6 Techniques in Gynecologic Oncology

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Gynecologic oncologists have been performing various minimally invasive procedures for some time for both uterine and cervical cancer. For apparent early-stage ovarian cancer, a minimally invasive approach also seems adequate; however, for advanced disease, an open exploration and maximal effort at tumor debulking still remains the standard of care. Minimally invasive procedures may be used for radical hysterectomy, pelvic and para-aortic lymphadenectomy, and omentectomy. Although most associate radical hysterectomy with cervical cancer, para-aortic lymphadenectomy with uterine cancer, and omentectomy with ovarian cancer, these procedures may be used for any gynecologic malignancy. Some patients may undergo more than one of these minimally invasive techniques. Minimally invasive procedures unique to gynecologic oncology are described in this chapter.

6.1 Introduction

In the 1960s, gynecologists developed laparoscopy as a means to visualize pelvic anatomy and quickly innovated from diagnostic to operative laparoscopy by performing tubal ligations in the 1970s. However, in the 1980s, urologists led the development of the approach for the treatment of cancer, with gynecologic oncologists trailing the uptake with minimal utilization throughout the 1990s. In 2003, a minority of gynecologic oncologists felt that a minimally invasive approach was appropriate for treating any pelvic malignancy [1]. However, less than 5 years later, the majority of gynecologic oncologists recognized the value of patient care and oncologic equivalence in relation to minimally invasive surgery [2]. As frequently happens with new technologies and procedures, widespread adoption into clinical care often occurs based on retrospective studies, clinical judgment, and expert opinion. This, too, has been the case in gynecologic oncology, in which minimally invasive surgery is now routinely employed to treat women with uterine, cervical, and ovarian cancers.

For women with uterine cancer, many gynecologic oncologists were performing minimally invasive hysterectomy and staging long before the data showed it was oncologically equivalent to open surgery. In 2012, however, results from the LAP2 study were published [3]. This randomized study of 2,616 women with uterine cancer confirmed what all had assumed: open and minimally invasive approaches to uterine cancer had equivalent disease-free and overall survival rates [3]. Furthermore, women who underwent laparoscopy had better short-term quality of life and shorter hospital stays than those who had laparotomy. Interestingly, long-term (6 months) quality of life characteristics were equivalent [4].

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Similar to the treatment of women with uterine cancer, a majority of patients with cervical cancer are being offered a minimally invasive approach for treatment. Typically, radical hysterectomy and bilateral pelvic lymphadenectomies are performed for stage IA2/IB1 disease as well as for stage IA1 disease with high-risk features such as lymphovascular space invasion. However, the oncologic equivalency of this approach in these tumors is supported by retrospective studies that demonstrate equivalent pathologic parameters and recurrence rates, not survival [5, 6]. A prospective validation study similar to LAP2 is currently under way [7].

Unlike uterine and cervical cancers, the appropriateness of a minimally invasive approach for women with ovarian cancer remains controversial [2] because the goal of surgery for women with ovarian cancer is complete cytoreduction to microscopic disease. For women with stages III and IV disease, we believe strongly that optimal cytoreductive surgery can only be achieved through a laparotomy via a vertical incision, and we do not perform minimally invasive surgery for tumor debulking in these patients. However, some have advocated a diagnostic laparoscopy in patients with obvious metastatic disease to assess for resectability of tumors [8, 9]. This use of minimally invasive surgery may be appropriate in women with widely metastatic disease. For women with clinical stage I disease, a minimally invasive surgery and staging are reasonable. The necessary staging surgery for ovarian cancer, including exploration, peritoneal biopsies, omentectomy, and pelvic and para-aortic lymphadenectomies can be done laparoscopically [10, 11]. For these patients with disease limited to the ovaries, a minimally invasive surgery seems equivalent to a laparotomy [12].

