Chapter 32B
Vaginal Hysterectomy

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DEFINITIONS

Endopelvic fascia—The layer of fibroelastic connective endopelvic tissue surrounding the bladder, vagina, and rectum. By investing the central pelvic organs in a continuous fashion from the vaginal introitus to the axial skeleton (sacrum), this tissue furnishes suspension to the entire uterovaginal complex and surrounding organs. Division of the paracolpium portion of this continuum is necessary for the completion of a vaginal hysterectomy.

Enterocele—Formed from a separation of the rectovaginal fascia or the pubocervical fascia from the posterior cervix or anterior cervix, respectively. An enterocele is a pelvic hernia that descends through the posterior vaginal fornix or anterior vaginal fornix. The most common location for an enterocele is the posterior superior vaginal segment.

Intramyometrial coring—A surgical technique useful for removal of a large uterus during vaginal hysterectomy. After the uterine vessels have been divided, the myometrium can be circumferentially incised with a scalpel placed parallel to the long axis of the uterus and beneath the serosal covering of the uterus. In effect, coring converts the normal spherical shape of the uterus into an elongated cylindrical or rod shape, enhancing the surgeon's ability to facilitate uterine removal.

Morcellation—A surgical technique that is useful in reducing the size of an enlarged uterus after the paracolpium and uterine vasculature are ligated. The cervix is divided in a vertical fashion until the enlarged fundus is encountered. At that point, leiomyomata or myometrial segments can be removed using various types of sharp and blunt dissection until the fundus is sufficiently reduced in size to allow completion of extirpation of the organ.

McCall culdoplasty—The most commonly employed technique to reattach the uterosacral ligaments to the posterior vaginal cuff. This technique is useful in posterior enterocele prophylaxis.

The technique of operating through the vagina is a prerogative of the gynecologic surgeon. Vaginal surgery is an essential prerequisite in the cultural and surgical training of a qualified gynecologist. However, in the United States, the most common operation gynecologists perform, the hysterectomy, is predominantly done abdominally or with one of the various endoscopic techniques.

Vaginal hysterectomy is the signature operation of the gynecologic profession. Ample evidence shows that the vaginal approach results in lower morbidity, less pain, more rapid recovery, more rapid return to normal activities, consumption of fewer health care dollars and resources, and a host of other benefits. A gynecologic surgeon should have the ability to perform abdominal, endoscopic, and vaginal hysterectomies. However, vaginal hysterectomy is, and should remain, the hallmark of gynecologic extirpative hysterectomy surgery, and the ability to perform hysterectomy via the vaginal route is a measure of surgical excellence. Vaginal hysterectomy is the “gold standard” for the surgical removal of the uterus because it is minimally invasive when compared to all other routes and techniques. The vaginal route should be considered primary unless a specific contraindication to that approach is recognized. Surgeons' preference of route is not an indication for avoiding the vaginal approach.

INDICATIONS

With the advent of evidence-based research and outcome studies, several randomized controlled trials have documented the advantages of the vaginal approach to hysterectomy. A 2010 Cochrane review concluded that vaginal hysterectomy, rather than abdominal, should be performed whenever technically feasible to reduce complications, shorten hospital stays, and accelerate the patient's return to normal activities. Endoscopic approaches were recommended only in those cases where the vaginal approach was not practical. Unfortunately, these clear evidence-based recommendations have not stimulated a change in physician practice patterns. Several authors have addressed the reasons for the continued dominance of the abdominal route for hysterectomy. Johns and colleagues suggested that the route of hysterectomy is usually determined by the skill, experience, and preference of the operating gynecologist. Unfortunately, few other parameters really matter in day-to-day practice. Dorsey and associates stated that the hysterectomy patient is best served by a surgeon who selects the route with which he or she is most confident and comfortable; however, ideal surgical care remains the responsibility of the surgeon. With that in mind, training programs should do whatever is necessary to provide graduates with skill sets that give patients access to evidence-based care. Julian has addressed this concept in detail.

Suggesting that the competency and comfort of the surgeon to perform a vaginal hysterectomy is a requisite to selection of that route may restrict its implementation as a primary technique. Surgeons who prefer to use abdominal or laparoscopic techniques may therefore not choose the route that is most minimally invasive to the patient. Hysterectomy guidelines have been developed in order to identify when abdominal hysterectomy is truly mandated (**Fig. 32B.1**). Using these guidelines, expert gynecologic surgeons have achieved vaginal hysterectomy rates in excess of 90% without sacrificing quality of care. In contrast, the overall US average for the vaginal approach is approximately 30%, with that figure including laparoscopically assisted vaginal hysterectomy. More recent data indicate that the advent of robotic techniques will further complicate the selection of hysterectomy route in a way that does not rely on outcome data. In an era of pressure to consume fewer health care dollars, the more expensive abdominal, laparoscopic, and robotic approaches continue to flourish despite incontrovertible evidence that vaginal hysterectomy provides as good or better outcomes at less cost.

Vaginal hysterectomy traditionally has been indicated for women with uterine or pelvic organ prolapse, and traditional indications for abdominal hysterectomy have included an

enlarged uterus, prior pelvic surgery, malignancy, and extrauterine disease, such as endometriosis or pelvic inflammatory disease. We now know that successful vaginal hysterectomy can be done in most of these patients; however, special techniques, such as uterine coring or morcellation, are often helpful, and such ancillary techniques as laparoscopic lymphadenectomy may be required in women with cervical or endometrial cancer. Laparoscopy may also be useful to help evaluate an adnexal mass prior to removal or the extent of endometriosis before completing the surgery with a vaginal hysterectomy and oophorectomy. Laparoscopy may also be used as an aid to reassure and give confidence to the less experienced vaginal surgeon to objectify the pelvic anatomy so that vaginal hysterectomy, in many cases, can be accomplished. With increasing confidence and skill that comes from experience, there are very few patients with indications for hysterectomy in whom the procedure cannot be performed vaginally.

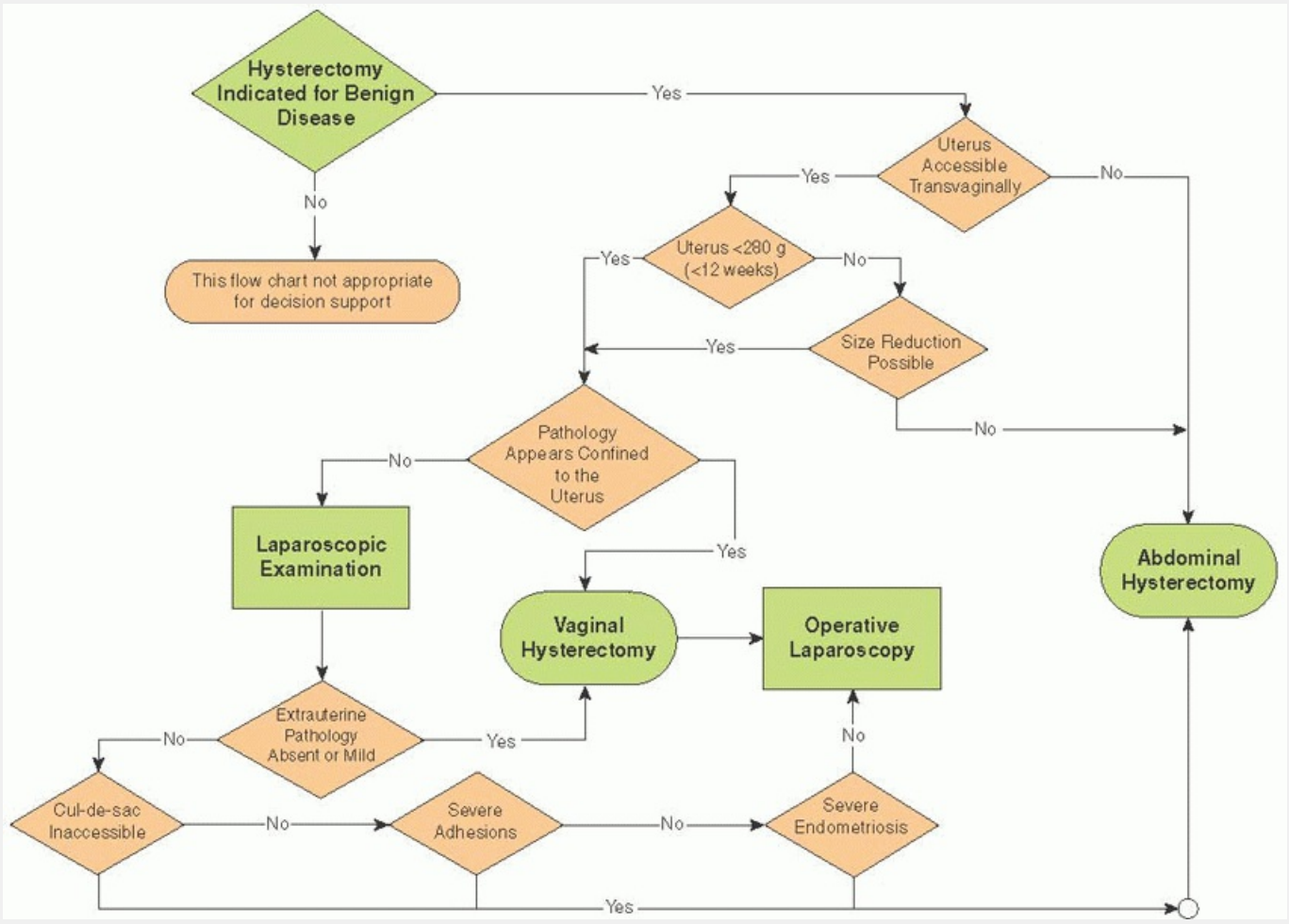

FIGURE 32B.1 Determining the route of hysterectomy. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007;95, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

PREOPERATIVE PREPARATION

If the surgeon is concerned about unintentionally injuring the rectum, it may be important for the patient to cleanse the rectum with an electrolyte purgative or a Phospho soda enema given the evening before surgery. Bowel cleansing evacuates solid stool from the rectum, reduces the bacterial load of the intestinal tract, and reduces the incidence of postoperative ileus and constipation.

A single-dose antibiotic as a prophylactic measure, usually a first-generation cephalosporin, should be given within 1 hour before the operation is started. Prophylactic antibiotics have been documented to reduce the risk of postoperative infections. The vaginal pH may be checked at a preoperative visit and prior to prepping the patient. If the pH is elevated above normal (3.8 to 4.2), the normal vaginal ecosystem has been altered. A vaginal pH in the range of 5.0 or greater suggests the potential for bacterial vaginosis and the likelihood that the facultative bacteria normally present in the vagina at concentrations of 10^3 have reached concentrations of 10^8. This finding strongly suggests that the vagina is infected before the start of the operation. These patients may not be protected by routine prophylactic antibiotics but may benefit from postoperative therapeutic antibiotics and ideally correction prior to arrival in the operating room. In such patients, consider administration of 500 mg of metronidazole orally twice daily from the second to the seventh postoperative day. This practice reduces the postoperative infection rate following vaginal hysterectomy.

Gynecologists have long believed that a Betadine solution used as a preoperative vaginal scrub will remove most potential pathogens in the vagina, but this has recently been questioned. Some surgeons prep patients with

70% ethanol, even in the vagina, and use a self-adherent surgical drape that covers the rectum and conveniently keeps pubic hair and the labia from interfering with the operative field. Shaving of the pubic hair

is unnecessary, and shaven patients are more uncomfortable postoperatively. Clipping of pubic hair is preferred if hair removal is desired.

Copious lavage of the vaginal vault before, during, and after vaginal hysterectomy may also help to prevent postoperative infections by removing nonadherent bacteria from the vaginal epithelium. Lavage is not used as frequently in the vaginal approach as in other surgical approaches despite the fact that the vagina is a clean contaminated operative field.

The type of stirrups used for the lithotomy position is solely at the discretion of the surgeon. No matter what type is used, careful attention is required to protect vulnerable vascular, bony, and neurologic points in the lower extremities. Some surgeons prefer candy cane-type stirrups. The patient should be positioned with the buttocks at the end of the surgical table or just beyond. The table is placed at a zero horizontal position without Trendelenburg. In this manner, the surgeon can look directly into the vagina without having to look over the weighted speculum. Boot-type stirrups have achieved popularity and may also be used with the patient in the standard lithotomy position. Here, the femur is vertical, and the tibia/ fibula horizontal and oriented toward the contralateral shoulder. Hyperflexion of the femur is discouraged with either type of stirrup. If a procedure lasts more than 4 hours, the risk of neurovascular injury increases. For that reason, every 90 minutes to 2 hours, lowering the legs from the standard lithotomy position into a low lithotomy position for a period of approximately 10 minutes should be considered. Also, final positioning of the patient should protect the patient, allowing the surgeon to operate comfortably, and provide adequate room for surgical assistants to be effective. Assistants need to stand inside the stirrups to see the operative field to both observe and learn the operation. Pneumatic compression stockings are also recommended.

OPERATIVE TECHNIQUE

An examination under anesthesia before initiating the operation to confirm the preoperative findings is recommended in all cases. Undetected pathology may be appreciated during an anesthetized exam along with a more complete assessment of the subtleties of the patient's anatomy. Placement of a tenaculum for applying traction on the cervix can document the degree of descensus. If more descensus is desired, strong traction on the cervix with vigorous massage of the uterosacral ligaments, especially the left uterosacral ligament, for approximately 30 seconds results in a further descensus of the cervix of approximately 2 to 3 cm.

Although some surgeons prefer to stand during vaginal hysterectomy, others prefer to sit. Assistants to the surgeon should be as comfortable as possible during the operation. The height of the operating table and the surgeon's chair should be adjusted accordingly. If sitting, an instrument tray may be placed on the surgeon's lap, making it easier to have access to the desired instruments during the operation. The number of instruments used during vaginal surgery should be kept at a minimum to prevent instruments from obscuring the surgeon's vision.

Catheterization of the bladder before the initiation of vaginal hysterectomy is performed at the preference of the surgeon. Sometimes, it is easier to identify unintentional cystotomy when the bladder is moderately distended (approximately 200 mL) with urine, dyed fluid, or sterile infant milk. If the bladder becomes too distended, catheter drainage of the bladder may improve the visibility within the restricted operative space. If a cystotomy occurs, it is usually best to complete the vaginal hysterectomy before proceeding with repair of the bladder. In many cases, the cystotomy may make the bladder dissection easier because now, the location of the bladder is clear and the correct plane of dissection is more easily visualized. Sometimes, a finger in the bladder may also facilitate a difficult vesicocervical or vesicouterine dissection. The bladder must be mobilized adequately around the area of operative injury so that the surgeon can completely evaluate the extent of the cystotomy and be

certain that the repair is completed without excess tension on the injured site.

The initial anterior vaginal incision should be made through the full thickness of the vaginal epithelium at the border of the vaginal rugae and the smooth epithelium covering the cervix (**Fig. 32B.2**). An initial circumscribing cervical incision made on the cervix at the junction of rugae and smooth epithelium preserves vaginal length and helps avoid unintentional entry into the bladder anteriorly and rectum posteriorly. In addition, an incision at the point where the vaginal rugae begin to reflect away from the smooth epithelium of the cervix appropriately places the epithelial incision closer to the point of entry into the posterior and anterior peritoneum (**Fig. 32B.3**). An incision in this location allows the surgeon to avoid excessive dissection of the connective tissues between the vagina and the peritoneum, reduces blood loss from cervical artery branches, shortens operative time, and facilitates identification of the peritoneal entry points.

Julian has reported on the benefit of infiltrating the vaginal wall with a mixture of 1:200,000 epinephrine diluted in normal saline to control small blood vessel bleeding from the vagina. However, in our experience, oozing from the incised

vaginal epithelium rarely results in significant blood loss when the incision is made where the vaginal rugae start. If oozing from the incised edges of the vagina becomes a problem, it is easy to control with electrocautery.

