Laparoscopic Excision of Deep Fibrotic Endometriosis of the cul-de-sac and rectum.

Harry Reich, MD, FACOG
Advanced Laparoscopic Surgery
Shavertown, PA

Laparoscopic Excision of Deep Fibrotic Endometriosis of the Cul-de-Sac and Rectum

I.   INTRODUCTION

Diagnosis and treatment of endometriosis is the most frequent reason for gynecologic operative laparoscopy in the United States.1 Therefore, the laparoscopist must be thoroughly familiar with the current standards of diagnosis and management of this complex disease.

The most common presentations of endometriosis include pelvic pain, infertility, and adnexal mass. The ovaries, the posterior leaf of the broad ligament, and the cul-de-sac of Douglas behind the uterus are the most common locations of endometriosis, and the left side is more frequently affected than the right, as the rectosigmoid and its mesocolon - both often involved with endometriosis - enter the pelvis from the left side.[2,3] Extensive endometriosis refers to bulky deep fibrotic endometriosis deposits that can often be palpated preoperatively as tender pelvic nodules. These nodules consist of endometriotic glands and stroma surrounded by fibromuscular tissue that have accumulated over many years in response to cyclic monthly activation of the endometriosis. They represent a long-standing chronic inflammatory response. Histopathologic examination to document endometriotic glands and stroma is necessary to substantiate a diagnosis of the endometriosis in any suspect lesion.

Extensive endometriosis usually involves the posterior cul-de-sac of Douglas, the area surrounded posteriorly by the anterior rectum, anteriorly by the posterior vagina and cervix, and laterally by the uterosacral ligaments. The lesions can often obliterate the normal anatomy of the cul-de-sac, with the rectum sticking to the posterior vagina, cervix, and uterine fundus. One or both pelvic sidewalls overlying the ureters and the rectosigmoid are often affected. Less commonly involved areas include the anterior cul-de-sac (the area above the bladder and the anterior uterus), the appendix, and the small bowel. Extensive bulky endometriosis may also be present in the uterine muscle itself, where it is called adenomyosis.

The revised American Fertility Society classification (rAFS) for endometriosis does not address extensive deep cul-de-sac endometriosis because it does not allow points for intestinal disease. Extensive cul-de-sac disease that does not cause complete obliteration is often classified as Stage 1 or 2. This is the same stage often assigned to women with no endometriosis after the surgeon sees the remains of retrograde menstruation, resembling coffee grounds or tobacco stains.[4]

TeLinde and Scott defined the objectives of surgical treatment of endometriosis in 1952: "one should excise or fulgurate all evident endometriosis."[5] The surgical objectives of laparoscopic treatment are similar (ie, to remove all evident endometriosis by excising large superficial and deep lesions and vaporizing smaller deposits). Laparoscopic surgery can often decrease the considerable and obvious traumas of open laparotomy for conditions that can be managed in a more conservative manner. However, laparoscopic excision of endometriosis can be a frustrating, time-consuming experience. Laparoscopic surgery for endometriosis requires a thorough

knowledge of scissors, electrosurgery, carbon dioxide (CO2) laser, and suturing techniques for dissection and hemostasis. The operative advantages of a laparoscopic approach to the cul-de-sac include:

1. Easy intraoperative access to the rectum and vagina

2. A magnification source that is easier to manipulate than an operating microscope, yielding a very close view of lesions involving the deep pelvis and rectum.

3. The ability to perform an underwater examination at the end of the procedure during which all blood clots are evacuated and complete hemostasis is obtained.

4. The general advantages of laparoscopic surgery, including same-day diagnosis and treatment, short hospitalization, rapid recuperation, superior cosmetics results, excellent patient acceptance, cost-effectiveness, and results at least equal to those obtained with laparotomy.

II. DIAGNOSIS

A. Presentation

Patient is a 32-year-old nulligravid woman who presents with a history of infertility and pelvic pain. Additional symptoms include dysmenorrhea and dyspareunia. The pain is felt mostly on the left side of her pelvis, and it radiates down the left leg. The patient reports that she began menarche when she was 11 years old and has been taking oral contraceptives since she was 26 to 30 years old. Her menstrual periods are regular. She has been taking nonsteroidal anti-inflammatory agents for pain control. Additional symptoms include constipation and pain during bowel movements.

Patient 1 was diagnosed with extensive cul-de-sac endometriosis after palpation of a tender left uterosacral ligament nodule and a mid cul-de-sac anterior rectal-posterior vaginal nodule. Laparoscopy confirmed this diagnosis and was used to dissect the cul-de sac down to the loose areolar tissue of the rectovaginal septum. The deep fibrotic endometriosis was then removed from the left uterosacral ligament, the posterior vagina and cervix, and the anterior rectum. The patient was discharged home on the evening of the procedure and returned to full activity in less than one week with no pelvic pain. She conceived her first child 8 months after the operation and has remained pain free at her 3-year follow-up.

B. Clinical symptoms

- What are the most common symptoms of extensive endometriosis?
- Do all patients with rectal involvement have rectal bleeding?
- What is necessary for a diagnosis of extensive cul-de-sac endometriosis?

The most common symptom of extensive endometriosis is pelvic pain, and the most common sign is pelvic tenderness. This pain is usually more severe on one side and often radiates to the back and legs. The pain may be present throughout the menstrual cycle but is especially evident during the menses (severe dysmenorrhea). Dyspareunia is common. Pain during bowel movements (dyschezia) may also be present. Pelvic pain can be severe enough that conventional therapy for pain is not adequate.

Patients with deep full-thickness vaginal endometriosis may present with irregular vaginal bleeding. Deep rectal endometriosis is rarely accompanied by rectal bleeding.[6] Most rectal bleeding associated with endometriosis is from hemorrhoids caused by straining during bowel

movements, which may result from a fibrotic endometriotic–related rectosigmoid stricture.

