23 Retroperitoneal infrarenal, inframesenteric, and pelvic lymphadenectomies
Katherine A. O'Hanlan

INTRODUCTION

Pelvic and para-aortic lymphadenectomy is an essential step in staging of pelvic malignancies, is often used to determine primary therapy, helps remove all grossly or occult positive disease, and enables stratification of malignancies for valid comparisons of treatments, all with the purpose of optimizing survival. A transabdominal laparoscopic approach for pelvic (Querleu et al. 1991) and infrarenal aortic (Querleu et al. 1993) lymphadenectomy was first described by Querleu and colleagues for staging cervical, endometrial, and ovarian malignancies. Urologists (Ferzli et al. 1992) and later Gynecologic Oncologists (Vasilev and McGonigle 1995) subsequently developed retroperitoneal approaches for pelvic, infrarenal aortic (Vasilev and McGonigle 1996), and suprarenal aortic (Possover et al. 1998) artery lymphadenectomy. Because the predominant drainage of malignancies of the cervix is to pelvic nodes, and of the endometrium and ovaries is to pelvic and aortic nodes (Matsumoto et al. 2002), this chapter will focus on use of a direct retroperitoneal approach for staging or restaging cervical, uterine, and ovarian carcinomas.

INDICATIONS

Cervical Carcinoma

Resection of bulky nodes prior to combination chemotherapy and radiotherapy has been shown to result in improved overall survival (Cosin et al. 1998). When PET or CT scans show enlarged pelvic nodes, lymphadenectomy and then radiation of the nodal beds and at least one nodal segment higher is indicated. Additionally, it is useful to rule out aortic adenopathy when there are bulky nodes in the pelvis, prior to initiating radiotherapy to the pelvis alone (Tillmanns and Lowe 2007).

Endometrial Carcinoma

The ability to laparoscopically remove pelvic and inframesenteric aortic nodes implicated in endometrial carcinoma was established by the GOG (Childers et al. 1993). However, it has been demonstrated that endometrial carcinoma can metastasize directly along the infundibulopelvic vessels to the infrarenal aortic lymph nodes in as many as two-thirds of the 77% of women with aortic metastases, especially if they have grade 2 or 3 disease, or a deeply invasive grade 1 endometrial carcinoma (Dowdy et al. 2008). A thorough lymphadenectomy may have a therapeutic benefit, because pathologically negative nodes can be found to harbor occult disease when specially stained or step-sectioned (Amezcua et al. 2006).

Ovarian Carcinoma

Staging of ovarian carcinoma included the right and left inframesenteric nodes and pelvic nodes until it was shown, not surprisingly, that lymphatic metastases could follow the ovarian vascular supply to the infrarenal aortics where the infundibulopelvic vessels originated (Onda et al. 1996). Now it is standard to resect bilateral infrarenal aortic nodes in staging ovarian (Takeshima et al. 2005, Morice et al. 2003) and primary peritoneal (Aletti et al. 2009) epithelial malignancies because there is decussation of lymphatics above the inferior mesenteric artery, even though the left side is slightly favored (Morice et al. 2003, Roger et al. 2008). In these aforementioned instances, a retroperitoneal lymphadenectomy can be performed first in the surgical care plan.

METHODS

Preparation

Patients should always be consented for a laparoscopic lymphadenectomy with the knowledge that laparotomy may be necessary. Any node dissection around a major artery indicates reserving two units of packed red blood cells. While bowel preparation is not indicated if retroperitoneal lymphadenectomy is the sole procedure, it can facilitate the rest of the staging procedure if hysterectomy, omentectomy etc., are to be performed.

All patients with cancer should receive at least 30 to 40 mg of low-molecular weight heparin to prophylax against deep vein thrombus formation. The procedure is performed typically in supine position if it is the sole procedure. If hysterectomy and other abdominal procedures will be performed later, then the modified lithotomy position is preferred. Arms are tucked by the patient's side, and shoulder bolsters are carefully positioned. The surgeon is on the patient's left side with monitors on the right, one at the level of the feet, and the other at the level of the diaphragm.