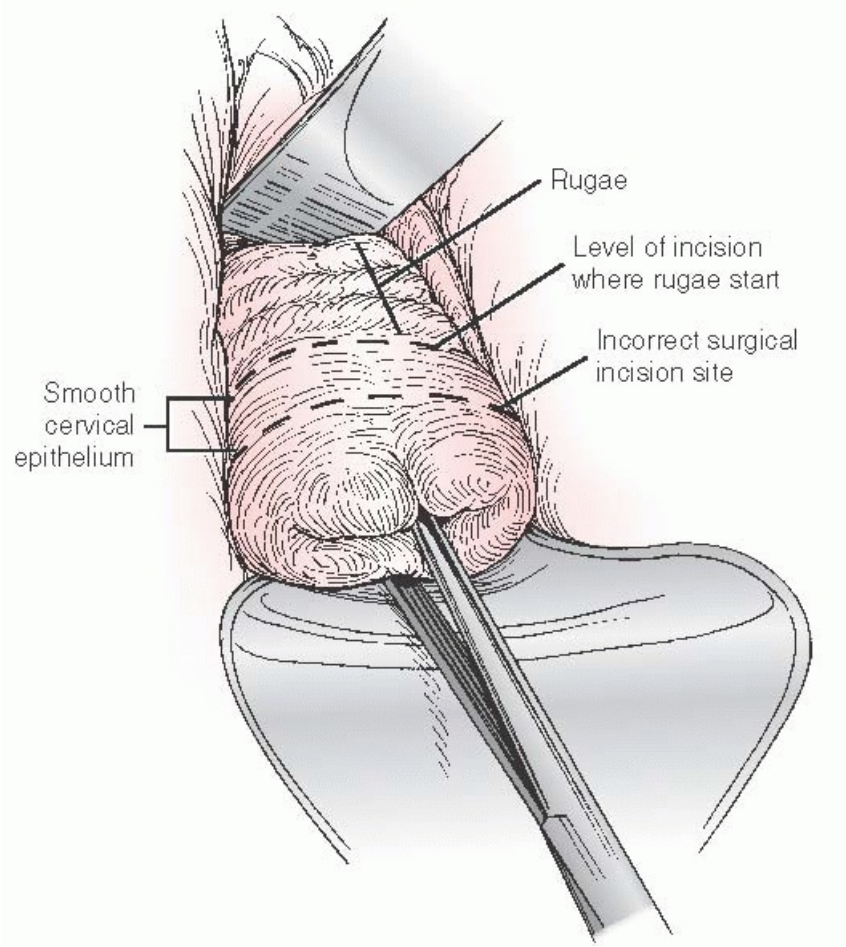

FIGURE 32B.2 Initial incision should be a full-thickness incision at the border where the vaginal rugae begin and the smooth cervical epithelium on the cervix ends. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

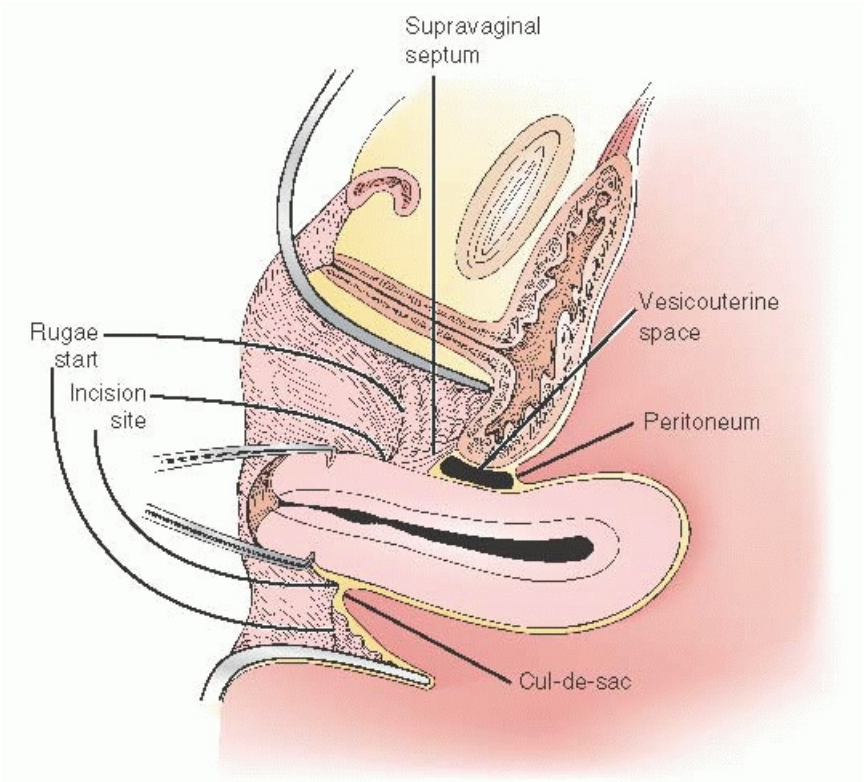

FIGURE 32B.3 Relationship between the vaginal rugae and the anterior and posterior peritoneum. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

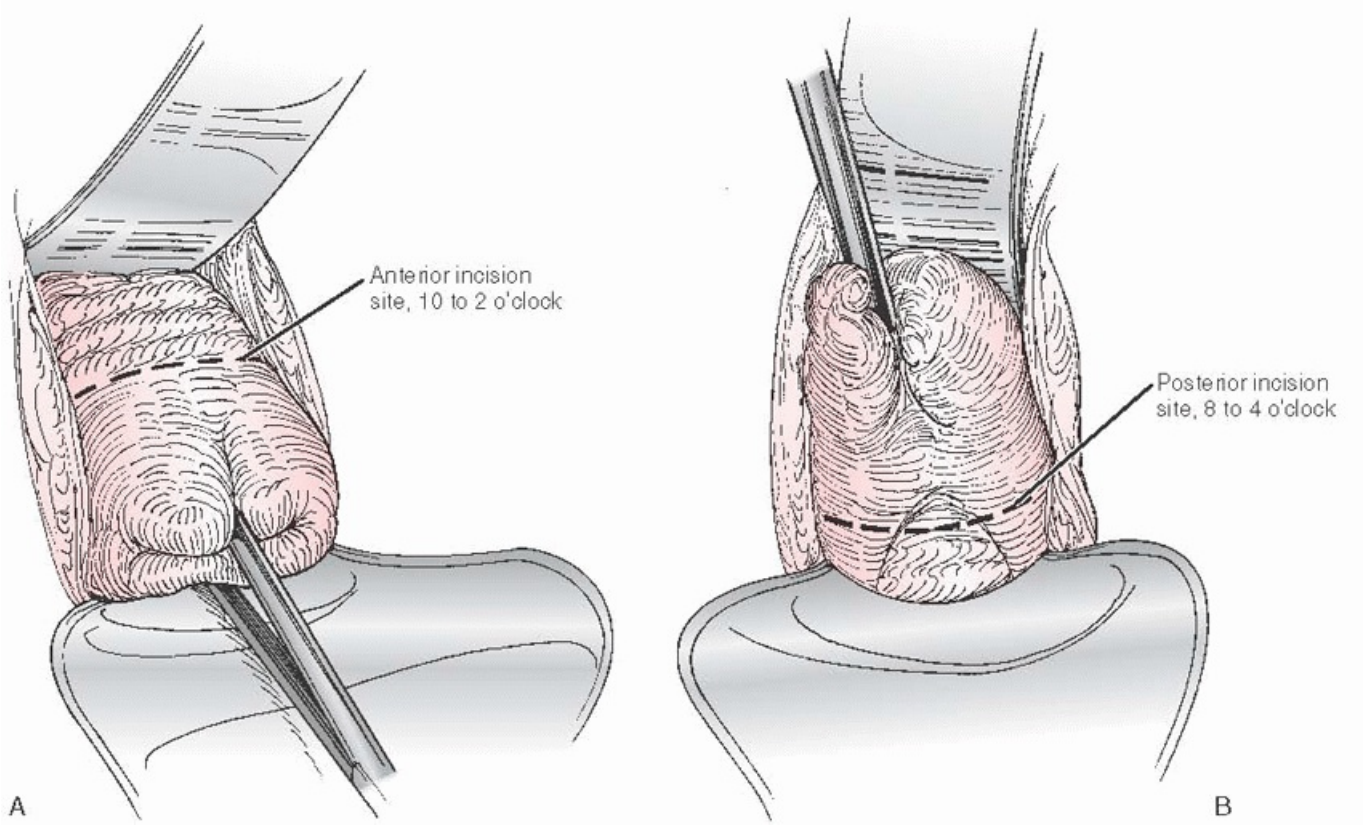

FIGURE 32B.4 A: When the cervix remains within the vagina when traction is applied with a tenaculum, the anterior full-thickness vaginal incision needs only to be performed between 10 and 2 o'clock. **B:** Initial full-thickness vaginal incision needs only to be performed between the 8- and 4-o'clock position. Note this incision is placed posteriorly where the vaginal rugae begin and where the uterosacral ligaments attach to the cervix. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA:

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At the beginning of the operation, when the cervix is still within the vagina, a circumscribing incision around the cervix is difficult to perform with a scalpel or electrocautery instrument because it is difficult to maintain either device perpendicular to the circumscribing vaginal incision. This issue is not a concern when the cervix protrudes from the vagina. However, when the cervix cannot be brought out of the vagina with traction, the initial incision should be made on the anterior vaginal wall from approximately the 10- to 2-o'clock position and on the posterior vaginal wall between the 8- and 4-o'clock positions. These incisions provide adequate space for transection of the paracolpium allowing the cervix to descend for subsequent entry into the posterior and anterior peritoneum and ligation of the uterine vasculature at the appropriate time (**Fig. 32B.4A, B**).

After completing the vaginal incisions, the cervical tenaculum is replaced on the posterior lip of the cervix with taut traction of the cervix achieved by elevating the tenaculum anteriorly. If the posterior incision in the vagina is placed at the appropriate level where rugae are not present and at the point where the uterosacral ligaments join the cervix, the posterior cul-de-sac and peritoneum can readily be identified with an Allis clamp or tissue forceps. This step is facilitated by putting the vaginal epithelium and accompanying peritoneum on stretch as the peritoneum bulges outward

toward the surgeon (**Fig. 32B.5**). The importance of properly performing this step cannot be overstated. Entry into the posterior peritoneum is best accomplished by an incision directly above the tissue forceps that grasps the outward U-shaped bulge of the peritoneal fold (**Fig. 32B.6**). If the incision is placed closer to the cervix in an attempt to prevent injury to the rectum, the dissection often proceeds into the posterior cervical stroma. Unfortunately, an incision placed nearer to the cervix frequently results in a retroperitoneal dissection, which continues in this plane and ultimately pushes the peritoneum superiorly and posteriorly, obscuring identification of the peritoneum and frustrating the surgeon. Should this occur, the posterior lip of the cervix and vagina can be cut in a vertical direction that exposes the peritoneum at a higher level so it can be recognized and entered directly. This procedure is a cervicocolpotomy (**Fig. 32B.7**).

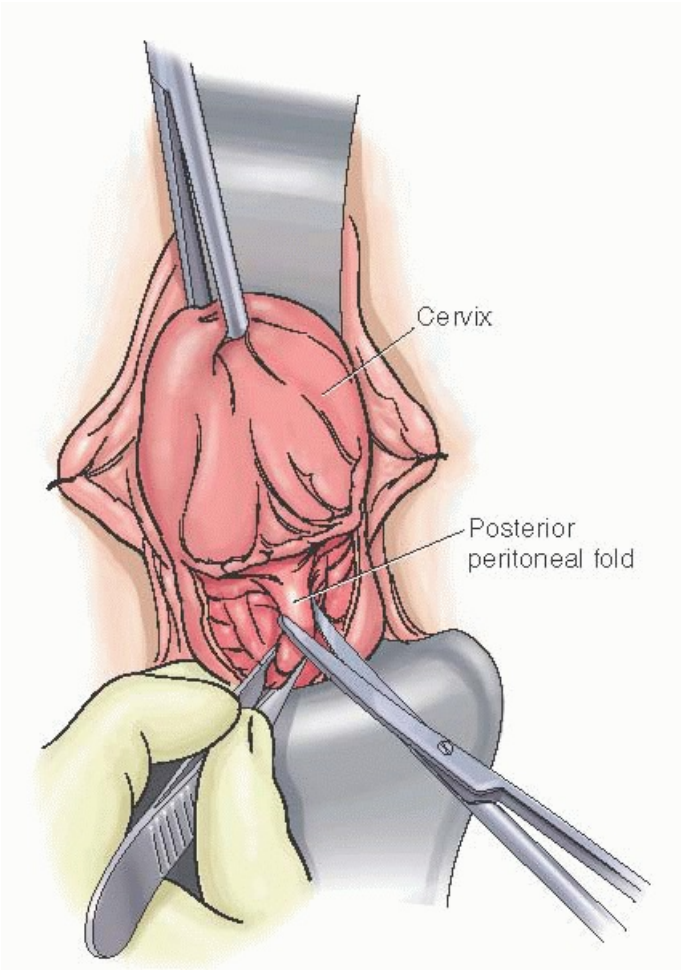

FIGURE 32B.5 With traction on the cervix anteriorly, the posterior peritoneal fold is grasped with tissue forceps, and the peritoneum is entered by incising with scissors the peritoneal fold directly above the tissue forceps. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:107, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

The posterior peritoneum is then opened with curved scissors, and a long-bladed Steiner Auvard weighted speculum is introduced into the posterior peritoneal cavity. Examination of the cul-de-sac can reveal further pathology, for example, endometriosis, leiomyomata, or adnexal pathology—that may need to be addressed later in the operation. Identification of the uterosacral ligaments by palpation can be accomplished during examination of the cul-de-sac by placing a digit medial to the ligament and identifying the rectouterine fold through the posterior colpotomy incision.

Oozing of blood from the posterior incision between the vagina and peritoneum may occur. Placement of a weighted speculum into the posterior peritoneal cavity will compress

most bleeding points in this area until completion of the surgery and cuff closure. If the vaginal epithelium has not been completely circumscribed, once posterior dissection has been developed, the vaginal epithelial incision should be completed by connecting the previous anterior and posterior incisions before the supportive ligaments of the uterus can be clamped.

