INTRODUCTION

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

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

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

PREOPERATIVE CONSIDERATIONS

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

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

**Surgical Technique**

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

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

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

If one or both adnexae are to be left in situ, the uterus is placed on traction anteriorly and medially and a window created in the avascular space of Graves (between the ureter and the infundibulopelvic ligament) in the medial leaf of the broad ligament peritoneum. Two large, curved clamps (e.g., Kelly and Heaney) are placed across the utero-ovarian ligament/fallopian tube complex (the round ligament is not included) and the pedicle divided and suture ligated. The adnexae may then be allowed to drop into the posterior pelvis or packed into the paracolic gutters out of the surgical field, with care taken not to injure the infundibulopelvic ligament, for the remainder of the hysterectomy.
At the conclusion of the case, the adnexal pedicle can be sutured to the round ligament stump on each side to avoid adherence to the vaginal cuff and resulting dyspareunia. If the adnexae are re-approximated to the round ligament stumps, the peritoneal defect lateral to the infundibulopelvic ligament should be closed with a running, nonlocking stitch of 3-0 delayed absorbable suture to prevent an internal small bowel herniation and entrapment.

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

Prior to approaching the uterine vessels, it is preferable to mobilize the bladder so that unanticipated bleeding from the uterine vasculature or cardinal ligament can be safely controlled with clamps without concern over bladder injury. With cephalad traction on the uterus, the lower border of the previously incised
FIGURE 2.2 Total abdominal hysterectomy: The anterior leaf of the broad ligament is opened, exposing the bladder.

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

Attention is then directed toward dividing the uterine vessels and cardinal ligaments. Clamp placement across the uterine vessels and cardinal ligament is a common area of ureteral injury during abdominal hysterectomy. The medial leaf of the broad ligament peritoneum is incised posteriorly and medially toward the uterosacral ligament, releasing the ureter laterally. Excess peritoneum and areolar tissue is carefully dissected from around the uterine vessels, but overzealous efforts to “skeletonize” the uterine vessels should be avoided. The uterine vessels are secured with a heavy curved clamp (Heaney, Zeppelin, or Masterson) placed perpendicular to the long axis of the uterus at the level of the uterine isthmus (internal cervical os). At the level of the uterine isthmus, the clamp will be 1.0 to 1.5 cm above the ureter as it traverses the cardinal ligament. The tip of the clamp is placed against the uterus to ensure the uterine vessels are completely encompassed. The clamp should be placed across the pedicle as close to a 90° angle as possible, rather than the diagonal, to minimize the amount of tissue incorporated in the pedicle. A second clamp (straight Kocher) is placed just above the Heaney clamp at a 45° angle to control back-bleeding from the uterine
side (Figure 2.5). The uterine vessels are divided and ligated with a 1-0 delayed absorbable suture. The needle should be placed precisely at the lower border of the tip of the clamp; the suture is tied down as the clamp is released. Some surgeons prefer to place a second suture in a transfixed stitch distal to initial ligature; however, this is usually unnecessary. The pedicle of the uterine-side back-clamp is secured with a 1-0 suture ligature in a Heaney transfixed stitch and the clamp removed to clear the operative field. To reduce back-bleeding from the specimen during the cardinal ligament dissection, the contralateral uterine vessel pedicle should be clamped, divided, and ligated at this time.

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

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

**FIGURE 2.3 Total abdominal hysterectomy:** Division of infundibulopelvic ligament.
A variety of techniques can be used to transect the uterus and cervix from the proximal vagina, depending on the clinical situation and anatomy. The easiest and most straightforward technique consists of placing heavy curved clamps (e.g., Heaney, Zeppelin, and Masterson) from each side below the cervix across the cervicovaginal junction, at right angles to the long axis of the uterus, and dividing the cervix from the upper vagina with heavy curved scissors (Figure 2.7). To avoid injury to the bladder, the bladder must be mobilized at least 1 cm below the cervicovaginal junction to allow safe placement of these clamps and permit sufficient space for suture ligating the pedicles without incorporating the bladder. These clamps incorporate the lower cardinal ligaments, the lateral vagina, and the uterosacral ligaments. The vagina is closed with a Heaney transfixion stitch of 1-0 delayed absorbable suture at each angle and a series of figure-of-eight stitches working toward the midline to complete the closure (Figure 2.8). Each suture is held long and used to provide upward traction on the vaginal cuff prior to placement of the next stitch. This technique is well suited for the patient with a short cervix and clearly demarcated cul de sac. For patients with a cervix that protrudes more than 1 to 2 cm into the vagina, this technique requires resection of a portion of the upper vagina (to have sufficient room to place clamps beneath) and results in unnecessary shortening of the vagina.

The technique of retrograde hysterectomy is an excellent alternative in the case of an elongated cervix or obliterated cul de sac. In this method, an anterior colpotomy is created 0.5 to 1.0 cm below the cervicovaginal junction using the ESU. An empty sponge-stick placed transvaginally and elevated against the anterior cervicovaginal junction delineates the anatomy and provides a convenient starting point for the colpotomy. The cervicovaginal junction is circumferentially incised by placing a series of curved Heaney clamps, with each pedicle being clamped, divided, and secured with a Heaney transfixion stitch of 1-0 delayed absorbable suture in sequence (i.e., each...
pedicle is tied before the next clamp is placed. The ties from each pedicle are held long and used to provide upward traction on the vaginal cuff, optimizing exposure for placement of the next clamp. Grasping the cervix with a straight Kocher clamp and applying upward traction will also improve exposure. The final two clamps are placed across the posterior proximal vagina and the specimen excised. A simple method for closing the vaginal cuff consists of placing a horizontal mattress stitch of 1-0 delayed absorbable suture on either side of the vaginal cuff, working from posterior to anterior, below the tip of the cervix.
FIGURE 2.6 Total abdominal hysterectomy: Transection of the cardinal ligament. The pedicle is ligated (inset).
clamp, through the medial anterior vaginal wall, then reversing direction and placing the needle through the anterior lateral vaginal wall and exiting the posterior lateral vaginal wall just beneath the “heal” of the clamp. The suture is tied as the clamp is released, effectively securing the lower cardinal ligament, lateral vagina, and uterosacral ligament in a single stitch. The remainder of the vaginal cuff is closed with several figure-of-eight stitches of 1-0 delayed absorbable suture.

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

**POSTOPERATIVE CONSIDERATIONS**

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

**Operative Note**

**PROCEDURE: TOTAL ABDOMINAL HYSTERECTOMY**

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

**COMPLICATIONS**

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

**Suggested Reading**