Laparoscopic Gynecologic Anatomy
-The Surgical Essentials
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INTRODUCTION

A sound knowledge of surgical anatomy is a requirement for performing laparoscopic procedures that are safe, efficient and effective. The gynecologic laparoscopist must have a working knowledge of the anterior abdominal wall, the superficial peritoneal landmarks within the pelvis, the structural anatomy of the pelvic retroperitoneum, and the endopelvic fascial support of the pelvic viscera. A knowledge of the anterior abdominal wall allows the laparoscopist to establish entry ports quickly and safely. Superficial peritoneal landmarks within the pelvis alert the operator to vital anatomic structures below the surface. A knowledge of the retroperitoneal structures facilitates dissection in these areas in an avascular manner without injuring the ureter or important nerves or causing hemorrhage. A knowledge of the endopelvic fascia and pelvic visceral support allows the laparoscopist to perform effective reparative procedures.

ANATOMY OF THE ANTERIOR ABDOMINAL WALL

The relevant landmarks on the anterior abdominal wall include the umbilicus, the anterior superior iliac spines, the pubic symphysis, and the pubic tubercles. Depending upon the body habitus and weight of the patient, the umbilicus may lie slightly above, at, or below the bifurcation of the aorta. In all patients, the left common iliac vein crosses the midline of the body approximately 3 to 6 cm. inferior to the level of the umbilicus. These anatomic relationships must always be in mind when placing a Veress needle or trocar through the umbilicus.[1,2,3,4] In the thinner patient, the surface of the anterior abdominal wall is significantly closer to the aorta and vena cava because of the decreased amount of adipose tissue in the wall itself, as well as in the fatty layers surrounding these great vessels.

In establishing lower lateral pelvic ports, the operator must avoid lacerating the inferior and superficial epigastric vessels.[4,5] The inferior epigastric artery and vein travel on the undersurface of the rectus abdominis muscle on its lateral third in the regions of the lower quadrants of the abdomen. These vessels originate from the external iliac vessels just before they exit the pelvis underneath the inguinal ligament. The inferior epigastric vessels are found just medial to the round ligament, as it exits through the internal inguinal ring. In most cases, their identification may be visually assured through the peritoneum within the pelvis. These vessels cannot be identified by transillumination of the anterior abdominal wall.

However, the superficial epigastric artery and vein may be found by transillumination, especially in the thinner patient. These vessels travel within the subcutaneous tissue of the anterior abdominal wall in variable locations lateral to the umbilicus. Vascular complications during laparoscopic procedures are commonly related to damage to these anterior abdominal wall vessels.[4,6,7,8,9] The majority of vascular injuries in the placement of lower abdominal ports can be avoided by placing the ports lateral to McBurney's point. This point is anatomically located on the abdominal skin as one-third the distance from the anterior superior iliac spine, along a line from the iliac spine to the umbilicus.

In the placement of lower central trocars, the operator must remember that the urachus is a midline structure running from the bladder to the umbilicus on the undersurface of the anterior abdominal wall. In rare circumstances, this conduit can remain partially patent and filled with urine.

Laceration in these cases can lead to postoperative extravasation of urine.[10,11] The bladder itself can be lacerated, especially if the bladder has not been drained of urine.[6,7,9,12]

The pubic tubercle is approximately 2 cm. lateral to the pubic symphysis on the body of the pubic bone. Lateral to the tubercle, along the superior pubic ramus, is the pectineal (Cooper's) ligament. The ilioinguinal nerve is located approximately 2 cm. lateral and superior to the pubic tubercle within the anterior abdominal wall. This nerve can be injured when placing sutures into the space of Retzius during a vaginal needle urethropexy and in some techniques of laparoscopic urethropexy. The operator must stay within l to 2 cm. of the pubic tubercle in order to avoid injuring the ilioinguinal nerve.[13]

SUPERFICIAL PERITONEAL ANATOMY

All laparoscopic procedures need to begin with a routine inspection of the pelvis and upper abdomen. A clockwise evaluation should include inspection of the appendix, ascending colon, falciform ligament, liver, gallbladder, omentum, transverse colon, stomach, right and left hemidiaphragms, descending colon and sigmoid colon. The pulsations of the left ventricle of the heart can be observed through the left hemidiaphragm. The laparoscopist should note the location and severity of adhesions, inflammation, endometriosis externa, cul-de-sac fluid, tumors, cysts, peritoneal studding, or distortion of any pelvic or abdominal anatomy.