Technique

Because success of a retroperitoneal approach depends on creating and maintaining a pneumo*retro*peritoneum, this procedure is always performed first. Any leak of carbon dioxide into the peritoneum will preferentially collapse the retroperitoneum due to the weight of the bowel.

There are two methods of entering the retroperitoneum: laparoscopic guidance or direct incision. When a laparoscopic survey of the abdomen is indicated first, then a single direct transumbilical puncture is made. The apex of the umbilicus is everted to form a nipple, with depression of the periumbilical tissue to facilitate eversion of the umbilical apex first incision into the apical scar. Pre-emptive anesthesia with 5 cm^3 of bupivicaine without epinephrine is given prior to making a 5-mm incision in the scar, grasping the edges and adjacent skin very widely with towel clips to elevate the umbilicus maximally, and directly inserting an atraumatic 5-mm trocar at a 90° angle (O'Hanlan et al. 2007). Abdominal survey is performed. If a washing is needed, a secondary 5-mm trocar can be inserted near the right anterior superior iliac crest.

Next, a 3-cm incision is made at the left MacBurney site, that is, 2 cm medial and 2 cm superior to the anterior superior iliac crest (Fig. 1). Identifying each of the two paper-thin layers of oblique fascia, and open with a spreading technique using a hemostat and finger guidance. Visual guidance laparoscopically is also useful to show proximity to the peritoneal lining so the surgeon is careful to not perforate this thin layer. Entry into the retroperitoneum is heralded by palpating the absence of any fascia layer attached to the ileac crest, allowing the finger to sweep toward the interior of the ileac fossa (Fig. 2).

If no intraperitoneal inspection is desired first, then it is possible to make a left-sided McBurney skin incision without peritoneal insufflation, and using opening of the hemostat before an advancing finger, again identifying that two fascial layers have been penetrated, and that the underside of the iliac crest has been accessed.

After either entry technique, the surgeon's finger is then used to separate the peritoneum off of the muscular wall as far as possible, sweeping in a cephalad, posterior and caudal directions, and postero-medially to palpate the left common iliac

Figure 1 Palpating the two fascial layers while opening with hemostats. Not shows in the laparoscopic guidance.
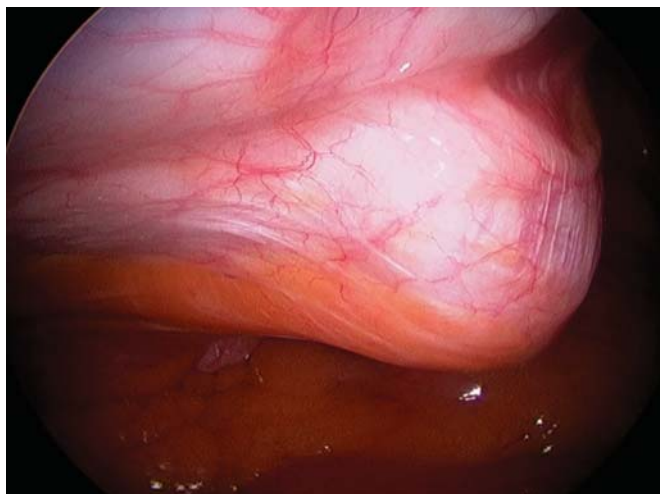

Figure 2 Laparoscopic guidance during dissection through the two abdominal wall fascial layers, careful not to perforate the peritoneum. Using the finger, the peritoneum is swept off of the abdominal wall and the parietal pelvis.

artery. A blunt-tip 5-mm trocar is inserted directly through a separate 5-mm incision in the axillary line about 4 to 6 cm above the level of the first (see diagram) directly onto the surgeon's fingertip to protect the peritoneum from puncture, also under laparoscopic guidance. The carbon dioxide insufflator is now attached to the new 5-mm port, allowing insufflation of the retroperitoneum to about 10 to 12 mm Hg pressure, and then collapse of the intraperitoneal compartment is facilitated by the opened umbilical trocar. The posterior location of this port permits easier mobility of the operating ports after insertion of the 30° 5-mm laparoscope. A 12-mm blunt-tip hernia trocar is then inserted through the left-sided McBurney incision and secured by the inflated balloon, to maintain the pneumo*retro*peritoneum.

