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Chapter 26

Laparoscopic Lymphadenectomy

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INTRODUCTION

Since the introduction of laparoscopic lymphadenectomy in the late 1980's by Dargent,[1] this procedure has been used in patients with gynecologic and urologic malignancies, as well as in some lymphomas. There are only a handful of reports on this procedure, and even fewer reports that outline complications related to this technique. The true incidence of complications related to this procedure is therefore impossible to evaluate. Furthermore, the currently available literature reflects the early experience of pioneering laparoscopists.

The complications of laparoscopic lymphadenectomy can be divided into two large categories (Table 1). The first are those complications that are inherent to laparoscopy itself, regardless of the procedure being performed. This would include such occurrences as subcutaneous emphysema and trocar injuries to bowel or the inferior epigastric vessels. The second group includes those that are inherent to the procedure regardless of the method by which it is performed. Obturator nerve injury, deep venous thrombosis, and postoperative lymphocele are examples of this type of complication.

This chapter will focus on the known and potential complications of laparoscopic pelvic and para-aortic lymphadenectomy. Complications of this procedure can be categorized into the systems injured, and further divided according to the nature and management of these injuries. For example, a small-bowel enterotomy occurring during a laparoscopic procedure might be considered a minor complication if recognized immediately and repaired laparoscopically during the initial surgical procedure. On the other hand, the same small-bowel enterotomy would be considered a major complication if not recognized at the time of the primary

Table 1.
Categorization of the Complications of Laparoscopic Lymphadenectomy.

I. Complications inherent to laparoscopy, regardless of the procedure.

 Example: Subcutaneous emphysema

 Trocar injury to viscus/vessels

II. Complications inherent to lymphadenectomy in general.

 Example: Obturator nerve injury Lymphocele

procedure, resulting in laparotomy at a repeat operation (Table 2).

VASCULAR INJURIES

Vascular injuries related to laparoscopic lymphadenectomy are potentially life-threatening complications. Perhaps the most common vascular injury of laparoscopy in general, and laparoscopic lymphadenectomy in particular, is injury to the inferior epigastric and other superficial wall vessels (Figure 1). In one series of laparoscopic lymphadenectomies by Kavoussi, six out of ten vascular complications occurred as a consequence of trocar injury to anterior abdominal wall vasculature.[2] Vascular injury related to the procedure itself depends on whether a pelvic and/or para-aortic lymphadenectomy is being performed. Vessels likely to be injured during performance of a pelvic lymphadenectomy include the obturator, internal iliac, external iliac, and the common iliac artery and vein. In the male, the testicular artery and vein should be considered in this category as well. Vessels likely to be injured during a

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Table 2.

Complications of Laparoscopic Lymphadenectomy Categorized by Nature and Management.

I.   Minor vs. major complications

II. Recognized vs. unrecognized complications

III. Injury repaired at laparoscopy vs. laparotomy

IV. Injury repaired at primary vs. secondary surgery

Figure 1. Extensive postoperative ecchymosis extending from the suprapubic port site.

para-aortic lymphadenectomy include the aorta and vena cava, as well as the common iliac, inferior mesenteric, lumbar, and renal vessels.

Fortunately, injury to the major pelvic vessels during laparoscopic pelvic lymphadenectomy is probably an uncommon occurrence. Kavoussi, et al. reported the combined experience of eight institutions in performing laparoscopic pelvic lymphadenectomy for early prostatic carcinoma.[2] Seven of nine vascular injuries reported by these investigators resulted from trocar injuries to the abdominal wall vessels. The remaining two injuries included damage to the obturator vein and external iliac artery. Querleu, et al. reported their initial experience with laparoscopic lymphadenectomy in 39 women with cervical carcinoma.[3] While none of these patients suffered major vascular injury, one patient developed a large pelvic hematoma. This was managed conservatively, did not require transfusion, and resolved spontaneously. Burney, et al. reported a combined experience with laparoscopic pelvic lymphadenectomy for prostatic carcinoma.[4] One of these patients developed a pelvic hematoma which subsequently became infected after percutaneous drainage. Kavoussi, et al. also experienced one pelvic hematoma which required neither transfusion nor drainage.[2]