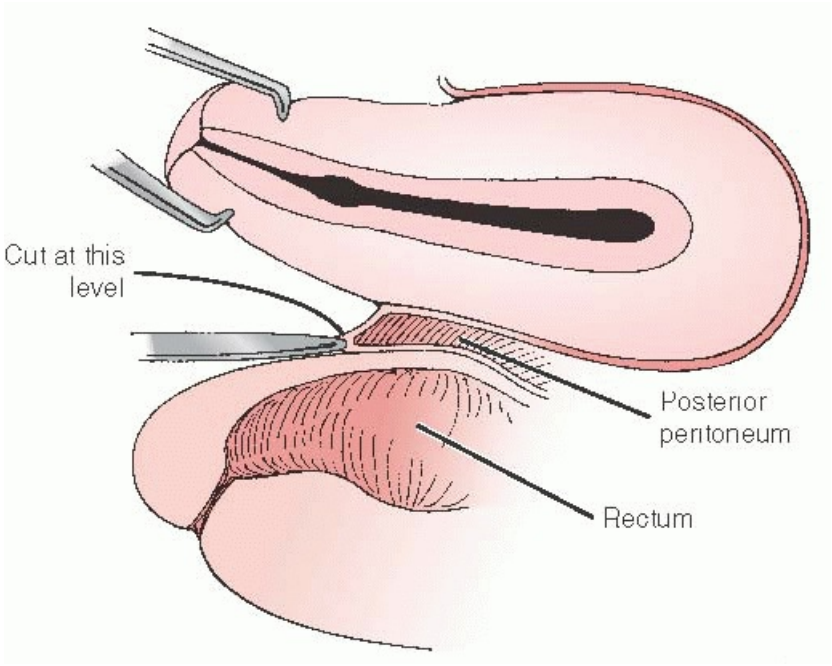

FIGURE 32B.6 Transverse view of entering the peritoneal cavity. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:107, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

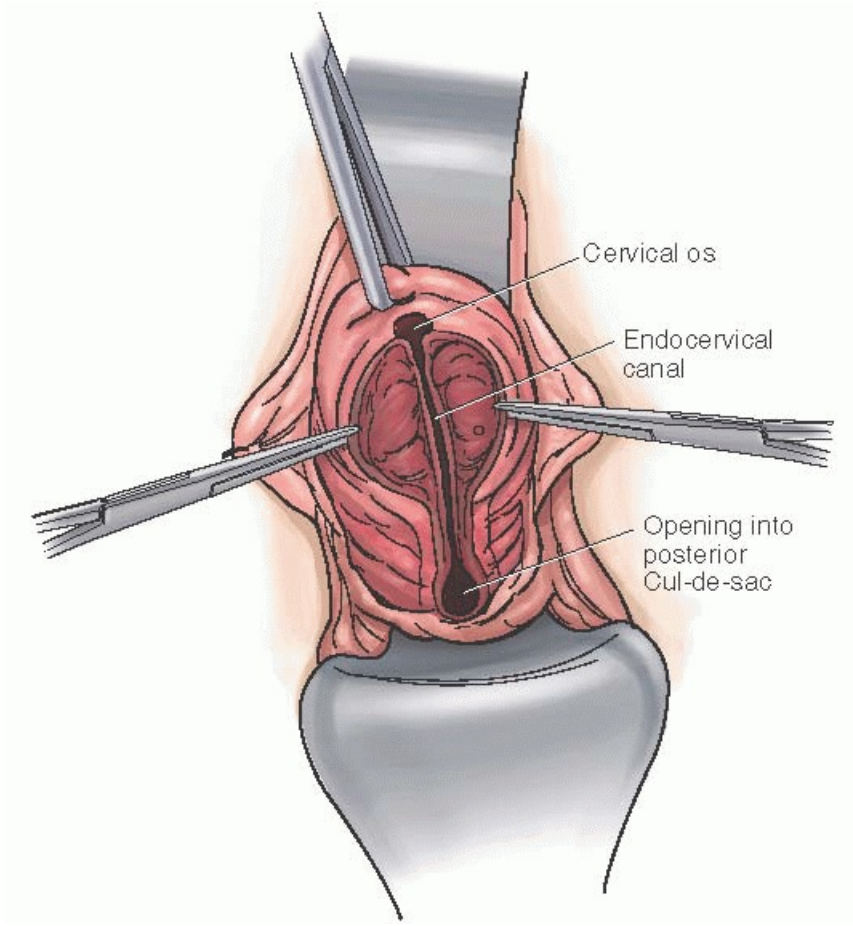

FIGURE 32B.7 Cervical colpotomy for entry into the posterior peritoneum. The posterior cervix is grasped with Allis clamps approximately at 4- and 8-o'clock positions. The cervix is incised starting at the 6-o'clock position and incising the cervix and posterior wall of the uterus until the posterior peritoneum is entered. Once the peritoneum is entered, a weighted speculum is placed into the posterior peritoneal cavity. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams &

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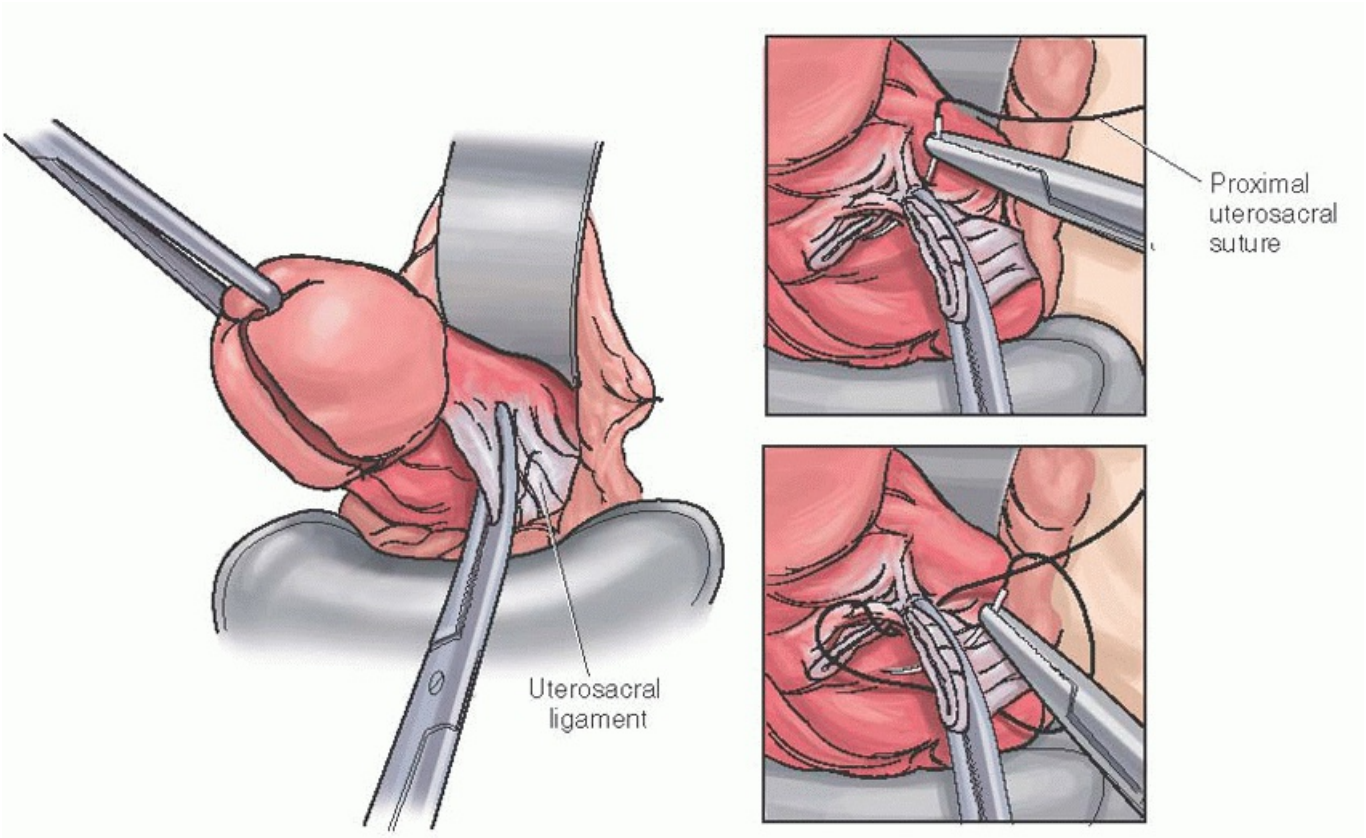

FIGURE 32B.8 The uterosacral ligament is clamped, cut and ligated. Note that the tip of the clamp closely approximates the cervix. The suture ligature is initially placed with the clamp in an almost vertical orientation for maximum exposure to the anterior blade of the clamp but as the needle comes through the pedicle, the clamp is rotated more horizontally to provide better exposure to the underside of the pedicle for easy retrieval of the needle. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:109, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

Transection of the uterosacral ligaments is the single most important step in successfully completing a vaginal hysterectomy. The uterosacral ligament pedicle should be completed by placing the medial jaw of the clamp within the rectouterine fold while holding the clamp vertical and not try to swing around the cervix in a more horizontal plane. The medial tip of each clamp should be placed within the peritoneal cavity in the rectouterine fold and the lateral tip around the outside of the ligament. Special hysterectomy clamps have been developed to improve on the traditional Heaney clamp (**Fig. 32B.8A-C**). After transection of the pedicle, rotating the handles of the clamp laterally and superiorly facilitates suturing at the tip of the clamp. This rotation brings the tip of the clamp into full view and exposes a triangular area beneath the clamp for easier retrieval of the needle. Placement of a double clamp for uterine supportive or vascular structures is not necessary. Each uterosacral ligament should be secured by a transfixation suture to the posterolateral surface of the vagina and tied behind the clamp at about the 4- and 8-o'clock positions. Lateral traction on this suture provides the best exposure to the remaining structures that need to be transected to complete hysterectomy (**Fig. 32B.9**). This traction and the use of large hysterectomy clamps largely replace the need for lateral retractors in the vagina. Clamping and tagging the uterosacral ligaments separately allows for their identification, later use in cuff repair, and, if desired, a McCall culdoplasty at the end of the procedure. The uterosacral ligament pedicle is the only one that needs to be tagged during a vaginal hysterectomy and the only one that may safely be placed under traction.

After making sure the tips of the clamps are within the posterior peritoneal cavity, the cardinal and pubocervical

(bladder pillar) ligaments are clamped by placing a clamp horizontally

and clamping from the apex of the uterosacral pedicle to a point on the anterior cervix medial to the bladder pillar encompassing all the remaining connective tissue of the paracolpium (**Fig. 32B.10**). If already entered, the anterior peritoneum should not be pulled into this clamp at this point of the operation. A complete anterior dissection is needed to safely complete this pedicle. Bringing the anterior and posterior peritoneal edges together should only be accomplished with the uterine artery pedicle as this maneuver serves to seal off the broad ligament and effectively prevents bleeding from the vascular plexus located within the leaves of the broad ligament. Because the anterior peritoneum usually begins at the level of the uterine vessels, there is not enough peritoneal mobility to bring both the anterior and posterior peritoneal surfaces together at the level of the cardinal ligaments. Therefore, to be certain that the surgeon can seal both leaves of the broad ligament together with the uterine artery, it is best to avoid any attempt to bring the peritoneal edges together when the uterosacral or cardinal ligament is clamped. A simple suture ligature first at the tip and then around the end of the clamp is usually sufficient for hemostasis of the cardinal ligament without the need for transfixation. This suture ligature is not tagged or held.

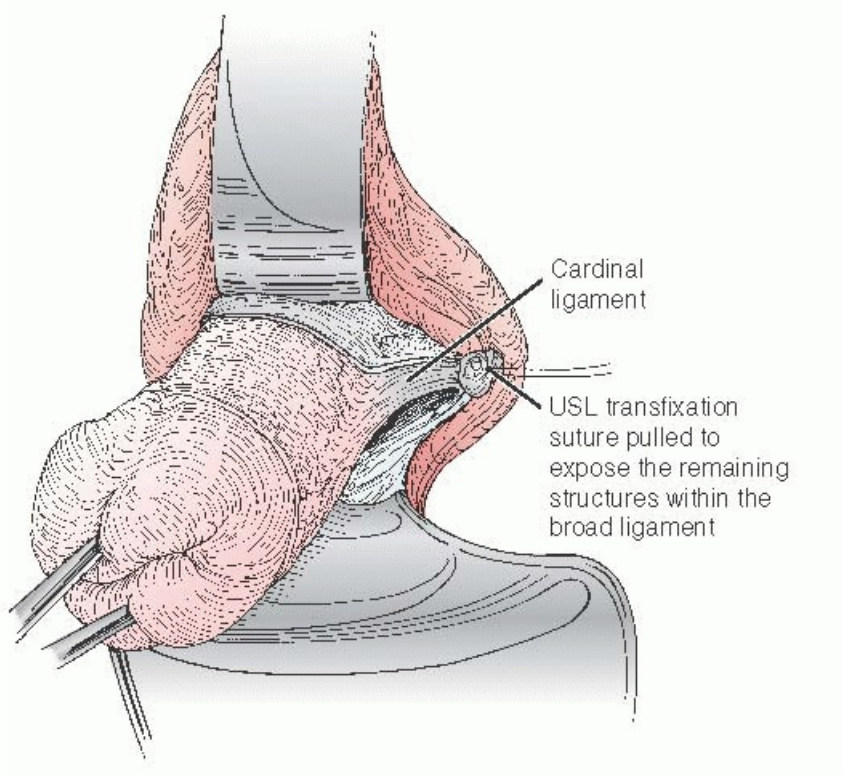

FIGURE 32B.9 Traction on the uterosacral ligament suture laterally exposes the cardinal ligament. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:116, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

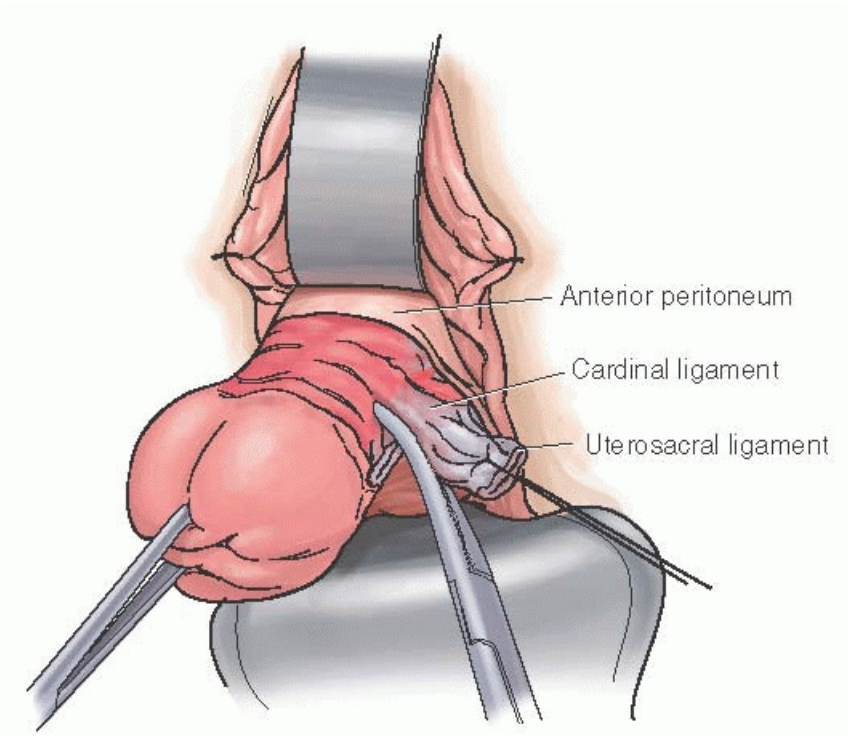

FIGURE 32B.10 With traction on the uterosacral pedicle, the cardinal ligament is exposed and can be clamped with the posterior jaw of the clamp in the posterior peritoneal cavity and the tip of the anterior jaw at the edge of the cervix. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:110, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

If exposure is good, the uterine arteries may be clamped, divided, and ligated at the point before entering the peritoneum anteriorly under the bladder. They are best clamped in their entirety and under direct visualization. In contrast to the uterosacral and cardinal/pubocervical clamps that are placed perpendicular to the body of the cervix, the uterine artery clamp is placed parallel to the long axis of the uterus as the tip of the clamp secures the uterine artery as it bifurcates into ascending and descending branches (**Fig. 32B.11**). As traction is placed on the uterus when the artery is cut, there is a definite sensation that the uterus descends signifying that the entire uterine vascular bundle has been transected, including the ascending and descending branches. If descent of the uterus is not noted, often an additional portion of the uterine artery remains and must be secured with another clamp. A single well-tied suture is all that is required for the uterine artery pedicle. Limiting the tissue within the clamp to the vascular bundle helps to make the pedicle manageable and the suture ligature more secure. Many surgeons try to include middle portions of the broad ligament with the uterine artery because they feel a need to place clamps on the remaining portions of the broad ligament as they proceed up on each side of the uterus.

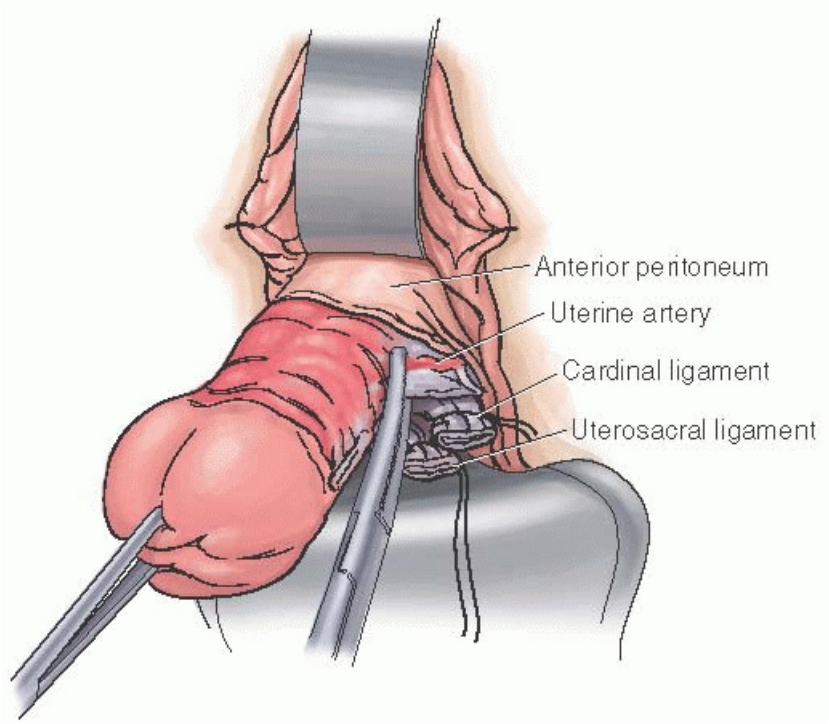

FIGURE 32B.11 If exposure is good after the cardinal ligaments have been divided, the uterine vessels may be clamped before the anterior peritoneum is entered. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:136, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

Complete development by dissection of the vesicocervical and vesicouterine spaces is a prerequisite to identifying and opening the anterior peritoneum. This step is perceived to be the most difficult portion of the vaginal hysterectomy procedure. Adequate exposure, by division of the paracolpium and full dissection of the anterior avascular spaces, makes this key step of hysterectomy much easier to complete.

