

## The role of laparoscopy in the diagnosis and treatment of conditions associated with chronic pelvic pain

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Although chronic pelvic pain has been described in a variety of ways, it is most commonly defined as nonmenstrual pelvic pain, of 6 months or more duration, that is severe enough to cause functional disability or require medical or surgical treatment [1,2]. The prevalence of chronic pelvic pain varies, and affects an estimated 12% to 39% of reproductive-age women (Rachel Williams, PhD, personal communication and submitted for publication, 2004) [3]. This condition accounts for 10% of all outpatient gynecology visits and is listed as the preoperative indication for 10% of the 590,000 hysterectomies performed annually in the United States. Health care costs related to chronic pelvic pain, including physician consults, mental health visits, and out-of-pocket patient expenses, are estimated at over \$2.8 billion per year [4–6]. This figure does not include expenses related to surgical or other procedural interventions performed for the evaluation and treatment of pain. Despite the expense and magnitude of this problem, chronic pelvic pain remains a poorly understood and difficult-to-treat condition that often results in surgical intervention.

The etiology of chronic pelvic pain may be characterized as visceral or somatic [2,7]. Visceral disorders can arise in genitourinary or gastrointestinal organs (eg, endometriosis, adhesions, ovarian masses, pelvic inflammatory disease, malignancies, constipation, or irritable bowel syndrome). Somatic pain often originates from pelvic bones, ligaments, muscles, and fascia [2,7]. Lapa-

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roscopy has proved most useful as a diagnostic tool in the evaluation of pelvic pain originating from visceral pathology. It is one of the most common surgical diagnostic tools used and there has been a progressive increase in the number of diagnostic laparoscopies over the years. In 1987, 17% of laparoscopies were performed for chronic pelvic pain; this figure is currently in upward of 40% [7]. Laparoscopy boasts many advantages including the ability to diagnose visceral pathology and provide surgical treatment with minimally invasive techniques if necessary while avoiding the morbidity of a laparotomy [1]. Despite these advantages, and its usefulness in confirming certain diagnosis associated with chronic pelvic pain, significant controversy remains regarding the selection of patients for laparoscopy.

### **Laparoscopy and endometriosis**

Endometriosis is a chronic gynecologic condition defined by the presence of functioning endometrial glands outside of the uterus [8]. It is a histologic diagnosis made at the time of surgery. It is estimated to affect 10% of reproductive-aged women [9] and is found in 15% to 80% of women undergoing surgery for chronic pelvic pain [1,10]. Although some women with mild disease are asymptomatic, many women experience chronic pelvic pain or infertility [11,12]. The most commonly associated pain symptoms include non-menstrual pain, dysmenorrhea, and dyspareunia. If endometriosis is left untreated, symptoms may progress and lead to worsening pain that is less responsive to treatment [13].

Laparoscopy is generally considered the most appropriate means to confirm the diagnosis of endometriosis. Once endometriosis is suspected and laparoscopy is planned, preoperative evaluation should be targeted at detecting occult lesions or better planning the surgical approach. For example, ultrasound can be useful for the evaluation of an adnexal mass found on pelvic examination or for the detection of an occult endometrioma [14]. Suspicion of an endometriotic cyst should prompt a thorough evaluation of both adnexa. Approximately one third of endometriotic cysts are bilateral, some of which are too small to detect by physical examination alone [15]. Preoperative imaging may also be useful in women with complaints of dyschezia, rectal bleeding, or those with thickening or nodularity of the rectovaginal septum. These symptoms may be indicative of a rectosigmoid lesion, which may require bowel resection and reanastomosis. Traditionally, MRI, CT, or barium enema is the test of choice for detecting such lesions. Endorectal ultrasound may offer advantages over these techniques, however, because it is associated with less radiation exposure and has been reported to have greater sensitivity and specificity to detect rectal endometriosis when compared with MRI or CT [16].

At the time of laparoscopy, endometriosis can be found in a variety of locations with many different appearances. Endometriosis most frequently occurs on the ovaries and pelvic peritoneum, including the cul-de-sac, uterosacral

ligaments, ovarian fossa, and vesicouterine fold. Although less common, lesions on the fallopian tubes, appendix, sigmoid colon, and rectovaginal septum are also possible. Typical lesions are described as black, powder-burn, or puckered black stellate lesions [17]. Atypical lesions, however, such as clear vesicles, peritoneal pockets, red flame lesions, and yellow-brown patches, can be present but are often missed or overlooked [18–20]. Between 15% and 30% of women with endometriosis have only atypical lesions [21,22]. It is important to identify these lesions because they can also contribute to pelvic pain [23].