Opening the Space

At this point, usually only adventitia is seen, with hints of the muscular red of the psoas muscle on the dorsal aspect (the "floor"), but more careful inspection will reveal the ureter vermiculating anteriorly medially or on the peritoneal "ceiling", and allow for gentle sweeping of the adventitia up and off of the dorsal "floor" until the major vessels are seen, if they are not seen immediately (Fig. 3). The peritoneum is swept off of the muscular abdominal wall laterally and more superiorly along the anterior axillary line so that a third 5-mm blunt-tip trocar can be inserted under direct visualization with care not to inadvertently puncture the peritoneum (Fig. 4). Now the surgeon can use a 5-mm Ligasure or the 5-mm Advance and a blunt dolphin-tip grasper, to lift the peritoneum off the left common iliac artery from the level of the ureter crossing at the bifurcation, cephalad to the renal artery. The ureter is left attached to the "ceiling" having been identified along its entire length. The ovarian artery and vein are seen lateral to the ureter below the level of the inferior mesenteric artery (IMA), but these vessels cross the ureter medially and find their origins on the antero-lateral aspect of the aorta and the left renal vein. They can be ligated above the ureteral crossing and later resected with their nodal bundles when the dissection is performed. The aorta is exposed along its left side to reveal the
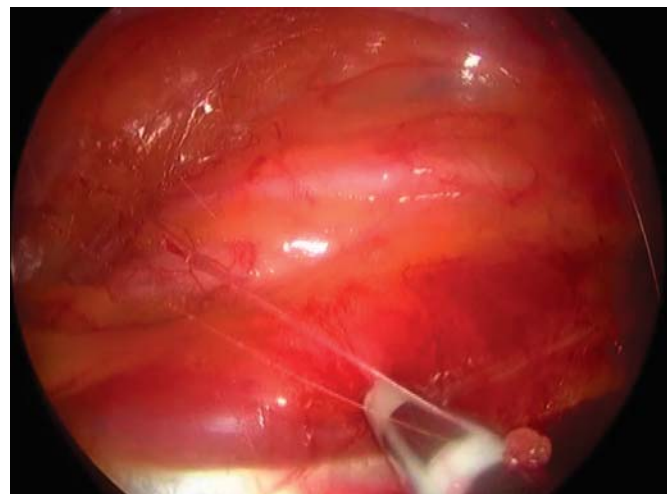

Figure 3 The newly opened adventitial space seen upon insertion of the scope, with the ureter seen crossing the common iliac artery, anterior to the psoas muscle.

origin of the IMA. Above the IMA, the duodenum is identified and lifted up off the aorta up to the level of the left renal vein, typically found crossing anterior to the aorta, often with an azygous branch extending posteriorly and behind the aorta. The tortuous left renal artery is usually posterior and slightly superior to the left renal vein. It is sometimes necessary to sweep the renal capsule superiorly up off the psoas to allow broad access to the left renal vessels. Frequent identification of the vermiculations of the ureter reassure the surgeon of the essential landmarks.

