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CHAPTER 8.4

Laparoscopic Procedures for Gynecologic Surgery

Camran R. Nezhat, MD
Cliff Schmiesing, MD
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Laparoscopic Surgery for Endometriosis

Surgical Considerations

Description: There are numerous theories about the etiology of endometriosis, including: (a) the peritoneal cavity is seeded with endometrial cells via the fallopian tubes during menses; (b) totipotential cells in the peritoneal cavity are transformed by hormonal exposure into endometrial cells; (c) endometrial cells are transported intravascularly or via lymphatics to ectopic sites, where they respond to hormonal stimuli (this theory has been used to explain the presence of endometriosis in the brain and pleura); (d) decreased cytotoxic response of the immune system suggests that it is a failure of natural killer-cell activity to eliminate ectopic endometrial cells; and (e) it is an inherited disorder, because the incidence of endometriosis is higher in first-degree relatives. Intervention usually is indicated for intractable pain, infertility, or impaired function of the gastrointestinal (GI) or genitourinary (GU) tracts. GU endometriosis may range from superficial involvement of peritoneum overlying the ureters and bladder to frankly invasive endometriosis penetrating through to bladder mucosa. Scarring and fibrosis can → ureteral obstruction and hydronephrosis with renal insufficiency. Patients with GI endometriosis may have thickening of the rectovaginal septum, suggesting obliteration of the posterior cul-de-sac or rectosigmoid involvement. Adhesions may make rectovaginal examination difficult or painful. Pelvic structures may be immobile, suggesting adhesions are fixing bowel or bladder to the uterus. Sigmoidoscopy should be performed to r/o malignancy and to determine whether endometriosis has penetrated through to the bowel mucosa.

Two treatment approaches can be taken. **Hysterectomy** and **bilateral salpingo-oophorectomy** (**BSO**) may be indicated for patients with severe symptoms who have not responded to medical or conservative surgical treatment and who do not desire fertility (see **laparoscopic hysterectomy**, p. 852). **Bilateral oophorectomy** might be necessary to eliminate the estrogen that sustains and stimulates the ectopic endometrium. Conservative surgery is indicated for women who desire pregnancy and whose disease is responsible for their symptoms of pain or infertility. Although seldom curative, surgery improves fertility and offers at least temporary pain relief. **Laparoscopy** (Fig. 8.4-1) is the most appropriate surgical technique for the diagnosis and treatment of endometriosis. Data from animal and clinical studies suggest that laparoscopic surgery is more effective for adhesiolysis, causes fewer de novo adhesions than laparotomy and reduces impairment of tuboovarian function. Special consideration must be given to the patient's past Hx of abdominal or pelvic surgery, pelvic inflammatory disease (PID) and endometriosis, as this will affect the choice of surgical approach. Ovarian endometriosis is common and can be challenging to diagnose and treat. It can be divided into Type I (primary endometriomas or small cysts measuring > 3 cm on the ovarian surface) or Type II (secondary endometriomas, usually functional [e.g., follicular] in origin, which become enlarged to > 3 cm). Regardless of classification, it is critical to remove all endometriotic lesions to prevent exacerbation and recurrence.

Bladder endometriosis: If the lesions are superficial, **hydrodissection** and **vaporization** are adequate for removal. Using hydrodissection, the areolar tissue between the serosa and muscularis beneath the implants is dissected. The lesion is circumscribed with a laser and fluid is injected into the resulting defect. The lesion is grasped with forceps and dissected with the laser. Traction allows the small blood vessels supplying the surrounding tissue to be coagulated as the lesion is resected. Frequent irrigation is necessary to remove char, ascertain the depth of vaporization, and ensure that the lesion does not involve the muscularis and mucosa. Endometriosis extending to the muscularis but without mucosal involvement can be treated laparoscopically, and any residual or deeper lesions may be treated successfully with hormonal therapy. When endometriosis involves **full bladder-wall thickness,** the lesion is excised and the bladder reconstructed in one layer. Simultaneous cystoscopy is performed and bilateral ureteral catheters are inserted. The bladder dome is held near the midline with the grasping forceps and the endometriotic nodule is excised 5 mm beyond the lesions. An incision is made with the CO_2 laser, using the suction-irrigating probe as a backstop. The specimen is removed from the abdominal cavity with a long grasping forceps. The lesion is regrasped and removed with the laparoscope as one unit. CO_2 distends the bladder cavity, allowing excellent observation of its interior. After again identifying the ureters and examining the bladder mucosa, the bladder is closed. Cystoscopy is performed to identify possible leaks. The duration of laparoscopic segmental cystectomy is 35 min. Patients are discharged the following day and instructed to take trimethoprim and sulfamethoxazole for 2 wk. The Foley catheter is removed 7–14 d later, and cystograms are made.