Many other conditions can have a similar appearance to both typical and atypical endometriosis, making visual diagnosis even more problematic. For example, endosalpingiosis, hemangiomas, carcinomas, residual carbon from prior surgeries, inflammatory changes and fibrosis, schistosomiasis, and splenosis have been mistaken for endometriosis [17,21,24,25]. In a well-conceived prospective study of 44 women undergoing laparoscopy for the evaluation of chronic pelvic pain, Walter et al [26] found that visual diagnosis of endometriosis, when compared with histologic confirmation, had a positive predictive value of 45%, negative predictive value of 99%, sensitivity of 97%, and specificity of 77%. These values, however, varied by anatomic site and type of lesion. The low positive predictive value of visual diagnosis of endometriosis indicates that diagnosis should be established only after histologic confirmation.

To evaluate adequately all potential anatomic sites for both typical and atypical endometriosis lesions, a minimum of two trocar sites with a “near-contact” laparoscopy technique is recommended [7]. Near-contact laparoscopy allows an eightfold magnification of visual fields, which may increase the ability to identify nonpigmented lesions. Others have also suggested that visualizing the pelvic cavity under a pool of irrigation fluid can also increase identification of nonpigmented lesions [27]. Intraoperative transvaginal sonography, after filling the pelvis with irrigation fluid, can improve characterization of adnexal structures and may help identify occult endometriomas [28].

Laparoscopy offers a key advantage over the medical treatment of endometriosis because it allows definitive histologic diagnosis and surgical treatment in one procedure. There has been only one randomized, double-blind, placebo-controlled clinical trial of conservative surgical treatment of endometriosis [29]. In this study of 63 women with pelvic pain and stage I-III endometriosis, women were randomized to laser ablation of endometriosis lesions and laparoscopic uterine nerve ablation or to diagnostic laparoscopy only. Nearly 63% of the intervention group, compared with only 23% of the control group, reported improvement or resolution of their symptoms at 6 months after surgery. This study, however, has important limitations that reduce its external validity. Namely, histologic confirmation of endometriosis was not performed; adhesiolysis and uterine nerve ablation were part of the surgical intervention (making the independent effect of laser ablation on pelvic pain outcomes indiscernible); and only 10% of women had stage III endometriosis. Despite these limitations, this trial supports the role of conservative surgical treatment as an effective treatment for endometriosis-related pelvic pain.

Although laparoscopic destruction is generally considered an effective treatment modality for endometriosis-related pelvic pain, there remains much discussion on whether surgical laser ablation, electrocoagulation, or peritoneal excision are equally effective. There are no studies that compare the specific laparoscopic technique on pain outcomes. There are, however, important theoretic advantages in using peritoneal excision rather than ablation or coagulation. First, peritoneal excision is the only method that allows for histologic confirmation of endometriosis. Second, deeply infiltrating lesions are common and are correlated more strongly with pain symptoms [30,31]. Because such lesions can extend up to 20 mm into the subperitoneum, peritoneal excision is more likely completely to remove the disease than laser ablation or electrocoagulation techniques [32].

Careful laparoscopic evaluation of the pelvis is essential to diagnose endometriosis accurately, but endometriosis is not always associated with the cause of chronic pelvic pain. Up to 30% of women with endometriosis are actually pain free. In the 70% of women with pelvic pain, extent of disease does not frequently correlate with the extent of disease [1,33].

### **Laparoscopy and pelvic adhesions**

Pelvic adhesions can be caused by surgery or by a variety of diseases including endometriosis, pelvic inflammatory disease, and appendicitis. In general, any pelvic inflammatory process can cause adhesion formation, which in turn can lead to infertility, bowel obstruction, and even chronic pain [7,34,35]. The incidence of pelvic adhesions in the general population is not known; however, earlier publications report that 27% to 60% of patients undergoing laparoscopy for pelvic pain are found to have adhesions at the time of laparoscopy [34].

The role of adhesions in the development of chronic pelvic pain remains controversial. Most women with pelvic adhesions are asymptomatic. In cases where pain and adhesions are present, the extent or location of adhesive disease does not always correlate with intensity of pain [7,35,36]. Furthermore, there are no physical examination findings that can reliably predict the presence or absence of adhesions. Previous pelvic or abdominal surgery seems to be the only historical predictor associated with adhesive disease [7,34].