In our own experience with more than three hundred pelvic lymphadenectomies for gynecologic malignancies, injury to major pelvic vessels is a rare event.[5,6] The vessel most likely to be injured is an aberrant obturator vein emerging from the obturator canal, across the nodal bundle, to empty into the external iliac vein. On one occasion, a 5 mm laceration in the external iliac vein was sustained during a lymphadenectomy during a second look laparoscopic procedure. The patient had

Figure 2. Endoscopic clip applied to the lower vena cava following a small venotomy created during a low right para-aortic laparoscopic lymphadenectomy.

undergone a previous lymph node sampling during debulking for ovarian carcinoma. The external iliac vein was injured while opening the retroperitoneal space. The laceration was repaired laparoscopically with a clip applicator. The patient did not require transfusion, or experience any postoperative complications. Three other patients have had vena cava injuries complicating their laparoscopic lymphadenectomy. The first
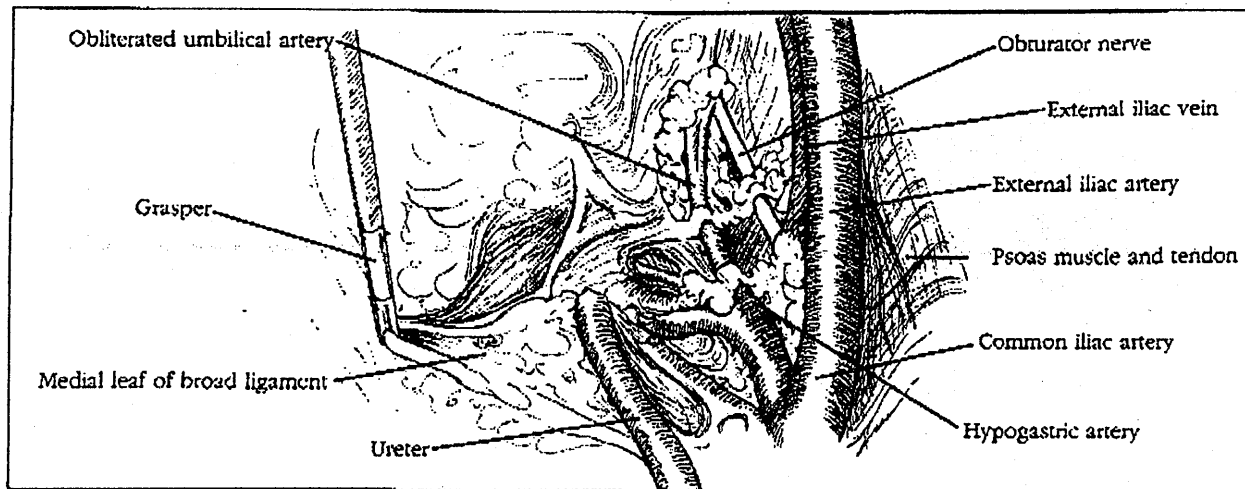
Figure 3. Anatomic relationships during a pelvic lymphadenectomy.

required open laparotomy for vascular repair, was transfused with four units of packed red blood cells, and went on to develop a deep venous thrombosis. The remaining two cases were managed laparoscopically with endoscopic vascular clip applicators (**Figure 2**). Neither of these two patients received a transfusion or had any other postoperative complications.

Experience with external iliac and vena cava injuries has revealed that bleeding in the presence of adequate pneumoperitoneum (i.e. 15 mm H_2O), even from large veins, is relatively limited. A theoretical but nonetheless important concern is the possibility of an air embolus, especially with damage to larger vascular structures. This is even more dangerous if the lymphadenectomy is performed using an argon beam coagulator, since this type of gas is not readily absorbed into the circulation. The diagnosis of gas embolism is made via auscultation with a conventional or transesophageal stethoscope. A "wheel-mill" murmur is presumptive evidence of air entrapment in the right heart. Management consists of the placement of a central line into the right ventricle, and subsequent aspiration of the embolized gas. While such a complication is yet to be reported for laparoscopic lymphadenectomy, CO_2 embolism has been reported with other laparoscopic procedures.

