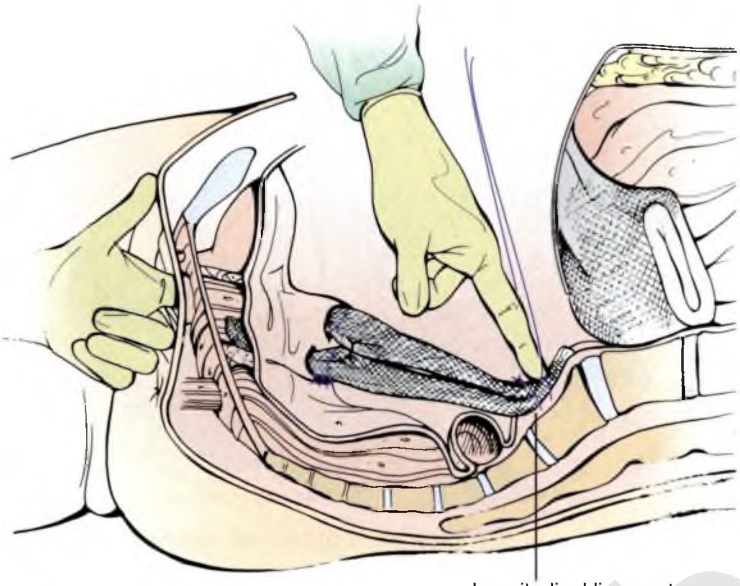

FIGURE 36.12 Tie down the sacral sutures.

prepped and draped. The operative team completed a time-out.

A Pfannenstiel skin incision was performed followed by dissection of the subcutaneous fat layer to the rectus fascia. The fascia was incised and this incision extended laterally on each side. The rectus muscles were divided in the midline and the peritoneum entered with care to protect underlying structures. The patient was then placed in moderate Trendelenberg position. A self-retraining retractor was placed so as to facilitate exposure of the sacral promontory and vaginal vault and the bowel packed with moist laparotomy sponges.

An end-to-end anastomosis (EEA) sizer was then placed in the vagina to elevate and better visualize the vaginal vault. Using traction/countertraction created by elevation of the vaginal stent and downward traction on the bladder, electrocautery dissection was used to open the peritoneum overlying the anterior vaginal wall and the vesicovaginal space was entered. The plane between the vaginal and bladder was developed.

The rectovaginal space between the posterior vaginal wall and rectum was then developed. Using traction/countertraction created by elevation of the vaginal stent and downward traction on the rectum, electrocautery dissection was used to open the peritoneum overlying the posterior vaginal wall and the rectovaginal space was entered. This dissection was carried to the perineal body, and laterally to the levator ani muscles along the pelvic sidewalls. A second mesh leaf measuring approximately 3 cm × 6 cm was then sutured to the posterior vaginal wall using 0 polypropylene sutures.

Two leaves of polypropylene mesh measuring 4 by 14 cm were cut. The first leave was sutured to the anterior vaginal wall using three interrupted transverse sutures of 2-0 PDS. Similarly, the second leaf was sutured to the posterior vaginal wall using three interrupted transverse sutures of 2-0 PDS, and incorporating the levator ani muscle in the lateral stitches. The anterior and posterior mesh leaves were then sutured together at the vaginal vault.

Two long Allis clamps were used to elevate the peritoneum overlying the sacral promontory. The peritoneum was then incised with electrocautery in a longitudinal direction. Dissection to the level of S1–S2 was performed using bunt technique until the anterior longitudinal ligament and middle sacral artery were identified. Two 2-0 polypropylene sutures were placed in the anterior longitudinal ligament and held for later use. A Halban culdoplasty was then performed using three sutures of 2-0 PDS placed longitudinally in a running fashion.

The vaginal stent was elevated to determine the desired elevation of the vaginal vault to allow a tension free attachment to the sacral promontory. The two mesh leaves were brought up to the sacral promontory and the sacral sutures were brought through the two mesh leaves at the appropriate level. Excess mesh was then excised. The sacral sutures were tied down, and the mesh was reperitonealized using a 3-0 polygalactin 910 suture in a running fashion. Hemostasis was achieved using electrocautery.

Diagnostic cystoscopy was performed using a 17-French sheath and a 70° lens with sterile water as the distending media. With water running, the cystoscope was advanced into the urethral meatus and into the bladder. A thorough survey was made following the points of a clock. The ureteral orifices were noted to be patent bilaterally. The 70° lens was then exchanged for a 0° lens. With water running, the cystoscope was retracted, providing a view of the urethral lumen.

The retractor and sponges were removed. Sponge and instrument counts were correct. The fascial incision was closed in a running fashion with 0 PDS suture. The subcutaneous tissue was closed with interrupted sutures of 3-0 polygalactin 910 and the skin was closed using subcuticular sutures (or staples). A sterile pack was placed. The patient was returned to a supine position and the transferred to the recovery room in stable condition. She tolerated the procedure well.

COMPLICATIONS

Intraoperative	Postoperative
Cystotomy 3.1% (0.4–15.8%)	Recurrent prolapse 10–15%
Rectotomy, enterotomy, 1.6% (0.4–2.5%)	UTI 10.9% (range 2.5–25.9%)
Ureteral injury 1.0% (0.8–1.9%)	Wound problems (infection, hematoma, superficial separation) 4.6% of surgeries (range 10.4–19.8%)
	Hemorrhage 4.4% (range 0.18–16.9%)
	Ileus 3.6% (range 1.1–9.3%)
	Dyspareunia 2–7%
	VTE 3.3% (range 0.4–5.0%)
	Reoperation for SBO 1.1% (0.6–8.6%)
	Mesh exposure/erosion
	Incisional hernia repair 5.0% (0.4–15%)
	Urinary incontinence

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CHAPTER 37

Rectocele Repair Using the Defect-directed Approach

Geoffrey W. Cundiff

INTRODUCTION

Providing optimal care for a rectocele, or prolapse of the posterior vaginal wall, begins with recognition of the heterogeneous nature of pelvic organ prolapse, and a focus on the primary goal of intervention, relief of symptoms. Rectoceles frequently occur with concurrent prolapse of the anterior vaginal wall and vaginal apex, and a durable repair requires attention to these support defects as well.

While prolapse is ubiquitous in parous women, it does not warrant treatment unless it is symptomatic. The symptoms commonly attributed to posterior prolapse include pelvic pressure, and a sensation or visualization of protrusion, defecatory dysfunction, and sexual dysfunction. While symptoms of protrusion are almost always due to prolapse, predicting which patients will have relief from defecatory dysfunction and sexual dysfunction depends on a thorough understanding of the anatomy of support of the posterior wall as well as the differential diagnosis of these symptoms. Perineal rectoceles commonly present with complaints of defecatory dysfunction, including, a sense of incomplete emptying, tenesmus, and the need to splint or use digital manipulation for defecation. However, longstanding constipation can also be a contributing factor for prolapse, in which case surgical repair should not be expected to alleviate symptoms. Similarly, some techniques of surgical repair of rectocele can cause obstructed defecation or dyspareunia. Consequently, in the context of recurrent rectocele, the presence of these symptoms bears careful consideration.

There are a variety of surgical techniques available to the surgeon treating rectocele, including the posterior colporrhaphy, trans-anal repair, and the defect directed repair. Each of these approaches has strengths and limitations. The defect-directed repair, also known as the site-specific fascial repair, aims to maximize relief of symptoms without new functional symptoms, through recreating normal anatomy. The technique is based on Richardson's observations at the time of rectocele repair and during cadaveric dissections, of discrete tears or breaks in the rectovaginal septum. He advocated an anatomical repair limited to repair of these fascial tears or defects without attempts to narrow the vaginal caliber or perineum. This approach appears to improve the relief of protrusion symptoms and obstructed defecation due to prolapse, without causing de novo defecatory dysfunction or dyspareunia. However, its reliance on native tissues that may be compromised in women with pelvic organ prolapse, may have a negative impact on its durability. Nevertheless, it is a good choice for a patient that desires a repair using native tissue, especially if she has no risk factors for recurrence.

PREOPERATIVE CONSIDERATIONS

Preoperative estrogen cream promotes a healthier mucosal epithelium in atrophic postmenopausal patients. A bowel prep is not generally indicated preoperatively, unless the patient has retained stool in the rectum after defecation. Antibiotic prophylaxis with a second generation cephalosporin or metronidazole is recommended, although there is minimal data to show its efficacy. Deep venous thromboembolism prophylaxis is also recommended. The patient should be positioned in lithotomy or modified lithotomy position. Either regional anesthesia or general anesthesia is appropriate. Submucosal infiltration with injectable lidocaine with epinephrine simplifies postoperative pain and assists dissection and hemostasis. A Foley catheter should be placed during the surgery to drain the bladder. Following is a brief description of the surgical procedure used (see also video: *Rectocele Repair Using the Defect-directed Approach*).