In patients where adhesions are a suspected cause of chronic pain, surgical exploration is the only way to confirm their presence. Laparoscopy has become the least invasive way of diagnosing the presence of adhesions.

The authors favor laparoscopy for lysis of adhesions primarily because of the faster recovery and the diminished overall tissue trauma, which may lessen the risk of reformation of adhesions or de novo central sensitization [37]. The goal is to restore normal pelvic anatomy. Every attempt should be made to identify avascular planes and bluntly develop small vascular pedicles that can be cauterized and divided quickly; minimizing coagulum and bleeding raw areas diminishes the likelihood of recurrent adhesion formation.

A recent review of several observational studies found improvement in symptoms following adhesiolysis between 38% and 84%, but these findings are limited by wide variability in follow-up time and inconsistent use of standardized pain assessment tools [38]. The benefit of adhesiolysis has been cast into serious doubt by a recent well-designed randomized controlled trial of laparoscopic adhesiolysis versus diagnostic laparoscopy in a cohort of men and women. This trial of 100 participants with chronic abdominal pain showed no difference in outcomes between the two groups on verbal rating pain change scale, visual analogue scale, and quality of life instruments. At 1-year follow-up, 27% reported having relief or much improved pain in both groups [39]. The authors counsel patients that there is a known but unquantifiable risk for recurrent adhesions and that adhesiolysis is probably best performed during diagnostic laparoscopy for when there is obvious organ involvement.

## **Laparoscopy for evaluation of ovarian pathology**

### *Ovarian cysts*

Most ovarian cysts are benign and are rarely associated with chronic pelvic pain. Although ovarian cysts, such as hemorrhagic cysts and follicular cysts, are often asymptomatic, when they cause pain the pain is usually acute and resolves spontaneously within one or two cycles. Sometimes acute pain is so intense that it requires immediate surgical intervention as in the case of ovarian torsion or intraperitoneal hemorrhage.

In rare cases cysts may cause recurrent or chronic pelvic pain [1,40], but data are lacking on laparoscopic treatment of ovarian cysts for relief of chronic pelvic pain [1]. The exception is ovarian endometriomas: complete laparoscopic resection (cystectomy) leads to a significant decrease in recurrence and pain compared with drainage or cauterization of the cyst lining [41].

### *Ovarian remnant and residual ovary syndrome*

Ovarian remnant syndrome is often defined as pelvic pain or dyspareunia associated with regrowth of residual ovarian tissue after salpingo-oophorectomy. The distinction has been made between ovarian remnant syndrome and residual ovary syndrome, which is described as the presence of persistent pelvic pain or dyspareunia or a pelvic mass after conservation of one or both ovaries at hysterectomy [42]. In small clinical series both residual ovaries and ovarian remnants have been associated with chronic pelvic pain [42–44]. The current recommended treatment for retained ovaries is surgical removal. Laparoscopy is the preferred surgical method; however, these surgeries are often difficult, because of dense adhesions, and require extensive laparoscopic experience. Current published reports demonstrate marginal pain relief after surgery with

one study showing that only 48% of women experienced prolonged relief after laparoscopic treatment of ovarian retention syndrome [42]. At the time of this review the authors found no prospective randomized trials on laparoscopic removal of retained ovarian tissue and resolution of pelvic pain.

### **Laparoscopy and hernias**

Hernias are a rare cause of chronic pelvic pain. Hernias occur in approximately 0.25% of women and 70% of these are indirect inguinal hernias. Direct inguinal hernias account for only 1% to 2% of groin hernias in women [45]. Only 1.6% to 6% of women with abdominal hernias have symptoms of chronic pelvic pain [45–47]. Most hernias present with progressively worsening pain during the upright position or they may become incarcerated and present with acute pain. More specifically, sciatic hernias can present with pain radiating to the buttocks and posterior thigh [48].

Inguinal, femoral, and sciatic hernias can all be identified and treated during laparoscopy. In a small study of 20 patients with sciatic hernias, Miklos et al [48] showed that laparoscopic surgical repair could result in significant symptom relief. Hernias should always be included in the differential diagnosis of chronic pelvic pain, and laparoscopy is a very useful tool in the diagnosis and treatment of hernias associated with pain.