In this chapter, minimally invasive procedures that are unique to gynecologic oncology are described and include radical hysterectomy, pelvic and para-aortic lymphadenectomy, and omentectomy. Although most associate radical hysterectomy with cervical cancer, para-aortic lymphadenectomy with uterine cancer, and omentectomy with ovarian cancer, these procedures may be used for any gynecologic malignancy. For example, a patient with clinical stage II uterine serous carcinoma may undergo a radical hysterectomy, pelvic and para-aortic lymphadenectomies, and omentectomy.

6.2 Total Laparoscopic Radical Hysterectomy

6.2.1 General Considerations

A radical hysterectomy removes not only the uterine fundus and cervix (as in a simple hysterectomy) but also a portion of the upper vagina and parametrium en bloc. Removal of these additional margins are what classifies the procedure as "radical" and what increases the operative morbidity and technical difficulty beyond those of a simple hysterectomy. For women with early stage cervical cancer, however, this extra dissection is necessary to determine disease status beyond the cervix, since the tumor may have already spread to the vagina or the parametrium by either direct extension or through the lymphatics into the parametrial nodes.

The radicality of the procedure may be tailored to tumor factors such as size and location. The most commonly used classification for radical hysterectomy was originally proposed in 1974 by Piver, Rutledge, and Smith (Table 6.1) [13]. In 2008, Querleu and Morrow proposed an updated classification that considered parasympathetic nerve preservation and paracervical tissue involvement (Table 6.2) [14].

For patients with cervical cancer, radical hysterectomy is almost always accompanied by pelvic lymphadenectomy. Pelvic lymphadenectomy is important because 15–20 % of patients with stage I disease may have disease that has spread to draining nodes and lymphatic channels, and tumors carrying emboli may bypass the parametrium and directly implant in the pelvic nodal basins [15]. Currently, data are emerging that lymphatic mapping and sentinel node biopsy may be adequate for women with early stage cervical cancer (tumors <2 cm) [16, 17]; however, this approach is not yet the standard of care. Removal of aortocaval nodes is done at the discretion of the surgeon.

Removal of the ovaries is not necessarily required as part of radical hysterectomy. Performance of salpingo-ophorectomy should be personalized to patients based on age, reproductive history, and tumor histology. If adnexectomy is to be performed, we recommend leaving the infundibulopelvic ligament intact until after complete mobilization of the parametrium because the additional tension created by this ligament greatly assists in the parametrial dissection.

Finally, for a minimally invasive laparoscopic radical hysterectomy, a good uterine manipulator is of utmost importance. A variety of manipulators exist, each with their strengths and weaknesses. For the most part, these devices will improve visualization, create proper countertension during bladder, ureteral, and parametrial dissections, and delineate the appropriate margins for vaginal colpotomy.

Table 6.1 Piver-Rutledge-Smith classification of radical hysterectomy

Name (type)	Point of uterine vessels transection	Amount of vagina removed	Point of uterosacral ligament transection
Simple (I)	At insertion into cervix (level of the internal os)	Minimal	At insertion into cervix
Modified radical (II)	At level of the ureter	1–2 cm	Midway between cervix and rectum
Radical (III)	At their origin from the internal iliac vessels	Upper half	At their origin
Extended radical (IV)	At their origin from the internal iliac vessels	Upper three-fourths with paravaginal tissue	At their origin
Partial exenteration (V)	At their origin and en bloc with ureters (and possibly bladder)	Entire vagina above levator muscles	At their origin (and possibly en bloc with rectum)

Modified from Piver et al. [13]