GI/GU endometriosis: In a patient with no Hx of pelvic surgery, the **direct-trocar insertion method** may be used with an intraumbilical incision. The incision is made within the umbilicus because this is the anatomical area closest to the fascia and peritoneum and involves the least risk of injury to retroperitoneal structures. Once the incision is made, the trocar is placed through the skin incision. Using an intraumbilical incision and inserting the trocar at 90° facilitates access to the abdominal cavity and decreases the risk of aortocaval injury. This technique of direct-trocar insertion may *(Print pagebreak 847)* not be recommended for patients who have had prior laparotomy or laparoscopy that revealed adhesive disease. After insufflation of the abdomen with CO_2, assessment of intraabdominal and pelvic structures is made. A second skin incision is made 2–3 cm above the symphysis. A Foley catheter should be in place throughout the procedure to allow continuous drainage of the bladder, thereby reducing the likelihood of trocar injury to the bladder. A 5-mm trocar is placed under direct visualization with attention to peritoneal vessels and bladder. Two lateral ports are placed in a similar fashion, taking care to avoid the inferior epigastric vessels. The suction irrigator, a blunt grasper, and the bipolar cautery are placed into the trocars. Filmy adhesions of the bowel or omentum to the anterior abdominal wall or uterus are lysed using CO_2 laser, bipolar cautery, monopolar scissors, or hydrodissection. Treatment of peritoneal endometriosis ranges from laser ablation of superficial peritoneal implants to excision and dissection of deeply embedded, fibrotic areas. Scarring from endometriosis that has penetrated the peritoneum to involve deeper structures destroys normal surgical planes and distorts anatomical relationships. Identification of structures and landmarks is critical before attempting to treat the peritoneal disease. During laparoscopy, normal anatomic relationships along the pelvic sidewall may appear distorted. Because scarring from endometriosis may change these relationships, patients are at risk for accidental ureteral or vascular injury at the time of surgery. Identification of ureters and blood vessels is critical prior to treatment of pelvic sidewall disease. Although different modalities have been used, hydrodissection and high-power superpulse or ultrapulse CO_2 lasers are the best options for endometriosis treatment. Because the CO_2 laser does not penetrate water, this fluid backstop allows the surgeon to work on selected tissue with a greater safety margin.