In contrast to mild endometriosis, extensive endometriosis of the deep cul-de-sac may not require laparoscopy for diagnosis because it is usually strongly suspected on clinical examination (ie, pelvic pain and tenderness). Laparoscopy is then used to treat the endometriosis. However, histopathologic examination of the excised tissue is necessary to confirm the diagnosis of endometriosis: the absence of endometriotic glands with surrounding stroma usually means that endometriosis is not present. If suspicious lesions are ablated without pathologic examination of the specimen, then it will not be clear whether the lesions were caused by endometriosis, fibrosis (old scar tissue), or "old blood" (hemosiderin-laden macrophages).

III. RECTOVAGINAL EXAMINATION

- Should all patients have a rectovaginal examination?
- How is a rectovaginal examination performed?

The rectum and vagina are readily accessible, and their examination should be the mainstay of clinical diagnosis of endometriosis. If the patient agrees to a rectovaginal examination, nodularity or tenderness in the uterosacral ligaments may be revealed. Cul-de-sac nodularity is pathognomonic of endometriosis. This nodularity is caused by the presence of fibromuscular tissue surrounding the endometriotic glands and stroma inside the uterosacral ligaments near their insertion into the cervix and in the angle made by anterior rectum and posterior vagina or the angle made by the posterior vagina and cervix. Rectovaginal examination is diagnostic of endometriosis when deep cul-de-sac or rectovaginal septum nodularity is palpated and specific tenderness in these nodules is elicited. Unfortunately, most gynecologists routinely avoid rectal examination.

A rectovaginal examination should be done routinely in patients with pelvic pain or a history of endometriosis despite patient discomfort. The patient is talked through the rectovaginal examination to limit embarrassment from exposure with resulting spasm of the anterior abdominal wall, anal sphincter, and buttocks. Preparatory explanation does much to allay these fears, especially a warning that the patient may feel that she is losing control of her continence during the examination, although this is unlikely to happen.

The patient is asked to strain down as if defecating. The gynecologist then places a gloved, lubricated middle finger on the anus. Gentle pressure is applied until the sphincter yields and the finger eases into the anus. Upward tension is put on the cervix using the index finger in the vagina, and the middle finger in the rectum palpates the uterosacral ligaments including their insertion and the junction of vagina with cervix and rectum. If nodules are discovered, their tenderness and mobility from the surrounding tissues is assessed, as is the degree to which the rectum is tented to the lesion. The withdrawn finger is inspected for blood.

During the rectovaginal examination, an experienced clinician can often pinpoint the tender endometriotic nodules to be excised during surgery. If endometriosis is diagnosed clinically, the patient should not be subjected to diagnostic laparoscopy but should be referred to a surgeon with experience in excising cul-de-sac and rectal endometriosis.

In patients with extensive endometriosis, the extent of endometriosis is generally related to the severity of pain and the location of pain and tenderness is correlated with the location of endometriotic implants.[7] However, these factors are not related in patients with less severe forms of endometriosis.[8]

IV. HISTORY of SURGICAL TREATMENT

For patients who are infertile or want to remain fertile, reconstructive surgery can be considered using either laparotomy microsurgery or laparoscopy, depending on the skill and experience of the surgeon. For patients who are in pain and do not want to remain fertile, hysterectomy with bilateral salpingo-oophorectomy is commonly performed. However, a problem with that approach is that the hysterectomy is usually performed with an intrafascial technique, leaving fibrotic endometriosis on the vagina and rectum because it is assumed that the remaining endometriosis will resolve after castration. Therefore, future surgical procedures may be necessary for pain from vaginal cuff or rectal endometriosis.

In the 1970s, laparotomy for endometriosis consisted of uterine suspension, salpingoovariolysis with excision of endometriomas followed by ovarian repair, and presacral neurectomy. The deep cul-de-sac including anterior rectum and posterior vagina was largely neglected.[9] In the 1980s, similar laparotomy procedures were done, but most of those who did them progressed to laparotomy excision and then to laparoscopic excision of cul-de-sac lesions.[10] There appear to be few present day advocates for a predominately laparotomy approach to treating extensive endometriosis.

At laparotomy, retrocervical deep fibrotic endometriosis is managed commonly with bowel resection, assuming that the major portion of the lesion infiltrates the anterior rectum. In those cases the deep fibrotic lesion is mobilized, starting on the posterior uterus and progressing downward to the rectum where it appears to be attached.[6,12]

In New York City, laparotomy for extensive endometriosis is rarely done. At Columbia Presbyterian Medical Center (New York City) in the last 20 months, 424 patients with pelvic pain had a discharge diagnosis of endometriosis. Laparotomy was done in 108 of these patients: 76 had abdominal hysterectomies and 20 of these had supracervical hysterectomy with bilateral salpingo-oophorectomy. Supracervical hysterectomy was typically done for women with extensive cul-de-sac endometriosis that could not be adequately resected at laparotomy despite the presence of a colon and rectal surgeon for 8 of these patients. No laparotomies were done for to excise endometriosis of the deep cul-de-sac, anterior rectum, posterior vagina, and rectovaginal septum, and ureters; laparoscopy was done in these cases.

Until the end of the 1970s, minimal and mild endometriosis was destroyed laparoscopically by unipolar or bipolar coagulation. More severe endometriosis was treated using laparotomy, usually hysterectomy, which did not treat most rectovaginal endometriosis. In younger women, severe endometriosis was treated using adnexectomies (rarely cystectomies) and anterior resections of the rectum. The literature of this period focused on infertility and mild endometriosis and was biased by the fact that deep endometriosis – unless very severe and large – was not recognized and thus was untreated.