Challenges Establishing Pneumo*retro*peritoneum
When the peritoneum is perforated, the retroperitoneal space will collapse due to the weight of the visceral bowel. Small leaks can sometimes be managed by opening the umbilical trocar a small amount to let the peritoneal compartment vent. Closure of the leak is often possible using hemoclips, suture, or Endoloop. It may, however, be easier to insert an additional 5-mm trocar to allow use of a flexible 5-mm liver retractor, or a 12-mm trocar for use of an Endopaddle (see diagrams) to simply elevate the anterior peritoneal "ceiling" in each area that is being operated on. In fact, this may facilitate all cases in which the anterior peritoneum limits access to the nodal beds with confidence, especially in the obese patients.

Harvesting the Left Aortic Nodes
Nodes are harvested in order of easy access. First the nodes from the IMA down to the crossing of the ureter are resected in a caudal direction (Fig. 5). There is no need to strip the IMA of its own nodal investment, needlessly increasing the risk of chylo*retro*peritoneum. Remove the fibrofatty tissue at the base of the IMA for only 1 cm, and then all the lateral nodal tissue, using bipolar vessel-sealing confidently along the posterior and medial base of the nodal specimen (Lamberton et al. 2008). Remove these nodes using a 10-mm spoon forcep through the 12-mm port.

Next, remove the Infrarenal (IR) nodes starting at the IMA dissecting in a cephalad direction, after confident identification of the ureter and all of the renal vasculature (Fig. 6). The locations of these vessels medial to the ureter must be ascertained
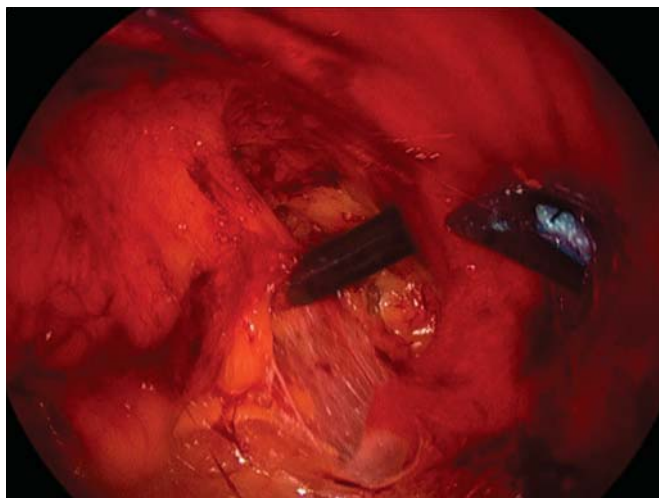
with certainty despite distortion of the anatomy caused by the lifting of the anterior peritoneum. There can be significant variability of the left renal vasculature, warranting a cautious technique of spreading, opening and identifying until all of the major vessels and minor variations, including the unusual azygous vein, are exposed (Fig. 7). Use bipolar sealing along the medial base of the aortic specimens to coagulate lumbar vertebral arterial branches and the origins of the left ovarian artery and vein (Fig. 8). The IR nodes should be harvested from the anterior aspect of the aorta over to the left margin of the vena cava, and from the anterior aspect of the renal vein, so that nodes clearly above the ovarian artery origin are thoroughly removed (Fig. 9).

Resecting the Right Aortic Nodes
Next, to obtain the right inframesenteric nodal specimen, cross the bifurcation of the aorta, opening the space below the
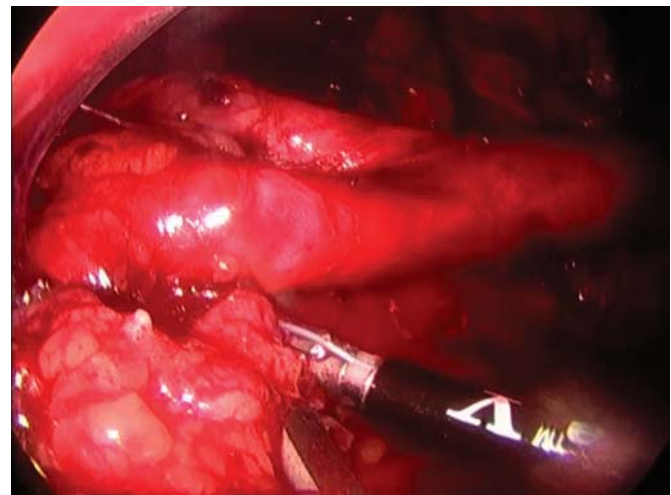

Figure 5 After exposing the length of the left side of the aorta, the nodal bundle sis resected from the inferior mesenteric artery downward to the crossing of the ureter.