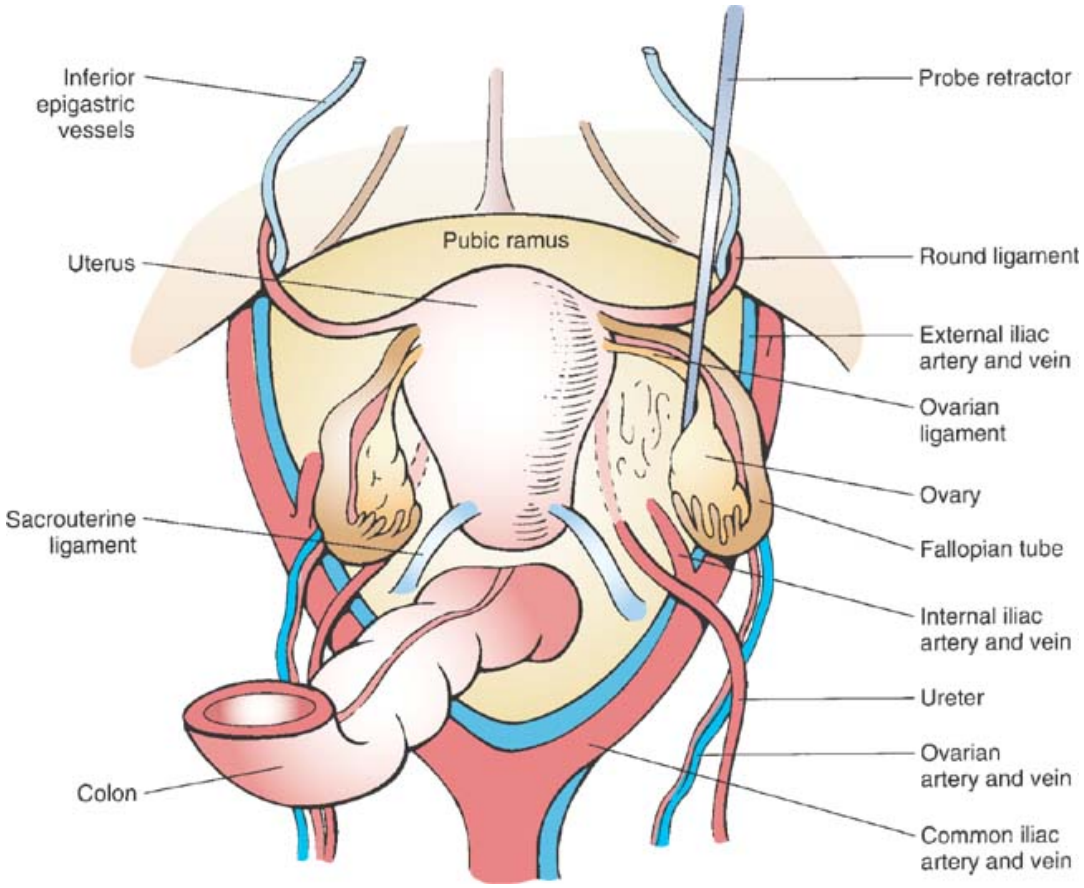

Figure 8.4-1. 1. Laparoscopic view of the female pelvis.

Ovarian endometriosis: A Type I endometrioma of < 2 cm is vaporized using laser or bipolar coagulation. Larger Type I lesions may require excision using scissors or biopsy forceps. For Type IIA endometriomas, the procedure begins with lysis of periovarian adhesions using laser or monopolar scissors. The ovarian cortex is evaluated, the endometrioma cyst is identified, the cyst wall is perforated (using laser or scissors), and an irrigation device is inserted to assess cyst contents and wall. Suspicious areas are biopsied and sent for frozen-section analysis. A plane is developed between the cyst wall and ovary by grasping the wall and separating it from ovarian stroma, using traction and countertraction. Difficult areas where endometriosis has embedded through the cyst wall, disrupting the *(Print pagebreak 848)* planes, require hydrodissection and bipolar cautery to control bleeding vessels in the ovarian bed. In some cases, it is necessary to remove a portion of the ovary attached to the cyst wall until a plane can be found. Redundant

ovarian tissue is approximated with low-power laser or electrosurgery to avoid adhesions. Suturing should be avoided; but, if necessary, 4-0 polydioxanone sutures can be placed to close the defect.

Usual preop diagnosis: Endometriosis

Summary of Procedures

	Ovarian Endometriosis Procedure	GI/GU Endometriosis Procedure
Position	Dorsal lithotomy, legs in stirrups ± steep Trendelenburg	
Incision	Intraumbilical; lateral suprapubic; or midline suprapubic	
Special instrumentation	CO_2 laser or other cutting instrument; bipolar Kleppinger forceps; suction irrigator, uterine manipulator	± Ureteral stenting, cystoscope, sigmoidoscope
Antibiotics	Cefotetan 1 g iv	
Surgical time	45 min–3 h, depending on extent of disease	1–4 h
Closing considerations	Close fascia of all 10–12 mm ports; subcuticular closure for 5 mm trocar sites	
EBL	Minimal	
Postop care	Mild disease: PACU → home; otherwise, discharge on POD 1 (peritoneal disease).	Ambulate POD 0; Foley catheter.
Mortality	0.08–0.2/1,000	
Morbidity	Overall complication rate: 2.5% Conversion to laparotomy: 0.42% VAE (CO_2 embolism) Peroneal nerve damage Vascular damage Bowel injury: Rare Urinary tract injury: Rare	Urinary tract injury
Pain score	4–8	4–8

Patient Population Characteristics

Age range	Reproductive age	20s–40s
Incidence	10–15% of all reproductive age women/25% of all gynecologic laparotomies	1–11% of women with known endometriosis
Etiology	Numerous theories (see above).	Extensive disseminated endometriosis
Associated conditions	Infertility; pelvic pain; bladder or bowel symptoms; HTN (2° to urinary tract involvement); GI tract involvement (3–7%)	Pelvic pain; GI or GU symptoms

Anesthetic Considerations

See Anesthetic Considerations following Laparoscopic Hysterectomy, p. 854.

Suggested Reading

1. Berker B, Nezhat C, Nezhat F, et al: Laparoscopic treatment of endometriosis. In *Nezhat's Operative Gynecologic Laporoscopy and Hysteroscopy*. Nezhat C, Nezhat F, eds. Cambridge University Press, New York: 2008, 263–303.

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Laparoscopic Surgery for Ectopic Pregnancy

Surgical Considerations

Description: Ectopic pregnancy is defined as a pregnancy occurring outside the uterus. The majority of ectopic pregnancies occur in the fallopian tubes (95–97%); the remainder occurs in the cornua (2–4%), ovary (0.1%), cervix (0.1%), or abdomen (0.03%). Ectopic pregnancy remains a leading cause of maternal morbidity and mortality. Predisposing factors include Hx of tubal ligation or other tubal surgery, pelvic inflammatory disease (PID), IUD use and Hx of in vitro fertilization (IVF) or other treatments for infertility. Other associations include developmental anomalies of the Müllerian system, intrauterine polyps, or myomas.