In the late 1970s and the early1980s microsurgery was promoted, emphasizing careful destruction of superficial endometriosis by bipolar coagulation or resection and removal of ovarian endometriosis followed by reconstruction of the ovary. However, deep endometriosis continued to be underdiagnosed.

From 1986 onwards, the concept of non-pigmented endometriosis was introduced; thus, women previously classified as "normal" were now classified as having minimal endometriosis. Unfortunately, this increased recognition of endometriosis was skewed by false-positive results because normal women with hemosiderin ladened macrophages from retrograde menstruation were classified as having minimal-to-mild endometriosis. Thus, groups of 'normal' women contained varying numbers of unrecognized and untreated women with minimal endometriosis and many women who were treated for endometriosis were, in fact, disease free. The bias of non-recognition of most deep endometriotic disease persisted.

The increasing use of endoscopic surgery for the treatment of ovarian endometriosis was paralleled by a diversification of techniques with possibly different results. The removal of the cyst wall by stripping followed by suturing or gluing of the ovary is technically similar to microsurgery. Vaporization of the cyst wall is poorly defined ranging from focal treatment to superficial vaporization to deeper vaporization.

In the 1990s, deep endometriosis has been increasingly recognized during laparoscopic surgery , or by clinical examination. Resection of deep endometriosis comprises techniques ranging from debulking to complete resection and resection-reanastomosis of the rectum, a difference that is rarely stated clearly in the medical literature. The recent trend to recognize and treat deep endometriosis is already producing a progressive shift of disease severity of the reported series of deep endometriosis, which will include increasing numbers of women with less severe deep endometriosis, which was previously diagnosed as mild to moderate disease.

Endometriosis can be more readily resected using laparoscopy than using laparotomy. At laparotomy, the ovary and vesicouterine peritoneal fold are readily accessible, but the surgeon is far from the deep posterior cul-de-sac. Laparotomy on the anterior rectum, posterior vagina, and ureters is much more difficult than using laparoscopy because the laparoscope is right on top of the lesion being excised.

Actually the laparoscopic approach is hard work because it involves a series of mini-operations including obtaining specimens from each uterosacral ligament insertion, posterior vagina, posterior cervix, anterior rectum, and tissue surrounding one or both the ureters.

V. SPECIAL EQUIPMENT

• What special equipment aids the surgeon in preparing a patient for laparoscopic resection of endometriosis?
• Is endoscopic suturing capability essential for a successful procedure?

A 3-chip camera system is mandatory for laparoscopic resection of endometriosis. Most 1-chip cameras cannot visualize the endometriotic deposits because the surrounding fibrosis causes too much glare on the video monitor when the laparoscope is placed close to the peritoneum.
A combination of scissors, CO2 laser, electrosurgery with various instruments (electrodes), and aqua dissection is used for dissection. Strong, usually reusable, straight, blunt-tipped scissors have the advantage of supplying both tactile sensation and a crunch-like feeling when cutting adjacent to or across fibrotic endometriosis or at its junction with softer normal tissue. A Valtchev uterine mobilizer (Conkin Surgical Instruments, Toronto, Ontario, Canada) is used to antevert the uterus and delineate the posterior vagina. For complete cul-de-sac obliteration dissection, a sponge on a ring forceps is inserted into the posterior vaginal fornix and a #81 French rectal probe is placed in the rectum to aid in the dissection of the rectum off of the posterior vagina.

Operating room tables capable of a 30-degree Trendelenburg position are necessary for laparoscopic cul-de-sac work. A steep Trendelenburg position (20 to 40 degrees) and shoulder braces with the patient's arms at her sides can be used without adverse effects (see section on patient positioning).[13]
Laparoscopic suturing is useful in procedures involving deep lesions of the vagina and rectum, but most operations do not require it. Extracorporeal tying is facilitated by using a trocar sleeve without a trap to avoid difficulty in slipping knots down to the tissue. The ideal trocar sleeve is short, does not protrude far into the peritoneal cavity, has a screw grid for retention, and has no trap. [14]

Surgical skill remains paramount. Ambidexterity separates the laparoscopic surgeon from those trained traditionally because the laparoscopic surgeon must often hold the camera with the dominant hand during laparoscopy. Use of thermal energy sources (laser and electrosurgery)

should be limited to decrease thermal necrosis, which may cause adhesion formation during healing. Additional training in bowel, bladder, and ureteral surgery is invaluable.

VI. PATIENT PREPARATION AND POSITIONING

A. Preoperative Preparation

- Should patients have bowel preparation?
- Is suppression of ovulation useful before surgery?
- Does long-term suppression of ovarian function decrease endometriosis?

The laparoscopic procedure is performed before ovulation if possible to avoid operating on or injuring an ovary containing a corpus luteum. Ovulation is suppressed using low-dose oral contraceptives, if necessary. Depot leuprolide acetate may be given 1 month before the procedure, dependent only on when the patient wants the surgery and not on where she is in her menstrual cycle.

Preoperative or postoperative ovarian suppression is not used for long-term therapy because this treatment does not decrease the endometriotic glands or stroma or the fibromuscular tissue surrounding them. [15] In our clinical experience, depot leuprolide or danazol therapy rarely result in long-term pain relief when ovarian endometriomas or deep fibrotic endometriosis exists, and this therapy may make surgical procedures more difficult.

