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Retroperitoneal anatomy during excision of pelvic side wall endometriosis

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Abstract

Surgical management of endometriosis has been shown to improve dysmenorrhea at all disease stages and is recommended in severe disease for treatment of infertility. Deeply infiltrating endometriosis (DIE) produces thick inflammatory tissue that precludes visualization of anatomical landmarks and distorts normal anatomy. Excision of DIE poses several technical and surgical challenges that mandate a clear understanding of the anatomy of the pelvic sidewall. This review details relevant surgical anatomy and addresses the principles of safe retroperitoneal entry, ureterolysis and excision of endometriotic lesions. Proper use of these techniques should facilitate safe and successful surgery for management of DIE.

Keywords

retroperitoneal anatomy; laparoscopic surgery; deeply infiltrating endometriosis; surgical management; ureterolysis

Introduction

Ectopic endometrial tissue is the key pathologic finding of endometriosis, thought to be caused by dissemination of endometrial cells into the pelvis. The disease is clinically characterized by symptoms of pelvic pain, dysmenorrhea, dyspareunia and infertility¹. Endometriosis has been found in 10% of all reproductive-aged women, but up to 45% of those with pelvic pain^{2,3}. After the ovaries, implants are most commonly found in posterior broad ligament, pelvic cul-de-sac and uterosacral ligament⁴, although endometriosis has been reported in distant sites including the umbilicus and the appendix^{5,6}. Deeply infiltrating endometriosis (DIE) may obliterate the pelvic cul-de-sac, while adhesions to the peritoneum may obscure the ureters or distort their course.

Surgery for endometriosis has been shown to improve pain symptoms when performed at all disease stages^{7,8}. Surgical intervention is also recommended for removal of severe disease for infertility, particularly in stage III disease^{7,9}. Hence the Practice Committee of the American Society for Reproductive Medicine recommends treatment of endometriotic

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Conflicts of interest None

lesions at the time of diagnostic laparoscopy¹⁰, although the optimal surgical intervention has yet to be determined. A randomized double-blinded study comparing excision to ablation failed to find any significant differences in post-operative pain¹¹. However this study had a larger number of patients with DIE in the excision group rather than ablation group, limiting the generalizability of the observations. A follow up to this study also showed better relief of dyspareunia with excision¹². Excision of an endometrioma cyst wall has been shown to have superior outcomes than ablation in terms of pain, recurrence, need for surgery and fertility¹³.

When patients are appropriate candidates for surgery, our personal preference is to attempt excision rather than ablation of endometriosis if at all available. This preference also applies to DIE of the pelvic sidewall. However, excision of endometriosis overlying the posterior broad ligament, as is common, poses several technical challenges to the surgeon due to the proximity of the peritoneum to the ureters and branches of the internal iliac artery¹⁴. While the ureter is frequently visible through the peritoneum, DIE leads to a thick layer of inflammatory tissue that precludes visualization of these landmarks in many cases. In addition, the chronic inflammatory state may produce fibrotic adhesions that distort the course of the ureters. Neo-angiogenesis is also common with endometriotic lesions, making the area of excision more susceptible to bleeding. Thus performing a safe excision of endometriosis may require direct entry into the retroperitoneum to directly visualize and track the course of the key anatomical landmarks. A clear understanding of the anatomy of the pelvic sidewall is thus required. This review covers the surgical principles required for access to the retroperitoneum for management of DIE.

Entering the retroperitoneum

The first step is to enter the retroperitoneal space (Figure 1). The space is entered by looking for a site with normal peritoneum, tenting it with laparoscopic Allis graspers, and sharply entering, away from any sites with disease¹⁴. The retroperitoneum is entered most safely through the medial leaf of the broad ligament near the pelvic brim. Tenting the peritoneum maximizes the distance from underlying retroperitoneal structures and minimizes the chance of injury¹⁵. While some prefer to enter the retroperitoneum by creating a peritoneal window medial to the ureter¹⁴, we tend to prefer entry just lateral to the ureter. In patients with extensive side wall involvement, entering the retro-peritoneum at the level of the pelvic brim is safest because endometriosis rarely affects this anatomical region.

The peritoneum is incised sharply, millimeter by millimeter, while maintaining tension until dissection reaches the loose areolar tissue that forms a plane for dissection. This dissection plane is not always easily identified or may not exist if the broad ligament is covered with DIE, producing a thickened and inflammatory peritoneum. In this case, sharp dissection will need to continue within the retroperitoneum together with a meticulous dissection until key anatomic landmarks can be identified.