SURGICAL TECHNIQUE

The surgical approach begins with a transverse incision in the posterior fourchette from 4 o'clock to 8 o'clock (**Figure 37.1**). This divergence from the standard perineorrhaphy, usually performed with a posterior colporrhaphy to decrease the size of the genital hiatus, is possible as repairing the attachments of the rectovaginal fascia to the apical support and perineal body has been shown to decrease the gaping genital hiatus without a perineorrhaphy. Moreover, the lack of a perineorrhaphy may be why the defect-directed approach has a lower rate of post surgical dyspareunia.

The transverse incision is then joined by a midline longitudinal incision in the epithelium of the posterior vaginal wall (**Figure 37.2**). This incision is carried approximately two-thirds of the vaginal length. The vaginal epithelium is then dissected off the underlying tissue in the plane between the mucosa and the vaginal muscularis or rectovaginal septum (**Figure 37.3**). Finding this plane is essential to identifying the location of the rent in the rectovaginal septum. This dissection is facilitated by using sharp dissection combined with counter traction provided by Allis clamps, a self-retaining retractor, or by using a finger behind the vaginal mucosa. Moreover, as the rent can occur in the midline of the rectovaginal fascia or at its attachments, the dissection should be carried laterally to the normal attachment of the rectovaginal fascia to the levator ani

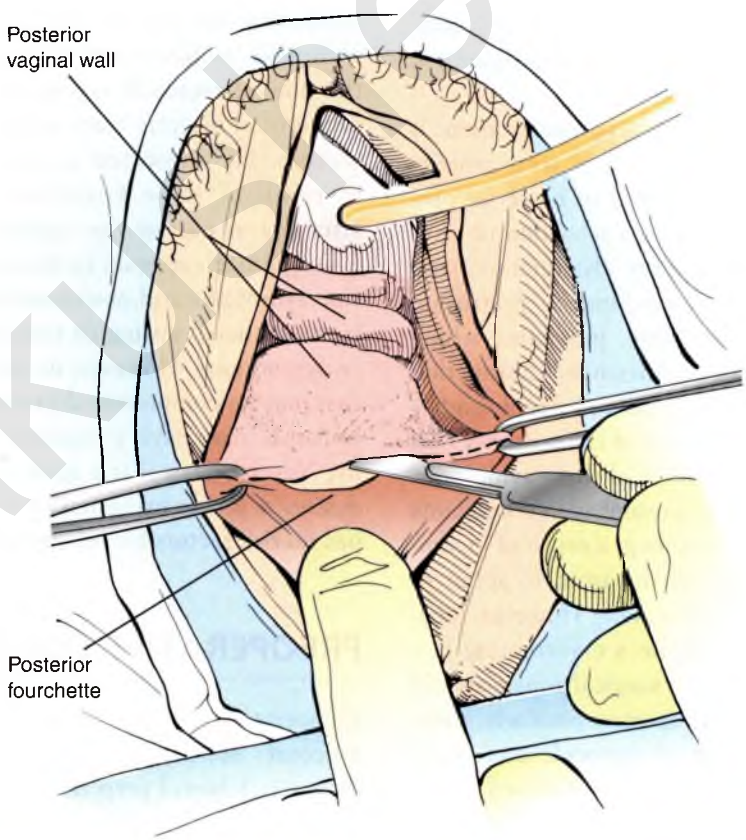

FIGURE 37.1 A transverse incision is made in the posterior fourchette.

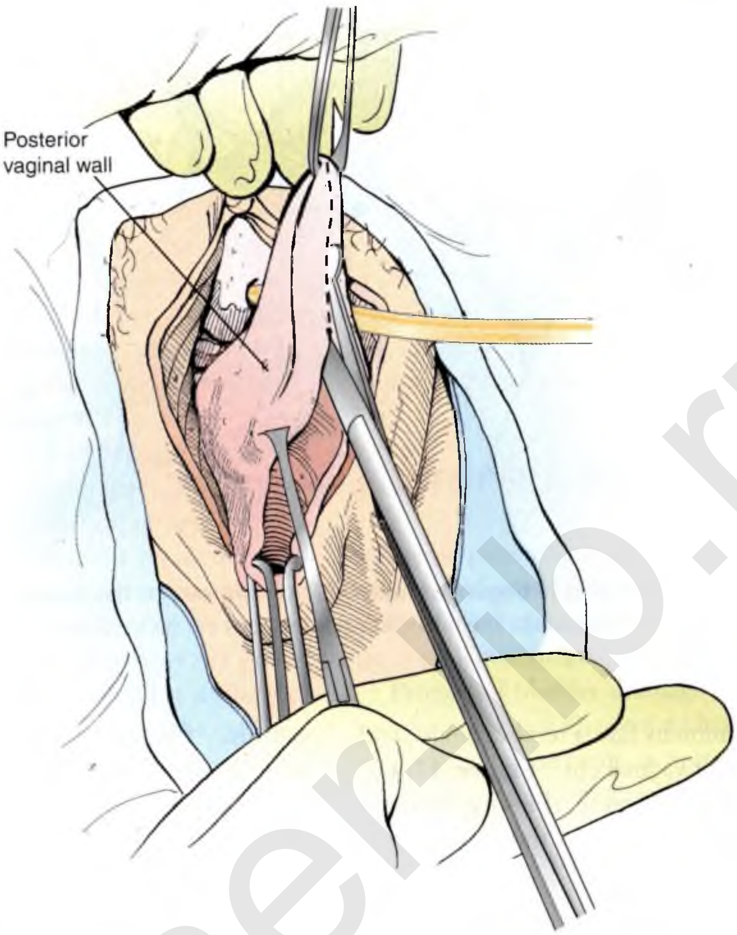

FIGURE 37.2 A midline longitudinal incision joins the transverse incision: This extends approximately two-thirds of the vaginal length.

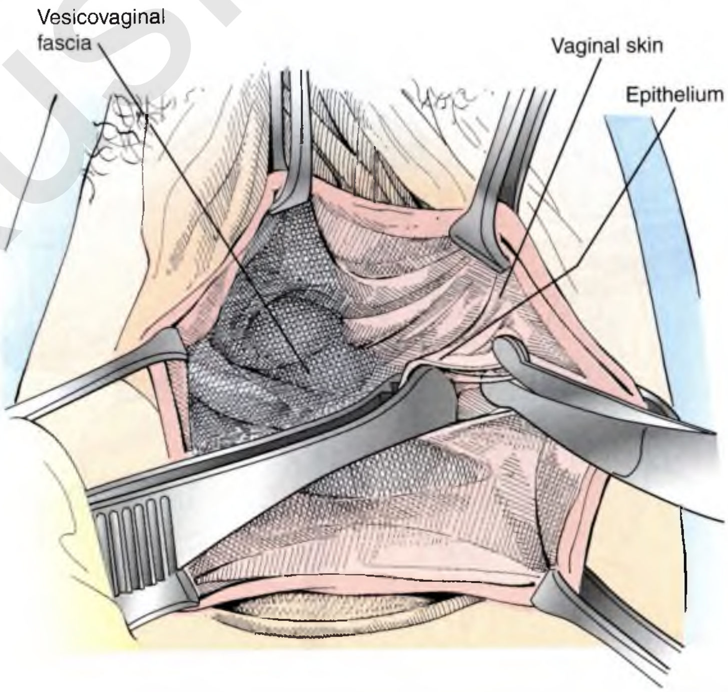

FIGURE 37.3 The epithelium is dissected off the underlying tissue: This is best accomplished by sharp dissection, cutting the thin fibers attached to the epithelium.

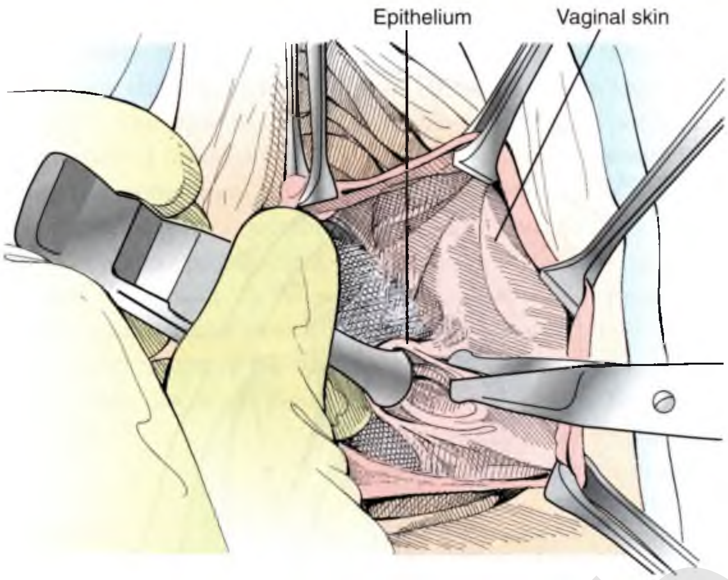

FIGURE 37.4 The dissection is begun laterally and carried out to the levator ani muscles (arcus tendineus fascia rectovaginalis): The dissection also includes the perineal body inferiorly, and superiorly it is carried to the cervix or vaginal cuff.

muscle at the arcus tendineus fascia rectovaginalis, and superiorly to the cervix or vaginal cuff (**Figure 37.4**).