The peritoneum on the undersurface of the anterior abdominal wall covers three structures, thus creating "umbilical folds".
Running from the dome of the bladder to the umbilicus is the median umbilical fold, underneath which is the obliterated urachus. Lateral to the median umbilical fold are the medial umbilical folds, under which are found the obliterated umbilical arteries. Dissection along the medial aspect of the obliterated umbilical artery toward the internal iliac artery in retroperitoneal dissection allows laparoscopists to locate the origin of the uterine artery. Just lateral to each medial umbilical fold is the lateral umbilical fold, which is formed by the peritoneum over the inferior epigastric artery and vein.

The uterosacral ligaments run from the cervix, around the rectum, to insert upon tough, presacral fascia over S2, S3 and S4. Anterior traction on the uterus places the uterosacral ligaments on tension, thus making them easier to identify. Near the cervix, the ureters are found just behind the peritoneum, just lateral to these ligaments.

THE URETER

Each ureter enters the pelvic cavity just superficial to the bifurcation of the common iliac artery and just deep to the ovarian vessels, which are in the infundibulopelvic ligament. This entrance is located at the level of the pelvic brim overlying the sacroiliac juncture. The ureter travels in its own endopelvic fascial capsule which is attached to the parietal peritoneum of the pelvic sidewall. In the patient placed in the dorsolithotomy position in preparation for laparoscopic surgery, the ureter courses almost horizontally and points towards the ischial spine. The ureter then passes just lateral to the uterosacral ligament, approximately 2 cm. medial to the ischial spine. This

area is just beneath the uterine artery, approximately l.5 cm. to 2 cm. lateral to the side of the cervix. The ureter forms a "knee" turn at this point and travels medially and anteriorly to pass on the anterolateral aspect of the upper third of the vagina towards the bladder in its own "tunnel" of endopelvic fascia. The ureters enter the empty bladder approximately 5 cm. apart, course obliquely through the bladder wall for approximately l.5 to 2 cm., and then enter the bladder at the corners of the trigone approximately 2.5 cm. apart.

The blood supply to the ureter originates from the various arteries along this path, including the ovarian, the internal iliac, the uterine, and the vesicals. The vascular supply travels in the longitudinal endopelvic fascial sleeve around the ureter. The ureter and this surrounding endopelvic fascial sleeve may be dissected together, away from the peritoneum and other structures during laparoscopic surgery without compromising its blood supply.

During any pelvic surgery, whether abdominal, laparoscopic, or vaginal, the ureter may be injured anywhere along its course.[6,12,14,15,16] These injuries are generally mechanical or thermal in nature. Thermal injuries typically occur with laser energy or monopolar or bipolar electrical energy. Such injuries may damage the vascular sleeve that nourishes the ureter. Mechanical injuries can occur in a myriad of situations. These injuries may kink, occlude, or even transect the ureter. Staples, clips, sutures and scissors are the most common culprits. Table 1 outlines the common sites of ureteral injury.

THE ENDOPELVIC FASCIA AND PELVIC SUPPORT[17]

The endopelvic fascia is visceral connective tissue found between the peritoneum and the parietal fascia covering the musculature of the pelvic basin. The pelvic basin is composed of a floor (the levator ani and coccygeus muscles), two sidewalls (the two obturator internus muscles), and a back wall (the piriformis muscles and sacrum). The front wall is the fused pubic bones. Microscopically, endopelvic fascia is a relatively loose, three-dimensional meshwork of collagen fibers, intermingled with varying amounts of elastin and smooth muscle. In contrast, the parietal fascia is predominantly collagen arranged in a regular, tough, unyielding structure. The endopelvic fascia forms sheets of visceral supporting tissue that fuse around visceral arteries and veins to form stronger sheaths. Also enveloped within these sheaths are visceral nerves, lymph nodes and channels, and varying amounts of adipose deposits.