Injuries related to unspecified vessels resulting in postoperative hematomas have also been reported.

Querleu, et al. reported one patient with a spontaneously resolving pelvic hematoma.[3] Other reports include infected and sterile pelvic hematomas that subsequently became infected after percutaneous drainage, or that required transfusion.[2,4]

HOW-TO MANAGEMENT OF VASCULAR INJURIES

Laparoscopic management of vascular injuries varies according to the type (artery or vein) and the size of the vessel injured. The modalities utilized in managing these vascular injuries include pressure, monopolar and bipolar electricity, clips, and sutures. Depending on the caliber of the injured vessel, use of any one of these modalities alone may achieve hemostasis satisfactorily (**Figures 3, 4**).

When any vessel is injured, it is of utmost importance to control the bleeding as quickly as possible. This usually can be accomplished by using a laparoscopic grasper to occlude the bleeding vessels. If visualization is obscured, or if the vessel is a large vein and grasping may result in its further laceration, pressure should be applied. In our practice we frequently use laparoscopic instruments, lymph node pads, 4 x 4-inch gauze, or mini-laparotomy pads to achieve immediate control of bleeding through pressure. To be prepared for prob-

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lems, a common practice is to place a mini-laparotomy pad through a 12 mm port prior to performing a lymphadenectomy.

Arterial bleeders should be quickly controlled as blood loss can be rapid. Care should be taken to avoid arterial pumping of blood onto the telescope. When this occurs, visualization of the operative field is obscured and the telescope must be removed for cleansing, which utilizes valuable time and increases blood loss. Another common pitfall in controlling vascular injuries occurs during aspiration of pooled blood. While the pooled blood is being suctioned, the pneumoperitoneum frequently is being suctioned as well. This can result in poor or no exposure to the operative site and can create a cascade of time-consuming events (e.g., bowel falling out of upper abdomen; lens becoming clouded by blood, etc.).

Small venous bleeders may be controllable with pressure alone; a laparotomy pad can be packed into the retroperitoneal space while attention is drawn to another surgical area. Later in the operative procedure the packing can be removed and the area inspected for hemostasis. Placing laparotomy pads into the abdomen at laparoscopy is an extremely helpful tactic, useful in many situations. However, it also produces a new potential complication: retained laparotomy pads. Laparotomy rings, such as used when laparotomy is performed, cannot be used, so the surgeon relies heavily on the operating nurses to account for all pads. If the count is incorrect, or if the surgeon wants to include an additional safety measure, a postoperative x-ray should be obtained. (Figure 5) illustrates a radiograph of the abdomen, demonstrating two retained retroperitoneal laparotomy pads. These pads had been placed during a laparoscopic bilateral para-aortic lymphadenectomy.

Monopolar electricity can be used for adequate control of many small arterial and venous bleeders, either by use of fulguration or by coaptation of vessels via application of cutting current to a grasper applied to the vascular injury. Bipolar electrocautery can be used to control venous and arterial bleeders satisfactorily and has the capability of controlling veins and arteries of a larger caliber. Bipolar electrocautery is an unacceptable form of vascular injury control in vessels that should not be sacrificed or vessels of extremely large caliber, such as the iliac vessels and the vena cava. In these and other situations where vessels are smaller, clips or suturing techniques should be used.

Laparoscopically applied clips can control large venous bleeders adequately, and prefabricated slip-knots can be used to control moderate-sized arterial bleeders. In these instances, a grasper is placed through the prefabricated loop and affixed to the injured vessel. The loop is slipped over the grasper and onto the vessel.