The cervix should then be retracted downward and inferiorly, and the anterior subvaginal tissue, including the supravaginal septum and the bladder, elevated in the midline and placed on a small amount of tension with an Allis clamp or tissue forceps and elevated. The supravaginal septum is part of the pericervical ring and is identified and incised using curved scissors with the tips pointing downward toward the body of the cervix. The handles of the scissors are not elevated above the horizontal axis because that maneuver would increase the likelihood of dissection into the body of the cervix (**Fig. 32B.12**). Dissection in the proper plane using gentle traction and countertraction exposes the vesicouterine space, the proper avascular cleavage plane to bloodlessly elevate the bladder away from the anterior uterus and thereby gain access to the anterior peritoneum. Gentle push and spread of the blades of the scissors will allow identification of the proper plane of dissection. Bleeding is a warning sign of deviation anteriorly toward the bladder, posteriorly toward the cervix, or laterally toward the bladder pillars. After the vesicouterine

plane is fully developed, a lightweight right-angled retractor can be placed into this space to elevate the bladder and expose the anterior peritoneal fold.

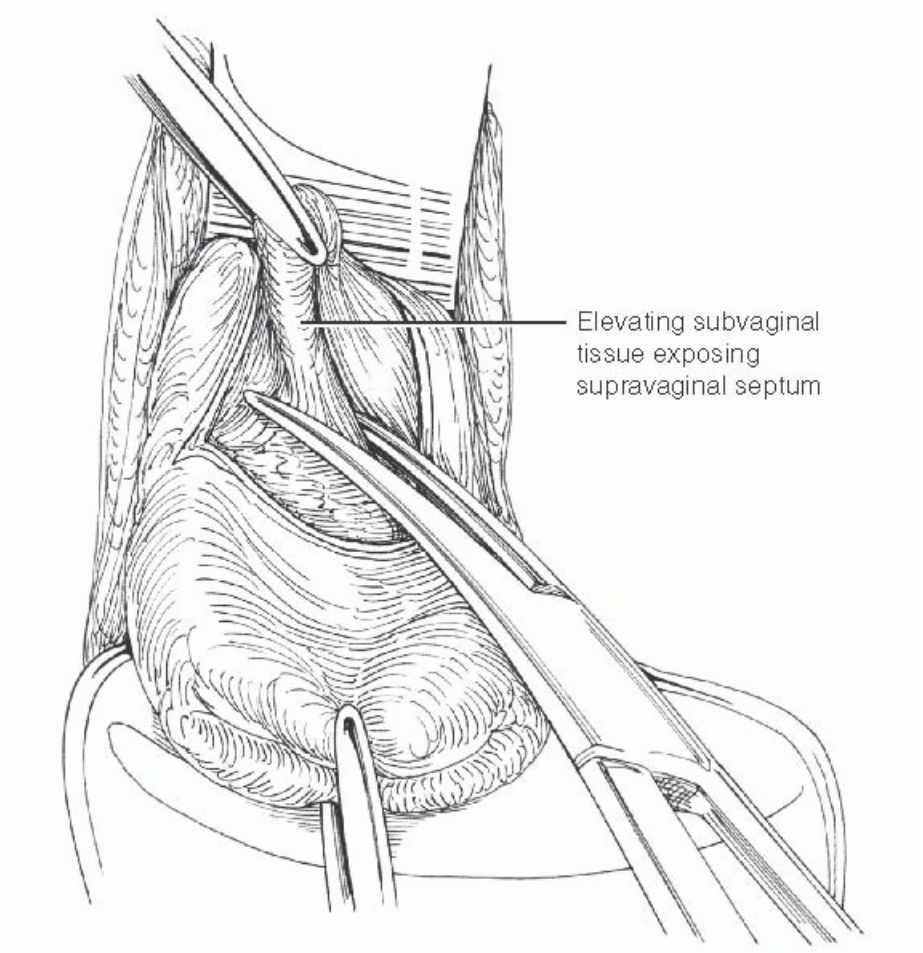

FIGURE 32B.12 Entry into the anterior peritoneum involves incising the supravaginal septum to gain entry into the vesicouterine space. Once the vesicouterine space has been entered, the space is developed by spreading the dissecting scissors for placement of a retractor to elevate the bladder. (From Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia: Lippincott Williams & Wilkins; 2006:109.)

If the patient had a previous cesarean section, the scar of this procedure can be readily visualized and identified separately from the bladder (**Fig. 32B.13**). Controlled dissection of a cesarean section scar is easier and more directly visible from the vaginal than from the abdominal or endoscopic approach. A low transverse cervical cesarean section incision is made in the portion of the cervix near the isthmus of the uterus. For that reason, in the nonpregnant state, the scar is close to the anterior vaginal incision used to develop the vesicocervical and vesicouterine avascular spaces in vaginal hysterectomy and can be readily identified and dissected. A cesarean section scar distorts the anatomy by occluding the vesicouterine space between the scar and the urinary bladder. Further dissection above the scar can be performed by identifying the scar, the bladder, and the peritoneum as independent structures. On occasion, it is also possible to dissect under the scar, which keeps the dissection even further from the urinary bladder (**Fig. 32B.14**). Sheth has described the utility of the broad ligament space in the presence of cesarean scar. Gentle lateral pressure along the side of the cervix and uterine body will allow the anterior leaf of the broad ligament to separate lateral to the cesarean scar. At that point, digital or instrument dissection can proceed medially above the scar and often allow complete isolation of the scar. Classical and low vertical cesarean and myomectomy scars present further

challenges that must be individualized based on case-by-case findings.

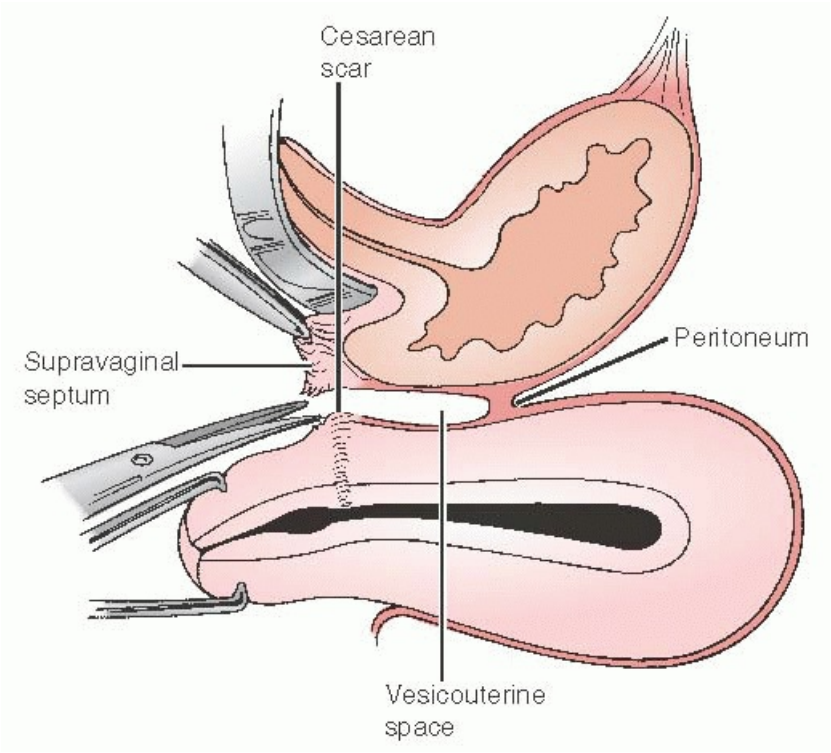

FIGURE 32B.13 Relationship between the supravaginal septum, vesicouterine space, cesarean section scar, and anterior peritoneal fold. (From Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:109. Copyright © 2007 Lippincott Williams & Wilkins.)

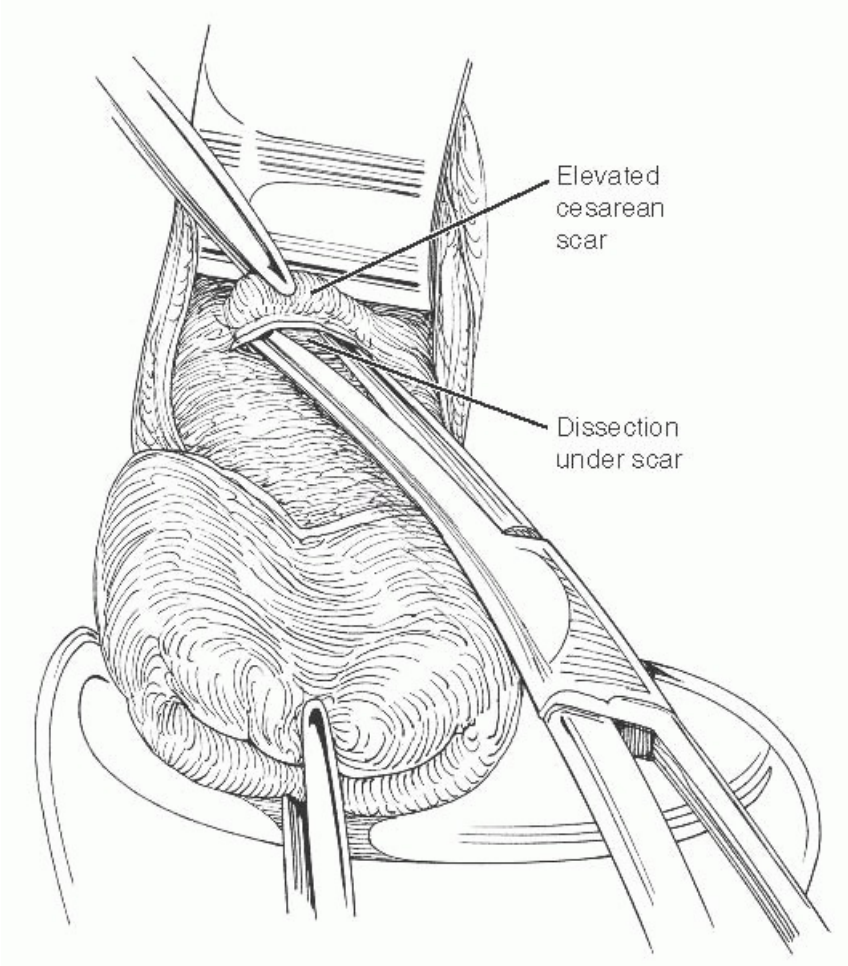

FIGURE 32B.14 Sometimes it is possible to dissect beneath the cesarean section scar to gain entry into the superior part of the vesicouterine space to identify the anterior peritoneal fold. (From Kovac SR, Zimmerman CW,

eds. *Advances in reconstructive vaginal surgery.* Philadelphia: Lippincott Williams & Wilkins; 2006:110.)

After dissection of the vesicouterine space, the anterior peritoneum is grasped under direct vision and entered via a 1-cm opening with the scissors. The shining surface of the peritoneum is recognizable after all adventitial tissue is dissected away and may be identified visually or with the so-called silk sac sign prior to incision. Upon confirmation of entry into the peritoneal cavity by seeing intraperitoneal fat, the opening is further stretched by spreading of the scissors into this space to allow insertion of the right-angle retractor into the anterior cul-de-sac. This retractor should remain in this position for the remainder of the hysterectomy in order to safely elevate the bladder out of the operative field. Proper dissection and peritoneal entry reduce the risk of operative injury to the bladder and ureters (**Fig. 32B.15A, B**). Because of the surgeon's desire to avoid injury to the bladder, there is the tendency to dissect as far as possible from the bladder. This move may cause the surgeon to enter into the connective tissue capsule of the cervix and myometrium of the lower uterine segment. Further retroperitoneal dissection in this area will cause bleeding and further delay anterior peritoneal entry. Similar to the posterior dissection, this problem is more likely when the initial incision into the vagina is made too close to the cervix. Further dissection beneath the peritoneum covering of the anterior uterine segment results in failure to enter the anatomic vesicouterine space between the bladder and uterus. Excessive bleeding, frustration, and a lack of progress will occur. Failure to identify the correct tissue plane or a lack of caution results in either further retroperitoneal dissection or unintentional bladder penetration. Cystoscopy may be performed at any point in the process of anterior dissection to confirm integrity or injury to the bladder and ureters.

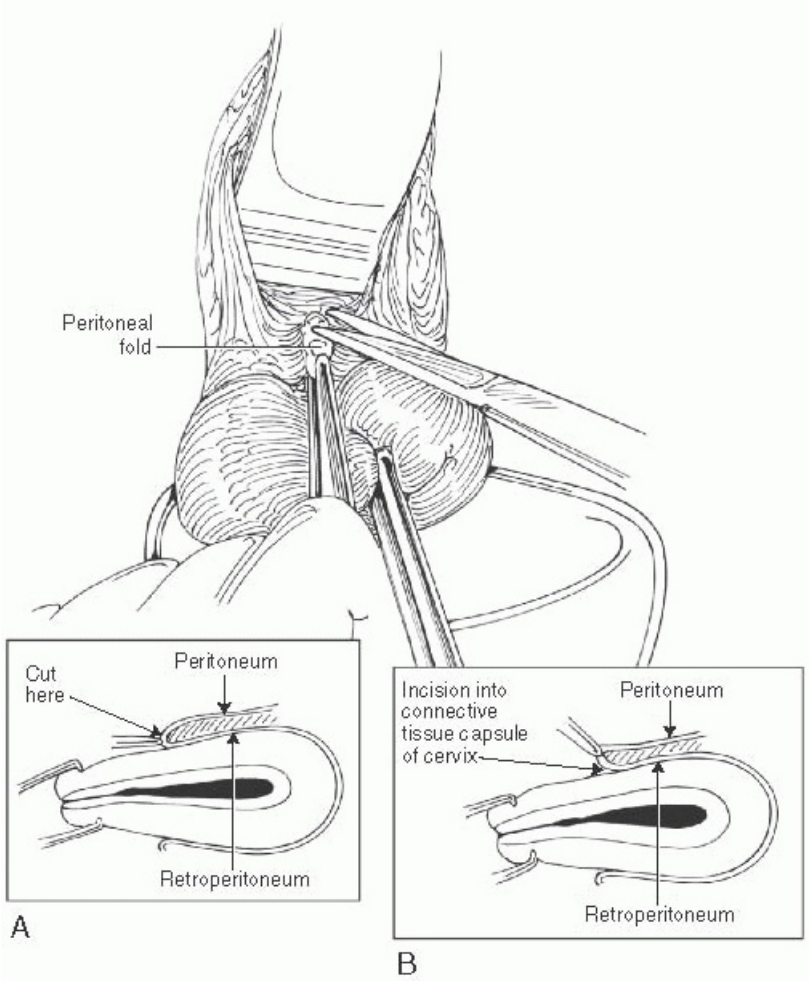

FIGURE 32B.15 Entry into the anterior peritoneum. Peritoneal fold is grasped with tissue forceps and pulled downward. Scissors incise peritoneal fold just above tissue forceps. **A:** Lateral view demonstrating the method for entering the anterior peritoneum. **B:** Retroperitoneal dissection with elevation of the peritoneal fold. (From Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia: Lippincott Williams & Wilkins; 2006:110.)