Identifying and isolating the ureter

The ureters, measuring approximately 25–30 cm, connect the renal pelvis bilaterally to the bladder. The relative anatomy of the ureters to other structures is critical for safe dissection. The two areas of importance in the retro-peritoneum are the pelvic brim and the area where the ureter passes under the uterine artery. These are the two most common locations of ureteral injury during gynecologic surgery¹⁶.

The ureters course from the renal pelvis through the abdominal space medial to the psoas major muscles. They enter the pelvis at the pelvic brim after crossing the common iliac arteries at the level of their bifurcation into the internal and external iliac arteries (Figure 2a–b). Therefore the ureters are found medial and anterior to the external and internal iliac vessels as they enter the pelvis, as well as posterior and medial to the infundibulopelvic ligament.

The ureters continue from the pelvic brim into the pelvic sidewall, where they are the most medial structures within the retroperitoneum. In patients with normal anatomy, the intermittent peristalsis of the ureters is frequently visible through the peritoneum. As the ureters continue in the pelvis, they cross underneath the uterine artery as the uterine artery enters the uterus at the level of the cardinal ligament. This anatomical relationship between the ureters and the uterine artery is frequently summarized as "water under the bridge." Finally the ureters enter the bladder at the postero-lateral angles of the trigone.

DIE often involves the medial leaf of the broad ligament overlying the ureters and demands skill with ureterolysis (Figure 2c–d). Ureterolysis is often necessary to peel off the ureter from the medial leaf of the broad ligament or uterosacral ligaments and is often best approached starting at the pelvic brim^{15,17}. The surgery requires dissecting the ureter off of the medial leaf of the broad ligament. All dissections should be performed parallel to the vital structures in the pelvis. While the dissection is performed bluntly, millimeter by millimeter, if possible, the ureter may not easily peel off the broad ligament in patients with endometriosis. Therefore scissors are often required to cut the fibrotic interface¹⁵. Bleeding can occur at any time so a clear view of the ureter is important to allow hemostasis.

Vasculature of the retroperitoneum

The most important vessel within the retroperitoneum for the gynecologic surgeon is the internal iliac artery and its branches. The anterior division of the internal iliac artery gives rise to the obturator artery, umbilical artery and uterine artery (Figure 3a). The superior vesical artery typically arises as a branch off of the umbilical artery, after which the umbilical artery is obliterated and often referred to as a "ligament."

The external iliac artery is the most lateral vessel in the retroperitoneum, found immediately medial to the psoas muscle and immediately lateral to the external iliac vein (Figure 3b).

Several anatomical principles facilitate identification of retroperitoneal vasculature in patients with challenging anatomy. The medial umbilical fold on the anterior abdominal wall

contains the distal obliterated umbilical artery. In adults, it is first seen as the paramedial ligamentous structure of the anterior abdominal wall just lateral to the urachus.

Tracing the obliterated umbilical artery back to its origin by using gentle traction on the medial umbilical fold will define the internal iliac artery and uterine artery. The most medial branch of the internal iliac artery is the uterine artery, which is immediately medial to the obliterated umbilical artery. In addition, the uterine artery is immediately lateral to the ureter. Arterial pulsations will often also help confirm the identity of the uterine artery. However, as the uterine artery continues into the pelvis, it crosses the ureter anteriorly and remains medial to it before finally dividing into smaller spiral arteries.

Further lateral to the umbilical artery is the obturator artery, which dives into the obturator canal posterior to the obturator nerve (Figure 3c) and provides sensory innervation to the medial thigh as well as motor input for thigh adduction. DIE may extend from the medial leaf of the broad ligament all the way to the obturator nerve.

Pararectal space

The pararectal space, while not technically a part of the retroperitoneum, is accessed via the retroperitoneum (Figure 3d). The pararectal space is found posterior and inferior to the base of the broad ligament. This space contains the autonomic nerves of the superior hypogastric plexus and provides sympathetic motor and sensory innervation to the pelvic viscera. To reduce the risk of damage to splanchnic autonomic nerves, dissection of DIE should not continue past the pelvic vein¹⁴.