Once the dissection is complete, the surgeon must identify the location of the rent in the rectovaginal septum. Placing the nondominant index finger trans-anally to elevate the rectum helps to delineate compromised support (**Figure 37.5**). The rectal muscularis, which is the tissue that herniates through

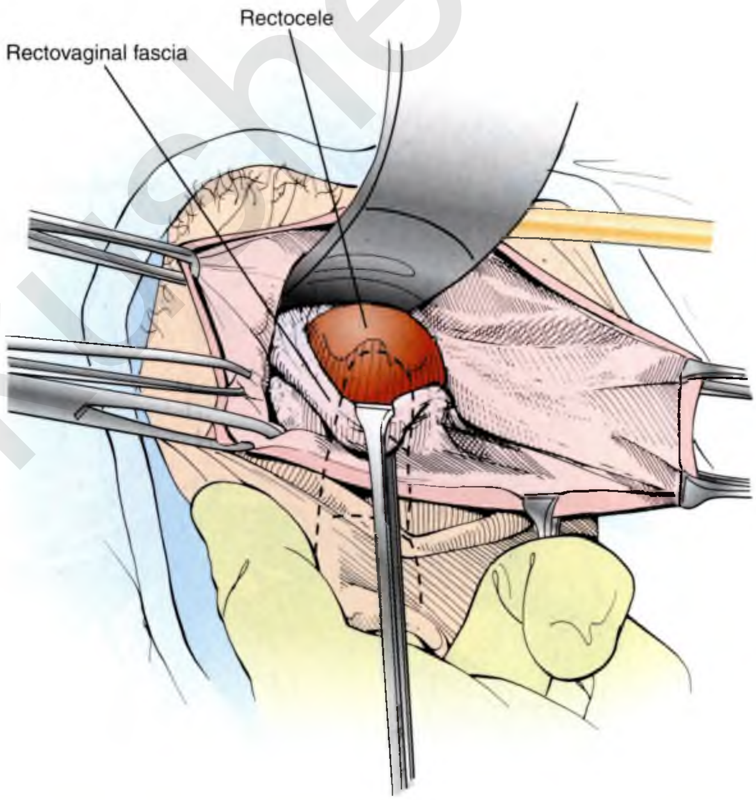

FIGURE 37.5 Finding the tear in the rectovaginal fascia is simplified by providing elevation of the posterior vaginal wall via a rectal finger.

the rent, is distinguished by its elasticity and lack of tensile strength, ruddy color, and more vascular nature. The edges of the rent should be clearly delineated, keeping in mind that it is frequently separated from the perineal body or the lateral attachment, or both (**Figure 37.6**).

Once the rent is identified, the repair is limited to reapproximation of the edges in an interrupted fashion, burying the knots beneath the rectovaginal fascia (**Figure 37.7**). Some surgeons advocate a permanent suture, although a monofilament delayed absorbable suture provides similar results. Plication is not a surgical goal as it tends to narrow the vaginal caliber. When the defect in the rectovaginal septum is in the superior portion, it is important to determine whether Level I apical support is also compromised, as a successful repair in this circumstance will require repair of apical support as well, for example by uterosacral suspension (Chapter 38).

As previously noted, a perineorrhaphy is not generally part of the repair, although if the defect in the rectovaginal septum is in its attachment to the perineal body, then prior to reattachment, the intrinsic muscles of the perineal body should be assessed and repaired with reconstruction of the perineal body to restore normal anatomy

Closure of the vaginal epithelium is accomplished with a simple running approach using an absorbable suture. The longitudinal incision is closed first, followed by the transverse perineal incision (**Figure 37.8**). Vaginal narrowing is not a surgical goal, so excessive removal of skin should be avoided. For large rectoceles, it may be necessary to trim a minimal amount of the vaginal skin, but just to the point where the skin edges fall together. A vaginal pack can be placed for several hours to enhance hemostasis.

POSTOPERATIVE CONSIDERATIONS

For most patients, the defect-directed rectocele repair can be performed in a day surgery setting as an outpatient. If it is combined with other prolapse repairs, then on overnight stay is indicated.

Prolonged bladder drainage in not generally necessary for patients with normal bladder function, although an indwelling catheter is appropriate until the vaginal pack is removed. Urinary retention is rare after an

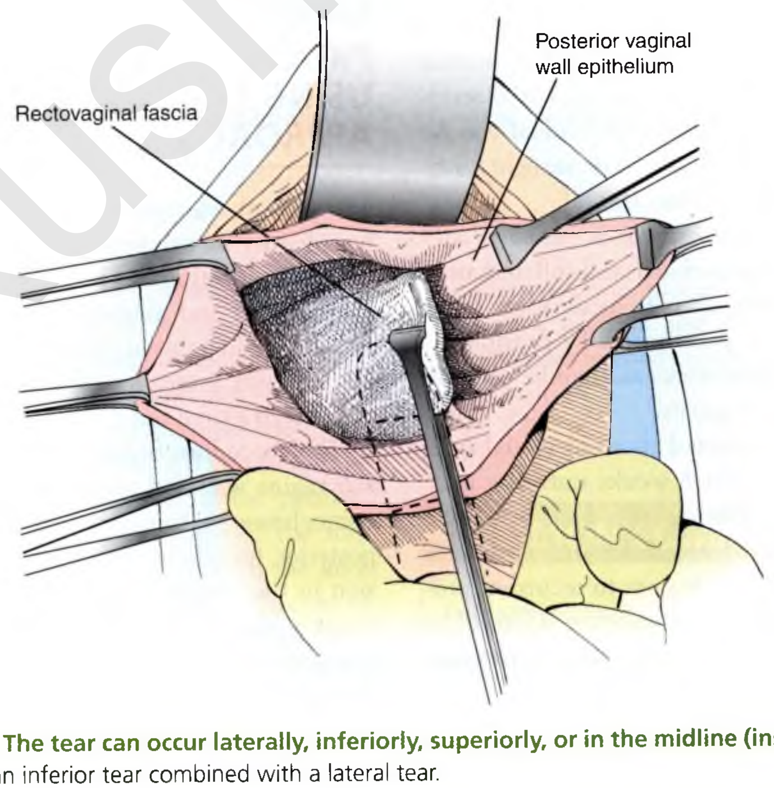

FIGURE 37.6 The tear can occur laterally, inferiorly, superiorly, or in the midline (inset): Frequently, there will be an inferior tear combined with a lateral tear.

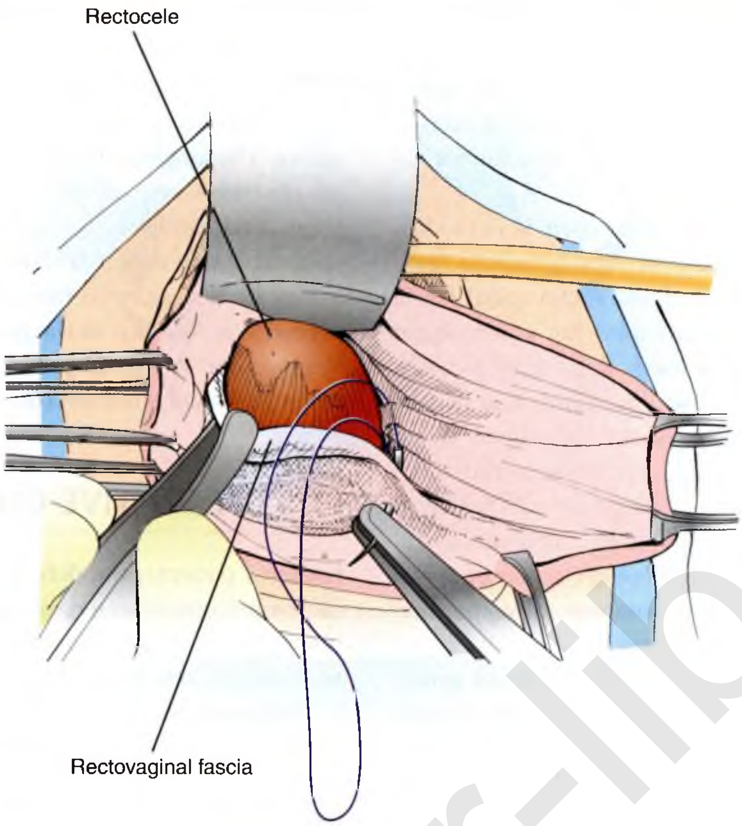

FIGURE 37.7 The edges of the tear should be defined and then reapproximated in a simple interrupted fashion, burying the suture below the fascia.

isolated rectocele repair, although postoperative spasm of the pelvic floor can cause a functional obstruction occasionally. Consequently, confirmation of normal voiding, including measurement of the post-void residual is a good practice. The post-void residual can be measured with an ultrasound device or straight catheterization and should be less than 100 ml.

Postoperative pain management is usually adequately managed with nonsteroidal anti-inflammatory drugs. A regular schedule of oral medication helps to minimize postoperative pain needs, by providing a baseline analgesia. Oral narcotics can then be used on an as needed basis for pain spikes.