Table 6.2 Querleu–Morrow classification of radical hysterectomy

Type	Extent of resection	Ureter	Comment
Type A	The paracervix is transected medial to the ureter but lateral to the cervix. Uterosacral and vesicouterine ligaments are not transected at a distance from the uterus Vaginal resection is minimal without removal of the paracolpos	Ureter palpated or directly visualized without freeing from bed	
Type B1	Paracervix is transected at the level of the ureteral tunnel Partial resection of ureterosacral and vesicouterine ligaments No resection of caudal (deep) neural component of the paracervix (caudal to the deep uterine vein) Vaginal resection of at least 10 mm of the vagina from the cervix or tumor	Unroofing of ureter Ureter rolled laterally	**Type B2**: Type B1 + removal of the lateral lymph nodes
Type C	Transection of paracervix at junction with internal iliac vascular system, uterosacral ligaments at the rectum, and vesicouterine ligaments at the bladder Resection is 15–20 mm of the vagina from the tumor or cervix and corresponding paracolpos	Ureter completely mobilized	**Type C1**: with autonomic nerve sparing/preservation **Type C2**: without autonomic nerve sparing/preservation
Type D1	Resection of the paracervix at the pelvic side with vessels arising from internal iliac system, exposing the roots of the sciatic nerve	Ureter completely mobilized	
Type D2	Resection of the paracervix at the pelvic side, with hypogastric vessels plus adjacent fascial or muscular structures (laterally extended endo-pelvic resection)	Ureter completely mobilized	

Modified from Querleu et al. [14]

6.2.2 Procedure

What follows is a description of the Piver-Rutledge-Smith type III radical hysterectomy. Once mastered, this procedure can easily be modified for more (type IV) or less (type II) radical procedures. The order of the steps listed may differ slightly from surgeon to surgeon. Although this surgery can be performed with monopolar electrocautery, we recommend using one of the many advanced vessel sealing devices because they tend to have better hemostasis and, more importantly, less lateral thermal spread. The latter is particularly important when dissecting near the ureter.

The surgery begins with a careful exploration of the entire peritoneal cavity for evidence of intraperitoneal spread. This includes inspection of the upper abdomen and all peritoneal surfaces. For women with cervical cancer, if metastatic disease is encountered, the surgery should be terminated and the patient reassigned to chemotherapy and/or radiation.

The round ligament is then divided and the retroperitoneal space is entered. Gentle blunt dissection in this avascular space is performed, and the external iliac vessels, internal iliac artery, and ureter are identified. A careful examination of the pelvic lymph nodes should be made, and any enlarged or abnormal-appearing nodes should be removed and sent for frozen section evaluation. One of the few limitations of the minimally invasive radical hysterectomy is the decreased tactile sensitivity for palpating lymph node basins.

A bladder flap is then created using a combination of the advanced vessel sealing device and blunt dissection. Early in the surgery only a small bladder flap is necessary. However, throughout the procedure, the surgeon returns to the bladder, further dissecting it from the pubovaginal fascia to achieve the desired vaginal margins.

The pararectal and paravesical spaces are then opened. We favor opening the pararectal space first, although this varies based on the surgeon's preference. The pararectal space is entered by bluntly dissecting between the ureter and internal iliac artery along the curve of the sacrum. This is another avascular space bordered by the internal iliac artery/levator ani laterally, the rectum medially, the sacrum posteriorly, and the cardinal ligament (parametrium) anteriorly.

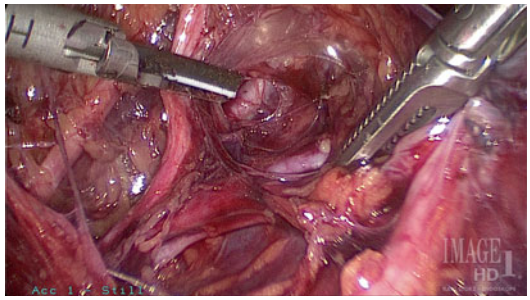

Fig. 6.1 The uterine artery is seen at its origin from the internal iliac (hypogastric) artery

Once the pararectal space is opened to the pelvic floor, the paravesical space should be opened. With anterior retraction of the proximal portion of the severed round ligament and using the superior vesicle artery as a landmark, this space can be entered either medially or laterally to that vessel (although we favor lateral entry). Again, blunt dissection is used to open this avascular space bordered by the obturator internus muscle laterally, the bladder medially, the pubis symphysis anteriorly, and the cardinal ligament posteriorly. Care must be taken not to create an inadvertent cystotomy. Historically, after opening these spaces, the surgeon would place one finger in each space, palpating the cardinal ligament to rule out tumor infiltration. With a minimally invasive approach, this is not possible. However, opening these two spaces does help identify the uterine artery and its surrounding parametrial tissue (Fig. 6.1).