There are two important purposes of the endopelvic fascia: 1. To function as flexible conduits and physical supports for the visceral pelvic vasculature, visceral nerves, and lymph tissue, and 2. To mechanically suspend the pelvic viscera - the bladder, the cervix and vagina, and the rectum - within the pelvis over the levator plate in order to secure pelvic visceral support. For instance, the cardinal ligaments not only surround and support the internal iliac vessels and uterine vessels, but also attach to the upper third of the vagina and cervix in order to position these structures horizontally over the levator plate for support.

An understanding of the endopelvic fascia - composition, purpose and location - facilitates retroperitoneal surgical dissections. Blunt probing parallel to the pelvic blood vessels reveals the sheaths of endopelvic fascia. Dissection in the proper plane between the endopelvic fascia and vessels allows the oncologic surgeon to safely perform lymphadenectomies. Likewise, reparative

pelvic procedures, such as urethropexies and paravaginal defect repairs, demand a familiar appreciation of the endopelvic fascia and normal supportive anatomy.

PELVIC VASCULATURE

The internal iliac artery travels parallel and just posterior to the ureter. The external iliac artery is several cm. anterior to it on the psoas muscle. The external and internal iliac arteries may then be followed superiorly to find the bifurcation of the common iliac artery at the pelvic brim overlying the sacroiliac joint. Through the peritoneum, the right common iliac artery may then be followed superiorly to find the bifurcation of the aorta, above the "presacral" space at approximately the fourth lumbar vertebra. The left common iliac artery is harder to identify because of the overlying mesentery of the sigmoid colon. The left common iliac vein is located just medial and inferior to the left common iliac artery in the "presacral" space. All these vessels are enveloped in sheaths of endopelvic fascia.

THE LYMPH SYSTEM

The lymphatic system is composed of multiple lymph nodes connected by an extensive network of intercommunicating capillaries and vessels. These structures are contained within the sheaths of endopelvic fascia which also envelop the pelvic vasculature. For descriptive purposes, the lymph system has been artificially divided into groups of lymph nodes described in relation to the nearest artery. Therefore, lymph nodes are found in the pelvis along the obturator artery, the external iliac artery, the internal iliac artery, the common iliac artery, and the middle sacral artery. In addition, lymph nodes have been described in the parametrium, surrounding the uterine vessels and their branches.

VISCERAL NERVES

The visceral nerves, likewise, are enveloped within the endopelvic fascia and areolar fat. They enter the pelvis from the superior hypogastric plexus found in the "presacral" space. These nerves are multiple and very fine, making them difficult to visualize, even with the laparoscope. Sometimes meticulous dissection within areolar fat may reveal the larger fibers.

The right and left hypogastric nerves then travel along with their internal iliac arteries and ureters to enter their respective inferior hypogastric plexuses. Each inferior hypogastric plexus contains multiple ganglia over an area of 3 x 5 cm. and is located just lateral to the uterosacral ligament in the pelvic sidewall. Many of these visceral nerves form the uterovaginal plexus (Frankenhauser's plexus), located around the uterine vessels and ureter just lateral to the cervix, and enter the uterus via the uterine vessels. Relatively few of these visceral nerves are found in the substance of the uterosacral ligament. This may be one reason why transection of the uterosacral ligaments has a high failure rate in alleviating visceral pelvic pain.

The visceral nerves are responsible for sympathetic and parasympathetic control of the glands, smooth muscles and vasculature of the pelvic organs - bladder and urethra; uterus and cervix, vagina; sigmoid colon, rectum, and anal canal. Also, these nerves transmit afferent sensations - such

as pain, pressure, distension - back to the spinal cord. Ablation of these visceral nerves in certain locations in the pelvis may somewhat relieve pelvic pain in a few, well selected cases. However in extensive ablation, such as in a radical hysterectomy, visceral dysfunction may result, such as bladder atony.

REGIONS AND SPACES WITHIN THE FEMALE PELVIS
The Paraaortic Region

The paraaortic region is the anatomic area from the renal vessels down to the bifurcation of the aorta in the posterior abdominal retroperitoneum. This also includes the lymph tissue around and lateral to the aorta and vena cava. The lateral borders are the ovarian vessels and ureters. Lymphadenectomy for the purposes of evaluating metastatic spread of pelvic cancer is the primary reason the gynecologist needs to be familiar with the paraaortic region.