Patients should be instructed to avoid sexual relations and use of tampons for 6 weeks until the incisions are fully healed. During the first 6 weeks, activities that increase intra-abdominal pressure should be avoided as they predispose to recurrent prolapse. An over-the-counter stool softener is useful to minimize straining at defecation, especially in patients with preoperative constipation.

Operative Note

PROCEDURE: RECTOCELE REPAIR USING THE DEFECT-DIRECTED APPROACH

The patient was taken to the operating room, where her identity was confirmed. After the establishment of adequate anesthesia, pneumatic compression devices were placed and antibiotic prophylaxis initiated. She was placed in a dorsal lithotomy position, and the vaginal field was prepped and draped. The operative team completed a time-out.

The procedure began with infiltration of the posterior vagina wall and perineum with 1% lidocaine with epinephrine. A transverse incision was made in the posterior fourchette followed by a longitudinal incision in the midline of the posterior vaginal wall. This incision was carried two-thirds of the vaginal length. Using countertraction, the vaginal mucosa was sharply dissected of the underlying tissue out to the levator ani

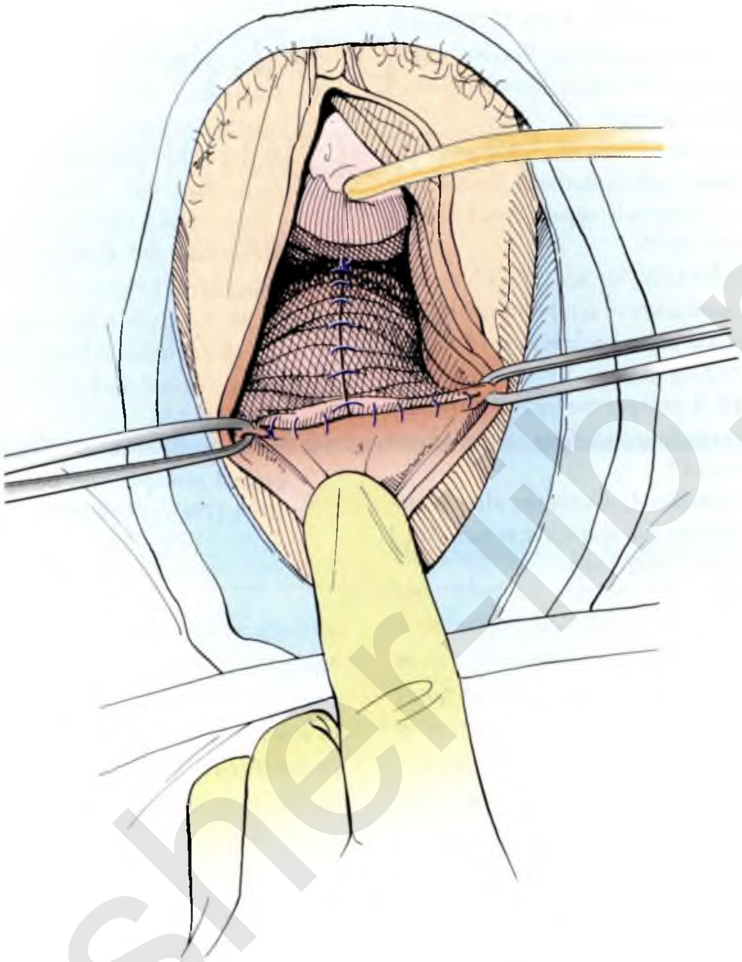

FIGURE 37.8 The epithelium is reapproximated in a running fashion, closing the longitudinal and transverse incisions separately.

muscles. This dissection was then continued superiorly to the cervix, fully defining the rectovaginal fascia. Hemostasis was achieved using electrocautery.

A rectal exam helped to define an inferior separation of the rectovaginal fascia from the perineal body. The perineal body was intact. A stitch of 2-0 polydioxanone was brought through the right aspect of the perineal body, and then through the right margin of the rent in the rectovaginal fascia, and was tied with the knot beneath the fascia. Additional interrupted stitches of 2-0 polydioxanone were placed in the same fashion to close the rent. The mucosa of the longitudinal incision was closed in a simple running fashion using 3-0 polyglactin 910. The transverse incision was also closed in a simple running fashion using 3-0 polyglactin 910. A sterile pack was placed. The patient was returned to a supine position and then was transferred to the recovery room in good condition. She tolerated the procedure well.

COMMON COMPLICATIONS

Intraoperative	Postoperative
Rectotomy (rare)	Reoccurrence of prolapse (10–15%)
	Dyspareunia (2–7%)

Suggested Reading

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CHAPTER 38

Overlapping Sphincteroplasty

Geoffrey W. Cundiff

INTRODUCTION

Fecal incontinence is reported in 3% of community-dwelling individuals but increases with increasing age, reaching a prevalence of 54% in nursing-home residents. This association with increasing age predicts an overall increase in patients suffering fecal incontinence as the population ages. Most authors agree that the true prevalence of this condition is underestimated in the current scientific literature due to under reporting related to embarrassment. Fecal incontinence has tremendous psychosocial and economic implications for individuals as the loss of such a basic function is emotionally devastating and can lead to poor self-esteem, depression, social isolation, and decreased quality of life. It is not surprising that fecal incontinence is the second leading reason for nursing-home placement, even though fewer than one-third of individuals with this condition seek medical attention.

Among women seeking benign gynecologic care, 28% report fecal incontinence, which supports most epidemiologic studies identification of female gender as an independent risk factor for developing fecal incontinence. This increased prevalence among women is felt to reflect a risk factor unique to women, parturition. The differential diagnosis of fecal incontinence is complex, including systemic, pharmacologic, neurological, anatomical, and functional factors, and in a given individual the etiology is frequently multifactorial. Anatomic and structural causes of fecal incontinence are usually due to obstetric or surgical trauma. Direct damage or de-innervation of the internal anal sphincter (IAS), external anal sphincter (EAS), and the puborectalis can result in varying degrees of fecal incontinence. Those with impaired resting tone from a defective IAS tend to complain of passive incontinence (incontinence at rest), which is worse during sleep because of decreased EAS activity. An inability to respond to sudden distention and to suppress defecation is often seen with external sphincter dysfunction. External and internal sphincter dysfunction often results in incontinence of liquid stool. Incontinence of solid stool is usually seen with widening of the anorectal angle from damage to the puborectalis muscles. Damage to the anal cushions usually causes minor soiling. Other anatomic and structural abnormalities associated with fecal incontinence include obstructive disorders such as pelvic organ prolapse, descending perineum syndrome, anismus, and intussusception; fistulas from diverticulitis, inflammatory bowel disease, cancer, or surgical trauma; and decreased rectal compliance from inflammatory bowel disease, cancer, and radiation. Decreased compliance results in higher intraluminal pressures with smaller volumes of stool, poor storage capacity, urgency, and incontinence.

The overlapping sphincteroplasty is specifically indicated for women with injured EASs, and consequently, effective use of this repair requires a surgeon to have a thorough understanding of all the factors contributing to fecal incontinence in a given patient. This means that the reconstructive surgeon must have a complete knowledge of normal and pathological anorectal function, and utilize this knowledge in working up the patient to determine the factors contributing to fecal incontinence. In a woman with fecal incontinence, the integrity of the anal sphincter should be assessed by anorectal exam, and then confirmed with endoanal ultrasonography. Endoanal ultrasonography helps to distinguish the anatomy of the EAS and distinguish the location of the defects as well as allowing assessment of the IAS. However, its utility is limited to assessment of anatomy, and the function of the sphincter is equally as important. De-innervation of the EAS due to stretch injury of the pudendal nerve is common in women after vaginal delivery, and studies show that the overlapping sphincteroplasty is less effective in women with a concurrent pudendal neuropathy. Proper preoperative counseling of patients regarding postoperative expectations of continence, therefore requires an assessment of pudendal nerve function. Judging voluntary contraction of the EAS on physical exam provides useful information, although many surgeons also assess nerve function using Pudendal Terminal Nerve Latency testing.

PREOPERATIVE CONSIDERATIONS

The surgical field in an overlapping sphincteroplasty is contaminated, but trying to limit the amount of stool in the field can decrease the degree of contamination. A bowel prep can be useful toward this end, provided that it is not too aggressive or given too late, as in these circumstances the patient may present for surgery with runny diarrhea. We usually use magnesium citrate, and a Fleets enema the morning of surgery.

The patient should be positioned in lithotomy or modified lithotomy position. Either regional anesthesia or general anesthesia is appropriate. Antibiotic prophylaxis with a second generation cephalosporin or metronidazole is recommended, although there is minimal data to show its efficacy. A risk assessment for deep venous thromboembolism is also indicated and prophylaxis for thromboembolism is usually indicated due to the lithotomy position and length of the surgery. Submucosal infiltration with injectable lidocaine with epinephrine simplifies postoperative pain and assists dissection and hemostasis. A Foley catheter should be placed during the surgery to drain the bladder. Following is a brief description of the surgical procedure used (see also video: *Overlapping Sphincteroplasty*).