Figure 4 Sweeping the peritoneum away from the abdominal wall, to allow for additionally trocars to be inserted under direct vision.
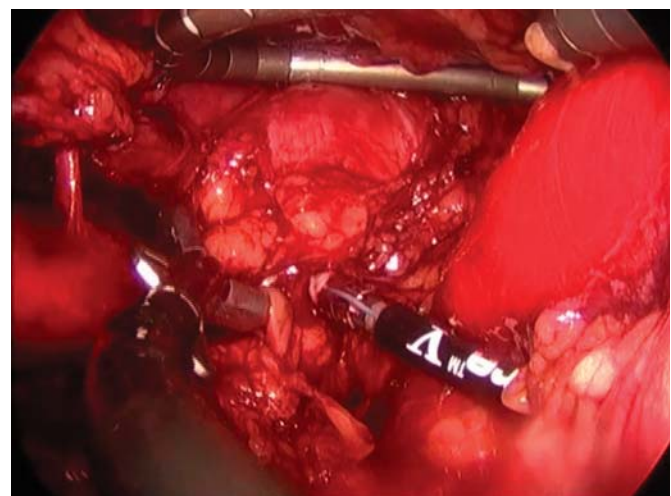

Figure 6 The duodenum is swept up off the nodal bundle above the inferior mesenteric artery using the 5 mm liver retractor. A real hand articulating bullet grasper is used to help resect the nodal bundle working up from the Inferior mesenteric artery.
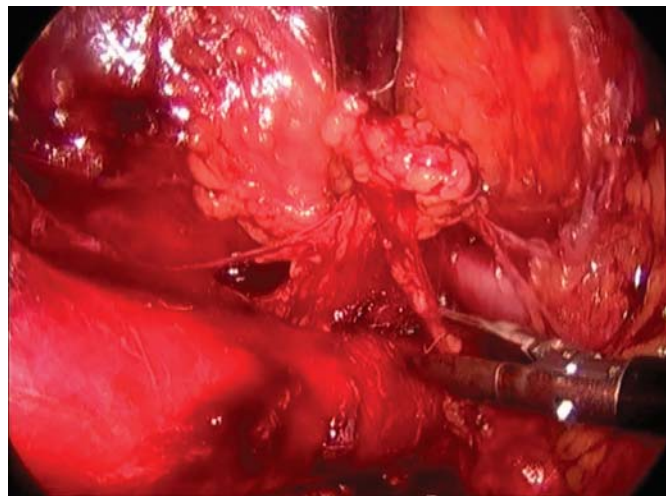
Figure 7 The left renal artery and vein have been identified and the left ovarian artery transected.
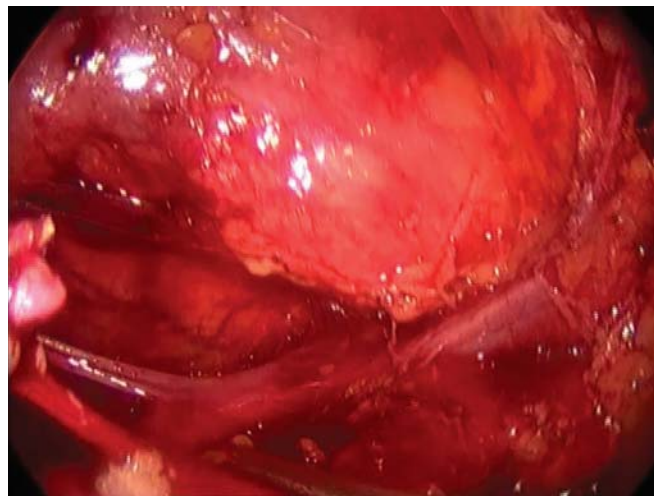