Gonadotropin-releasing hormone (Gn-RH) agonist therapy may provide temporary pain relief in some patients with endometriosis [16], and this treatment can be extended in time if estrogen add- back therapy is also used [17]. Some authors have suggested that patients with pelvic pain should be treated with Gn-RH agonists empirically, before establishing a pathological diagnosis[18]. However, this author does not believe that empiric treatment is wise because it only decreases surgery in women who do not have endometriosis but it delays the definitive surgical approach in those who have endometriosis. One suspects that the empirical use of Gn-RH agonists for pelvic pain has been proposed and been successful because many gynecologists misdiagnose endometriosis at laparoscopy, after seeing the remains of retrograde menstruation (resembling coffee grounds or tobacco stains). Furthermore if fertility is an issue, current data from controlled studies suggest that surgical removal of endometriosis is the only treatment that increases fertility rates. [19]

The patient should receive medical treatment for coexistent problems. Patients are encouraged to hydrate and eat lightly on the day before surgery. To evacuate the lower bowel, Fleets Phospho-Soda prep kit #3 is administered the day before surgery as follows: first, Fleet Phospho-Soda mixed into a half glass of cool clear juice in the late afternoon, then 4 bisacodyl tablets in the early evening, and finally a Fleet bisacodyl enema (10 mg) 1 to 2 hours before bedtime. Intravenous antibiotics, usually cefoxitin 2 g or cefotetan 2 g, are administered just before surgery in all cases. Lower abdominal, pubic, and perineal hair is not shaved.

B. Positioning of the Patient

- What type of anesthesia is used at laparoscopy?
- Why is a steep Trendelenburg position used?

Before the induction of anesthesia, bilateral ulnar pads (Zimfoam laminectomy arm cradle set, Zimmer, Warsaw, IN) are applied and both of the patient's arms are tucked at the side, the right arm on a padded arm board. Straight shoulder braces are placed over the acromioclavicular joint. The legs are placed in lithotomy position with the hips extended (thigh parallel to abdomen) using Allen stirrups (Edgewater Medical Systems, Mayfield Heights, OH) that are adjusted to the individual patient by the nursing staff before the patient is

anesthetized. All laparoscopic procedures for extensive disease are done using general endotracheal anesthesia with orogastric tube suction to minimize bowel distension.

Anesthesia examination is done before the patient is prepped.
The patient is flat (0 degrees) until after the umbilical trocar sleeve is in place. The patient is then placed in a steep Trendelenburg position (20 to 30 degrees) to allow the small intestines to fall out of the pelvis. A Foley catheter is inserted during surgery when the bladder becomes distended. The Foley catheter is removed along with the intravenous line when the patient is awake and aware of it, usually in the recovery room, no more than 2 hours after the surgery has been completed.

VII. LAPAROSCOPIC SURGICAL PROCEDURES

What is the goal of laparoscopic treatment of extensive endometriosis?

The major indications for laparoscopic treatment of extensive endometriosis are pelvic pain, infertility, or both from deep fibrotic endometriosis causing partial or complete cul-de-sac obliteration.[20] The two major contraindications to the laparoscopic approach are contraindications for general anesthesia and lack of laparoscopic skills. Otherwise, laparoscopy is always preferred to laparotomy for treatment of extensive endometriosis. When using laparotomy, the surgeon is far from the deep posterior cul-de-sac. As previously discussed, laparotomy on the anterior rectum, posterior vagina and ureters is much more difficult than using laparoscopy because the laparoscope is right on top of the lesion being excised. Laparoscopy is converted to laparotomy only if a major complication (such as a vascular injury to a major vessel) occurs during the procedure. (I have not converted an extensive endometriosis laparoscopic operation to laparotomy in 16 years.)**]** The index of suspicion for cul-de-sac or bowel endometriosis should be high when the patient reports deep dyspareunia, pain radiating into the back or leg, pain with bowel movements, tenesmus, or rectal bleeding with menses. Less frequently encountered symptoms include the symptomatic or asymptomatic pelvic mass and hypermenorrhea. The diagnosis may be known from another surgeon's operative report, pathology report, pictures, or video, or the diagnosis may be confirmed, when suspected, at a primary laparoscopic procedure by a capable surgeon. Unfortunately, this diagnosis is often missed at the time of diagnostic laparoscopy if the surgeon looks for blue-brown lesions instead of white fibrotic ones. Symptomatic endometriotic glands are always associated with and surrounded by some degree of fibrosis caused by repetitive, long-standing inflammation.

The goal of laparoscopic treatment of extensive endometriosis is to excise all visible and palpable endometriosis and to restore normal anatomic relationships. Benefits to the patient include substantial symptom relief and resolution of infertility in many cases, circumvention of major abdominal surgery with its related morbidity, and avoidance of the hypoestrogenic effects of ovarian suppression therapy, which prohibits fertility during its administration and never eradicates deep infiltrating endometriosis. The laparoscopic approach can be lengthy, and the persistent nature of the disease may dictate more than one application. Therefore, determining factors in achieving the desired outcome are the surgeon's skill and tenacity and the patient's persistence.

A. Cul-de-sac Obliteration

- What is the definition of cul-de-sac obliteration?
- What is the difference between partial and complete cul-de-sac obliteration?
- How do you diagnose cul-de-sac obliteration intraoperatively?

In the woman who has not had a hysterectomy, the anterior peritoneal reflection on the rectum (rectouterine pouch or pouch of Douglas) folds at an average distance of 4 cm from the anal

verge. The rectovaginal fascial septum separates the rectum from the vagina. In 1921, Sampson defined cul-de-sac obliteration as "extensive adhesions in the cul-de-sac obliterating its lower portion and uniting the cervix or the lower portion of the uterus to the rectum; with adenoma of the endometrial type invading the cervical and the uterine tissues and probably also (but to a lesser degree) the anterior wall of the rectum."[21] Cul-de-sac obliteration secondary to endometriosis implies the presence of retrocervical deep fibrotic endometriosis beneath the peritoneum. This endometriosis is located on or in the anterior rectum, posterior vagina, posterior cervix (the cervical vaginal angle between the upper vagina and the cervix), rectovaginal septum, or uterosacral ligaments; often one area predominates.