SURGICAL TECHNIQUE

The surgical approach begins with a transverse incision in the posterior fourchette from 4 to 8 o'clock (**Figure 38.1**). This incision is then extended bilaterally in a semilunar fashion. The incision should extend sufficiently on to the perineum to provide access to the lateral aspects of the EAS. The transverse incision is then joined by a midline longitudinal incision in the epithelium of the posterior vaginal wall. This incision is carried approximately half of the vaginal length. The vaginal epithelium is then dissected off the underlying tissue in the plane between the mucosa and the vaginal muscularis or rectovaginal septum. This dissection is facilitated by using sharp dissection combined with countertraction provided by Allis clamps, a self-retaining retractor, or by using a finger behind the vaginal mucosa. This technique of dissecting the posterior vaginal wall is further described in Chapter 37. For the overlapping sphincteroplasty, the extent of the dissection only needs to include the distal posterior wall, as the goal is to provide access to the perineal body (**Figure 38.2**).

Once the perineal body is exposed, the surgeon begins the dissection of the EAS. The goal of the dissection is to isolate the scarred ends of the ruptured EAS so that they can be reapproximated. Depending on how the torn sphincter healed, the EAS may be in a U configuration with scar tissue on the ends, or it may be a donut with the anterior portion limited to scar tissue. Preoperative endoanal ultrasonography is helpful to determine which configuration is present. In the case of the U configuration, the scarred ends are dissected individually, while in the donut configuration the scarred anterior portion is divided first to allow the dissection of the distal scarred ends.

Regardless of the anatomy, the dissection is facilitated by the use of a muscle stimulator to identify the functional portion of the EAS. We use a Pena muscle stimulator to stimulate the muscle through the skin at 3 and 9 o'clock. This not only confirms the location of the EAS, but also demonstrates the contractile portion of the EAS. The stimulator is useful throughout the dissection to insure that the dissection is proceeding as planned.

Once the location of the EAS ends are confirmed, the scarred end is grasped with an Allis clamp, which provides traction so that the sphincter can be dissected away for the surrounding tissue. Skin hooks or Allis clamps on the perineal skin provide the countertraction to permit this dissection (**Figure 38.3**). Needle point electrocautery is useful for this dissection for its precision and hemostasis. Understanding the anatomy of the EAS is essential to optimally performing this dissection. Vascular supply and innervation, via the Pudendal arteries and nerves, courses medially to the EAS from Alcock's canal, entering the sphincter at

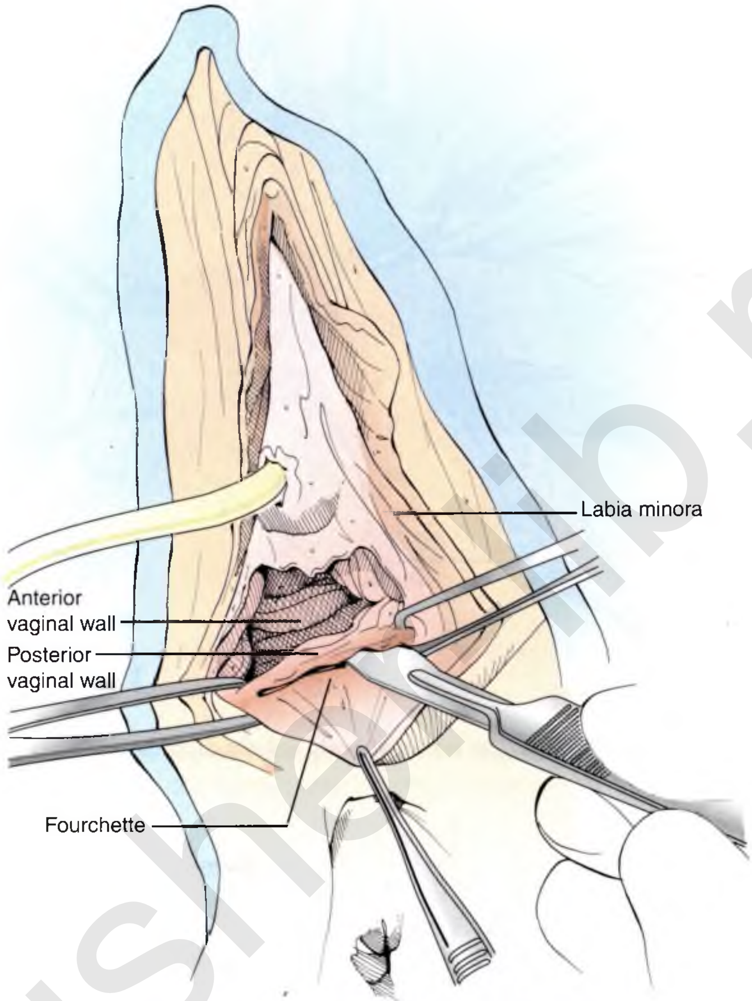

FIGURE 38.1 A transverse incision is made in the posterior fourchette: The incision is then extended bilaterally in a semilunar fashion to provide access to the lateral aspects of the EAS. A longitudinal incision in the posterior vaginal wall is also performed.

3 and 9 o'clock. Knowledge of this anatomy stipulates that the dissection should be limited to the anterior portion of the EAS between 11 and 2 o'clock. The right distal end of the ruptured EAS is dissected in the same fashion (**Figure 38.4**). The medial portion of the dissection should carefully directed to the plane between the EAS and IAS, the intersphincteric plane, to help distinguish between the EAS and IAS.

Given the contaminated surgical field, we generally irrigate the wound regularly during the repair. Saline irrigation is adequate, and can be used before each layer of the closure. The repair begins with closure of the IAS, if the IAS is also ruptured. Preoperative ultrasonography helps to delineate whether or not the IAS is compromised. If the IAS is also compromised, repair is accomplished by plicating the ends using a simple running closure using a 3-0 monofilament delayed absorbable suture, such as polydioxanone (**Figure 38.5**).

Next the EAS is repaired. The theoretical benefit of the overlapping sphincteroplasty comes from placing the sutures in the scarred ends of the EAS rather than the muscle itself, as well as overlapping the two scarred ends to minimize the likelihood of postoperative separation.

Overlapping of the ends of the EAS is accomplished through placement of interrupted longitudinal stitches through the two scarred ends. An appropriate

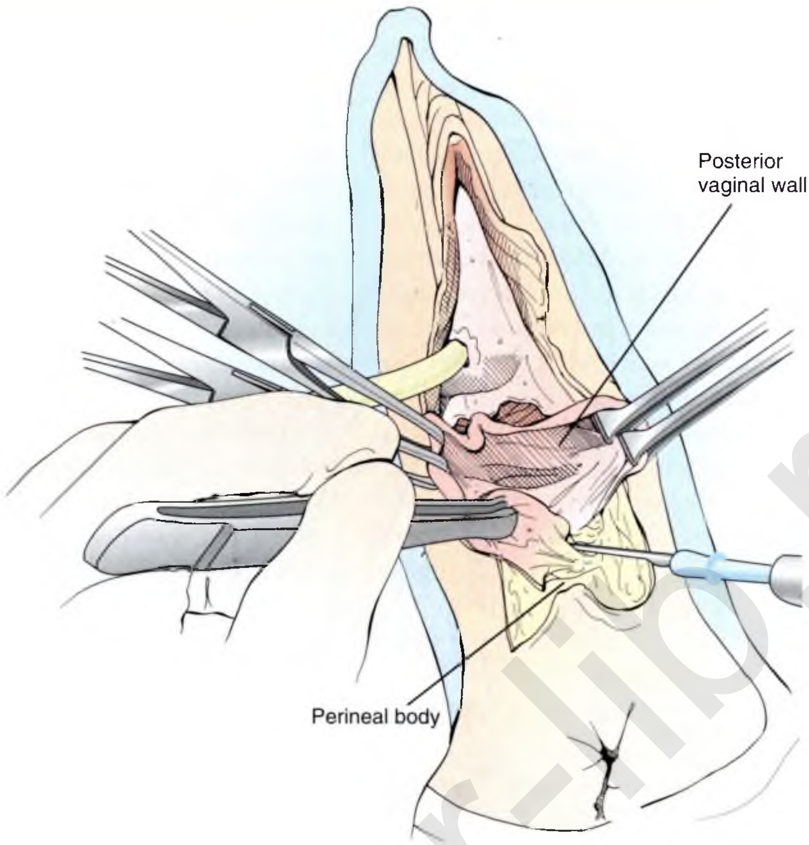

FIGURE 38.2 The perineal body is fully dissected.