Figure 9 The completed right infrarenal node dissection revealing the right ovarian vein, the left renal vein, and the root of the inferior mesenteric artery.
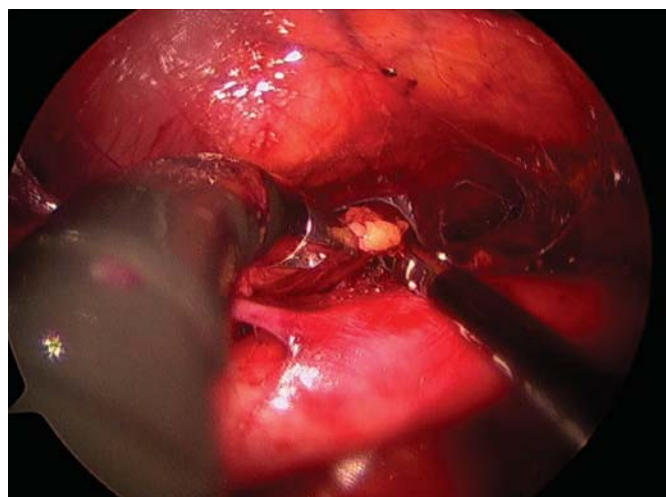

Figure 8 The articulating grasper elevates and facilitates resection of the right infrarenal nodal bundle.
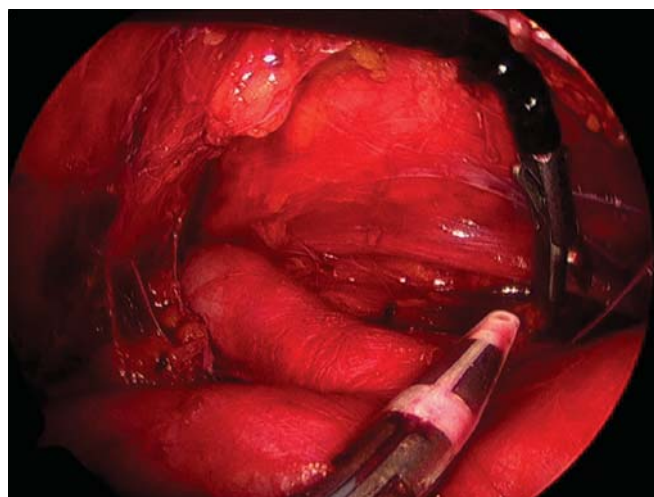

Figure 10 The right common ileac artery has been exposed and the nodal bundle anterior is being resected. Note the ureter, the lateral border of the dissection.

IMA anterior to the right common iliac artery, carefully lifting the peritoneum anticipating the right ureter as the lateral-most border (Fig. 10). Open the space tracing the path of the ureter superiorly, recognizing the crossing of the ovarian vessels, as they course medially to their origins on the right side of the vena cava and aorta, exposing up to the origin of the right renal vein. Be careful not to lift the nodes off the vessels, but to elevate the duodenum off of the nodal bundle.

With the IMA stripped of its most proximal 1 cm, gently open underneath the precaval nodal bundle to expose the bluish vena cava. It is then possible to remove the nodal bundle anterior to the vena cava, starting just above the vessel, transecting confidently with bipolar sealing all the "fellow" veins that arise in this region, stripping all fibro-fatty lymph-bearing tissue off of the right common iliac artery and vein down to the ureter and remove the specimen (Fig. 11). Recall that the rightmost lateral margin of the CIA node dissection is only a filmy avascular web that can be spread and bluntly removed off of the psoas muscle (Fig. 12).