Once identified, the uterine artery is dissected and ligated at its origin using an advanced vessel sealing device. With gentle traction upward, the surrounding parametrial tissue is taken en bloc with the uterine vessels. As the parametrial tissue is freed laterally and deeply, the ureter is tunneled from underneath it as the parametrial tissue is brought up over it (Fig. 6.2). The tunneling of the ureter continues until its insertion into the bladder is reached. Along the way, the ureter is freed from its medial attachments and "rolled" laterally. When dissecting the deep portion of the parametrium, care must be taken not to disrupt

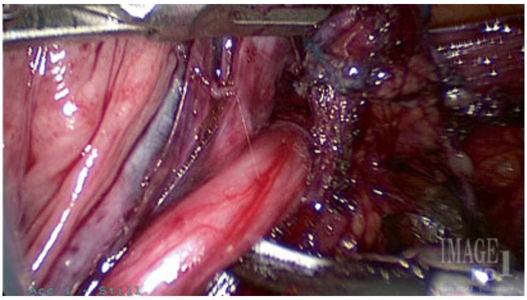

Fig. 6.2 The ureter is untunneled as it courses through the parametrial tissue

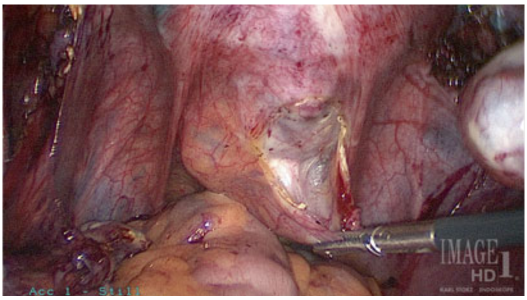

Fig. 6.3 The recotvaginal space is opened, exposing the uterosacral ligaments

the sympathetic nerve fibers innervating the bladder and rectum.

The vesicouterine peritoneal fold is now transected using the advanced vessel sealing device. This often requires further mobilization of the bladder downward. Care must be taken not to perform an inadvertent cystotomy during this portion of the procedure. Backfilling the bladder may assist in helping to decide the best surgical plane to take.

The uterus is now anteflexed, and the rectovaginal space is developed. Another avascular space, this can be entered by retracting the sigmoid colon caudally and posteriorly and incising the fold between the bowel and the posterior cervix (Fig. 6.3). This incision is extended laterally, and the rectovaginal space is developed bluntly. This mobilizes the rectum away from the vagina and exposes the uterosacral ligaments. With good visualization of the lateralized ureters, the uterosacral ligaments can now be transected at their origin using an advanced vessel sealing device (Fig. 6.4).

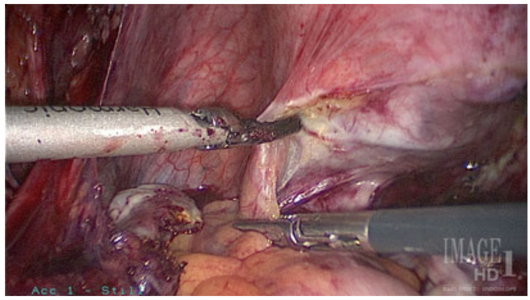

Fig. 6.4 The uterosacral ligaments are transected

With the bladder, the vesicouterine fold, the parametrium, and the uterosacral ligaments now freely dissected and the ureters mobilized laterally, a circumferential colpotomy incision can be made, taking care to achieve the desired vaginal margins. The radical hysterectomy specimen is removed through the vagina, and the vaginal cuff is closed either vaginally or laparoscopically based on the preference of the surgeon.

6.3 Pelvic and Para-aortic Lymphadenectomy

6.3.1 General Considerations

The most important key to safely perform lymphadenectomies for gynecologic malignancies is mastery of the anatomy and careful dissection to identify aberrant vessels and structures. For example, an accessory obturator vein may be present in up to 25 % of women and accessory renal arteries in 3 %. In addition, the bilateral ureters cross the dissection fields in multiple locations and should always be identified. Transecting tissue and nodal bundles without dissecting and identifying both known anatomic landmarks and unknown anomalies puts the patient at risk for major complications.