Partial cul-de-sac obliteration means that deep fibrotic endometriosis is severe enough to alter the course of the rectum, fusing it to a portion of posterior vagina. With complete cul-de-sac obliteration, fibrotic endometriosis and/or adhesions involve the entire cul-de-sac between the cervicovaginal junction (and sometimes above) and the rectum. Partial & complete cul-de-sac obliteration represent the same disease. The revised American Fertility Society classification, which doesn't recognize extensive disease, rates partial cul-de-sac obliteration as 4 points and complete cul-de-sac obliteration as 40 points, yielding partial obliteration as Stage 1 endometriosis & complete cul-de-sac obliteration as Stage 4 endometriosis.

At laparoscopy, careful inspection of the cul-de-sac is necessary to evaluate the extent of upward tenting of the rectum. To determine if cul-de-sac obliteration is partial or complete, a sponge test is performed (a sponge on a ring forceps is inserted into the posterior vaginal fornix and a rectal probe is inserted into the rectum). The normal cul-de-sac will show a portion of vaginal wall between the cervix and rectum as a distinct and separate bulge. The uterosacral ligaments are of normal caliber and are lateral. A diagnosis of partial cul-de-sac obliteration is made when rectal tenting is visible but a protrusion from the sponge in the posterior vaginal fornix is noted between the rectum and the inverted "U" of the uterosacral ligaments. Complete cul-de-sac obliteration is diagnosed when the outline of the sponge in the posterior fornix cannot be visualized initially through the laparoscope (ie, the fibrotic endometriotic nodules or rectum completely obscure the identification of the deep cul-de-sac).

1. Surgical Technique

   • Which structures need to be assessed for the presence of lesions during resection of deep fibrotic endometriosis of the cul-de-sac?
   • What surgical approach is used to excise these lesions?
   • Is the ureter likely to be damaged during the procedure?

   Deep fibrotic nodular endometriosis involving the cul-de-sac requires the excision of white fibronodular tissue from the uterosacral ligaments, posterior cervix, posterior vagina, and anterior rectum. Less commonly, the sigmoid colon, its mesocolon, and the lateral rectum are involved.[20]

   First, the anterior rectum is dissected from the posterior vagina throughout its area of attachment until loose areolar tissue in the rectovaginal space is reached (Figure 3A). This technique leaves the bulk of the lesion to be excised on the posterior vagina, including some lesion that was more closely associated with the rectum. With the rectal probe as a guide, the rectal serosa is opened at its junction with the cul-de-sac lesion using scissors or the CO_2 laser. Careful sharp and blunt dissection is done until the rectum, (normal or with contained fibrotic endometriosis) is separated from the posterior uterus, cervix, and upper vagina. After anterior rectal mobilization is complete, the fibrotic endometriosis is excised from the posterior vagina (the location of which is continually confirmed by a sponge in the posterior fornix), from the posterior cervix including its

uterosacral ligament insertions, and from the rectum. This excision is often accomplished en bloc as one large specimen, including the insertions of both uterosacral specimens laterally, the anterior rectal component inferiorly, and the posterior cervix–vagina superiorly. The blunt scissors are the main instrument used for this excisional dissection; the fibrotic lesion is kept on traction using a toothed biopsy forceps.

The ureter lies lateral to most cul-de-sac lesions. When the uterosacral ligament is pulled medially, risk of ureteral damage is minimal. When a ureter is close to the lesion, its course is traced starting at the pelvic brim, and the peritoneum overlying the ureter is opened to confirm ureteral position deep in the pelvis when necessary. Uterosacral fibrotic endometriosis may envelop the ureter, necessitating deep ureteral dissection and excision of the surrounding endometriosis. Microbipolar forceps with irrigation between the tips are used to control arterial and venous bleeding around the ureter.

Uterosacral ligaments infiltrated with endometriosis are removed early in the operation, sometimes before rectal mobilization. These lesions frequently make up a large portion of a rectal nodule. The uterosacral ligament is divided lateral to the rectum (where normal-caliber ligament meets distended fibrotic ligament) and is put on traction. The peritoneum is incised on both sides of the ligament, and the thickened portion of the ligament is excised to and including its insertion into the cervix. Soft loose areolar tissue, adipose tissue, uterine vessels, and the ureter are found beneath the ligament. Fibrotic tissue left at the periphery of the excision is coagulated with an irrigating microelectrode, especially at the junction of the cervix with the uterine fundus. Rarely, the ligament is involved all the way to the sacrum. In these cases, it may be best to divide the middle of the ligament and, with traction on the sacral side of the ligament, to pull it away from the rectum, ureter, and hypogastric vessels.

The dissection of the fibrotic endometriosis from the thickened vaginal wall proceeds using traction with a biopsy forceps to pull the lesion from one side to the other. Laser, aquadissection, electrosurgery, or scissors are used as needed. Often, with traction and the help of vaginal distension from below using a vaginal sponge pushed forward by a ring forceps, a distinct dissection plane becomes evident above or beneath the rectovaginal fascia, and the lesion can be pulled free from the vaginal wall. Sometimes, an endopelvic rectovaginal fascial layer infiltrated with endometriosis is identified, and after this layer is excised, soft, pliable upper posterior vaginal wall is uncovered. Hypertrophied tissue without endometriosis is often found at the cervicovaginal junction between the insertion of the uterosacral ligaments into the cervix, making it difficult to accurately distinguish between fibrotic endometriosis and fibromuscular tissue. This inverted "U" configuration should be excised or at least biopsied.