Patients present with lower quadrant pain, vaginal bleeding, and an ↑ β-hCG. Shoulder pain from subdiaphragmatic intraperitoneal blood is a less frequent finding. Treatment options for an asymptomatic ectopic gestation include operative laparoscopy or a trial of medical management with intramuscular methotrexate. In cases where the size of the ectopic pregnancy is too large for conservative medical management (> 3.5 cm), and the patient is hemodynamically stable, operative management is essential. Hypotension or an acute abdomen in the presence of a positive β-hCG value are strongly suggestive of rupture and require expeditious surgical intervention.

Access to the abdomen is obtained in the usual fashion (e.g., through a Veress needle or direct-trocar insertion, followed by insufflation and insertion of accessory trocars). Ruptured tubal pregnancies can be treated endoscopically if the bleeding has ceased or can be controlled. Actively bleeding vessels are identified and cauterized, and forced irrigation is used to dislodge clots and trophoblastic tissue. Depending on their size, the products of conception (POCs) are removed through either a 5 or 10 mm trocar sleeve or placed into an endoscopic bag for removal; or a minilaparotomy can be performed. Copious irrigation should follow to ensure hemostasis and identify and remove any remaining trophoblastic tissue. Trophoblast is invasive, and residual tissue may implant into bowel, bladder, peritoneum, or other abdominal structures and cause significant future morbidity.

For an unruptured ectopic pregnancy, the tube is identified and stabilized using laparoscopic forceps. To minimize bleeding, 5–7 mL of a solution of 50 U vasopressin in 100 mL NS is injected into the mesosalpinx just below the ectopic pregnancy and over the antimesenteric surface of the tubal segment containing the gestation. Intravascular injection of vasopressin solution can precipitate acute arterial HTN, bradycardia, or even death; therefore, care must be taken to avoid such injection. A linear incision is made over the thinnest portion of the tube. The pregnancy usually protrudes through the incision, and forceful irrigation will dislodge the gestation from its implantation site. Oozing from the tube is common, but usually ceases spontaneously.

In a ruptured tubal or isthmic pregnancy, resection of the tubal segment containing the gestation is preferable to salpingostomy. **Segmental tubal resection** is performed with bipolar electrosurgery, laser (KTP, argon, Nd:YAG, or CO_2), sutures, or stapling devices. Similarly, **total salpingectomy** can be performed by progressive coagulation and cutting the mesosalpinx, which is separated from the uterus using bipolar coagulation and scissors or laser. The isolated tube segment containing the ectopic pregnancy is removed intact or in sectioned parts through the 10-mm trocar sleeve. At the completion of the procedure, the abdomen is irrigated and inspected and incisions are closed in the usual fashion.

Usual preop diagnosis: Ectopic pregnancy

Summary of Procedures

Position	Dorsal lithotomy, legs in Allen universal stirrups, steep Trendelenburg
Incision	Intraumbilical, lateral suprapubic, midline suprapubic
Special instrumentation	CO_2 laser; laparoscopic instrumentation, uterine manipulator
Unique considerations	Intraperitoneal hemorrhage and hemodynamic instability are potential risks. Patient should be cross-matched for 2 U PRBCs.
Antibiotics	Cefotetan 1 g iv

Surgical time	45 min–2 h
Closing considerations	Fascia of 10–12 mm trocar sites closed in layers. Smaller 5 mm ports closed in a subcuticular fashion.
EBL	100 mL, severe hemorrhage, if ruptured.
Postop care	The patient may be admitted overnight for observation. Quantitative β-hCG should be followed until undetectable, to r/o the possibility of retained trophoblastic tissue.
Mortality	5/1000. For any laparoscopy: 0.08–0.2/1,000
Morbidity	Overall complication rate: 2.5% Hemorrhage and need for transfusion Conversion to laparotomy: 4.2/1,000 Air embolism: Rare Unintended puncture of a viscus: Rare Puncture of a major vessel: Rare Insufflation of incorrect site: Rare
Pain score	3–5

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Patient Population Characteristics

Age range	Reproductive-age females
Incidence	1/100 pregnancies
Etiology	Distorted tubal or uterine anatomy
Associated conditions	Hx of PID; endometriosis; tubal damage; IUD; IVF

Anesthetic Considerations

See Anesthetic Considerations following Laparoscopic Hysterectomy, p. 854.