If an injury to the bladder results, it will likely occur well above the trigone of the bladder and not near the ureteral orifices. Cystoscopy will reveal the exact location. This injury is simple to repair after the uterus has been removed. Unintentional operative cystotomy is a risk of any type of hysterectomy with any technique or approach. The overall incidence of operative cystotomy while performing and teaching this technique has resulted in a cystotomy rate of 1.2% with vaginal hysterectomies. Gilmour and others have documented the value of cystoscopy at the time of hysterectomy in recognizing urinary tract injury during the operation rather than later after the patient has left the operating room. Additionally, the overall rate of urinary tract injury was lower for the vaginal approach than in any other route of hysterectomy.

The use of a sponge on the surgeon's finger to push through the supravaginal septum and bluntly dissect the vesicouterine space superiorly to expose the anterior peritoneum is frequently taught. This technique could be considered as more of a technique of *accomplir forcee* (i.e., to accomplish with force) than a surgical dissection, as the cleavage plane becomes indistinguishable from the supravaginal septum up to the anterior peritoneal fold. No effort is made to visually or surgically identify any of the involved planes or tissues. The risk of tearing the bladder with this technique is potentially increased, especially if the patient had a previous cesarean section. Furthermore, the risk of not recognizing the injury is likely increased. The anterior peritoneum should always be opened under direct vision, never blindly, as unintentional entry into the bladder frequently results from an attempt to enter the peritoneum blindly.

Persistent attempts to open the anterior peritoneum if there is doubt that the peritoneal fold is clearly identified are unnecessary. Transecting the uterosacral and cardinal ligaments and perhaps the uterine vascular bundle prior to entering the anterior peritoneum will bring the uterus and peritoneal fold closer to the surgeon providing better exposure, thus simplifying this step of the procedure. Eventually, during this sequence of steps, the peritoneum will be identified and entry will be possible at some later point in the operation than is customary. Anterior peritoneal entry can also be safely facilitated, especially when the uterus is enlarged by adenomyosis or leiomyomata, with a vertical incision in the vaginal epithelium similar to the one used in an anterior colporrhaphy (**Fig. 32B.16**). This additional room for dissection of the bladder away from the cervix allows accurate identification of the bladder from the peritoneal fold. The surgeon may use a finger or a malleable uterine sound or retractor inserted through the posterior cul-de-sac and bent over the fundus of the uterus into the anterior cul-de-sac to help identify the exact location of the peritoneal fold. This step is especially useful in difficult cases or those in which the proper plane of dissection has not developed.

After both the posterior and anterior peritonea have been successfully entered, detachment of the uterus from its supportive ligaments can be accomplished if they have not already been surgically transected. As stated earlier, we prefer to secure and divide the uterosacral and cardinal ligaments before attempts to enter the anterior peritoneum. This extraperitoneal approach provides significant additional exposure for anterior peritoneal entry. Separating the cervix

from the paracolpium, along with the resulting descent of the uterus, increases visibility. This exposure is significant and makes the peritoneal identification/entry process less troublesome. The uterine artery can also be divided before anterior peritoneal entry, allowing even greater exposure. The key to successful vaginal hysterectomy is not to proceed in lock step through a draconian set of tasks but to identify structures and manipulate them surgically in the order that they present.

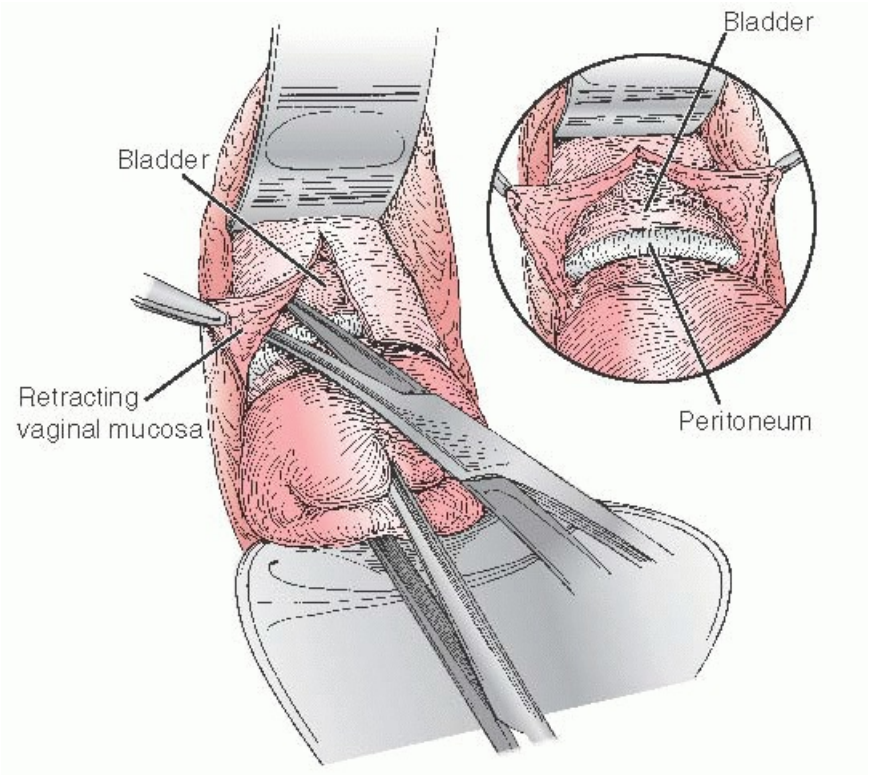

FIGURE 32B.16 Opening the anterior vaginal wall to expose the bladder and anterior peritoneal fold. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

The exact location of the ureter during abdominal, laparoscopic, and vaginal hysterectomy is always a concern. Nichols and Randall suggested that the risk of ureteral injury during a vaginal hysterectomy is greater because the ureters may be pulled downward and medially by the tethering effect of the uterine artery. By studying the surgical anatomy of the ureter during vaginal hysterectomy, it has been determined with the use of imaging that the uterine artery is not the primary factor drawing the ureter closer to the uterus. Instead, traction on the cardinal ligament is the chief factor affecting movement of the ureter, suggesting there is a margin of safety during each step of a vaginal hysterectomy. This concept was confirmed by magnetic resonance imaging studies with a brass tenaculum placed on the cervix in a resting state and under traction. When traction was applied to the cervix, the ureter's position was displaced upward and lateral to the position of the ureter at rest (**Fig. 32B.17A, B**). This movement confirmed radiographically that the ureters were displaced further laterally and superiorly from the cervix to a position of surgical safety. When bladder retraction was used, this effect was more pronounced. During surgical identification of the ureter at the time of radical vaginal hysterectomy, it can be observed that once the uterosacral and cardinal ligament complex has been cut, the ureter actually moves further out of harm's way. If the ureters have not been dissected and identified before the cutting of uterosacral and cardinal ligaments, it is difficult to dissect and visualize them vaginally once the ligaments have been cut during a vaginal hysterectomy because of this movement. Thus, it is evident that the uterosacral and cardinal ligaments, not the uterine artery, play a major role in determining the ureter's position during vaginal hysterectomy. Once these ligaments have been divided, the ureter will retract out of the operative field and make division of the uterine artery safer (**Fig. 32B.18A, B**).

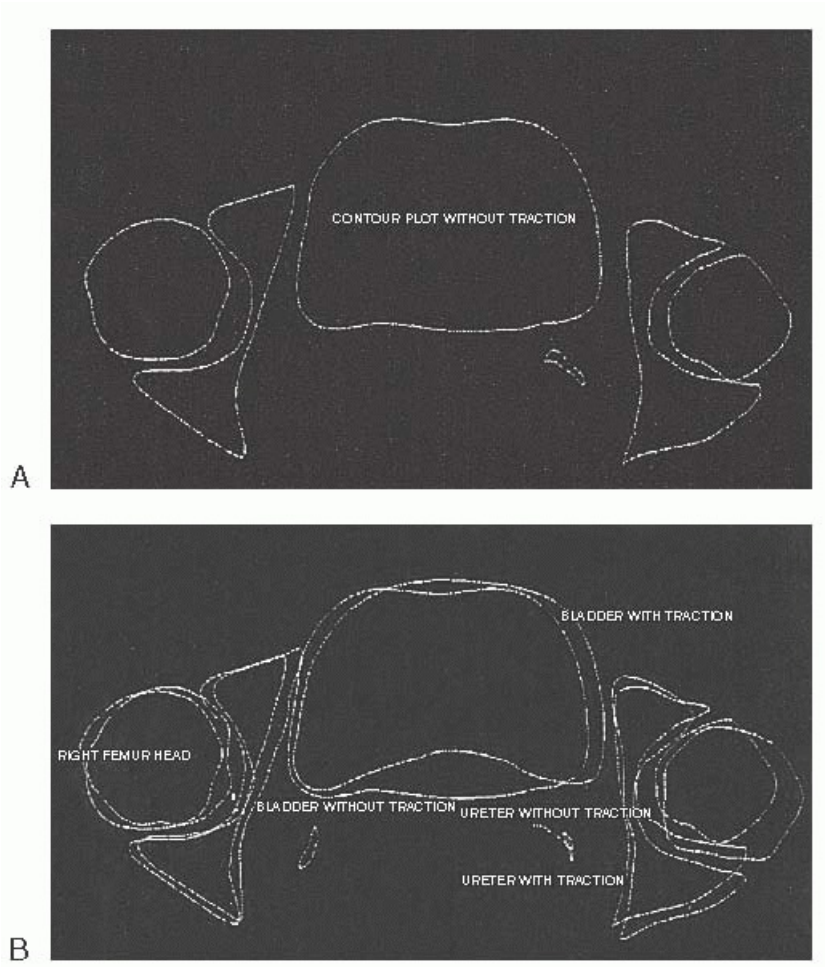

FIGURE 32B.17 A: Magnetic resonance imaging (MRI) studies of ureteral movement when downward traction is placed on the uterus. Ureter position is seen on the right. **B:** Overlay of MRI films. Traction on the uterus with a brass tenaculum is applied to the cervix. Note indentation to the bladder from the uterus and lateral and upward displacement of the ureter compared with the position of the ureter without traction to the uterus. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:112, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

Entry into the posterior peritoneum before clamping the uterosacral and cardinal ligaments is desirable. Anterior cervical and uterine plane dissection and placement of a retractor under the bladder also elevate the ureter out of the operative field (**Fig. 32B.19A, B**). Once the retractor is placed under the bladder, it should not be removed during any stage of the vaginal hysterectomy. During vaginal hysterectomy, if forceful traction is applied to the uterus with no retraction of the bladder, the ureter can be pulled medially and potentially placed in harm's way.

After posterior and anterior entry into the peritoneum and completely ligating the vascular pedicle, the remainder of the broad ligament may be dissected in the same manner familiar to the abdominal or endoscopic surgeon. Continued clamping up each side of the remaining broad ligament is not usually required for successful uterine removal. When the vaginal surgeon continues to place clamps above the uterine artery, the space to place each clamp becomes more restrictive, and placing sutures around these clamps becomes more difficult. This is

the type of problem that can create the conception that vaginal hysterectomy is a more difficult operation because of restrictive access and visibility. Clamping and suturing of the broad ligament above the uterine artery are unnecessary because there are only occasional significant blood vessels within the leaves of the broad ligament. There is no need to place clamps above the uterine artery until the round ligaments, fallopian tubes, and utero-ovarian pedicles are encountered, visualized, and prepared for ligation. Once the entire vascular

bundle has been transected, a sufficient amount of tissue has been transected to allow rotation of the uterus posteriorly.

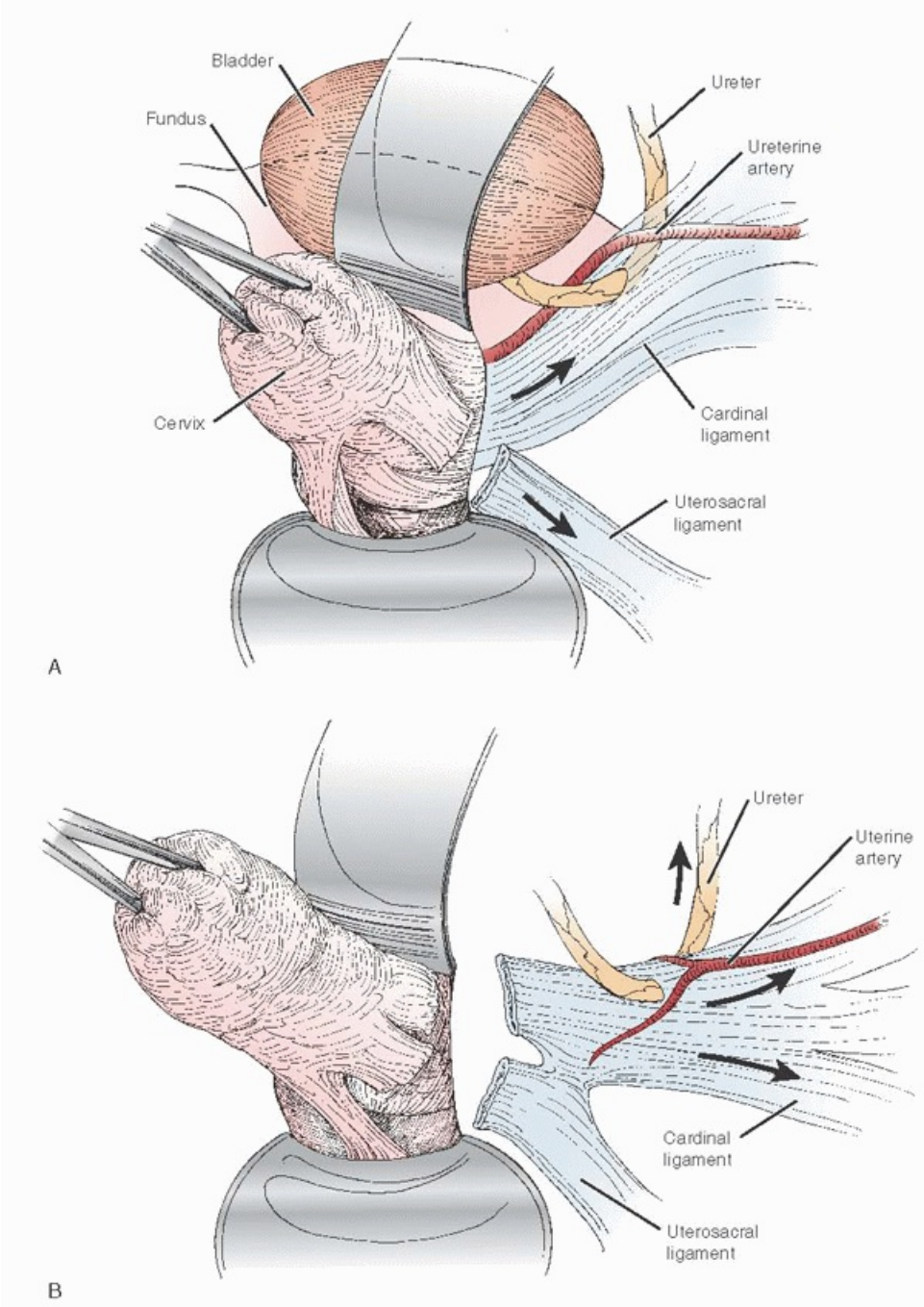

FIGURE 32B.18 A: Transection of the uterosacral ligament returns this structure to its original position. **B:** After both uterosacral and cardinal ligaments have been transected, ureters are displaced upward and lateral out of harm's way. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:113, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