Frequent palpation using rectovaginal examination helps identify occult lesions. On occasion, the lesion infiltrates deep into or completely penetrates the vaginal wall. Dissection is then performed accordingly with removal of all visible palpable fibrotic endometriosis. Electrosurgery using cutting current through a blunt-tipped or spoon electrode minimizes bleeding from the vascular vagina. Lesions extending full thickness through the vagina are treated with an en bloc laparoscopic resection of fibrotic vaginal wall endometriosis from the cul-de-sac into the vagina. Pneumoperitoneum is maintained with a sponge or by holding the labia together. The posterior vaginal wall defect is closed laparoscopically using interrupted polyglactin 910 suture on a CT-1 needle (Vicryl, Ethicon, Somerville, NJ)

B. Bowel Surgery

- How is rectal endometriosis classified?
- Is the mucosal surface of the rectum frequently involved?
- How are rectal defects repaired laparoscopically?

Endometriosis of the rectum and/or rectosigmoid may be superficial (serosal or adventitial), in the muscle (muscularis), or full thickness involving both the muscularis and the lamina propria of the mucosa; the mucosal surface is rarely broken. The lesions are anterior or lateral. Posterior wall endometriosis is a rarity but can form a "napkin ring" deformity. Fibrotic endometriotic nodules infiltrating the anterior rectal wall are the most common lesions and may be focal (cicatricial) or linear (a transverse bar often with associated stricture where the rectum is fused to the posterior vagina). Under the microscope, all of these lesions and those of the uterosacral ligaments, posterior vagina, and cervix are made up of fibromuscular tissue surrounding endometriotic glands and characteristic stroma.

Women with suspected or documented extensive endometriosis are counseled preoperatively regarding risk of bowel injury, methods of possible treatment, and the effect of bowel perforation and resection on their hospital stay and postoperative recuperation. Unplanned rectal perforation may occur with any kind of intervention near the bowel, but the risk of perforation is increased during excision of rectal endometriosis owing to the fibrotic nature of the disease and to related anatomic distortion. Traditionally, laparoscopic rectal injury has been treated with laparotomy closure, sometimes with colostomy. Although necessary in rare cases, this approach is more stressful for the patient (both physically and emotionally stressful) because she must then have the incisional surgery she had elected to avoid. Laparoscopic repair of the bowel with suture or staples is used for most bowel injuries, both anticipated and unintended. In rare cases where the bowel is unprepared and inadvertently opened, quick staple or suture closure followed by profuse irrigation until the effluent clears is usually satisfactory to prevent late infection.

The knowledge that the bowel can be successfully repaired laparoscopically should increase the confidence of the surgeon operating in the deep pelvis. Suturing experience is suggested for laparoscopists who perform extensive surgery for endometriosis.

1. Surgical Technique

Once separated from the vagina, the rectum and rectosigmoid are examined carefully with a long blunt probe inside. Lesions are assessed to determine if they are superficial, deep, or nodular. Superficial lesions involving the serosa or adventitia are excised by making an elliptical incision around the white fibrotic lesion with scissors or a CO2 laser at low power, elevating the lesion with a microtoothed forceps, and undermining it at its junction with soft, normal-appearing circular muscularis.

Endometriotic nodules infiltrating the anterior rectal wall are partially or totally excised usually with a probe or the surgeon's finger in the rectum beneath the lesion. The lesion is excised with scissors or the CO2 laser at the junction of nodular white fibrosis with yellow and pink soft normal tissue. Deep rectal muscularis defects are closed with suture. The 3-0 suture is applied using curved needles, and the knot is tied outside the peritoneal cavity and pushed downward with the Clarke knot pusher.[22] Enterotomies and full muscularis excisions are closed with suture or the circular stapler.

Laparoscopy can be used to excise nodules in the muscularis of the anterior or lateral rectum.[23] However, full-thickness penetration of the rectum may occur during this surgery. After identification of the rent in the rectum (which is usually surrounded by

fibrotic endometriosis) a #29 or #33 French closed circular stapler (Proximate ILS Curved Intraluminal Stapler, Ethicon) is inserted into the lumen just past the hole, opened 1 to 2 cm, and held high to avoid the posterior rectal wall. The anvil at the stapler tip is positioned cephalad just beyond the hole, which is invaginated into the opening, and the device is closed. The instrument is fired, then removed through the anus.[23] Alternately, a double-layer transverse repair is done using 3-0 silk or Vicryl. Anastomotic inspection is done to rule out leaks and additional holes by using the laparoscope underwater to search for blue dye in the peritoneal cavity after filling the pelvis with Ringer's lactate solution and the rectum with indigo carmine solution.

Full-thickness or muscularis endometriotic nodules of the anterior or lateral rectum can also be resected without opening the rectum by using laparoscopy, especially if the nodules are limited to a small circumscribed area. After delineation of the nodule, the closed circular stapler (Proximate) is used as previously described, and the lesion is invaginated into its opening. This procedure results in an anterior discoid resection of a wedge of anterior rectum containing the nodule and an anterior staple line.

Strictures are often made up of appendices epiploicae fused to fibrotic endometriotic implants on the sigmoid colon. Careful methodical dissection using a laser to separate these fatty appendages and microbipolar forceps for hemostasis may alleviate the stricture.

Laparoscopic low anterior resection is indicated for endometriosis encircling the rectum in the deep pelvis (which is often associated with some degree of sigmoid obstruction) or for extensive diffuse rectosigmoid endometriosis invading the <u>rectal</u> wall and causing severe symptoms refractory to other therapy.[24] The proximal and distal extents of the resection are determined. The sigmoid mesocolon is mobilized. The left ureter is identified. The mesorectum is dissected to the level of the levator ani complex if necessary. The colon is transected with scissors, electrosurgery, laser, or stapler, depending on the surgeon's preference. The decision to perform an intracorporeal or extracorporeal rectosigmoid anastomosis depends on the surgeon's preference, training, and laparoscopic skill. For the intracorporeal anastomosis, the proximal colon is divided and, after division of the distal margin, the specimen is removed through the anus with a sponge forceps. A circular stapler is introduced through the rectal stump to complete the anastomosis.[25] Two complete rings of tissue, one from the proximal and one from the distal colon, should be contained in the circular stapler. Once the rings are verified, the soundness of the anastomosis is confirmed by rectal enema containing dilute indigo carmine solution.