Suggested Readings

1. Farquar CM: Ectopic Pregnancy. *Lancet* 2006; 366:583–91.

2. Querleu D, Chapron C: Complications of gynecologic laparoscopic surgery. *Curr Opin Obstet Gynecol* 1995; 7:257–61.

3. Tedesco M, Curet, M: Laparoscopy in the Pregnant Patient. In *Nezhat's Operative Gynecologic Laporoscopy and Hysteroscopy,* 3rd edition. Nezhat C, Nezhat F eds. Cambridge University Press, New York: 2008, 499–508.

Laparoscopic Myomectomy

Surgical Considerations

Description: Uterine myomata or fibroids are the most common uterine neoplasm, affecting 20–25% of women of reproductive age. Their growth is influenced by many factors, such as estrogen acting alone or synergistically with growth hormone and human placental lactogen in pregnancy. The severity of symptoms depends on the number, size, and location of the tumors. Symptoms may include constipation, pelvic or abdominal pressure, urinary frequency and, most commonly, menorrhagia. Although leiomyomata are seldom the cause of infertility, there is a link between fibroids, fetal wastage, and premature delivery. Patients present with profound anemia from menorrhagia or menometrorrhagia, the usual indications for surgery. Other indications include rapidly changing size, ureteral compression, hydroureter, or hydronephrosis and size > 12 wk. Size, number, and location are the primary

factors that will determine surgical approach to myomata.

The simplest approach is a combination of **laparoscopy** and **minilaparotomy** for removal of myomas. This approach limits operative time. Three major objectives of laparoscopic myomectomy are: minimizing blood loss, which can be *(Print pagebreak 851)* severe; minimizing postop adhesion formation; and maintaining uterine-wall integrity. Preop treatment with GnRH analogues to shrink fibroids has been shown to decrease the size of the myoma and reduce the need for transfusion. Although myomectomy is performed to preserve fertility, postop adhesion formation often jeopardizes this goal. This can be minimized by using a single, vertical, anterior midline uterine incision.

The abdomen is entered in the usual fashion for laparoscopy (e.g., through Veress needle or direct trocar insertion, followed by insufflation and insertion of accessory trocars). To reduce blood loss in pedunculated myomas, diluted vasopressin (3–5 mL) is injected into the base of the stalk where it joins the uterine wall. IV vasopressin can cause ↑ BP, myocardial ischemia, dysrhythmias, or cardiac arrest, and should be avoided. The pedicle is coagulated with the bipolar forceps and cut with CO_2 laser or scissors. For subserosal or intramural myomas, diluted vasopressin is injected between the myometrium and the myoma pseudocapsule. An incision is made on the serosa overlying the myoma using the CO_2 laser or monopolar needle. As the incision is made, the myometrium is retracted away from graspers to expose the tumor. Vessels are coagulated prior to cutting. After the myoma is removed, the myoma bed is irrigated with LR, and bleeding points are coagulated again. After closure, the serosa is irrigated with LR. An adhesion barrier may be placed over the incision site to prevent future adhesion formation. Uteroperitoneal fistulae may follow laparoscopic myomectomy, because meticulous laparoscopic approximation of all layers of the myometrium is impossible. The use of electrocoagulation for hemostasis inside the uterine defect also may increase this risk.

Removal of the specimen is frequently the most challenging aspect of the operation. The myoma can be removed either by **morcellation of the specimen** or by extending the suprapubic incision. Alternatively, **posterior culdotomy** may be performed and the myoma removed via the vagina. A retractor is placed in the vagina and the laser is used to cut along the tented vaginal mucosa. After the myoma is removed, the incision can be closed using laparoscopic suturing. Minilaparotomy or culdotomy facilitate removal but increase postop wound complication risks, such as infection or hernia formation. After myoma removal, the abdomen and pelvis are irrigated, the patient is taken out of the Trendelenburg position, and any fluid that might have tracked into the upper abdomen is suctioned. The ports are closed in the usual fashion.

Usual preop diagnosis: Uterine myoma, fibroids

Summary of Procedures

Position	Dorsal lithotomy; steep Trendelenburg to move bowel out of operating field
Incisions	Infraumbilical, 5 mm lateral and 5–12 mm midline suprapubic; minilaparotomy via extension of suprapubic incision or posterior culdotomy for removal of large myomata
Special instrumentation	CO_2 laser; laparoscopic instrumentation, uterine manipulator
Unique considerations	For large myomata: pretreatment with GnRH analogues (3–6 mo). Intraop injection of dilute vasopressin (1 IU in 100 mL LR) into myometrium to ↓ bleeding.
Antibiotics	Cefotetan 1 g iv
Surgical time	1–3 h
Closing considerations	Close fascia of all 10–12 mm ports; 5 mm ports are closed in a subcuticular fashion. Fascial closure essential in minilaparotomy. Posterior culdotomy requires laparoscopic suturing or vaginal closure.
EBL	100–600 mL
Postop care	1–2 d hospital stay; early ambulation; clear liquids POD 0; gradually advance diet after discharge home.
Mortality	0.08–0.2/1,000
Morbidity	Rates: 1.3–5.9/100 Peroneal nerve damage from positioning Severe bleeding with possible need for transfusion Uteroperitoneal fistulae Infertility