Suturing techniques utilizing needles will probably require laparotomy. In this instance, consideration should be given to intraoperative consultation with a vascular surgeon.
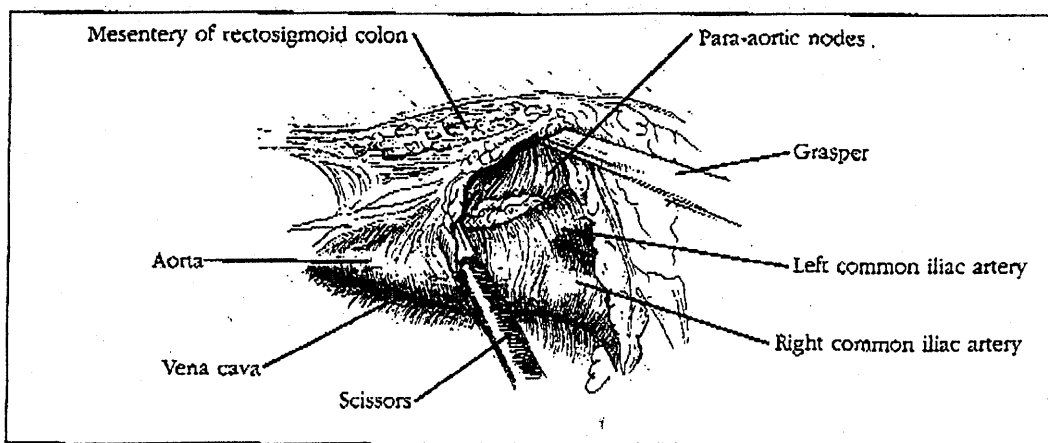

Figure 4. Anatomic relationships during a para-aortic lymphadenectomy.

Figure 6. Laparoscopic photograph from the umbilical port. The surgeon is placing an imbricating silk suture on the transverse duodenum (t) to imbricate an area which was superficially burned during a para-aortic lymphadenectomy. TD = transverse duodenum; VC = vena cava: A = Aorta.
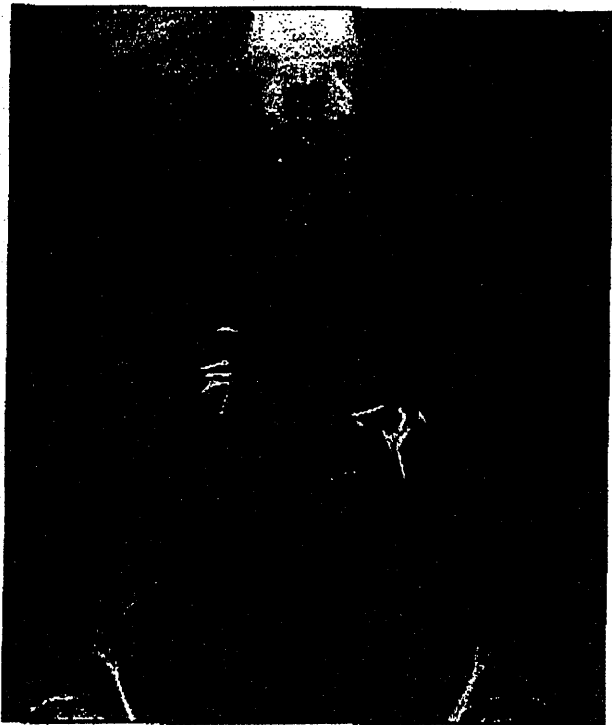
Figure 5. Radiograph demonstrating the radiolucent tags of a retained mini-laparotomy pad. These pads were initially placed following a laparoscopic bilateral low para-aortic lymphadenectomy.

GASTROINTESTINAL INJURIES

Bowel injury is a potential complication of any laparoscopic procedure. To date, there have been no reported gastrointestinal injuries at laparoscopic lymphadenectomy. This is not likely to remain the case since bowel can be easily damaged at trocar insertion, adhesiolysis, or thermal injury during dissection (**Figure 6**). Prevention of this complication begins with appropriate patient selection and preoperative preparation. This involves a complete mechanical bowel preparation and the intraoperative placement of an orogastric or nasogastric tube during all laparoscopic procedures. The net effect is to keep the bowel flat and empty, resulting in easier "packing" into the upper abdomen where it is less likely to enter the operative field.