For pelvic and para-aortic lymphadenectomies, we favor a four-port diamond configuration with 5-mm trocars in the umbilicus, one in the lateral lower quadrant, and suprapubic locations and a 12-mm trocar in the contralateral lateral lower quadrant. This larger port allows for placement of a specimen bag for removal of nodal bundles.

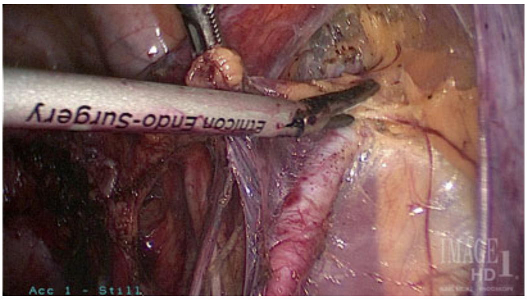

Fig. 6.5 The nodal tissue overlying the external iliac artery is gently retracted medially as the incision over the artery is extended distally

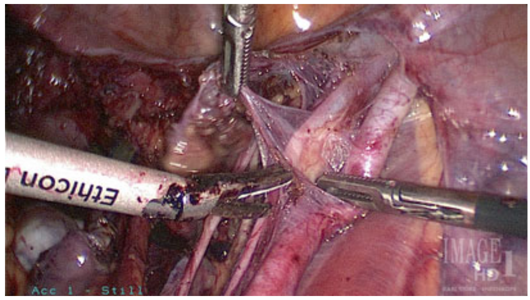

Fig. 6.6 The nodal tissue is carefully dissected from the external iliac vein

As previously described, these procedures are best performed with an advanced vessel sealing device (bipolar or ultrasonic). These devices allow for rapid coagulation and transection of tissue and vessels with minimal lateral thermal spread.

6.3.2 Procedures

6.3.2.1 Pelvic Lymphadenectomy

To begin the pelvic lymphadenectomy, the camera starts in the umbilical port. The tissue overlying the external iliac artery is grasped and the peritoneal surface is incised just lateral to the vessel. The surgeon can then enter the avascular space between the external iliac artery and the psoas muscle. With medial tension on the nodal bundle and after identification of the genitofemoral nerve as it runs on the medial aspect of the psoas muscle, the incision over the external artery is extended distally (Fig. 6.5). The assistant grasps the cut round ligament and elevates it toward the anterior abdominal wall to allow for this distal dissection. The dissection continues until the circumflex iliac vein is visualized.

The nodal bundle is then freed from the external iliac vein by gently pulling medially on the bundle and bluntly dissecting the avascular space between the vein and the nodes (Fig. 6.6). In order to avoid tearing the nodal bundle and the subsequent oozing from the nodes, it is important to grasp a large amount of nodal tissue as opposed to a small bite at the edge. Because the vein is much less resilient than the artery, care must be taken to visualize the edge of the vein and avoid any accidental venotomy. During this portion of the procedure, the assistant can use a blunt instrument to retract the vein along its route to aid in visualization and countertraction.

After the nodal bundle is medialized from the external iliac vein, the obturator space is entered bluntly, and the obturator nerve is identified. This structure is the deep margin of the dissection, and care must be taken not to inadvertently transect this nerve. The nodal bundle can typically be released from the nerve by bluntly running an instrument on top of the nerve and in a parallel direction. Minimal bleeding may be encountered, but this typically can be halted by utilizing the nodal bundle for direct pressure. A more hemostatic approach can be performed by creating pedicles above the nerve by spreading with a blunt instrument parallel to the nerve and then using an advanced energy device to coagulate and transect these pedicles.