	GI/GU injury Air embolism Puncture of a major vessel Insufflation in the wrong place Need for emergent laparotomy Uterine rupture in pregnancy: 2% Adhesion formation
Pain score	4–6

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Patient Population Characteristics

Age range	Reproductive-age women; myomas shrink in postmenopausal women and are less symptomatic.
Incidence	20–25% of all women
Etiology	Benign transformation and proliferation of a single smooth-muscle cell
Associated conditions	Menorrhagia; anemia; ureteral obstruction; pelvic pain or pressure

Anesthetic Considerations

See Anesthetic Considerations following Laparoscopic Hysterectomy, p. 854.

Suggested readings

1. Glaser MH: Minimally invasive approaches to myomectomy. In *Nezhat's Operative Gynecologic Laporoscopy and Hysteroscopy,* 3rd edition. Nezhat C, Nezhat F eds. Cambridge University Press, New York: 2008, 316–33.

2. Querleu D, Chapron C: Complications of gynecologic laparoscopic surgery. *Curr Opin Obstet Gynecol* 1995; 7:257–61.

Laparoscopic Hysterectomy

Surgical Considerations

Description: Hysterectomy is the second most common gynecologic operation, after cesarean section. The indications for **hysterectomy** ± **salpingo-oophorectomy** include: leiomyomata (38%); malignancy (15%); ovarian tumors (10%); abnormal bleeding (13%); adenomyosis (9%); pelvic pain or adhesions (5%); endometriosis (3%); and uterine prolapse (1%). Other less common indications include parametrial disease, pelvic infection, and complications of pregnancy and delivery. Selection of surgical approach to hysterectomy requires consideration of the patient's age, medical Hx, Hx of prior pelvic surgery, the presence or possibility of adhesions or endometriosis, uterine size, adnexal pathology, and the presence or amount of uterine prolapse.

Laparoscopic hysterectomy offers the advantages of excellent visibility and exposure. There is shorter recovery time, rapid return of bowel function, less pain, and a lower wound complication rate. The disadvantages are higher cost and the level of surgical expertise required. The most commonly performed procedure is the **laparoscopically assisted vaginal hysterectomy** (LAVH), in which hysterectomy is begun by laparoscopy, but four or more steps are performed vaginally. Variants include: **total laparoscopic hysterectomy** (TLH), in which all steps are performed laparoscopically; **subtotal laparoscopic hysterectomy** (SLH), a supracervical hysterectomy; and **vaginally assisted laparoscopic hysterectomy** (VALH), in which four steps are completed laparoscopically and the procedure is completed vaginally. Combinations are usually performed, depending on findings at surgery. A mechanical and antibiotic bowel preparation is advised. Consultation with a urologist, bowel surgeon, and oncologist are sought

as necessary.

Access to the abdomen is obtained in the usual fashion (e.g., through a Veress needle or direct-trocar insertion, followed by insufflation and insertion of accessory trocars). Diagnostic laparoscopy is performed, adhesions lysed, and any endometriosis treated. The course of the ureters is noted through the peritoneum until they are no longer *(Print pagebreak 853)* visible at the level of the cardinal ligaments. When ureters cannot be identified clearly because of severe scarring or endometriosis, they are dissected retroperitoneally, and the dissection proceeds as for a radical hysterectomy. At the cardinal ligaments, the peritoneum is opened above or below the ureter and hydrodissection is performed to lift the peritoneum off the ureter without damaging it. Routine hysterectomy using hydrodissection to identify tissue planes and limit blood loss can be performed following identification of the ureters.

If the ovaries are to be spared, the uteroovarian ligament, proximal tube and mesosalpinx are cauterized and cut progressively, and the posterior leaf of the broad ligament is opened with hydrodissection. The bladder is dissected free from the cervix and uterus; and, if bladder trauma is suspected, 5 mL of indigo carmine injected iv (possible ↑ BP) may help identify the site of perforation. Next, the uterine vessels are identified, noted to be free of ureter, desiccated, and cut. At the level of the cardinal ligaments, the ureters and descending branches of the uterine artery are close to one another and the cervix; therefore, cardinal ligament dissection and cautery must be precise to prevent bleeding and ureteral injury. A small uterus can be removed easily through the vagina. In benign disease, a large uterus can be morcellated and then removed segmentally through the vagina. Pneumoperitoneum will be lost during this procedure, and care must be taken to keep instruments free of bowel or other abdominal structures as this occurs.