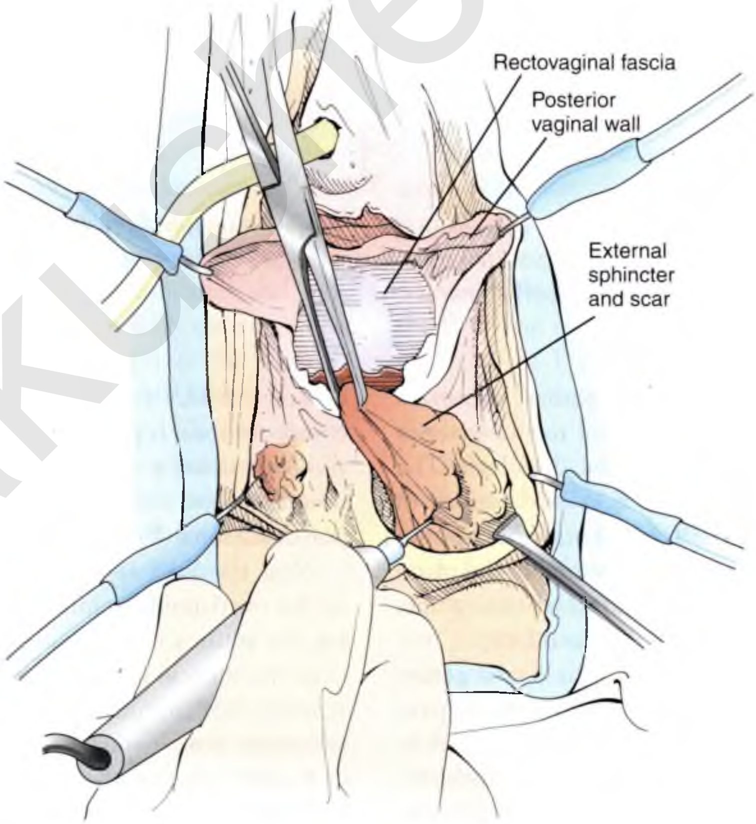

FIGURE 38.3 Dissection of the left distal end of the ruptured EAS is accomplished using needle point electrocautery. The dissection of the EAS is facilitated by countertraction on the scarred distal end of the EAS.

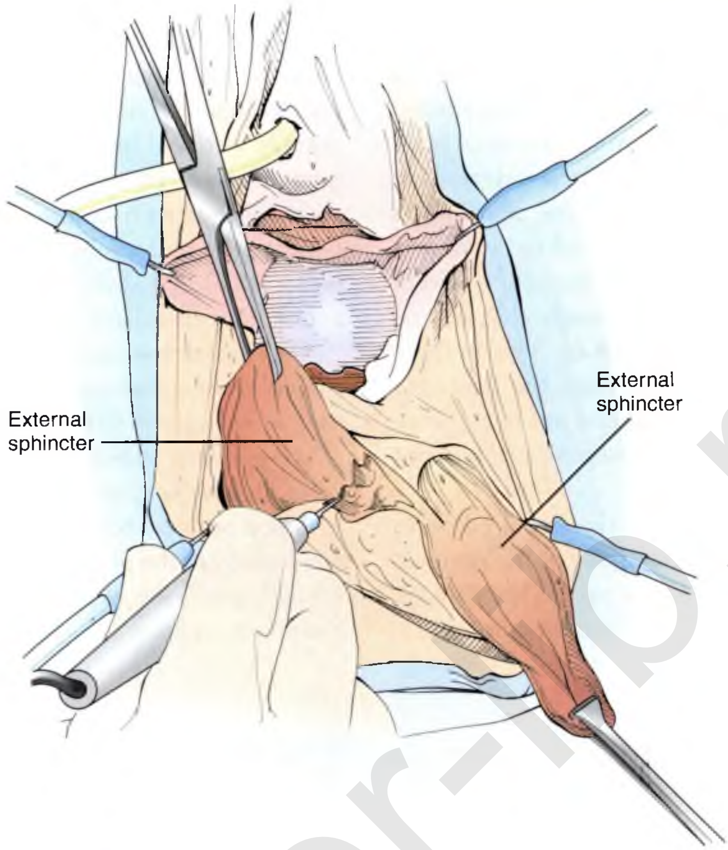

FIGURE 38.4 The right distal end of the ruptured EAS is dissected in the same fashion: Here, the plane between the EAS and IAS, the intersphincteric plane, is developed.

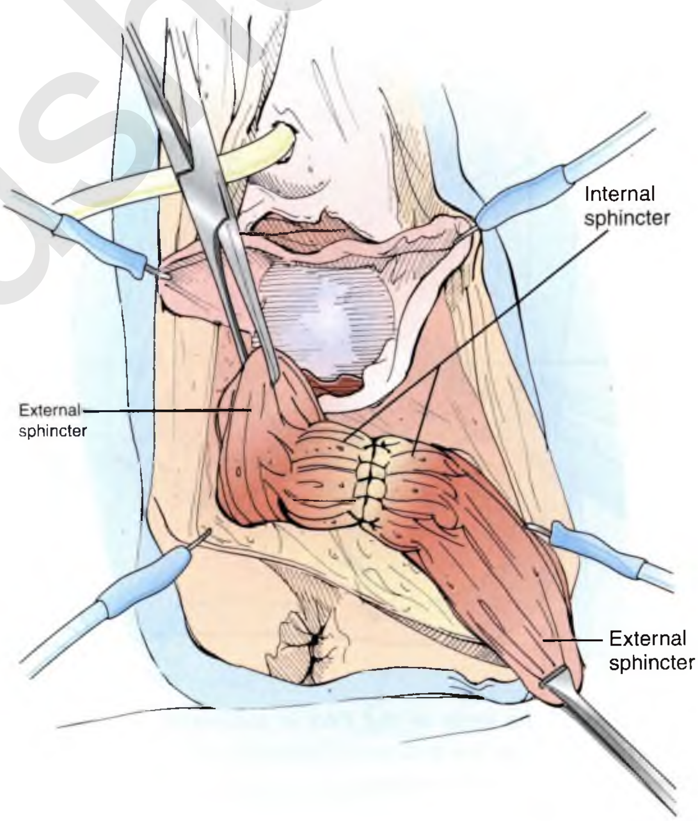

FIGURE 38.5 The repair begins with closure of the internal anal sphincter using a simple running closure.

suture is a 2-0 delayed absorbable monofilament suture, such as polydioxanone. Before placing these stitches, the surgeon should assess which scarred end should be on top of the other, and this is determined by seeing which configuration maximizes normal anatomy. Once the optimal configuration is determined, the first suture is placed, initially several centimeters proximal to the end of the scarred end to be on top, and then through the distal end of the other scarred end before being passed back though the scarred end that will be on top (**Figure 38.6**). Two to three additional stitches are passed through the two ends of the EAS, in the same fashion, and are held. Once all sutures have all been placed, they are tied without tension (**Figure 38.7**).

Optimizing the function of the repaired EAS requires restoring the normal anatomy of the perineal body. Repairing the EAS corrects part of the damage to the perineal body, although the other components, the perineal membrane and rectovaginal fascia, are also usually compromised. The repaired EAS can be sutured to the perineal membrane laterally, and the rectovaginal fascia should be reattached to the reconstituted perineal body (**Figure 38.8**). The reattachment of the rectovaginal fascia to the perineal body is accomplished with simple interrupted stitches buried beneath the rectovaginal fascia. We use a 2-0 monofilament delayed absorbable suture, such as polydioxanone, for this aspect of the repair.

Closure of the epithelium is accomplished in a simple running fashion using a 3-0 absorbable suture, such as polyglactin 910. First, the longitudinal incision of the posterior vaginal wall is closed. Next, the transverse incision is closed (**Figure 38.9**). Repair of the EAS and perineal body changes the three-dimensional morphology of the perineum, and it frequently requires a longitudinal closure on perineal skin to optimize normal vulvar anatomy.

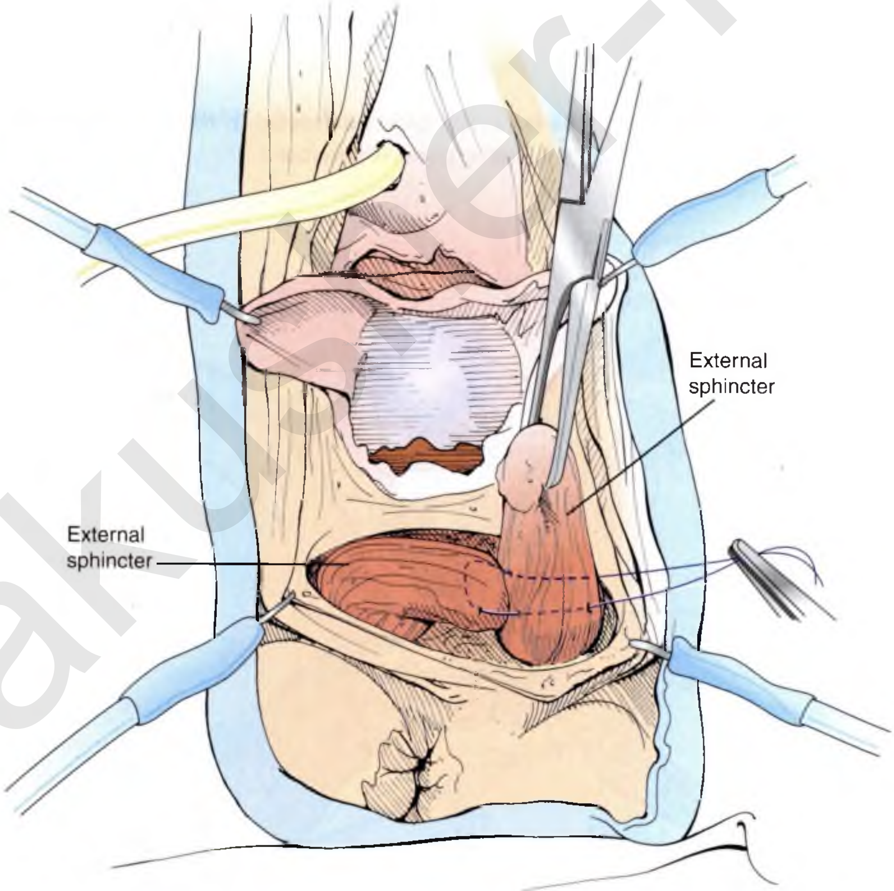

FIGURE 38.6 Overlapping of the ends of the EAS is accomplished through placement of interrupted longitudinal stitches: Here, the first suture is placed, initially several centimeters proximal to the end of the scarred end to be on top, and then through the distal end of the other scarred end before being passed back through the scarred end that will be on top.