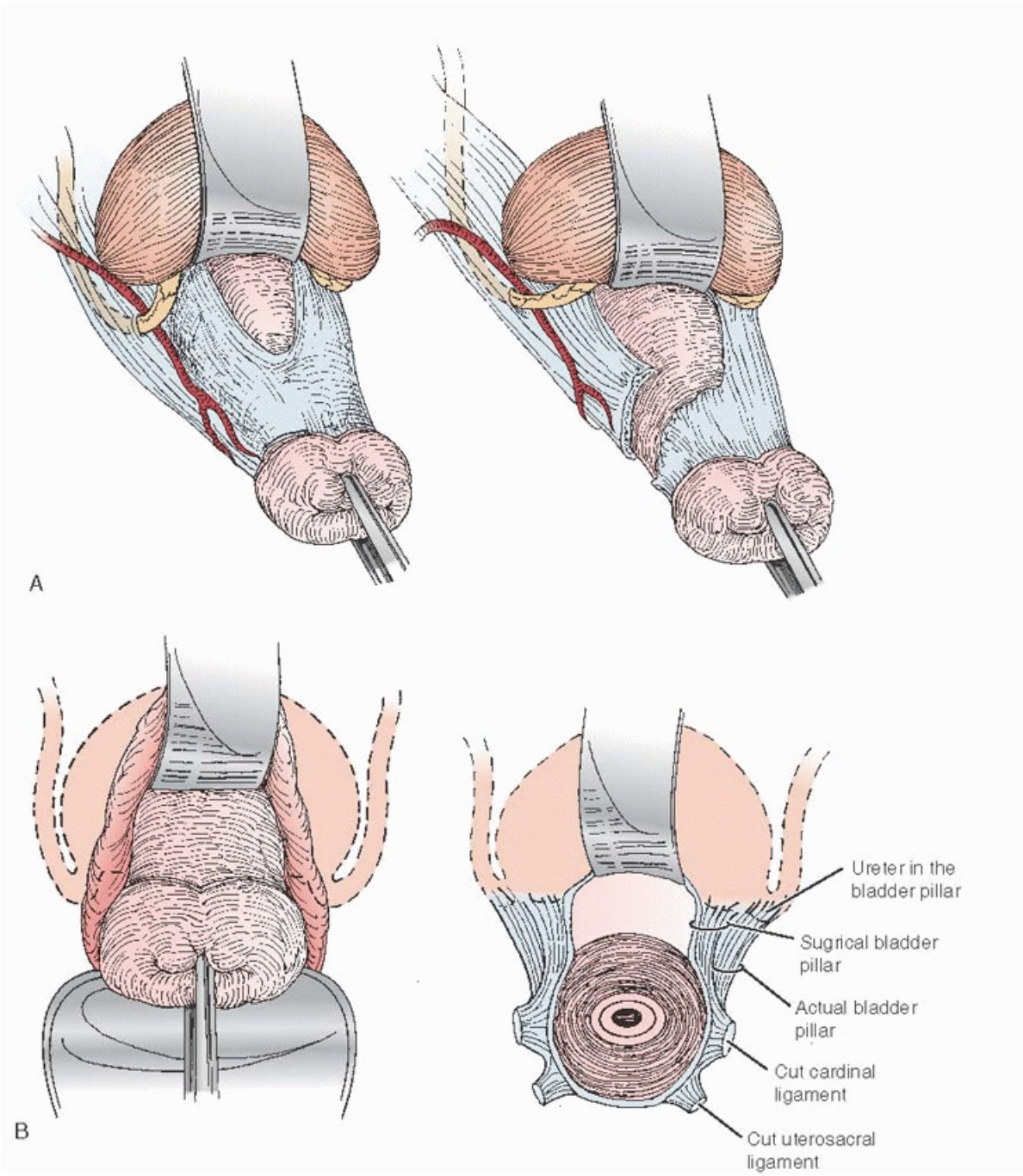

FIGURE 32B.19 A, B: Note elevation of the ureters out of harm's way with upward traction on the bladder during vaginal hysterectomy. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:114, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

If the uterus is small and the uterine artery has been secured, the next step in uterine removal is to deliver the fundus through the posterior or occasionally the anterior colpotomy (Döderlein technique). With a small, mobile uterus, simple traction may result in delivery of the uterus without the need for rotating the fundus one way or the other. If delivery of the uterus (regardless of the size) is challenging, the organ may be brought closer to the surgeon and out of the vagina by using the alternate technique of *intramyometrial coring.* This technique was introduced by Lash in 1941 and reintroduced in 1986 by Kovac for removal of large uteri; however, it may be used on uteri of any size. In this simple technique, the myometrium can be circumferentially incised with a scalpel placed parallel to the long axis of the uterus and beneath the serosal covering of the uterus with continuous traction on the cervix and direct

vision at all times (**Fig. 32B.20A, B**). This maneuver removes a core inside the uterus without violating the integrity of the endometrial cavity or uterine serosa. Ligation of the uterine artery is absolutely necessary prior to coring. The Lash or coring incision reduces the size of the uterus by decreasing its width, thereby increasing its length, similar to the way a baby's head becomes more cylindrical and less spherical as it becomes molded during childbirth. In effect, coring converts a spherical structure into an elongated cylindrical or rod shape, enhancing the surgeon's ability to facilitate transvaginal removal of a wide uterine fundus (**Fig. 32B.21A-C**). This process is a surprisingly bloodless maneuver once the uterine arteries have been secured. Strong traction is placed on the uterus during the coring, which restricts blood flow from the ovarian pedicles.

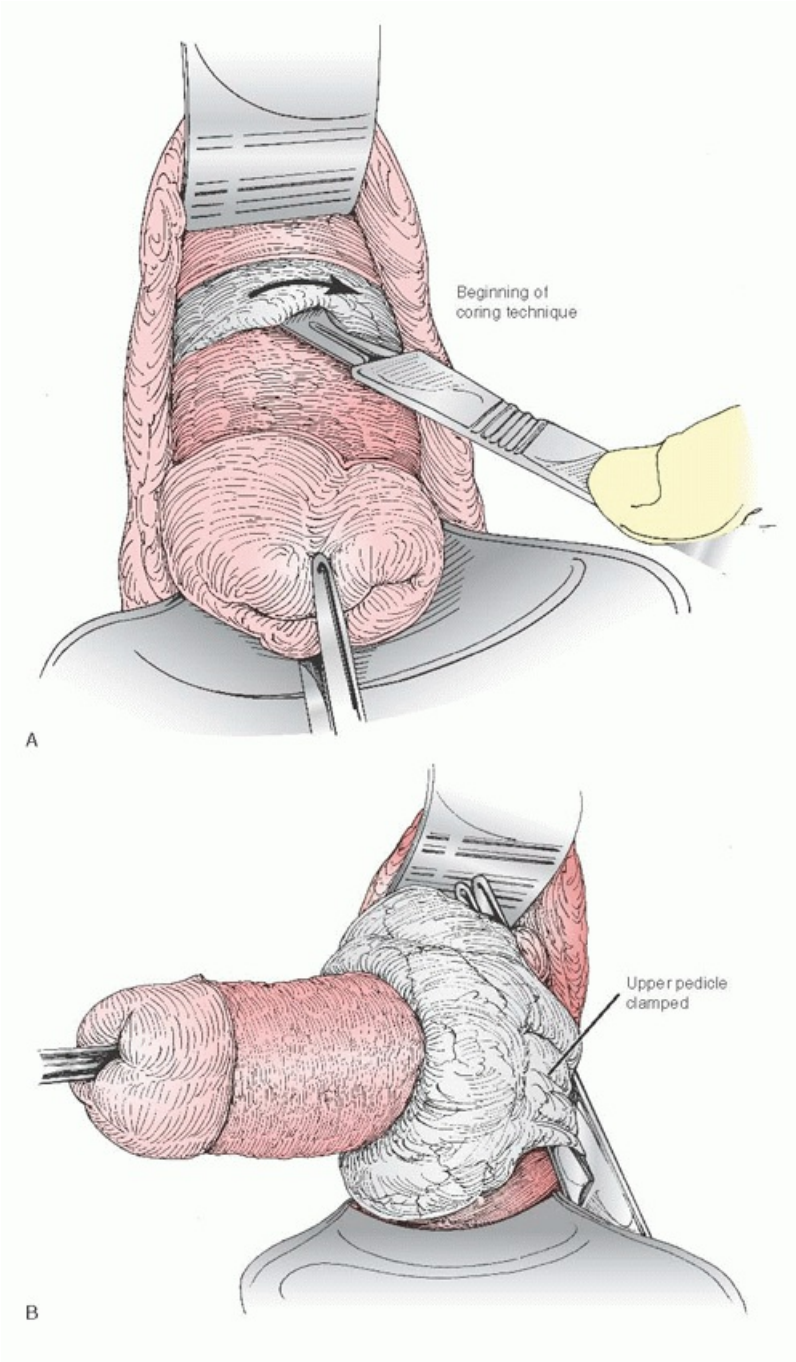

FIGURE 32B.20 A: Coring incision is started just below the serosal covering of the uterus anteriorly. **B:** Coring of a small uterus to facilitate exposure and clamping of the upper pedicle. No sutures were placed above the uterine artery to bring the uterus closer to the surgeon for removal of the uterus. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:118, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

During the coring procedure, the uterus will begin to descend through the vagina, allowing the surgeon to visualize the cornual portion of the uterus and exposing the utero-ovarian ligament, round ligament, and fallopian tube. Once these structures become visible, the surgeon is assured that the uterus can be removed vaginally.

Some surgeons prefer bivalving the uterus with *morcellation.* Morcellation is especially useful if multiple leiomyomata are present. A thyroid vulsellum clamp may be placed on either side of the cervix, and with strong downward traction, the cervix may be incised with a knife vertically until the fundus of the uterus is reached. Once the fundus is reached, wedges of myometrium or specific leiomyomata may be removed in a nearly bloodless field until the uterine size is sufficiently reduced to allow removal. Individual selection of technique for each case is needed. Coring is most useful in the presence of adenomyosis while morcellation is most useful in the presence of leiomyomata although neither technique is restricted to those respective clinical situations. No effort should be made to use either morcellation or coring until the uterine artery pedicles are secure.

Once the cornual pedicles are visualized, they can either be clamped individually. Depending on the surgeon's preference and experience, the clamp may be left on the pedicle or a suture may be placed around the tip of the clamp and tied or transfixed behind is appropriate. This suture may be tagged. The clamp or suture may be used to provide gentle traction on the pedicle and expose the ovary for evaluation or removal.

Once the uterus has been removed, it is appropriate to evaluate each pedicle to confirm hemostasis. If the ovaries are removed before confirmation that all pedicles are hemostatic, the surgeon may spend considerable operative time finding the source of such bleeding, as it frequently appears to be from a higher point but may actually be from one of the uterine pedicles. Each pedicle can be evaluated by starting at the 12-o'clock position within the peritoneal cavity and proceeding in a clockwise manner. The use of a surgical sponge folded longitudinally on sponge forceps may be very helpful as is an auxiliary light source. If brisk bleeding is noted, most often it can be found by placing traction on the uterosacral tag and looking between the uteroovarian and uterine artery pedicles. Bleeding from this area of the broad ligament is usually a result of the anastomosis of vessels between the ovarian and uterine artery. Because this is the most frequent site of this type of bleeding, the surgeon should direct his or her search to this area first. Placement of a long Kelly or Allis clamp at the site of bleeding without undue traction may be followed by a helical suture or a figure-of-eight suture passed through the vagina into the peritoneum from outward to inward will rapidly control this bleeding (**Fig. 32B.22**). Care should be taken to specifically identify sites of bleeding, to not suture blindly, and to control the depth of suturing in this area due to the proximity of the ureters.

If no bleeding points are discovered from any of the hysterectomy pedicles, the posterior vaginal epithelium will most likely be determined to be the source of bleeding. Posterior cuff bleeding may sometimes be rather brisk from the separation of the vagina and the peritoneal edge. It is likely to be more brisk in premenopausal patients especially those younger than 40 years of age. Before proceeding with any concurrent procedure, blood loss from this area should be controlled with electrosurgery or absorbable suture. Once hysterectomy pedicle and posterior cuff hemostasis is complete, further examination of the peritoneal cavity should reveal complete hemostasis from all potential bleeding sites. The anterior cuff is rarely a source of troublesome bleeding.

If only the uterus is to be removed, support of the vaginal apex becomes the next most important decision. If a salpingooophorectomy is planned in conjunction with the hysterectomy, it should be performed at this point.

VAGINAL OOPHORECTOMY

There appears to be some reluctance to combine vaginal hysterectomy with oophorectomy because vaginal oophorectomy is thought to be a risky and difficult procedure. Factors that seem to foster this perception are fear of restricted access to the ovaries and the belief that there is inadequate visibility of the adnexa along with safe access to the infundibulopelvic ligament during conventional vaginal surgery.

To obtain objective evidence regarding these perceptions, a prospective study was designed by Baden and Walker to determine whether there is adequate visibility and accessibility for transvaginal oophorectomy in most patients undergoing vaginal hysterectomy. After the uterus was removed, accessibility of the ovaries for transvaginal removal was assessed by stretching the infundibulopelvic ligament, placing traction on the suture tag used to ligate the uteroovarian ligament, round ligament, and fallopian tube and grading the position of the ovaries in relation to the long axis of the vagina. The degree of ovarian descent and visibility was graded with a system used to grade pelvic organ prolapse (**Fig. 32B.23**; **Table 32B.1**). The grade corresponded to the minimal degree of descent of either ovary.

To determine what grade would be considered accessible and visible for transvaginal oophorectomy by most gynecologic surgeons, the experience of other surgical specialties was considered. For example, the distance from the hymenal ring to the ischial spine is approximately 8 cm. In dentistry, the distance from the front teeth to the last molar is 6 cm; in otolaryngology, the distance from the front teeth to the tonsil for tonsillectomy is 10 cm. Therefore, it was postulated that any ovary that was positioned at grade I or lower in the vagina should be visible and accessible for transvaginal removal by most gynecologic surgeons. Of the 875 patients between 29 and *69* years of age who were evaluated for ovarian descent after hysterectomy, 92.9% had ovarian mobility to at least the midportion of the vagina (grade II). In another 4.6%, the ovary could be pulled down outside the hymenal ring (grade II). Only 2.5% of these patients had very little ovarian mobility, which would have made vaginal oophorectomy very difficult (2.4% grade I and 0.1% grade 0). Although this study provided objective evidence that the ovaries may be more visible and accessible for transvaginal removal than previously perceived, there may be times that the ovary may be inaccessible for transvaginal removal as a result of adhesive disease, endometriosis, suspected significant pathology, or other conditions. However, the ovary should not be presumed to be inaccessible at the start of any vaginal hysterectomy. Smale and colleagues, Davies and associates, and Sheth have reported

that planned vaginal salpingo-oophorectomy is successful in 94% to *97%* of women undergoing vaginal hysterectomy. The routine use of the laparoscope to perform an oophorectomy before a vaginal hysterectomy has been heralded as safe and comfortable and therefore has become commonplace. “To be sure we can get the ovaries” is a phrase too often heard worldwide to justify the use of abdominal, laparoscopic, or even robotic approaches to hysterectomy. For too many years, the belief that the ovaries were inaccessible because they are “too high” for transvaginal removal has been prevalent. This misconception has erroneously guided the selection of abdominal or endoscopic hysterectomy.

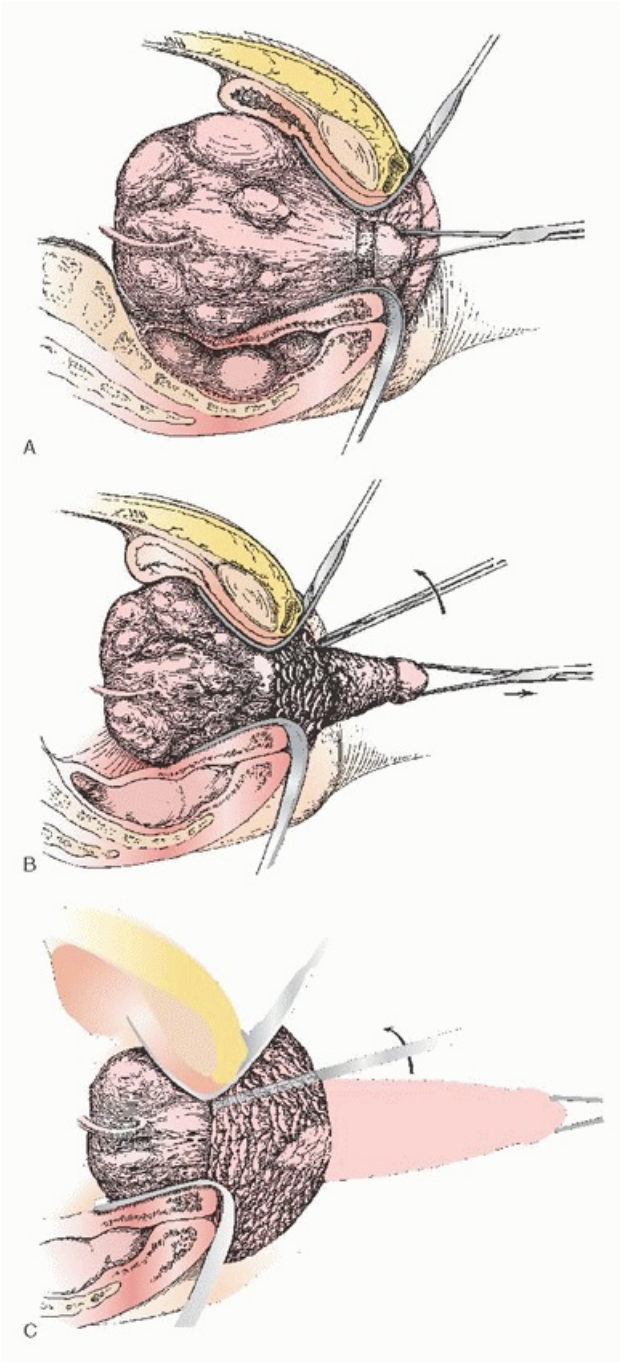

FIGURE 32B.21 A: The cervix has been circumscribed through the full thickness of the vagina around the cervix, the posterior and anterior peritoneum entered, and the uterosacral and cardinal ligaments secured. B: After ligation of the uterine arteries, an incision is made in a circumferential fashion parallel to the endometrial cavity and into the outer superficial myometrium in the same plane. Constant traction on the tenaculum while coring assists in developing the proper plane. C: Continued coring and traction reduce the size of the uterus by exteriorizing the inside of the uterus with an intact endometrial cavity through the introitus. Intramural myomas are sometimes transected during the coring process. (Reprinted from Kovac SR. Intramyometrial coring as an adjunct to vaginal hysterectomy. *Obstet Gynecol* 1986:76;131, with permission.)