C. Hysterectomy

Extensive endometriosis inside the uterus (adenomyosis) may cause symptoms after endometriotic excision. Adenomyosis is defined as the presence of endometrial glands and stroma interlocked within the myometrium, located at least 2.5 mm from the endometrial basalis layer and surrounded by hypertrophied smooth muscle. Magnetic resonance imaging may demonstrate adenomyosis because the low signal intensity junctional zone is increased in thickness. Adenomyomas (nodular bundles of adenomyosis) may present as a low signal intensity mass with indistinct margins.

Although excision of endometriosis with uterine preservation is almost always possible, hysterectomy should be considered for women with severe pelvic pain affecting their quality of life who do not desire fertility preservation. They require extensive counseling regarding alternatives and may select hysterectomy as their primary procedure if they have persistent or recurrent symptoms after other surgeries, especially when uterine adenomyosis is suspected. Concomitant oophorectomy is elective.

For patients with extensive endometriosis who have cul-de-sac obliteration, the goal at laparoscopic hysterectomy is the same as that for any surgery for endometriosis (ie, to excise all visible and palpable endometriotic implants).[24] The surgeon must free first the ovaries, then the ureters, and finally the rectum from the posterior vagina to the rectovaginal septum. As previously described, deep fibrotic nodular endometriosis involving the cul-de-sac requires excision of the fibrotic tissue from the uterosacral ligaments, posterior cervix, posterior vagina, and rectum. Hysterectomy with excision of all visible endometriosis usually results in relief of the pain.

Oophorectomy is not usually necessary at hysterectomy for advanced endometriosis if the endometriosis is carefully removed. The most severely affected ovary may be removed—especially if it is on the left—because this ovary frequently becomes adherent to the bowel. Another operation for recurrent symptoms is necessary in fewer than 5% of this author's patients in whom one or both ovaries have been preserved. Bilateral oophorectomy is rarely indicated in women younger than 40 years who undergo hysterectomy for endometriosis.

Hysterectomy should not be done to treat extensive endometriosis with extensive cul-de-sac involvement unless the surgeon has the skill and time to resect the deep fibrotic endometriosis from the posterior vagina, uterosacral ligaments, and anterior rectum. In these patients, excision of the uterus using an intrafascial technique leaves the deep fibrotic endometriosis behind to cause future problems. Furthermore, removing deep fibrotic endometriosis may be more difficult when there is no uterus between the anterior rectum and the bladder. After hysterectomy, the endometriosis remaining in the anterior rectum and vaginal cuff frequently becomes densely adherent to, or invades into, the bladder and one or both ureters.

1. Deep Fibrotic Endometriosis of the Vaginal Cuff After Hysterectomy

Excision of these lesions is often more difficult after hysterectomy than when a uterus is present. In this author's experience, fibrotic vaginal cuff lesions invariably involve one or both ureters and the base of the bladder. Careful dissection is necessary to free both the bladder anteriorly and the rectum posteriorly from the vaginal apex. Thereafter, the course of each ureter should be traced but not skeletonized. After this anatomy is identified, full-thickness excision of the vaginal cuff and rectal nodular lesions usually results in relief of the patient's pain and bleeding.

VIII. UNDERWATER EXAMINATION

- Why is a special check for hemostasis done at the end of each laparoscopic procedure?
- How is underwater hemostasis achieved?

At the close of each laparoscopic operation, complete hemostasis is documented by using an underwater examination to detect bleeding from vessels and viscera tamponaded during the procedure by the increased intraperitoneal pressure of the CO_2 pneumoperitoneum. The CO_2 pneumoperitoneum is displaced with 2 to 5 L of Ringer's lactate solution, and the peritoneal cavity is vigorously irrigated and suctioned with this solution until the effluent is clear of blood products, usually after 10 to 20 L. Underwater inspection of the pelvis is performed to detect any further bleeding, which is controlled using microbipolar forceps with irrigant pushed through its cleaning channel to coagulate through the electrolyte solution. A final copious lavage with Ringer's lactate solution is undertaken, and all clots are directly aspirated. At least 2 L of Ringer's lactate solution is left in the abdomen to separate raw surfaces during early healing, eliminate the pneumoperitoneum, and dilute the bacterial count in the peritoneal cavity, especially after bowel resection or hysterectomy. This procedure may decrease postoperative infection, further

decreasing postoperative hospitalization and recovery time. No other antiadhesive agents are used.

IX. POSTOPERATIVE CONSIDERATIONS

- Can extensive surgery for endometriosis be done on an outpatient basis?
- When can a regular diet be given to a patient who has had a rectal resection?

Most patients return home the same day or are hospitalized overnight after surgery for extensive endometriosis. Patients usually experience some fatigue and discomfort for approximately 1 to 2 weeks after the operation, but they may perform gentle exercise such as walking and may return to routine activities within 1 week. Sexual activity may usually be resumed after 2 weeks. Examinations within 1 week are indicated for pain, pressure, or pyrexia. Routine checks at 1 to 6 weeks are usually not indicated because a pelvic examination could impede healing. The patient is examined 8 to 12 weeks postoperatively, by doing a rectovaginal examination to check for cul-de-sac nodularity, tenderness, or both.

After bowel surgery, bowel function returns after an average of 24 to 30 hours; less inflammation and edema occur after staple than suture bowel closure. After passage of flatus or a bowel movement, the patient is started on a diet as tolerated. Usually the patient starts liquids in the morning of the first postoperative day and advances to solids in the afternoon if the morning diet was well tolerated.