For practical purposes, this region is divided into two areas. The lower paraaortic area is bounded by the bifurcation of the aorta up to the level of the inferior mesenteric artery, which is approximately 4 cm. superior to the bifurcation. Dissections for lymph tissue involving uterine, ovarian or cervical cancer involve this area. The infrarenal area (upper paraaortic area) goes from the level of the inferior mesenteric artery up to the left renal vein. The ovarian arteries exit the anterior aspect of the aorta in the midportion of this area. Lymph nodes here may be involved in the spread of ovarian cancer because of the lymphatic drainage from the ovary along the ovarian vessels. Therefore, lymph node sampling involving ovarian cancer involves this area.

In the paraaortic region, the ureter and ovarian vessels are found several cm. lateral to the aorta and vena cava. The abdominal ureter travels in its own visceral fascial sheath attached to the posterior parietal peritoneum. The right ovarian vein travels near the right ureter and empties into the vena cava. The left ovarian vein travels with the left ureter but empties into the left renal vein. These structures lie on the anterior surface of the psoas muscle, yet are ensheathed in visceral fascia, and along with the ureter, remain attached to the parietal peritoneum.

Elevation of the posterior abdominal parietal peritoneum lifts the ureter and ovarian vessels away from the psoas muscle. Therefore, blunt dissection in the proper plane allows the ureter and ovarian vessels to be easily separated from the psoas muscle. With this plane developed, the surgeon is assured that these structures are not in the field of paraaortic lymphadenectomy. The biggest concern on the left side is injury to the lumbar veins and arteries posteriorly. Anteriorly and medially, the major concern is avulsion of the ovarian arteries at their origin on the aorta. On the right lateral side, the ovarian vein can be injured as it enters the vena cava. The left renal vein is the major concern at the superior edge of the paraaortic region. Anomalous vessels should always be expected during these dissections. The inferior extension of this region is the "presacral" space.

"Presacral" Space

The "presacral" space is important to gynecologic surgeons when performing a "presacral" neurectomy or when removing presacral nodes. "Presacral" is a misnomer since this surgical area is just in front of the fourth and fifth lumbar vertebrae. The correct terminology is the lower "prelumbar" space. This space is bounded anteriorly by the parietal peritoneum and posteriorly by

the anterior longitudinal ligament and periosteum over the lowest two lumbar vertebrae and the promontory of the sacrum. The middle sacral artery and a plexus of veins are attached superficial to the anterior longitudinal ligament. The endopelvic fascia in this space envelopes fatty areolar tissue, visceral nerves, and lymphatic tissue. There is no one "presacral" nerve but a multitude of finer visceral nerves that course through, or even around this area over the common iliac vessels. The "presacral" nerves are the fibers of the superior hypogastric plexus which is located here.

The right lateral boundary of the "presacral" space is the right common iliac artery and the right ureter. The left lateral border is the left common iliac vein and left ureter, as well as the inferior mesenteric artery and vein traversing through the mesentery of the sigmoid colon. All of these structures must be identified when dissecting in this space. When performing a "presacral" neurectomy, the operator must excise all fatty areolar tissue in this area since it contains the visceral nerves that need to be ablated. Since these nerves may not travel in the central portion of the space but may be more lateral toward the iliac arteries and veins, the surgeon must dissect as laterally as possible without injuring the vital structures along its borders. Lateral and inferior dissection in the "presacral" space leads to the structures entering the pelvis over the pelvic brim.

Pelvic Brim Region

The pelvic brim at the sacroiliac joint is a very important location for the entry of multiple structures into the pelvic cavity and must be appreciated layer by layer. From the peritoneal surface, working posteriorly to the sacroiliac juncture, the following structures are found crisscrossing over one another: the peritoneum, the ovarian vessels in the infundibulopelvic ligament, the ureter, the bifurcation of the common iliac artery, the common iliac vein, the medial edge of the psoas muscle, the obturator nerve, and the parietal fascia just over the capsule of the sacroiliac joint. Just medial to the obturator nerve is the lumbosacral trunk traveling from the lumbar plexus to the sacral plexus of nerves. Because of the proximity of the ovarian vessels over the ureter at this level, the laparoscopic operator must realize that ureteral injury can occur during ligation or coagulation of the infundibulopelvic ligament. These structures then enter the pelvis and travel within the pelvic sidewalls.