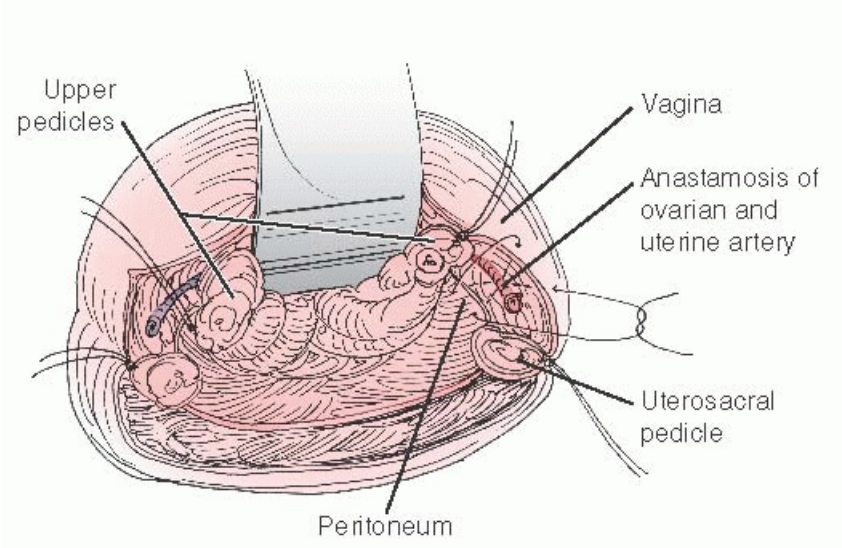

FIGURE 32B.22 The most common source of bleeding after removal of the uterus is the anastomosis between uterine and ovarian arteries. Suture placed through the lateral vagina into the lateral peritoneum in a figure-of-eight fashion and tied resolves most, if not all, bleeding from this area. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:120, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

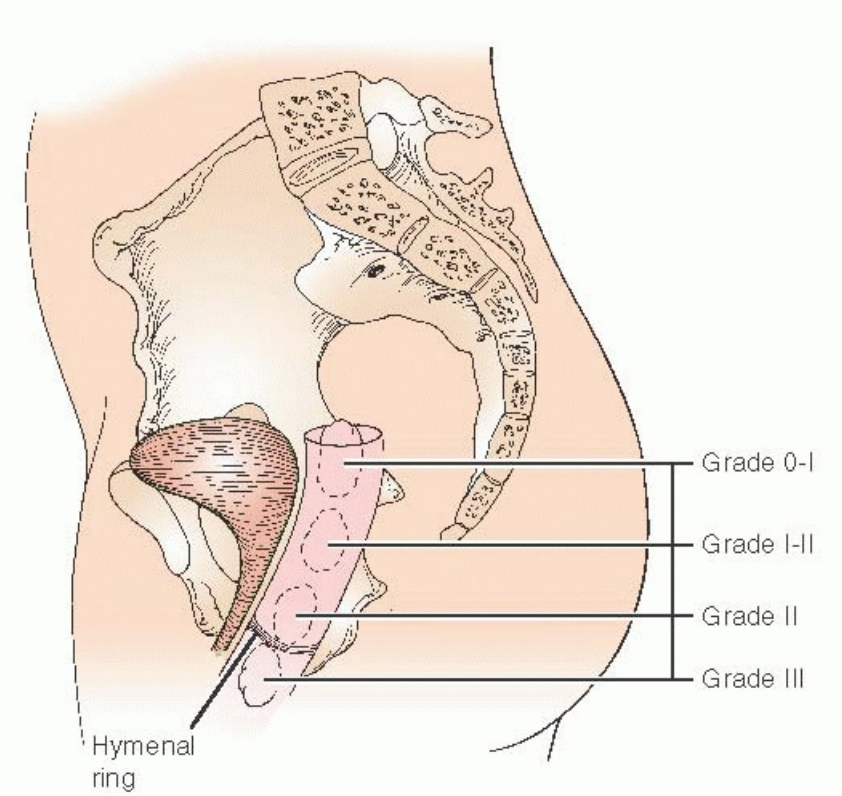

FIGURE 32B.23 Grading ovarian descent after vaginal hysterectomy with Baden-Walker Halfway System. Grade corresponds to the position of the ovary at the ischial spine superiorly and the hymenal ring inferiorly. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:120, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

TABLE 32B.1 The Baden-Walker Halfway System for Grading the Degrees of Ovarian Descent After Hysterectomy

GRADE	FINDINGS
0	No descent was defined. The infundibulopelvic ligament has little or no stretchability, and the ovaries are positioned at the lateral pelvic wall at or above the ischial spines and cannot, with traction, be brought into the long-axis plane of the vagina.
I	Infundibulopelvic ligament stretchability brings the descent of the ovaries into the long axis of the vagina with traction halfway between the ischial spines and the mid-vagina.
II	Infundibulopelvic ligament stretchability brings the descent of the ovaries into the long axis of the vagina with traction between the midportion of the vagina and the hymenal ring.
II	Infundibulopelvic ligament stretchability brings the descent of the ovaries into the longitudinal plane of the vagina with traction past the hymenal ring.

Good surgical practice dictates that objective determination of the visibility and accessibility of the ovaries is the primary criteria for selecting a particular route of oophorectomy. Thus, if the ovaries are found to be inaccessible at the time of vaginal hysterectomy, ovarian removal can be performed with the laparoscope or by a simple laparotomy once the initial vaginal operation is complete. The correct paradigm substantiated by clinical evidence is to first attempt ovarian removal by the minimally invasive transvaginal approach. If that is not possible, the surgeon should proceed with laparoscopy or laparotomy after completion of a vaginal hysterectomy for removal of the adnexa. Indications for salpingo-oophorectomy should not change regardless of the route of surgery.

Surgical Technique of Vaginal Salpingo-Oophorectomy

STEPS IN THE PROCEDURE

Vaginal Hysterectomy Bilateral Salpingo-Oophorectomy

1. History and physical exam for assessment of indications for surgery and appropriateness of patient for surgery, including medical and anesthesia clearance as needed.
2. Preoperative and examination under anesthesia to document adequate access to the cervix and apical vaginal structures, especially the uterosacral ligaments.
3. Careful positioning of the patient in the standard lithotomy position with the femur vertical and tibia/fibula close to the horizontal plane and oriented toward the opposite shoulder.
4. Debate and variation exist among experts regarding preparation of the bladder for surgery. Some surgeons, including the author, prefer catheter placement prior to surgery. Others prefer leaving fluid in the bladder in order to alert the surgeon of the presence of bladder injury.[1]
5. Grasp the cervix firmly, and in cases that do not include an adequate degree of prolapse, firmly massage the uterosacral ligaments to establish maximum descent prior to proceeding.
6. Grasp the posterior cul-de-sac. With downward traction on the vaginal epithelium and upward traction on the cervix, incise the posterior cul-de-sac and document peritoneal entry.
7. Complete circumscription of the vaginal epithelium around the cervix.
8. Dissect the vesicocervical space, transect the pericervical ring/supravaginal septum, and dissect the vesicouterine space. Place a retractor in the anterior dissection to elevate the bladder. Note

that there is no compelling reason to complete entry into the anterior cul-de-sac at this point unless specifically desired.

9. Identify, clamp, transect, and ligate the uterosacral ligament pedicle separately. This pedicle will be used in cuff closure.
10. Identify, clamp, transect, and ligate the cardinal/pubocervical ligament pedicle.
11. Identify, clamp, transect, and ligate the uterine vasculature.
12. Identify and enter the anterior cul-de-sac of not already accomplished.
13. Clamp and ligate the lower portion of the broad ligament (often including the ascending portion of the uterine vasculature) including the anterior and posterior peritoneum.
14. Deliver the fundus of the uterus posteriorly. An alternative is to deliver the fundus of the uterus anteriorly; however, posterior delivery is usually the more efficient method.
15. If uterine size does not permit fundal delivery, uteroreductive techniques (e.g., morcellation, coring, cervicectomy, or bivalving) may be helpful at this stage of the procedure.
16. Identify, clamp, and transect the adnexal pedicle (fallopian tube, round ligament, and utero-ovarian ligament) to remove the uterus.
17. If adnexectomy is desired, identify and divide the round ligament to begin the process. Then identify, clamp, divide, and ligate the mesovarium.
18. Identify, clamp, divide, and ligate the infundibulopelvic ligament to complete the removal of the adnexa.
19. Carefully inspect all pedicles for hemostasis.
20. Irrigate the surgical field.
21. If appropriate, perform one of the variations of culdoplasty (e.g., McCall) incorporating the uterosacral ligaments into the cuff to help prevent future prolapse.
22. Perform cystourethroscopy to document bladder and ureteral integrity.
23. Perform cuff closure. Several variations exist. Most surgeons prefer interrupted sutures rather than a running closure because of potential hematoma or abscess formation.
24. Vaginal packing is optional. It is not necessary in the absence of concomitant pelvic reconstructive surgery.

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[1]Author's note: The specific steps of vaginal hysterectomy do not necessarily proceed in a predetermined order, they all must be accomplished; however, the exact order is somewhat variable from case to case and from surgeon to surgeon. For example, some surgeons prefer anterior dissection first and others prefer posterior dissection initially. No evidence clearly favors one approach over the others; therefore, surgeon discretion is paramount. The steps outlined below are the ones favored by the author.

Vaginal salpingo-oophorectomy may be accomplished if sufficient descent is found in the following manner. Downward traction is applied to the surgical clamp or suture ligating the uteroovarian ligament, round ligament, and fallopian tube or the clamp securing that pedicle. The initial step in vaginal adnexal removal is a digital and visual exam of the structures in order to assess size and eliminate any adhesions that may be present. After those tasks have been accomplished, the end of the fallopian tube is directed toward the ovary with tissue forceps and a long, sharply angled clamp is placed between the round ligament, the uteroovarian ligament, and tube across the infundibulopelvic ligament. Under direct vision, the tube and ovary may be excised. A suture is placed approximately 2 cm from the tip of the clamp, and a single throw tie is tightened around the tip, which usually secures the ovarian artery (**Fig. 32B.24**). The suture is then placed behind the clamp for suture transfixation and firmly tied with several throws. As the suture is tied, the surgeon can appreciate the security of this suture around the infundibulopelvic ligament. Alternatively, some surgeons have used an Endoloop (Ethicon

Endo-Surgery, Cincinnati, OH) to secure the infundibulopelvic pedicle. If the Endoloop is used, at least the round ligament should be divided to debulk the pedicle prior to application of the suture.

An alternative method of salpingo-oophorectomy is the three-step technique described by Zimmerman and others. This technique is especially useful when descent of the adnexa is not pronounced; however, routine use of these steps makes difficult cases more manageable when they are encountered. The surgical steps mimic the same maneuvers that are used to remove the adnexa abdominally. After removal of the uterus, the utero-ovarian pedicle is held with a clamp, and the handle is rotated laterally and the tip pointed medially. This maneuver exposes the round ligament that can be clamped, transected, and ligated or divided with electrocautery. Division of the round ligament gives the surgeon access to the retroperitoneal

space between the leaves of the broad ligament. Gentle dissection of this space makes it possible to isolate, clamp, and ligate the mesovarium as a separate pedicle. Elimination from the adnexal complex of these two structures results in an additional and significant amount of descent of the tube and ovary. After division of the mesovarium, the only remaining tissue connected to the adnexa is the infundibulopelvic ligament. This ligament can be clamped and suture ligated or secured with an Endoloop. Division of the adnexectomy into three manageable steps increases surgical control, decreases the bulk of attachment, and decreases the likelihood of a complication during suture application. Transection of the round ligament and mesovarium as separate pedicles significantly increases descent of the adnexa, resulting in increased visibility of the infundibulopelvic ligament.

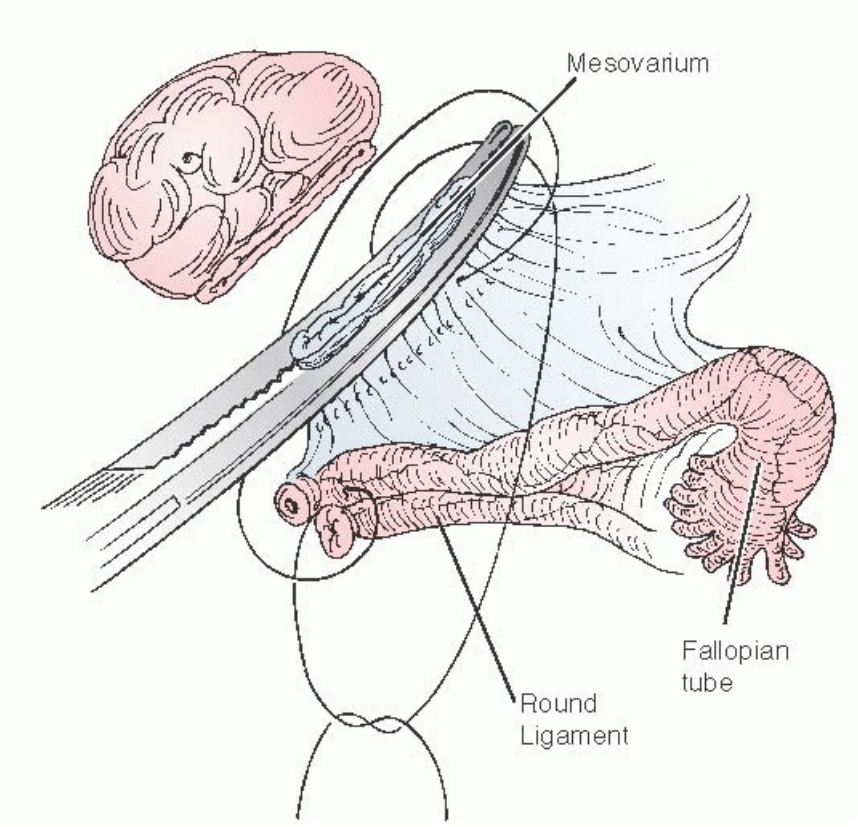

FIGURE 32B.24 The infundibulopelvic ligament has been clamped and the ovary and the tube removed. There is a single penetration of the infundibulopelvic ligament and its midpoint and tied around the end of the clamp. This transfixation suture usually occludes the ovarian artery. The suture is then passed around the end of the clamp and transfixed into the tissues behind the heel of the clamp and tied again. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:122, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

Consideration of salpingectomy only has recently become more prevalent. This idea is based on the emerging

idea that many malignancies that have been labeled as ovarian in the past are now suspected to have a salpingeal origin. Obviously, if the ovary was left in place, the surgery would be easier to accomplish. At this time, there is no definitive evidence to either support or refute this idea.