To remove the right IR nodes, again recall that the lateral margin of the upper nodal bundle is also avascular and can be stripped off the vena cava while watching out for the rare additional "fellow" veins, there still being a few above the IMA. It is easiest to start at the right renal vein and work caudally to the IMA.

Harvesting the Pelvic Nodes

To access the pelvic nodes on the right side, sweep the peritoneum off of the anterior sacrum very gently following the aortic bifurcation, using blunt instruments and maintaining broad contact with the membrane so as not to puncture. Expose the external iliac artery down to the level of the crossing of the deep circumflex iliac vein over the external iliac artery gong laterally. Strip the superior vesical artery of its lateral attachments and open the paravesical space. Identify the obturator nerve as the posterior margin of resection. Open the posterior aspect to reveal the pararectal space posterior to the internal iliac artery. Identify the genito-femoral nerve and
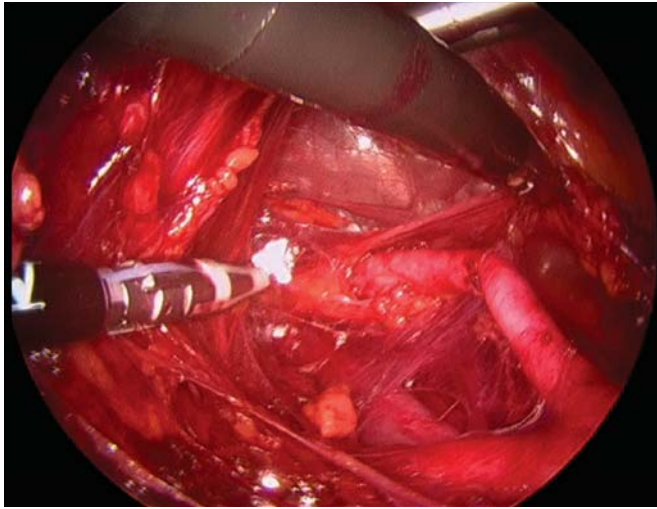
Figure 11 Preparing the right pelvic nodal filed for dissection, the peritoneum is being swept off of the sacrum using the Ligasure.
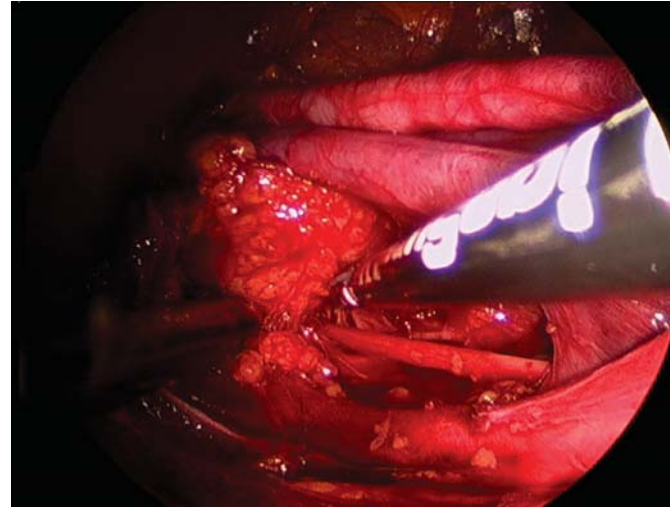