Pelvic Sidewall Region

Based on avascular planes, the pelvic sidewall consists of three surgical layers medial to lateral. The first layer is the parietal peritoneum with the attached ureter in its own endopelvic fascial sheath. When this peritoneum is incised and retracted medially, the ureter comes with it.

The second surgical layer consists of the internal iliac artery and vein and their visceral anterior tributaries, all enveloped within the endopelvic fascia, which also envelopes the lymph tissue, the visceral nerves, and fat deposits. Blunt dissection easily separates the first surgical layer from the second surgical layer in an avascular manner. Contained within the second surgical layer are the visceral branches of the internal iliac artery including the uterine, the superior vesical leading to the obliterated umbilical, the inferior vesical, the vaginal and the middle rectal. During retroperitoneal sidewall dissection, retraction of the obliterated umbilical artery places the superior vesical artery on stretch, which points the operator to the internal iliac artery. Thus, this second

sidewall layer can be readily located.

The internal pudendal, the inferior gluteal, and the obturator arteries are the parietal branches of the internal iliac and promptly course into or along parietal fascia. During dissection in this second surgical layer, any of these arteries and veins may be occluded for the purposes of hemostasis without any adverse reactions. The rich collateral blood circulation in the pelvis permits this. However, to emphasize, the operator must not perform any procedures in this second surgical layer until the ureter, the external iliac vessels, and obturator nerve and vessels have been positively identified. The laparoscopic surgeon must take great care in avoiding any laceration or injury to the ureter, external iliac vessels, or obturator nerve.

The third surgical layer consists of the parietal fascia over the obturator internus muscle, with the obturator nerve, artery and vein allowed to remain along this muscle, though the obturator nerve may at times be retracted medially. Likewise, blunt dissection along the obturator internus fascia easily allows the second surgical layer of visceral arteries and veins to be retracted medially in an avascular manner. This is accomplished in dissections in the obturator space. In fact, this may be done down to the level of the ischial spine, where the obturator internus muscle tendon exits the pelvis through the lesser sciatic foramen. This knowledge is important in performing laparoscopic paravaginal defect repairs. During paravaginal repairs, this area is approached through the space of Retzius.

In another perspective from anterior to posterior, the pelvic sidewall may be easily viewed through the laparoscope through the peritoneal covering, especially on the right side. Anteriorly is found the psoas muscle. On its medial aspect is the external iliac artery with the external iliac vein just medial and posterior to it. Just underneath the external iliac vein is the bony ridge of the arcuate line of the ilium, which cannot be seen. Also not seen are the obturator nerve, artery and vein coursing underneath this ridge along the anterior border of the obturator internus muscle, traveling toward the obturator canal. However in the thinner patient, the ureter and the internal iliac artery are easily seen several cm. below the external iliac vein, traveling in parallel in an almost horizontal position. The ureter characteristically peristalses, while the internal iliac artery, just posterior to the ureter, characteristically pulsates with the rhythm of the heart.

Base of Broad Ligament

The cardinal ligament is found at the base of the broad ligament and contains the uterine artery traveling medially towards the lower uterine segment. Dissection of the pelvic sidewall naturally leads into this area. The surgical area located next to the lower uterine segment is known as the parametrium. That area located just lateral to the vagina is called the upper paracolpium. The uterine artery branches from the internal iliac artery, which then continues into the superior vesical artery and then into the obliterated umbilical artery. The origin of the uterine artery may be laparoscopically identified by dissecting along the medial border of the obliterated umbilical artery while working backwards toward the internal iliac artery. The medial offshoot is then identified as the uterine artery.

Passing just underneath and crossing the uterine artery here is the ureter as it travels into the ureteric "tunnel". This area is approximately 2 cm. lateral to the side of the cervix and is very near

the uterosacral ligament, which is just medial. Therefore, the ureter must be carefully identified during uterine artery ligation, any dissection in this area, uterosacral ligament transection, or suture ligation of the uterosacral ligaments. In fact, any transection of the uterosacral ligament causes subsequent scarring that may pull the ureter medially, closer to the cervix. This situation may make subsequent hysterectomy more likely to injure the ureter.

The space just anterior to the base of the cardinal ligament is the paravesical space. The space just posterior (towards the sacrum) is the pararectal space.