CLOSURE AND SUPPORT OF THE VAGINAL CUFF

Closure of the peritoneum with vaginal hysterectomy is not routinely necessary for healing and rarely is indicated as a part of the procedure. Leaving the peritoneum open may help to expose any immediate intraperitoneal postoperative bleeding.

The remaining part of the vaginal hysterectomy is to support the vaginal cuff so that the chance that an enterocele or vaginal vault prolapse will develop later in life is reduced. Compensation for the connective tissue defect and disruption of the vaginal suspensory axis created by the removal of the cervix is best accomplished at the time of hysterectomy. Failure to adequately compensate for the cervical defect may expose the patient to an increased risk for posthysterectomy vaginal vault prolapse in the form of a posterior enterocele or apical anterior vaginal wall prolapse (anterior enterocele). Enterocele repair and suspension of the prolapsed posthysterectomy vagina are among the most technically demanding of all pelvic surgery procedures. Closure of the cervical defect along with reestablishment of the suspensory axis of the vagina by incorporating the uterosacral ligaments into the cuff is effective prophylaxis reducing the risk of future prolapse. As a general rule, closure of the cuff and correction of the cervical defect should consume approximately as much time as extirpation of the uterus.

The incidence of enterocele after hysterectomy can range between 0.1% and 16%. Nichols and Randall described a technique of excising excess peritoneum in the cul-de-sac to prevent future development of an anterior enterocele (**Fig. 32B.25**). Because this technique only removes excess peritoneum and does not address the cause of an enterocele after hysterectomy, subsequent enterocele formation has not been prevented because no musculofascial defect has been corrected or reinforced.

Several other methods to repair the posterior vaginal cuff for prolapse prophylaxis have been described. These procedures emphasize the use of the uterosacral ligaments in any repair. Inclusion of the uterosacral ligaments in cuff repair is very important because of their role as the primary suspensory elements in

the uterovaginal continuum of structures. Connecting the uterosacral ligaments to the cuff reestablishes the posterior arm of the suspensory axis of the vagina and should be considered during all hysterectomies regardless of route. The most commonly employed technique to close the posterior vaginal cuff is the McCall culdoplasty. This technique is designed to obliterate the cul-de-sac while it suspends the posterior superior vagina and its fascial attachments to the uterosacral ligaments. Bringing these supporting ligaments together in the midline is common; however, it is no longer believed to be necessary. Care should be taken to document ureteral patency after this procedure. The risk of ureteral occlusion is directly proportional to the number of uterosacral plication sutures placed. This type of prolapse prophylaxis technique is a marked improvement over previous beliefs that the only thing necessary after the uterus was removed was to close the vagina. Simple closure of the vagina resulted in a high incidence of vaginal vault prolapse and associated enterocele formation. More recently, simple closures such as those used by abdominal, laparoscopic, and robotic surgeons have resulted in an unacceptably high incidence of vaginal cuff dehiscence. Some form of McCall culdoplasty after all vaginal hysterectomies should be considered routine. Some modification of this step should also be considered if another approach to hysterectomy is used.

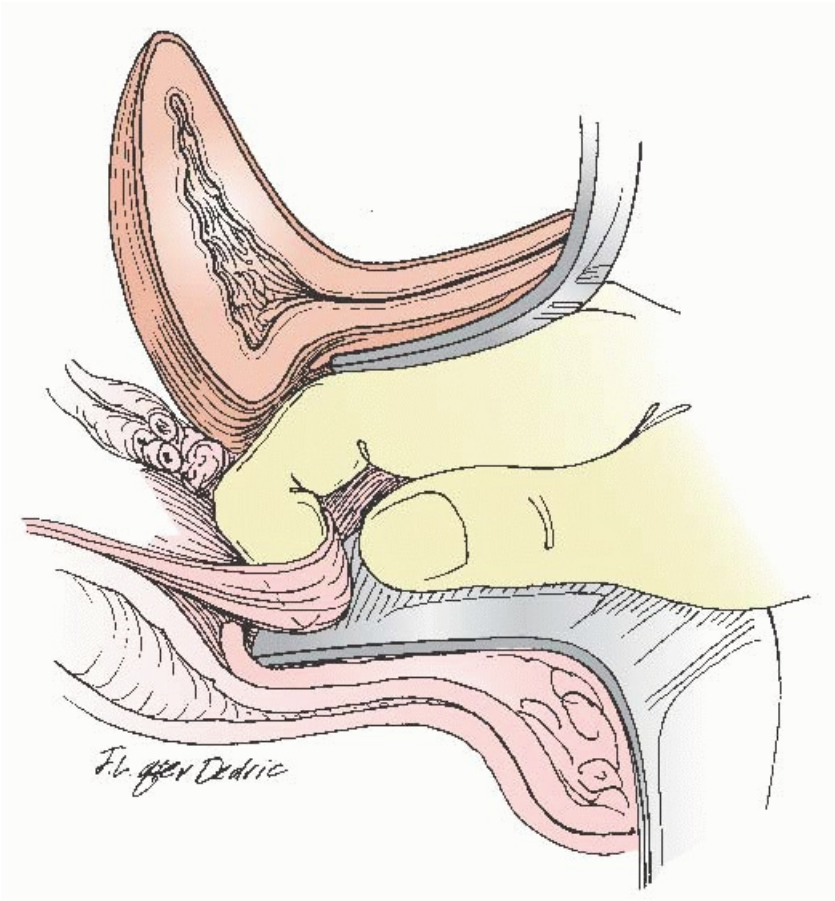

FIGURE 32B.25 Identification of excess peritoneum in cul-de-sac. Excision of excess peritoneum will not prevent future enterocele formation, as the cause of the enterocele is not determined. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:122, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

Recent advancements in pelvic reconstructive techniques, as well as an understanding of the cause of enteroceles, have brought us to a new method of preventing enteroceles and vault prolapse at the time of hysterectomy, especially with those patients who have a rectocele. Rectoceles and enteroceles result from an apical separation of the rectovaginal septum from the uterosacral ligaments. This distal displacement of the rectovaginal septum allows both of these vaginal defects to develop contiguously through the same fascial defect. Because enteroceles are routinely associated with rectoceles, they may not both be suspected during the vaginal hysterectomy. This idea suggests that failure to identify and manage the presence of an enterocele at the time of vaginal hysterectomy might be the cause of the increased incidence of rectocele and enterocele formation in later years.

Enteroceles may also form as a result of the separation of the rectovaginal fascia from the pubocervical fascia (**Fig. 32B.26**). As a result of hysterectomy and removal of the cervix, there is an iatrogenic separation of the rectovaginal septum and the fibers that normally connect this structure to the anterior vaginal fascia through the connective tissue that forms the pericervical ring. This separation widens the cul-de-sac and separates the normal fascial attachments thus allowing the peritoneum and accompanying intra-abdominal structures, to potentially protrude through this weakness with any increase in intra-abdominal pressure. This concept likely explains the fact that most posthysterectomy vaginal vault prolapse is located apically or on the apical anterior segment of the vagina (cervical defect). Proper cuff closure reduces this possibility by reconnection of all connective tissue elements by incorporation within the suture lines.

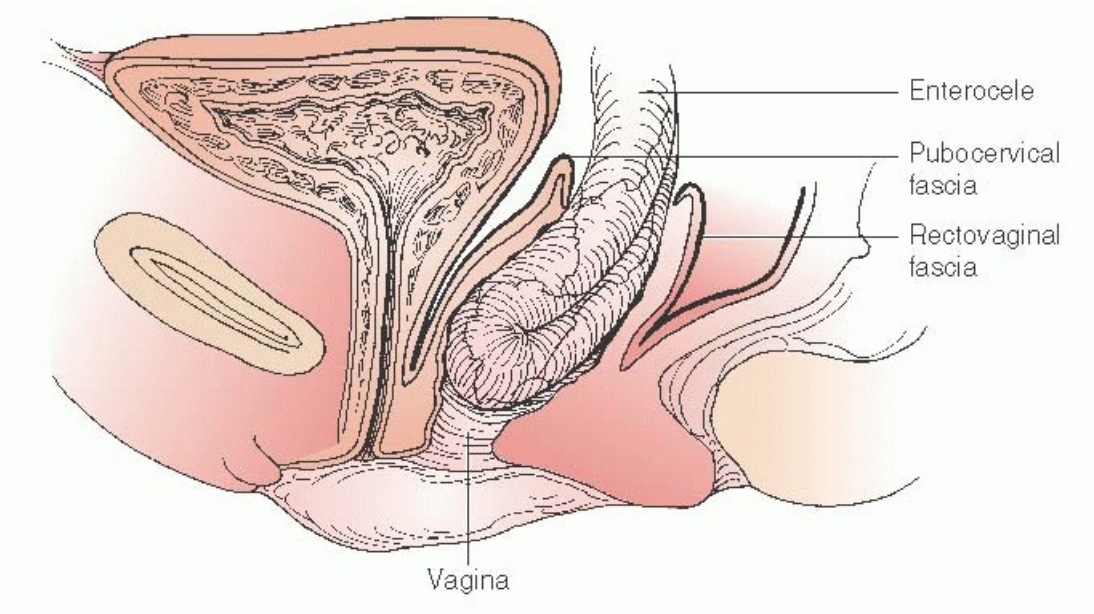

FIGURE 32B.26 Separation of the pubocervical and rectovaginal fascia with enterocele formation. (Reprinted from Kovac SR, Zimmerman CW, eds. *Advances in reconstructive vaginal surgery.* Philadelphia, PA: Lippincott Williams & Wilkins, 2007:124, with permission. Copyright © 2007 Lippincott Williams & Wilkins.)

An effort to restore normal anatomy from the disruption of these support and suspensory structures created by hysterectomy is the obligation of the hysterectomy surgeon regardless of route. McCall culdoplasty is intended to prevent incipient recto-enteroceles. If a true rectoenterocele is identified at hysterectomy, a repair should be considered.

Surgical Techniques

Cuff repair is as much a part of hysterectomy as removal of the uterus and adnexa. If a rectocele has not been identified, management of the vaginal cuff is performed by reducing the defect left by the absence of the cervix. Options include incorporation of the cardinal ligament pedicles in the repair particularly in the presence of a sizeable cervical defect. The cardinal ligament pedicles may actually be tied together across the midline with safety. Traditional McCall culdoplasty incorporates suture(s) in each uterosacral ligament accessed intraperitoneally and sutured into the posterior cuff. In the traditional technique, one or more sutures are placed and tied across the midline in order to occlude the posterior cul-de-sac. With recognition of the importance of the integrated suspensory axes, it is sufficient to incorporate the intraperitoneal portion of the uterosacral ligaments into the vaginal cuff ipsilaterally without plication into the midline. Simply securing this attachment is enough to allow the apex of the vaginal vault to remain suspended over the sacrococcygeal raphe. An effort should also be made to incorporate both the anterior and posterior fasciae into the repair of the cuff by suturing through the full thickness of the vaginal epithelium. Apical attachment of the anterior pubocervical fascia and the rectovaginal fascia posteriorly to the cuff is critical to successful cuff closure. Those two attachments close the space vacated by the absence of the cervix. The difference between the shorter anterior pubocervical fascia and the longer posterior rectovaginal fascia is resolved with soft tissue occlusion. Permanent suture may be used on the uterosacral sutures so long as they are not exposed intravaginally.

Debate exists regarding specific techniques of cuff closure. Some surgeons prefer running suture, others interrupted. Some prefer vertical closure, others horizontal. No definitive data exist to resolve these issues. Much more important are the concepts of reintegration of the suspensory axes of the vagina.

The presence of a rectocele requires the posterior vaginal wall be opened in the midline up to the level of the

newly formed cul-de-sac. The defect from separation of the rectovaginal fascia from the uterosacral ligaments is identified. If an enterocele sac is identified, opening of the sac with high ligation of the sac is unnecessary, as the mesothelial lining of the peritoneal sac has little supportive value. The sac is simply pushed upward by reattachment of the uterosacral ligaments to the posterior cuff and the rectovaginal septum. The vagina can be closed vertically or horizontally, as neither is superior in preserving vaginal length. Cruikshank and Pixley demonstrated that vaginal length depended on the support of the vaginal cuff, not any specific method of epithelial closure. They concluded that as long as there is good restoration of vault suspension, vaginal length is not affected by the vertical versus horizontal orientation of the vaginal epithelial closure. If the cuff has been adequately suspended, the cuff closure is positioned toward the anterior vagina wall, leaving more depth to the posterior vaginal wall for accommodation of coitus.

Some investigators have recommended that the vaginal cuff be left open or a drain placed within the vaginal (closure) incision to reduce the morbidity of vaginal cuff cellulitis or abscess formation. With the widespread use of prophylactic antibiotics and the recognition that irrigation during a vaginal procedure is required, there is no longer any need for those techniques. In addition, leaving the cuff open may lead to an increased incidence of enterocele formation and vaginal vault prolapse.

The decision to place packing into the vagina postoperatively is an optional one. A vaginal pack need not be used after vaginal hysterectomy unless concomitant pelvic reconstructive surgery is performed. Complete hemostasis should be achieved after vaginal hysterectomy and prior to cuff closure. Significant postoperative bleeding will rarely occur from the single vascular pedicle on each side of a hysterectomy bed. If that type of bleeding does occur, it is important to become aware of this problem as soon as possible and vaginal packing will only delay the diagnosis and not prevent the problem. Vaginal packing compresses the vaginal walls much more effectively than the apex of the vagina where there is no structure against which packing may compress the vaginal tissues. It is important to be aware of postoperative bleeding sooner rather than later while the patient is still hemodynamically stable, so a pelvic arteriogram or surgical intervention can be performed early in the course of any such bleeding. The arteriogram may demonstrate the bleeding site and allow arterial occlusion, thus preventing the need for a return to the operating room or laparotomy.

For some surgeons, it is not routine practice to insert an indwelling transurethral catheter following the removal of a normal-size uterus. Removal of an enlarged uterus may cause occasional transient insult to the bladder and transient postoperative voiding problems; therefore, in such patients, bladder drainage is usually suggested, at least overnight.

Routine cystoscopy following vaginal hysterectomy significantly increases the incidence of recognition of both bladder and ureteral injury. Before cystoscopy, 5 mL of indigo carmine is administered intravenously by the anesthesiologist. Alternatively, a single tablet of Pyridium 200 mg can be administered prior to the start of the procedure. The strong efflux of blue or ochre dye through each ureteral orifice following hysterectomy with or without pelvic reconstruction implies the integrity of the ureters. Although this routine may not be absolutely necessary with each vaginal hysterectomy, it certainly makes the surgeon more comfortable and helps protect the patient from unacceptable consequences.

BEST SURGICAL PRACTICES

- Randomized controlled trials have demonstrated that women treated by vaginal hysterectomy experience lower morbidity, less pain, more rapid recovery, and a more rapid return to normal activities compared with abdominal, endoscopic, or laparoscopically assisted vaginal hysterectomy. They also consume fewer health care dollars and resources. Little evidence is available to compare robotic and vaginal surgeries.
- Using guidelines to determine the route of hysterectomy adopted by the National Guideline Clearinghouse, and with maximum development of surgical technique, it is feasible to perform 90% of hysterectomies for

benign disease indications via the vaginal route.

- Following the National Guideline Clearinghouse guidelines for selecting the route of hysterectomy, even for a resident training environment, has been shown to decrease the number of abdominal and consequently endoscopic hysterectomies.
- To minimize bladder and rectal injuries, the anterior and posterior peritoneum should always be entered under direct vision.
- The risk of ureteral injury can be minimized by retracting the bladder anteriorly at all times after completion of the dissection of the vesicocervical and vesicouterine spaces and dividing the cardinal ligament before cutting, clamping, or suturing in the anterolateral area above the cervix.
- The only vascular pedicle above the uterine vessels contains the round ligament, utero-ovarian ligament, and fallopian tube. These structures can generally be clamped in a single pedicle.
- Transvaginal removal of the ovaries at the time of vaginal hysterectomy should be technically feasible in more than 90% of patients.
- Following vaginal hysterectomy, the presence of preexisting pelvic support defects should be carefully evaluated and repaired if present. The vaginal vault should always be resuspended to the uterosacral ligaments.

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