If the procedure is to be completed entirely laparoscopically, pneumoperitoneum can be maintained by placing a glove containing two 4” × 4” sponges in the vagina. The vaginal wall is cut circumferentially, and the uterus is pulled to mid vagina, but not removed, to preserve the pneumoperitoneum. Alternatively, the uterus may be morcellated and removed through a 10-mm suprapubic port or placed in a laparoscopic specimen bag. The suprapubic incision also may be extended into a minilaparotomy incision for specimen removal. The vaginal cuff is closed transversely using laparoscopic sutures, and any coexisting cystocele or enterocele is repaired. After the uterus is removed and the vaginal cuff closed, the pelvic and abdominal cavities are reevaluated, irrigated, and cleared of blood and debris. The skin and fascia are closed in the usual fashion.

Variant procedure: In patients with severe rectovaginal and vesical endometriosis, the retroperitoneal space is entered using hydrodissection, and the external iliac vessels, hypogastric artery, and ureter are identified. In cases where extensive dissection and resultant blood loss is anticipated, coagulation or ligation of the hypogastric artery with laparoscopic clips may be performed. Endometriosis of the rectum, rectovaginal septum, and uterosacral ligaments is treated by vaporization, excision, or a combination of these. Sigmoidoscopy with concurrent laparoscopic visualization of the pelvis may be necessary to r/o the presence of incidental enterotomy. Cystoscopy with ureteral stenting also may be indicated to identify anatomy. (Treatment of bladder and bowel endometriosis have been described in Laparoscopic Surgery for Endometriosis, p. 846.) After the ureter is identified along its course and entry into the bladder, the uterine vessels are retracted medially and separated from the ureter using a CO_2 laser. The uterus is retracted medially and the ureter laterally as the cardinal and uterosacral ligaments are cauterized and cut with the ureter under direct visualization. After these vascular pedicles have been ligated and all endometriosis treated, the hysterectomy and specimen removal proceed as described above.

Robotic Assistance: With the advent of robotic-assisted surgery all of the above procedures can be performed with three-dimensional visualization, improved magnification and 90° articulation of the robotic arm. With this set up, the surgeon sits at a console and two or three assistants are at the side of the patient. The only major difference is location and size of trocars used for the robotic arms as well as possible increased operative time. Patient positioning is not different from standard laparoscopy.

Usual preop diagnosis: Leiomyomata; malignancy; ovarian tumors; abnormal bleeding; adenomyosis; pelvic pain or adhesions; endometriosis; uterine prolapse; parametrial disease; pelvic infection; complications of pregnancy and delivery

Summary of Procedures

Position	Dorsal lithotomy; legs in Allen universal stirrups; steep Trendelenburg
Incisions	Intraumbilical; bilateral suprapubic; midline suprapubic (5 or 10 mm)
Special instrumentation	CO_2 laser; laparoscopic instruments, uterine manipulator
Unique considerations	Extensive ureterolysis and treatment of endometriosis may require addition of cystoscopy, ureteral stent placement, and/or sigmoidoscopy.

Antibiotics	Cefotetan 1 g iv
Surgical time	2–6 h. Operative time is increased in cases of extensive adhesiolysis or endometriosis.
Closing considerations	Close fascia of all 10–12 mm ports; 5 mm trocar sites closed in a subcuticular fashion. Mini-laparotomy closure if needed.
EBL	100–800 mL, depending on anatomy and difficulty of dissection
Postop care	Clear liquid diet; ambulate POD 1
Mortality	0.08–0.2/1,000
Morbidity	Overall complication rate: 2.5% Conversion to laparotomy: 4.2/1,000 Air embolism: Rare Peroneal nerve damage from positioning: Rare Unintended puncture of a viscous: Rare Puncture of a major vessel: Rare Insufflation of incorrect site: Rare Urinary and ureteral trauma, including fistulae: 1.6%
Pain score	6–9

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Patient Population Characteristics

Age range	30s–70s
Incidence	20% of women < 40 yr; 37% of women < age 65
Etiology	See Associated Conditions.
Associated conditions	Myomata; abnormal uterine bleeding; adenomyosis; malignancy; pelvic pain; endometriosis

Suggested Readings

1. Advincula A, Falcone T: Minimally invasive gynecologic surgery: the evolving role of robotics. In *Nezhat's Operative Gynecologic Laporoscopy and Hysteroscopy*, 3rd edition. Nezhat C, Nezhat F eds. Cambridge University Press, New York: 2008, 567–76.