Paravesical Space/Obturator Space

The paravesical and obturator spaces are important during pelvic lymph node dissections, as well as reparative vaginal procedures. The paravesical space is a potential space beneath the peritoneum, bordered by the bladder and the bladder pillar medially, the fascia of the obturator internus muscle laterally, and the base of the cardinal ligament posteriorly. Anteriorly is the pubic bone. Contained laterally in this space is the obturator space. The obturator space is defined from the obliterated umbilical artery medially, to the fascia of the obturator internus muscle laterally, and from the external iliac vein above to the obturator nerve and vessels below. This space contains the obturator nerve, which needs to be identified during pelvic retroperitoneal dissection. As mentioned before, this nerve enters the true pelvis at the pelvic brim beneath the iliac veins, and travels on the anterior border of the obturator internus muscle to enter the obturator canal along with the obturator artery and vein. The obturator nerve is actually loosely covered with endopelvic fascia and fatty areolar tissue. During dissection in this area, the nerve is easily exposed by gently sweeping away this tissue.

To the reparative vaginal surgeon, these spaces are usually approached through the space of Retzius and are known as the lateral compartment of the retropubic space.

Pararectal Space

The pararectal space is important when performing radical hysterectomies. This space is easily developed by bluntly dissecting the ureter medially toward the rectum, and by bluntly dissecting posterior to the origin of the uterine artery. The anterior border of this triangular space is the base of the cardinal ligament. The medial border is the ureter dissected toward the rectum, while the lateral border is the internal iliac artery. The space also contains the uterosacral ligament, which is found on the anterior and lateral border as it travels posteriorly towards the sacrum.

Space of Retzius

The space of Retzius, or the retropubic space, is a potential avascular space with very vascular borders. The laparoscopist uses this space to perform retropubic urethropexies and paravaginal defect repairs. It consists of an anterior compartment and two lateral compartments. The anterior compartment is bounded by the pubic bone anteriorly, and the endopelvic fascial capsule that surrounds the bladder posteriorly. Contained within this endopelvic fascial capsule is the rich network of perivesical venous sinuses within deposits of areolar fat. Centrally over the urethra, just under the pubic arch, is the deep dorsal vein of the clitoris which feeds into these venous

channels. Therefore, dissection in the anterior compartment of the space of Retzius must not be directed centrally where these vessels may be lacerated.

The lateral compartment of the space of Retzius (same as the paravesical space) is bounded laterally by the obturator internus fascia and the obturator nerve, artery and vein, just beneath the bony arcuate ridge of the ilium. The posterior border (toward the sacrum) is the endopelvic fascial sheath around the internal iliac artery and vein and its anterior branches, as they course towards the ischial spine. The floor of this lateral compartment is formed by the pubocervical fascia as it inserts into the arcus tendineus fasciae pelvis (fascial white line).

The pubocervical fascia is the thickened anterior portion of the endopelvic fascial (fibromuscular) coat surrounding the vagina. When attached to both fascial white lines laterally and to the cervix posteriorly, the pubocervical fascia forms a horizontal platform underneath the bladder. This intact platform prevents cystoceles. Many cystoceles are caused by a detachment of the pubocervical fascia from one or both fascial white lines. This is known as a "paravaginal" defect. Reattachment of this fascial platform to the fascial white lines is felt to correct this type of cystocele.

The fascial white line (arcus tendineus fasciae pelvis) is a linear thickening of the levator ani fascia from the posterior aspect of the pubic bone in a straight line to the ischial spine. This may be readily seen during a laparoscopic paravaginal defect repair. In the standing female patient, the fascial white line is horizontally oriented, therefore, in the supine patient, this line travels in an almost vertical manner. Just above the level of the fascial white line may be seen the muscle white line (arcus tendineus levator ani) which is the origin of the levator ani muscles.

When performing a retropubic colposuspension through the laparoscope, the operator must remember that just underneath the external iliac vein and artery is the lateral continuation of the pectineal (Cooper's) ligament. These structures are hidden in areolar tissue and endopelvic fascia. Therefore, placement of sutures through the pectineal (Cooper's) ligament must stay within 3 to 4 cm. of the midline in order to avoid inadvertent laceration of these great vessels. Accessory obturator arteries and veins are often present. These vessels course from the inferior epigastric vessels and drape across the pectineal (Cooper's) ligament on their way to anastomose with the obturator vessels in the obturator canal. The surgeon must always look for them, since they are present in approximately 40% of patients.