Figure 13 Freeing the obturator nodes from the obturator nerve. These nodes are bulky and solid in this patient with metastatic cervical cancer.
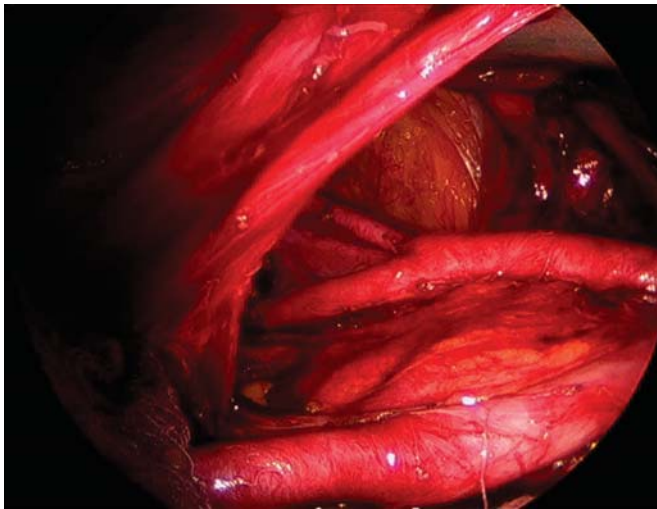

Figure 12 The completed right external iliac node dissection, with presacral nodes exposed.

begin to peel the nodal bundle *en masse* medially off the external iliac artery, then off of the vein, then under the vein off of the sidewall, posteriorly down to the obturator nerve, then medially off of the internal iliac. This large unitary bundle should be removed in a small plastic pouch (Fig. 13).

It is harder to remove the nodes from the left side, but entirely possible, using the same technique. All instruments are torqued inferiorly, and excellent visibility is possible with the 30° scope with the same technique as used for the right side.

After this procedure, the pneumo*retro*peritoneum is collapsed, and at least one fenestration in the peritoneum on each side is made using a transperitoneal view to avoid inadvertent injury to the bowel. No drains are placed. Only the large left inferior site requires closure with suture at the fascial level, and at the skin level. All incisions are treated with Dermabond.

Post-operative Management

Before transferring the patient to a trolley, a stretch binder is placed around the abdomen centered on the incisions, to compress the skin incisions and reduce likelihood of leakage of lymphatic fluid from the abdominal cavity. If leakage does occur, patients can simply place any bulky compressive non-sterile dressing (e.g., washcloths) under the binder over the leaking incision. The leakage resolves within a few days, but can be quite voluminous. Discharge is planned for the same day, unless hysterectomy and other procedures are performed.

DISCUSSION

Patients are warned preoperatively that they may experience copious wine-colored fluid leak through the vaginal incision or any of their abdominal incisions for a few days. If a leak develops, they are instructed to place a bundled-up bulky non-sterile washcloth or paper towels in their binder to enhance compression of the leaking port site. It is not clear if this speeds up resolution or only helps manage the significant leakage that some develop, but the leakage always resolves in a few days. Nearly all patients are discharged from the hospital the next day.

Infectious complications are rare. Chylous retroperitoneum or ascites has been described, with most cases resolving after dietary modification. Vascular complications, while potentially serious, are rare (Querleu et al. 2006). Some surgeons insert a 4 × 4 gauze pad into the retroperitoneum to facilitate visualization and for compression in case of vascular injury. Compression of any vascular injury for five minutes can facilitate laparoscopic suture repair. It is wise to have two units of packed cells prepared, and a 5-mm clip applier available in the room for any emergency. Avulsion of the IMA is not serious, but must be reliably sealed with a clip. Injury to the vena cava or left renal vein by avulsion of the ovarian vein may require multiple clips. Ureteral injury should be very rare, due to repeated re-identification, and following the "identify twice, cut once" rule. While obese patients benefit most from this procedure, obesity is also a common cause of converting to laparotomy.

CONCLUSIONS

This report highlights the safe removal of pelvic and aortic lymph nodes by a retroperitoneal approach. Inexperienced surgeons are encouraged to operate with senior surgeons because there is a steep learning curve.

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Author Information Sheet

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Katherine A O'Hanlan

Laparoscopic Institute for Gynecologic Oncology

4370 Alpine Rd. Suite 104, Portola Valley, Ca 94028

Fax: 650-851-9747 Phone: 650-851-6669

Email: ohanlan@AOL.com;

      kate.ohanlanmd@gmail.com

      kate@LIGOcourses.com