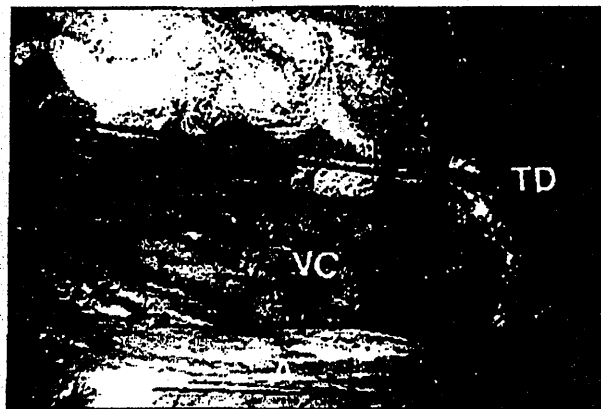Delayed bowel morbidity can occur throughout the postoperative period. Bowel herniation can result as a consequence of absent or inadequate fascial closure of the trocar defects (**Figure 7**). Spirtos, et al. reported two small bowel herniations in his series of thirty-five laparoscopic pelvic and para-aortic lymphadenectomies performed for gynecologic malignancies.[7] These two small bowel herniations which presented clinically with intestinal obstruction. It is notable that both occurred at lateral 12 mm trocar sites where stabilizing fascial screws were used followed by attempted fascial closure. Both cases were managed laparoscopically. While not reported, bowel obstruction can occur as a result of post-laparoscopic adhesion formation. We have managed a case of partial small bowel obstruction occurring after a laparoscopic lymph node biopsy, to diagnose non-Hodgkin lymphoma. The obstruction was attributed to an inflammatory reaction to the lymphoma itself, and resolved spontaneously.

HOW-TO MANAGEMENT OF GASTROINTESTINAL INJURIES

Laparoscopic management of gastrointestinal injuries has been covered in previous chapters. Consideration of laparoscopic hernia reduction is not unreasonable, depending on the clinical situation, and has been accomplished and reported in the literature. Large and small bowel injuries can be repaired intracorporeally or extracorporeally through a slightly enlarged port site.

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particularly for small bowel. These techniques are discussed in detail in earlier chapters.

GENITOURINARY INJURY

Laparoscopic injury to the urinary tract is well described in the literature. Cystotomy during trocar insertion, at adhesiolysis or dissection with endoscopic scissors and/or electricity have been described as a complication of laparoscopic lymphadenectomy, though not specific to this procedure.[2,4,8] Cystotomy can occur when opening the obturator space, if the obliterated umbilical artery is not retracted medially. Meticulous surgical technique and decompression of the bladder with a Foley catheter are the cornerstones to the prevention of this type of injury. Ureterovaginal and vesicovaginal fistulae, as well as injury to the patent urachus, are other potential though as yet unreported complications.

Perhaps of most concern, and certainly more germane to this procedure, is the possibility of ureteral injury. Pelvic lymphadenectomy places the ureter at risk for sharp, crush or thermal injury. This has been described in the urologic literature.[2,4] The lumbar portion of the ureter is at risk during para-aortic lymphadenectomy. This can take place if the lateral dissection overlying the psoas muscle is carried out above the ureter instead of in the correct surgical plane, thus incorporating the ureter with the nodal bundle. Such an injury has occurred in our experience; it was, however, recognized intraoperatively and managed laparoscopically. A transureteral stent was placed, the ureteral defect was oversewn, and a retroperitoneal drain was placed laparoscopically. The ureteral injury healed without complications, despite the patient receiving para-aortic radiotherapy. Though this is an area of current investigation, there is no proven role for prophylactic ureteral stent placement prior to laparoscopic lymphadenectomy.