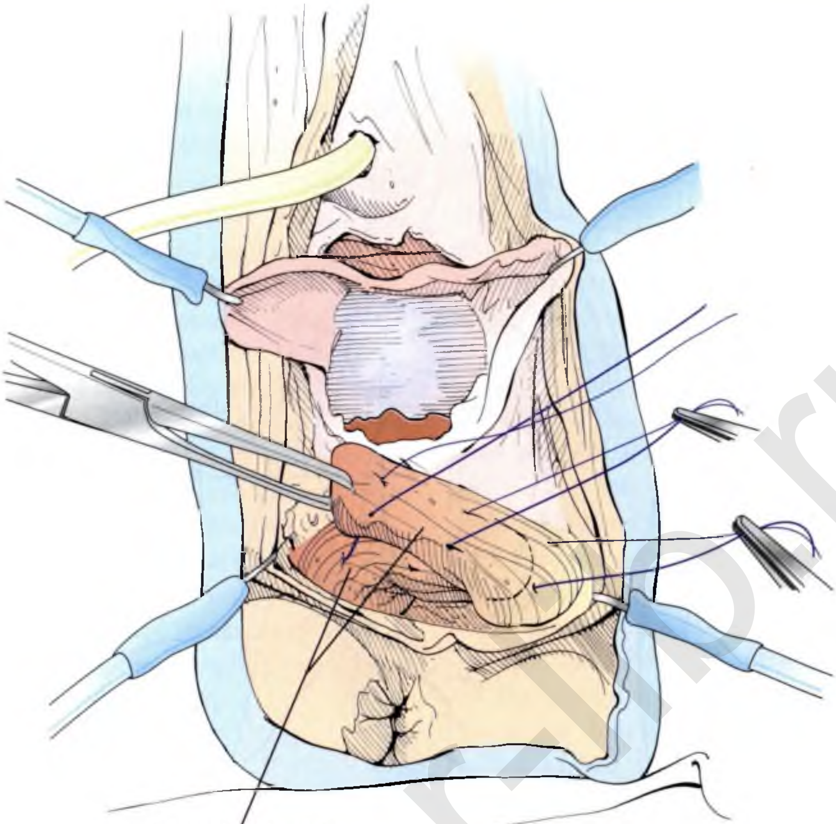

FIGURE 38.7 Two to three additional stitches are passed through the two ends of the EAS, in the same fashion and are held: Once all sutures have been placed, they are tied.

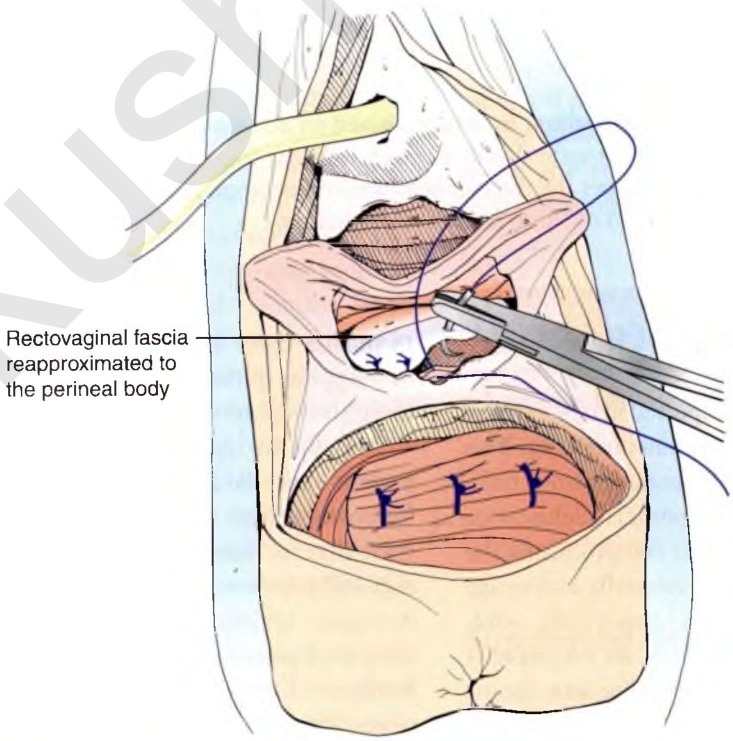

FIGURE 38.8 Reattachment of the rectovaginal fascia to the perineal body with simple interrupted stitches buried under the rectovaginal fascia.

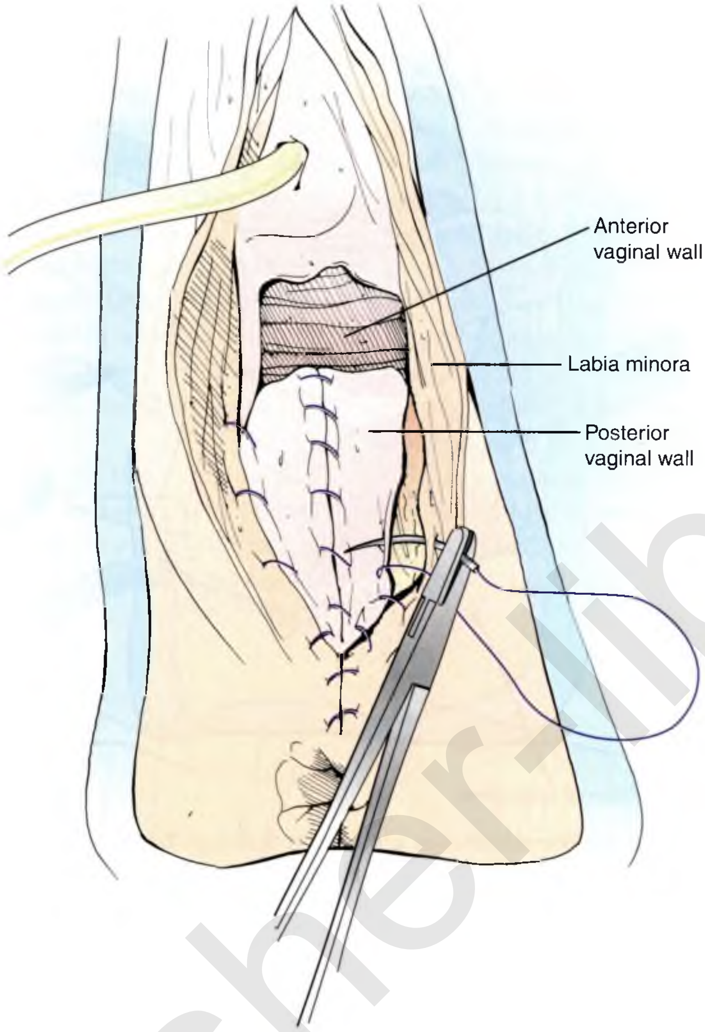

FIGURE 38.9 Closure of the epithelium is accomplished in a simple running fashion: First the longitudinal incision of the posterior vaginal wall is closed. Next the transverse incision is closed. Repair of the EAS and perineal body changes the three-dimensional morphology, and frequently requires a longitudinal closure on perineal skin to optimize normal vulvar anatomy.

POSTOPERATIVE CONSIDERATIONS

Superficial wound dehiscence is reported in up to 30% of patients undergoing overlapping sphincteroplasty. This is not entirely surprising given the contaminated field, and in most circumstances, the superficial dehiscence heals by secondary intention without compromising the sphincter repair. Nevertheless, we generally encourage postoperative perineal care that will empirically minimize the risk of dehiscence. Specifically, we ask patients to avoid sitting in favor of standing or lying, as a means to limit tension on the repair. We also advocate daily sitz baths to maximize wound hygiene. Underlining these recommendations and educating patients in how to pursue them leads us to admit patients undergoing overlapping sphincteroplasty for 1 to 2 nights. We continue this regime for 2 weeks after surgery.