Pelvic cul-de-sac

The pelvic cul-de-sac, also referred to as the rectovaginal space, is the lowest part of the pelvis in a supine patient and is a common site of disease. It is bordered anteriorly by the vaginal fascia, posteriorly by the rectal serosa and fascia and laterally by the uterosacral ligaments. When the cul-de-sac is obliterated, the uterosacral ligaments may not be clearly defined. The cul-de-sac is dissected starting at the rectovaginal septum using a transverse incision inferior to the cervix and superior to the rectum. The dissection proceeds until the uterosacral ligaments are clearly identified and the space is developed. The uterosacral ligaments may need to be cut or excised in order to restore normal anatomy and excise endometriosis. The cul-de-sac may also be entered laterally through the potential space that is developed during a retroperitoneal dissection after completion of ureterolysis. Because the rectum is surrounded by a layer of perirectal fat, all fat is left with the rectum in a dissection of the vagina off of the rectum.

Safe excision of endometriosis

Endometriotic implants must be completely excised in order to maximize therapeutic benefit^{17–20}. A combination of bipolar electrosurgery with sharp dissection is often helpful when removing these highly vascular structures. Radiofrequency electrosurgery using a bipolar instrument for coagulation is also useful in achieving hemostasis around the dissection planes. Radiofrequency electrosurgery with a monopolar instrument in

coagulation mode has deep penetration and should be minimized due to the possibility of lateral spread, which has been demonstrated as far as 8cm from the site of application^{21,22}. While fulguration with a continuous waveform with a monopolar instrument (high-voltage non-contact coagulation) may offer theoretical safety benefits in lateral spread compared with alternative monopolar electrosurgical techniques²³, no published data exist on the relative safety of this technique. In all cases, particular care must be taken to completely dissect the ureter away from an endometriotic implant before any electrosurgery can be applied to reduce the risk of thermal injury.

Dissection of the ureter should continue until the ureter is safely separated from the planned site of electrosurgery. It continues until the blood vessels are also clearly in view and separated from the planned area of electrosurgery and excision.

In some cases the lesions will extend to the obturator space. The dissection of the ureter and blood vessels should be complete. The obturator bundle is surrounded by fat. Dense fibrosis is commonly found in endometriotic lesions that extend into the fat of the obturator bundle. Careful separation of this tissue is needed to prevent injury to the nerve or blood vessels.

Excision of rectosigmoid lesions is performed similarly to excision of broad ligament implants. In certain cases, surgical management of DIE will entail unavoidable injury to the rectum. While unrecognized bowel injuries resulting from sharp dissection tend to present within 36 hours, electrosurgical damage may take days to present. If there is concern for injury to the bowel, intraoperative consultation with a general or colorectal surgeon is recommended. Serosal injury typically does not need repair, while injuries extending to the muscularis or mucosal layer will require repair perpendicular to the long axis of the bowel or possible segmental resection.

Conclusions

Surgical management of endometriosis requires a detailed understanding of the retroperitoneal anatomy. Skilled surgeons with experience in entering the retroperitoneum can reliably identify critical nearby structures, including the ureter, branches of the internal iliac artery and pelvic autonomic nerves, that should be preserved during surgical excision of endometriosis.

The retroperitoneum is preferably entered sharply at a site with normal anatomy by tenting the medial leaf of the broad ligament. A good site of entry is the pelvic brim, which is usually spared of endometriosis. Loose areolar tissue is dissected and the ureter and branches of the internal iliac vessels are identified. The ureter is typically fused to the peritoneum because of dense fibrosis. The surgeon should make judicious use of electrosurgery to avoid damage to key nearby structures and avoid electrosurgery with lateral spread.

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Figure 1.

Entering the retroperitoneum. a) The medial leaf of the broad ligament is drawn medially using laparoscopic Allis graspers to cause a tenting on the overlying peritoneum. b) This action maximizes the distance between the peritoneum and the ureters and vessels immediately underneath. c) Laparoscopic view of pelvis while tenting the peritoneum d) Retroperitoneal vessels and ureter are drawn away from the overlying pelvic peritoneum e) The peritoneum is incised sharply to the level of the loose areolar tissue. f) This dissection is continued until the ureters are clearly demarcated.

Figure 2.

Complex ureterolysis a) Endometriotic implants (represented in blue) can be found overlying the ureter or branches of the internal iliac vessels. b) Course of the ureter in the pelvis. c) Fibrotic endometriotic adhesions between the ureter and the broad ligament. d) Sharp dissection of the fibrotic interface.

Figure 3.

Important anatomy visible within the retroperitoneum a) Branches of the internal iliac artery. b) The external iliac vessels. c) The obturator nerve and artery. d) The pararectal space.