2. Lanfranco AR, Castellanos AE, Desai JP, et al: Robotic surgery: a current perspective. *Ann Surg* 2004; 239(1):14–21.

3. Nezhat F, Yadav J: Laparoscopy and Hysterectomy. In *Nezhat's Operative Gynecologic Laporoscopy and Hysteroscopy,* 3rd edition. Nezhat C, Nezhat F eds. Cambridge University Press, New York: 2008, 341–62.

4. Querleu D, Chapron C: Complications of gynecologic laparoscopic surgery. *Curr Opin Obstet Gynecol* 1995; 7:257–61.

5. Rock JA, Jones JW, eds: *TeLinde's Operative Gynecology*. 10th edition. Lippincott-Williams and Wilkens, Philadelphia: 2008.

Anesthetic Considerations

(Procedures covered: laparoscopic surgery for endometriosis, ectopic pregnancy, myomectomy, hysterectomy)

Preoperative

Respiratory	There can be intraop respiratory compromise from ↑ intra-abdominal pressure 2° CO_2insufflation; however, patients without significant respiratory disease tolerate the insufflation quite well. **Tests:** As indicated from H&P.
Cardiovascular	Insufflation of the abdomen (typically with pressures of 14–22 mmHg) ↑↑ SVR and ↓ venous return. ↑ $PaCO_2$→↑ dysrhythmias. These are usually well tolerated in the otherwise healthy patient. **Tests:** As indicated from H&P.
Gastrointestinal	Patients often have a mechanical bowel prep the night before. Check for Sx of dehydration (↓ skin turgor, orthostatic ↓ BP, ↑ HR, etc.) and hypokalemia (e.g., weakness, flattened T waves, dysrhythmias, etc.). The combination of ↑ intra-abdominal pressure + Trendelenburg position →↑ aspiration risk. **Test:** Electrolytes
Hematologic	These patients often are having surgery for abnormal uterine bleeding → consider anemia. **Test:** Hct
Laboratory	Other tests as indicated from H&P.
Premedication	Consider midazolam 1–3 mg iv

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Intraoperative

Anesthetic technique: GETA

Induction	Standard induction (see p. B-2). Rapid sequence induction (see p. B-4) usually is indicated for patients with an ectopic pregnancy. OGT/NGT to decompress stomach prior to surgery start.	
Maintenance	Standard maintenance (see p. B-2). Muscle relaxation helpful for initial trocar insertions and may be helpful throughout procedure.	
Emergence	Standard emergence	
Blood and fluid requirements	Usually minimal blood loss IV: 18 ga × 1 NS/LR @ 2–6 mL/kg/h	Before induction, these patients may need extra fluid 2° dehydration if given mechanical bowel preparation. During surgery, large volumes of fluid are sometimes given intra-abdominally for irrigation and hydrodissection → fluid overload; therefore, carefully account for all fluids, and titrate iv fluids to maintain euvolemia.
Monitoring	Standard monitors (see p. B-1). Foley catheter	
Positioning	and pad pressure points eyes	See Neuropathies, below.
	Bradydysrhythmias	Attributed to peritoneal or fallopian-tube stimulation. Rx: stop surgery; deflate pneumoperitoneum; administer atropine 0.5 mg or glycopyrrolate 0.4–0.6 mg.
	Bleeding Hypothermia	Vascular puncture a rare risk with trocar insertion. 2° the large volume of fluid and CO_2infused into the abdomen and lithotomy position. Consider warming iv fluids and use of forced-air warming device. Occasionally, the insufflating gas can enter a vein, hollow viscera, subcutaneous tissue,

Complications	Extra-abdominal insufflation	thorax, mediastinum, or pericardium. Fortunately, since the gas is usually CO_2 small volumes are absorbed quickly and usually do not cause major physiologic compromise; however, large volumes may → cardiopulmonary collapse (e.g., 2° pneumothorax, VAE). Subcutaneous air can compromise the airway in some cases. airway before extubation.
	Neuropathies	These can be long cases, with the patient in lithotomy position. Make sure the pressure points are padded well and, if the arms are out, relieve stress on the brachial plexus.
	Fluid overload	fluid volume entering and exiting the abdomen. Fluid absorption → fluid overload → CHF, edema.

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Postoperative

Complications	PONV VTE Hypothermia	→↑ Risk for PONV. See p. B-6. See p. B-7.
Pain management	Consider ketorolac 15–30 mg and LA into surgical wounds	Patients may complain of shoulder pain due to diaphragmatic irritation.

Suggested Readings

1. Gerges FJ, Kanazi GE, Jabbour-Kohoury SI: Anesthesia for laparoscopy–a review. *J Clin Anesth* 2006; 18(1): 67–78.

2. Goulson DT: Anesthesia for outpatient gynecologic surgery. *Curr Opin Anaesthesiol* 2007; 20(3): 195–200.