The space of Retzius is easily opened laparoscopically. The peritoneum above the bladder is incised between the obliterated umbilical arteries (medial umbilical folds). The visualization afforded by the magnification of the laparoscope with its bright, directed light source is superb. With dissection in the proper plane, this space can be opened with essentially no blood loss. Excellent exposure to all relevant surgical anatomy is easily obtained. The positive pressure pneumoperitoneum also tamponades small venous bleeders, allowing hemostasis of these vessels to take place.

More inferiorly in the anterior compartment of the space of Retzius, the fatty areolar tissue must be dissected off the anterior vaginal wall to reveal the pubocervical fascia. This is done with a blunt instrument through a laparoscopic port and a finger in the vagina to stabilize the pubocervical fascia. In this area, sutures are placed 2 to 3 cm. lateral to the urethrovesical junction in performing a retropubic colposuspension. The urethrovesical junction is identified by the Foley bulb being

pulled down gently to the vesical neck. The distal two-thirds of the urethra is fused with the anterior vaginal wall. Therefore, sutures placed in the pubocervical fascia and attached to the pectineal (Cooper's) ligament allow significant and sure elevation of the urethrovesical junction close to but not against the pubic bone.

Vesicovaginal Space

The vesicovaginal space is a potential space between the anterior surface of the vagina (pubocervical fascia) and the posterior aspect of the bladder. This space is bordered laterally by the bladder "pillars" which allow for passage of vesical arteries, veins, lymph channels, and visceral nerves, along with the ureters. These structures pass just lateral to the lower uterine segment and cervix, and course on the anterolateral surface of the upper third of the vagina to enter the bladder.

When performing a hysterectomy, the surgeon must incise the uterovesical peritoneal fold. The potential vesicovaginal space is created by dissecting avascularly on the pubocervical fascia between the bladder and the cervix and vagina. The extent of dissection depends on the amount of vaginal margin required. Care must be taken not to injure the important structures in the more lateral bladder "pillars".

Rectovaginal Space

The rectovaginal space is bounded superiorly by the cul-de-sac peritoneum and the uterosacral ligaments, laterally by the iliococcygeus muscles, and inferiorly by the perineal body. Posterior is the endopelvic fascial capsule around the rectum, and anterior is the endopelvic fascial capsule around the vagina. The rectum may be easily and bluntly dissected away from the vagina, since the rectovaginal space is the potential space between these endopelvic fascial capsules around the rectum and vagina.

Within this space, and just behind the endopelvic fascial capsule of the vagina, is another endopelvic fascial structure called the rectovaginal septum. The rectovaginal septum attaches to the cul-de-sac peritoneum and the uterosacral ligaments, while inferiorly it attaches directly to the perineal body. Laterally, the rectovaginal septum attaches to the fascial white lines on the parietal fascia of the levator ani muscles. In the standing female patient, this structure forms an almost horizontal platform between the vagina and rectum and is felt to prevent rectoceles. Therefore, the reattachment of the rectovaginal septum to the above mentioned borders is important in the repair of rectoceles.

CONCLUSION

The three-dimensional field of pelvic anatomy, especially when viewed through the two-dimensional visual plane of the laparoscope, can be most difficult to master. Just as technical skills can be constantly improved through study and consistent practice, so can one's working knowledge of gynecologic surgical anatomy. Operating gynecologic laparoscopists must master the surgical anatomy in which they work. They must actively search for superficial landmarks within the pelvis and abdomen, and then identify the underlying structures. This knowledge of normal pelvic anatomy and anatomic relations assists the laparoscopist when faced with difficult dissections in

distorted anatomy due to pathologic conditions. Confidence in anatomic relationships allows the surgeon to perform procedures in a safe and timely manner. The alert gynecologist must always observe, question, study and persist in order to gain this sure working knowledge. Years are required for each individual to master all the information within this very complex and confusing subject.

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TABLE 1
SITES OF URETERAL INJURY

1.   The pelvic brim, underneath the infundibulo-
      pelvic ligament

2.   Along the pelvic sidewall.

3.   Just next to the uterosacral ligament.

4.   Near the uterine artery.

5.   On the anterolateral vaginal fornix, especially with vaginal surgery.

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