NEUROLOGIC INJURY

Operative nerve injury can complicate any surgical procedure in the pelvis. There are, however, concerns that are particular to lymphadenectomy. Genitofemoral nerve injury is most likely to occur during removal of pelvic lymph nodes lateral. Such an injury results in medial thigh numbness but is otherwise of little clinical consequence. It is arguably the common injury encountered by the gynecologic oncologist. Injury of the obturator nerve is a more concerning though extremely rare
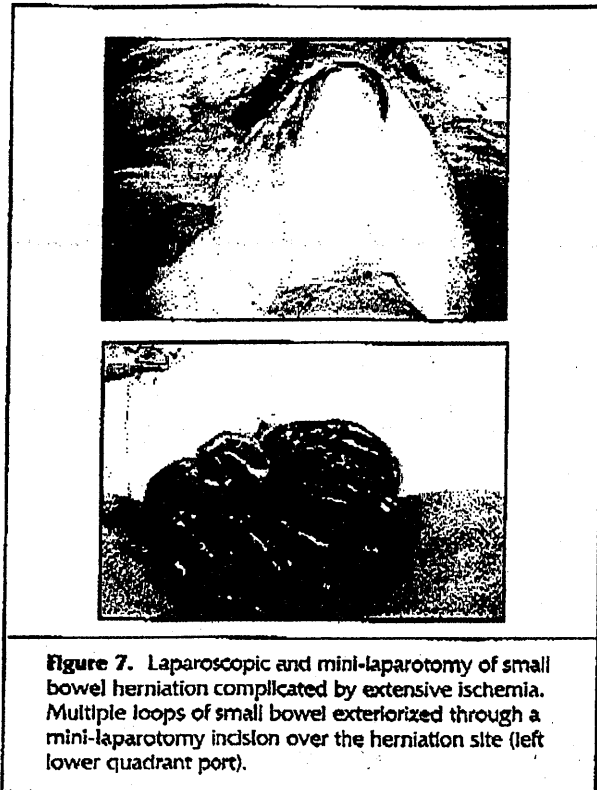

Figure 7. Laparoscopic and mini-laparotomy of small bowel herniation complicated by extensive ischemia. Multiple loops of small bowel exteriorized through a mini-laparotomy incision over the herniation site (left lower quadrant port).

complication of laparoscopic lymph node dissection.[2,4,8] This can only occur if it is not reliably identified prior to the resection of the obturator lymph node package. Theoretically, the femoral nerve, which lies within the body of the psoas muscle in the pelvis, is at risk during lymphadenectomy. This is particularly true if the nerve is not deep in the belly of the muscle and is exposed to extensive electrocautery during the dissection. Though not a direct operative injury, the ulnar nerve can also be traumatized if not properly padded in the course of tucking the arms for operative laparoscopy. Other positional complications can occur as well.

OTHER COMPLICATIONS

Various other injuries and complications can result as a consequence of this procedure. Both lymphocele and lymphedema have been reported to occur with laparoscopic lymphadenectomy,[2,4,8] as they can also occur

with open procedures. In our experience, with more than 300 pelvic lymphadenectomies, there have been two symptomatic lymphoceles.[5,6] As might be expected with any operative procedure, infectious complications have been reported with laparoscopic lymphadenectomy and include infected pelvic hematoma, clostridium difficile infection, and wound complications.[2,4,9] Likewise, retained foreign bodies and equipment failure can complicate the conduct of this safe and effective procedure (Figure 5).

Perhaps of most concern are thromboembolic events which can complicate any major operative procedure in the pelvis. Two separate series of laparoscopic lymphadenectomies performed for urologic malignancies reported three instances of deep venous thrombosis (1.5%) and no pulmonary emboli among 203 procedures.[8,9] Pomel, et al. reported a case of lower extremity thrombophlebitis complicated by a subsequent pulmonary embolism, following a staging laparoscopy for ovarian carcinoma.[10] More recently, Spirtos reported on a series of 40 patients who underwent bilateral pelvic and para-aortic lymphadenectomy for endometrial and ovarian cancer.[7] Of the 35 patients who were completed laparoscopically, two (5.7%) developed deep vein thrombosis during the postoperative period.

COMPLICATIONS REQUIRING LAPAROTOMY

Complications resulting in laparotomy have been related to damage to the ureter, bladder, bowel and vascular structures. Kavoussi, et al. reported a 4% (13/372) incidence of laparotomy related to laparoscopic pelvic lymphadenectomy.[2] Complications were recognized at initial laparoscopic surgery in seven patients, and six individuals required secondary laparotomy. Reasons for laparotomy included transection of the ureter (two patients), cystotomy (two patients), bowel injuries or obstruction (four patients), vascular injury (four patients), and wound dehiscence (one patient).