The internal iliac artery/superior vesicle artery, the medial border of the dissection, is then identified, and the nodal bundle is freed from it either bluntly or with the advanced energy device. This is best achieved with the assistant grasping the vessel and providing countertraction (Fig. 6.7). Care is taken not to go deep into this vessel because the ureter runs close to it and this risks injury. This part of the dissection is continued proximally along the internal iliac artery until the bifurcation of the common iliac artery is encountered. At this point the bundle is removed.

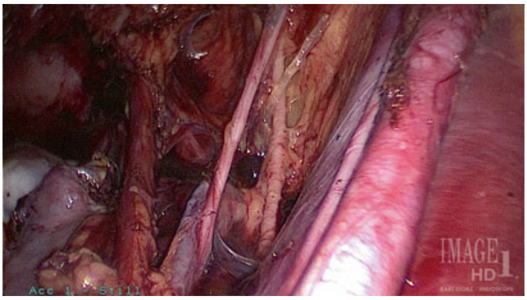

Fig. 6.7 The final aspect of the pelvic lymphadenectomy with the external iliac artery and vein, internal iliac/superior vesicle artery, and obturator nerve cleared of the nodal tissue

Remember that the ureter crosses at the bifurcation of the common iliac artery into the internal and external arteries, and visualization of the ureter is important to protect it from transection or thermal injury.

6.3.2.2 Para-aortic Lymphadenectomy

After the pelvic nodal bundles are removed, the dissection continues proximal along the common iliac artery. Getting proper set-up and visualization of the entire nodal basin to be dissected is not only the most difficult part of this procedure but also the most important. If this set-up is completed correctly and good visualization of the superior border is achieved first (whether it is the inferior mesenteric artery or the renal vessels), the actual dissection and removal of the nodal basins are somewhat straightforward.

The peritoneum over the common iliac artery is incised and elevated. The underlying nodal tissue is initially left adherent to the vessels as this peritoneal "tent" is raised. With graspers raising this tent, the small bowel may be retracted behind it out of the surgical field. Often visualization of the great vessels owing to the position of the small bowel is the greatest challenge of a laparoscopic para-aortic lymphadenectomy and as patient body mass index increases, so does the level of difficulty of retracting these organs. Many surgeons maintain the camera in the umbilicus throughout the para-aortic lymphadenectomy; however, we find that switching the camera to the suprapubic port and moving the monitors to the head of the patient often help with visualization and precision in instrument placement. This configuration with the camera held by the assistant using the suprapubic port and the bilateral lower quadrant trocars utilized by the primary surgeon standing between the patient's legs is particularly helpful if the renal vessels are the upper limit of the dissection (as opposed to the inferior mesenteric artery favored by some surgeons). One other technique to assist in visualization is to place a laparoscopic retractor through the umbilical port. We often exchange the 5-mm umbilical port for a 12-mm trocar to allow for placement of a large laparoscopic fan retractor to assist in holding the small bowel in the upper abdomen out of the surgical field (Fig. 6.8). Finally, if needed a fifth trocar may be introduced in the upper quadrant to allow for another assistant to help with retraction.