X. SUMMARY POINTS

- The diagnosis of extensive endometriosis involving the cul-de-sac and the rectum is often clinical, but it requires histopathologic confirmation.

- The rectovaginal examination can be very suggestive of the presence of endometriosis in the uterosacral ligaments, the posterior vagina or on the rectum.

- Adequate surgical instruments, patient preparation, and patient positioning are key elements for a successful procedure.

- It is not critical to differentiate between partial and complete cul-de-sac obliteration.

- The objective of laparoscopic surgery for endometriosis should be removal of the disease.

- Repair of rectal defects can be successfully achieved using laparoscopic surgery.

REFERENCES

Authors: Harry Reich, MD
Other References:

1. Peterson HB, Hulka JF, Phillips JM: American Association of Gynecolgic Laparoscopists' 1988 membership survey on operative hysteroscopy. J Reprod Med 1990;35:590-591.

2. Redwine DB (1987) The distribution Rof endometriosis in the pelvis by age groups and fertility. Fertil Steril 47:173-175.

3. Vercellini P, Aimi G, De Giorgi O, Maddalena S, Carinelli S, Crosignani PG (1998) Is cystic ovarian endometriosis an asymmetric disease? Br J Obstet Gynaecol 105:1018-21.

4. Revised American Fertility Society classification system of endometriosis: 1985. Fertil Steril 1985;43:351-352.

5. TeLinde RW, Scott RB: Diagnosis and treatment of endometriosis. General Practice 1952;5:61–65.

6. Gray LA (1973) Endometriosis of the bowel: Role of bowel resection, superficial excision, and oophorectomy in treatment. Ann Surg 177:580-586

7. Koninckx PR, Meuleman C, Demeyere S et al (1991) Suggestive evidence that pelvic endometriosis is a progressive disease, whereas deeply infiltrating endometriosis is associated with pelvic pain. Fertil Steril 55:759-765

8. Fedele L, Parazzini F, Bianchi S, et al: Stage and localization of pelvic endometriosis and pain. Fertil Steril 1990;53:155-158.

9. Kistner RW. Gynecology; Principles and Practice. 2nd edition. Pp 432-457. 1973

10. Batt, R. In The Atlas of Female Infertility Surgery (second edition). Editor: R. Hunt. Publisher: Year Book Medical Publishers, Inc., 1992.

11. Crosignani PG, Vercellini P: Conservative surgery for severe endometriosis: should laparotomy be abandoned definitively? Human Reprod 1995; 10:2412-8

12. Coronado C, Franklin R, Lotze E, et al: Surgical treatment of symptomatic colorectal endometriosis. Fertil Steril 63:411, 1990

13. Romanowski L, Reich H, Adelson MD, McGlynn F, Taylor PT. Brachial plexus neuropathies after advanced laparoscopic surgery. Fertility and Sterility 60:4; 729-32, October 1993.

14. Reich H, McGlynn F: Short self-retaining trocar sleeves for laparoscopic surgery. Am J Obstet Gynecol 1990;162:453-454.

15. Metzger DA, Olive DL, Haney AF: Limited hormonal responsiveness of ectopic endometrium: histologic correlation with intrauterine endometrium. Hum Path 1988;19:1417-1424.

16. Ling FW: Randomized controlled trial of depot leuprolide in patients with chronic pelvic pain and clinically suspected endometriosis. Pelvic Pain Study Group. Obstet Gynecol 1999;93:51-58.

17. Hornstein MD, Surrey ES, Weisberg GW, Casino LA: Leuprolide acetate depot and hormonal add-back in endometriosis: a 12-month study. Lupron Add-Back Study Group. Obstet Gynecol 1998;91:16-24.

18. Barbieri RL: Primary gonadotropin-releasing hormone agonist therapy for suspected endometriosis: a nonsurgical approach to the diagnosis and treatment of chronic pelvic pain. Am J Manag Care 1997;3:285-290.

19. Barlow D: Today's treatments: how do you choose? Int J Gynaecol Obstet 1999;64(suppl 1):S15-S21.

20. Reich H, McGlynn F, Salvat J: Laparoscopic treatment of cul-de-sac obliteration secondary to retrocervical deep fibrotic endometriosis. J Reprod Med 1991;36:516-522.

21. Sampson JA: Perforating hemorrhagic (chocolate) cysts of ovary. Arch Surg 1921;3:245-323.

22. Reich H, Wood C, Whittaker M: Laparoscopic anterior resection of the rectum and hysterectomy in a patient with extensive pelvic endometriosis. Gynecological Endoscopy 1998;7:79-83.

23. Reich H, McGlynn F, Budin R: Laparoscopic repair of full-thickness bowel injury. J Laparoendosc Surg 1991;1:119-122.
24. Reich H, McGlynn F, Sekel L: Total Laparoscopic hysterectomy. Gynecological Endoscopy 1993;2:59-63.
25. Ravitch MM, Ong TH, Gazzola L: A new, precise, and rapid technique of intestinal resection and anastomosis with staples. Surg Gynecol Obstet 1974;139:6-10.
26. Paul Manganiello, M.D., Associate Professor of Obstetrics and Gynecology, Dartmouth Medical School.
27. Nancy Snyderman, M.D., F.A.C.S, www.drkoop.com.
28. Well-Connected. http://my.webmd.com/content/dmk/dmk_article_40032. Nidus Information Services, Inc., 41 East 11th Street, 11th Floor, New York, NY 10003 or call 800-334-WELL (9355) or 212-260-4268 or fax 212-529-2349 or email postmaster@well-connected.com or on the Internet at www.well-connected.com.