Burney, et al. reported a laparotomy rate of 8% (4/54) for patients undergoing laparoscopic pelvic lymphadenectomy for urologic indications.[4] One of four patients required laparotomy at the time of the procedure. Indications for laparotomy included ureteral damage (one patient), small bowel obstruction (two patients), and mesenteric hematoma (one patient). An overall major complication rate of 16.7% (9/54) was estimated, with the inclusion of a large fascial hematoma, two bladder perforations, and two patients requiring

blood transfusion.

Laparotomy was required in 10% (3/29) of a series of patients undergoing laparoscopic pelvic and/or para-aortic lymphadenectomy for endometrial cancer, reported by Boitke, et al.[11] Two patients underwent secondary operations because of small bowel obstruction, and another patient had a vascular injury to a small branch of the aorta recognized intraoperatively and required mini-laparotomy but no transfusion at the time of the primary surgery. Both patients with small bowel obstructions were related to herniations through trocar sites, both of which were greater than or equal to 10 mm. No direct complications were observed directly resulting from the pelvic lymphadenectomy, although 2 of 22 patients undergoing para-aortic lymphadenectomy had major complications. An additional patient required percutaneous nephrostomy three weeks postoperatively because of a leak in the left lumbar ureter; this was attributed to thermal injury from monopolar current during a left para-aortic lymphadenectomy.

Spirtos, et al. reported a series of forty patients undergoing pelvic and para-aortic lymphadenectomy for gynecologic malignancies including thirty-five endometrial carcinomas, four ovarian cancers and one tubal malignancy.[7] Five patients required laparotomy at the time of the initial operation. In two cases this was secondary to vascular injury to perforating branches of the vena cava and right iliac vessels, respectively. Two other patients required a debulking at laparotomy for unsuspected intra-abdominal metastatic disease. A final patient was opened due to equipment failure.

Other authors report significantly lower incidence of laparotomy consequent to laparoscopic lymphadenectomy. None of the 39 patients who underwent laparoscopic lymphadenectomy for cervical cancer in a series by Querleu, et al. required laparotomy.[3] Pomel, et al. reported on ten cases of pelvic and para-aortic laparoscopic lymphadenectomies performed for early stage carcinoma of the ovary.[10] They mentioned one laparotomy at a second surgery, for postoperative hemoperitoneum. We have reported a 1.7% (1/60) laparotomy rate for patients undergoing para-aortic lymphadenectomy for cervical, endometrial, and ovarian carcinoma.[5] A single patient required laparotomy for a hole in the vena cava, which was created during a right-sided para-aortic lymphadenectomy. She required four units of blood and subsequently developed a deep venous thrombosis following surgery.

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THE LEARNING CURVE

Most surgeons report a decrease in the number and severity of complications, as well as operating times as experience is gained with this laparoscopic procedure.[2,4,8,9,12] Eighty-eight percent (14/16) of aborted laparoscopic lymphadenectomies reported by Kavoussi occurred during the initial dissections at each contributing institution.[1] Lang, et al. reported a significantly higher complication rate for the first 50 laparoscopic lymphadenectomies (14%), as compared to the next 50 such surgeries (4%).[8] In fact, five of the nine total complications occurred in among the first twenty patients. The adequacy of the procedure also increases with experience. Fowler, et al. and Rukstalis, et al. reported a clear improvement in the adequacy of the dissection, as estimated by the percentage of lymph nodes removed, as operators gained experience with the technique.[9,12] Our own experience with laparoscopically-assisted staging for endometrial carcinoma demonstrates a significant decrease in operating time with increasing experience.[13] Notably, the major complication rate was unaffected, although the rate of conversion to laparotomy decreased significantly. With time, laparoscopic lymphadenectomy becomes a safer and more time-efficient procedure.

CONCLUSION

Laparoscopic lymphadenectomy is an evolving technique which will play an increasingly important role in the management of gynecologic malignancies. Pelvic and para-aortic laparoscopic lymphadenectomy appears to be a safe, adequate, and feasible procedure, with a low complication rate. The risks include those traditionally attributed to laparoscopy, as well as those inherent to open lymphadenectomy. The use of simple preventive measures allows the patient to benefit from this technique, while diminishing the likelihood of morbidity.

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