Initially, we usually provide intravenous narcotics or patient-controlled analgesia immediately after surgery for postoperative pain management. Pain management thereafter is adequately managed with nonsteroidal anti-inflammatory drugs after postoperative day 1. A regular schedule of oral medication helps to minimize postoperative pain needs, by providing a baseline analgesia. Oral narcotics can then be used on an as needed basis for pain spikes.

Prolonged bladder drainage is not generally necessary for patients with normal bladder function, although an indwelling catheter is appropriate until the vaginal pack is removed. Urinary retention is rare after an isolated overlapping sphincteroplasty, although postoperative spasm of the pelvic floor can cause a functional obstruction occasionally. Consequently, confirmation of normal voiding, including measurement of the post-void residual is a good practice. The post-void residual can be measured with an ultrasound device or straight catheterization and should be less than 100 ml.

The optimal defecatory function after surgery is a well-formed stool. Constipation that results in either straining or the passage of large bulky stools can compromise the integrity of the repair. Conversely, loose watery stool make perineal hygiene more difficult. Consequently, we do not routinely use stool softeners, and try to minimize the use of narcotics.

Patients should be instructed to avoid sexual relations and use of tampons for 6 weeks until the incisions are fully healed. During the first 6 weeks, activities that increase intra-abdominal pressure should be avoided as they predispose to recurrent prolapse.

Operative Note

PROCEDURE: OVERLAPPING SPHINCTEROPLASTY

The patient was taken to the operating room, where her identity and the surgical plan were confirmed during a preoperative briefing. After the establishment of adequate anesthesia, pneumatic compression devices were placed and antibiotic prophylaxis initiated. She was placed in a dorsal lithotomy position, and the vaginal and perineal fields were prepped and draped. The operative team completed a time-out.

The procedure began with identification of the EAS using a Péna muscle stimulator. A transverse incision was then made at the fourchette and extended on to the perineum using a semilunar incision to provide access to the previously identified scarred ends of the EAS. A longitudinal incision was made in the posterior wall of the vagina and carried up half the length of the vagina. The underlying tissue was then sharply dissected off the underlying tissue to fully expose the perineum. An assessment of the perineal body revealed that the rectovaginal fascia was separated from the perineal body.

The Péna muscle stimulator was used to identify the contractile portion of the EAS and the scarred ends were grasped with Allis clamps. Skin hooks were placed on the epithelium to provide traction as the scarred end on the left was pulled anteriorly to provide countertraction. The left scarred end was then dissected away from the surrounding tissue using needle point electrocautery. The same procedure was used to dissect the right scarred end of the EAS, taking care not to dissect beyond 2 and 11 o'clock, respectively. Bleeding from the EAS was controlled with a figure-eight stitch of 2-0 polyglactin 910. The intersphincteric groove was then developed bilaterally.

After completing the dissection, the wound was irrigated. The IAS was then repaired using 3-0 polydioxanone in a simple running fashion. The wound was irrigated again. Assessment of the EAS revealed that overlapping the left end over the right end provided the best anatomical outcome. The EAS was then repaired so that the left end of the sphincter overlapped the right end, using three interrupted longitudinal stitches of 2-0 polydioxanone through and through the scarred ends of both muscles. Once all sutures were placed, the Péna muscle stimulator was used to confirm that the repaired sphincter contracted circumferentially.

The wound was further irrigated. The rectovaginal fascia was then reattached to the pineal body using 2-0 polydioxanone sutures in simple interrupted stitches, burying the stitches below the rectovaginal fascia. The wound was further irrigated. The posterior vaginal wall was closed using 3-0 polyglactin 910 in a simple running stitch. Assessment of the perineal anatomy revealed the need for a Y closure to optimize the perineal anatomy. The skin was further closed with a transverse running stitch at the fourchette using 3-0 polyglactin, followed by a longitudinal running stitch using 3-0 polyglactin.

The patient was returned to a supine position, extubated, and transferred to the post anesthesia unit in good condition.

COMPLICATIONS

Intraoperative	Postoperative
Rectotomy 5%	Superficial dehiscence 30%
	Complete dehiscence 2%

Suggested Reading

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4. Dunivan GC, Heymen S, Palsson OS, et al. Fecal incontinence in primary care: prevalence, diagnosis, and health care utilization. Am J Obstet Gynecol 2010;202:493.e1-493.e6.
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APPENDIX 1

Example Operative Note

Patient name: Doe, Jane

MRN: 123-45678

Date: 99/99/99

Surgeon: I. M. Surgeon

Assistant: I. M. Assist

Anesthesiologist: Anest. Thesiology

Procedure: Laparoscopic supracervical hysterectomy

Findings: Normal appendix, liver edge and gallbladder. No evidence of endometriosis, pelvic adhesions, or malignancy. Uterus enlarged to 12 weeks gestational age, normal adnexa, normal ovaries without lesions, cysts, or corpus luteum, cervix multiparous without overt lesions.

PROCEDURE

The patient was taken to the operating room, where her identity was confirmed. After the establishment of adequate anesthesia, pneumatic sequential compression devices were placed in the lower extremities and antibiotic prophylaxis initiated. Patient was placed in the dorsal lithotomy position, and a combined abdominal and vaginal prep and sterile drape was performed. Arms were padded and tucked in military position, and the hip and ankles placed in neutral position and knees flexed to 90° to minimize nerve compression. The operative team completed a 'time-out' when universal precautions where reviewed, including patient identification, site of surgery, and need for prophylactic antibiotics. The team's questions were answered. A Foley catheter was placed to drain the bladder. A forniceal delineator was placed transvaginally around the cervix, and a uterine manipulator was inserted into the uterus after the cervix was dilated to the appropriate size.

All port sites were infiltrated with bupivacaine. A 5 mm incision was made in the infraumbilical skin, and the subcutaneous tissue bluntly dissected down to the fascia with a Kelly clamp. A blunt insufflation needle was then inserted gently into the abdominal cavity and low entry pressures were confirmed. Three liters of CO_2 gas was then insufflated to achieve pneumoperitoneum and continuous insufflation was continued with a preset maximum of 15 mmHg. A 5 mm atraumatic, radially dilating trocar was then inserted into the abdominal cavity through the infraumbilical incision and safe entry confirmed by visualization through the laparoscope. Additional 5 mm RLQ and LLQ trocars were placed through incisions 1 cm medial and superior to the anterior superior iliac spine (ASIS). An 11 mm port was placed 3 cm above the symphysis pubis. The patient was then placed in Trendelenburg position. Bipolar desiccating forceps (at 35 W) were used during the case for vessel sealing. Tissue dissection was performed with a combination of blunt dissection, sharp scissor dissection, and monopolar nonmodulated current desiccation at 30 W.

The small and large bowels were retracted above the sacral promontory to expose the posterior cul-de-sac. The upper abdomen and the appendix were visualized to confirm absence of incidental pathology. The uterus was mobilized gently to confirm that the uterine vessels would be accessible and that the anterior cul-de-sac and bladder reflection could be seen. The course of both ureters was identified from the pelvic brim and traced down to the uterocervical junction.

The round ligaments were desiccated and divided allowing entry into the broad ligament, which was bluntly dissected open. The utero-ovarian ligaments were identified to be away from the ureters on both sides, and were then desiccated and divided. The ovaries were left in place. The anterior bladder flap was then mobilized sharply away from the round ligaments to the peritoneal reflection, using the vaginal forniceal delineator as a landmark. The bladder flap was carefully dissected free from the underlying cervix until the plane of Denonvillier's fascia was exposed. Small bleeders were desiccated and divided as needed. The uterine vessels were skeletonized sharply on both sides at the level of the uterosacral ligament insertion. A bipolar clamp was then used to desiccate both uterine pedicles at this site. The uterus blanched, reflecting loss of blood flow. A monopolar hook electrode was then used to amputate the uterine corpus at 50 W of cutting current. Small bleeders were desiccated subsequently from the cervical stump, and a bipolar clamp was inserted into the cervical canal to ablate any residual endometrial tissue. The uterine corpus was then fed into an electromechanical morcellator inserted through the midline suprapubic port and removed from the patient in multiple passes. The morcellator blade was monitored carefully at all times during operation to avoid incidental injury to other pelvic structures. Fragments of morcellated uterus were carefully searched for in the pelvis and in the pericolic gutters and any fragments encountered were removed to minimize the risk of parasitic myomas and/or sepsis.

The pelvis was deflated to 6 mmHg of intraabdominal pressure and all pedicles inspected for hemostasis. Thorough irrigation of the pelvis was performed with normal saline and evacuated. The pneumoperitoneum was released and as much CO_2 was evacuated as possible. The fascia of all 10 mm or larger ports was closed with braided absorbable suture, and the skin incisions were closed with subcuticular stitches. All instruments were removed from the vagina and the Foley catheter was left in overnight. The patient was extubated and transferred to recovery in good condition. No complications were observed.

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Note: Page numbers in italics indicate figures