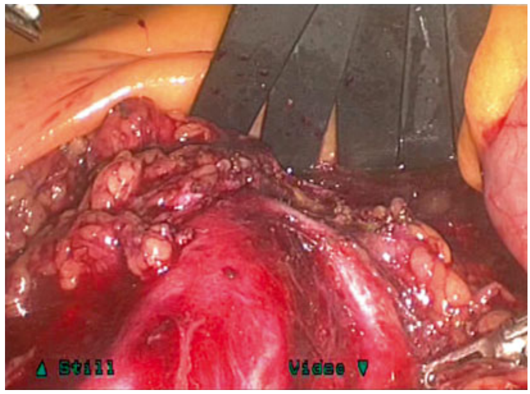

Fig. 6.8 A laparoscopic retractor is used to expose the bifurcation of the aorta

Once the peritoneum is open to the superior border of the dissection (inferior mesenteric artery or renal vessels), dissection is begun at the distal portion over the common iliac artery. The avascular plane between the nodal bundle and the artery is entered. The nodal bundle is grasped and elevated gently so as not to tear the inferior vena cava underneath it. The nodal bundle is mobilized along the common iliac artery and over the lower portion of the abdominal aorta. The advanced energy device is used to spread parallel to the vessels, creating pedicles that can then be taken with the device. This technique is particularly important over the vena cava at the level of the aortic bifurcation as this is commonly where the surgeon will encounter the fellow's vein. As the surgeon moves cephalad, the lateral portion of the vena cava should be identified and the nodal bundle should be separated from its lateral attachments. It is imperative at this point that the right ureter is identified and lateralized away from the dissection. The anatomic borders of this nodal bundle are the common iliac inferiorly and the lateral portion of the vena cava, the aorta, and the inferior mesenteric artery/renal vessels superiorly.

After this portion of the aortocaval nodes is removed, the nodes along the left side of the aorta can be removed. We find this more easily done separately from those nodes overlying the aorta and vena cava described above. When working in this area just lateral to the aorta, care must be taken to identify the left ureter because it courses close to the dissection. In addition, the surgeon should continue to gently create pedicles, since this will help visualize and avoid the lumbar vessel where they originate on the posterior portion of the aorta.

6.4 Infracolic Omentectomy

6.4.1 General Considerations

Laparoscopic omentectomy may be performed as part of the staging surgery for presumed early stage ovarian cancer in addition to certain types of high-risk endometrial cancers. If gross disease is visualized in the omentum or on other upper abdominal organs, we strongly recommend conversion to laparotomy for careful exploration and optimal tumor debulking. For staging of patients without evidence of metastatic disease, most surgeons perform an infracolic omentectomy.

Like all of the procedures described in this chapter, this procedure is best performed with an advanced vessel sealing device (bipolar or ultrasonic). We do not recommend using monopolar electrosurgical instruments because the dissection plane between the omentum and transverse colon can be small, and use of this technology risks a thermal bowel injury.

6.4.2 Procedure

We recommend placing the camera in the suprapubic port and moving the monitors toward the head of the patient. The surgeon stands between the legs of the patient and uses the bilateral lower quadrant trocars to operate. The assistant stands on the side of the patient holding the camera and utilizing the umbilical assistant port.

Utilizing the left lower quadrant and umbilical ports, graspers are used to raise the omentum toward the anterior abdominal wall allowing for visualization of the transverse colon. For a large omentum, this may require grasping the omentum toward its base close to the transverse colon. A fifth trocar may be introduced into the left upper quadrant (Palmer point) for an additional grasper if needed. We do not recommend pulling the omentum down into the pelvis and performing the procedure from above the omentum. This risks damage to both the transverse colon and the small bowel underneath the draping omentum. It is important to ensure visualization of the small bowel and transverse colon throughout the procedure. Slightly reducing the steep Trendelenburg position may help with visualization.

Using an advanced vessel sealing device placed in the right lower quadrant trocar, we start at the hepatic flexure and transect the edge of the omentum heading toward the transverse colon to enter the avascular space between the omentum and colon. We then head across the omentum toward the left side of the patient, mobilizing the omentum from the colon (Fig. 6.9). During the procedure, it is important to be mindful and avoid the bowel mesentery. As the omentum is released from its connections to the colon, the freed portion is placed into the left upper quadrant and the omentum is regrasped closer to the area still attached to the colon. As the splenic flexure is approached, the omentum becomes thicker and bunches up toward the spleen. While remaining in the same trajectory and coming across the base of the omentum, it is completely freed. We typically remove the omentum through the opened vagina.

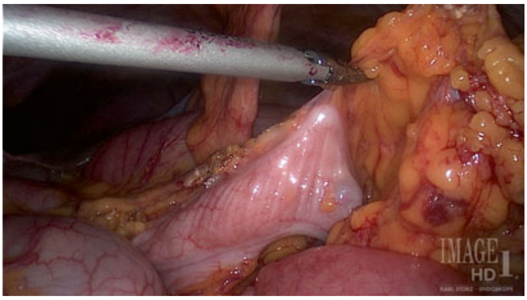

Fig. 6.9 The omentum is dissected from the transverse colon

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