### **Laparoscopy and vaginal apex pain**

Within the spectrum of chronic pelvic pain is vaginal apex pain, which most commonly presents as dyspareunia and impaired sexual function. Dyspareunia originating at the vaginal apex is a well-described condition that has long been suspected as a possible complication of hysterectomy [49]. When the Maryland Women's Study evaluated surgical outcomes in over 1200 women undergoing hysterectomy, they reported that an estimated 2.3% of the women studied, who were pain free prior to the procedure, developed dyspareunia after hysterectomy [50]. It is unclear what percentage of women develops pain at the vaginal cuff after surgery, but if one extrapolates from these data, then as much as 15,000 women annually may be at risk for developing posthysterectomy dyspareunia.

The pathophysiology of vaginal cuff pain is not well described. The neuronal wind-up theory proposes that surgical wounding leads to tissue and peripheral nerve injury [51]. Prolonged changes in the neural circuitry can develop in patients with abnormal healing processes, which lead to altered central processing at the level of the spinal cord (ie, neuronal wind-up) resulting in hyper-vigilance; lowered pain thresholds; and end-organ dysfunction (eg, posthysterectomy chronic vaginal apex pain).

Treatment options for vaginal apex pain are limited. Recent reports indicate that in patients with persistent posthysterectomy dyspareunia and whose pain is

localized to the vaginal apex, excision of the painful tissue may be the treatment of choice [49,52,53]. Follow-up information on patients undergoing vaginal apex resection is described in one case series of nine patients published by Sharp et al [52]. This case series reports improvement in dyspareunia and coital frequency. Laparoscopy is a minimally invasive technique for performing vaginal apex repairs. Although vaginal apex repair can be performed vaginally, it is only the laparoscopy approach that allows complete visualization of the pelvis and adhesiolysis that is often required to dissect the vaginal cuff from vital pelvic organs.

At the authors' institution over 40 such vaginal apex surgeries have been performed. Approximately 80% of patients who have undergone this procedure report relief in pelvic pain with smaller improvements in sexual function. Most patients experience pain relief for an average of 29 months, but pain most often recurs at reduced levels that do require continued medical therapy [54].

### **Laparoscopy for chronic pelvic pain of presumed uterine etiology**

For women who present with chronic pelvic pain presumably originating from the uterus (eg, dysmenorrhea, chronic endometritis, adenomyosis), hysterectomy with or without oophorectomy may be performed laparoscopically. Chronic pelvic pain unresponsive to medical management often leads to surgical intervention including hysterectomy. In the United States, of the 590,000 hysterectomies performed each year, 10% have chronic pelvic pain as the primary preoperative indication for the surgery [4,6,55]. Although hysterectomy is most often successful in relieving complaints associated with pathology (eg, fibroids, endometriosis), it may have the highest failure rates in patients with chronic pelvic pain as an indication for surgery [56]. Previous reports have shown that as many as 22% of patients with chronic pelvic pain continue to have pain after hysterectomy [57].

In cases where hysterectomy is not an option, neurolytic procedures, such as laparoscopic uterine nerve ablation and presacral neurectomy, may be considered. The authors caution, however, that current studies on neurolytic procedures have not identified patients in whom these procedures are most efficacious and results have been marginal. Small series report that presacral neurectomy may result in resolution of pain in 81% to 87% of patients undergoing this procedure [58]. The results are similar for patients undergoing laparoscopic uterosacral nerve ablation. It must be noted that none of these studies were randomized controlled trials, but they report reduction in pain levels associated with midline or central dysmenorrhea. In a randomized trial involving 71 patients, presacral neurectomy for the treatment of chronic pelvic pain associated with endometriosis decreased midline menstrual pain but not pelvic pain and dyspareunia [59]. In addition, a significant proportion of patients (37%) experienced severe side effects, such as constipation and urinary urgency. Presacral neurectomy cannot be routinely recommended.

Laparoscopic uterosacral nerve ablation is not associated with such complications and in uncontrolled studies it has a reported 59% efficacy rate. This has not been supported, however, with large randomized clinical trials [1,7].

Pelvic varicosities have been implicated by some studies as a potential source of chronic pelvic pain [7,60,61] and they may sometimes be identified during laparoscopy by decreasing intra-abdominal pressure and placing the patient in the Trendelenburg's position. Veins with a diameter greater than 8 to 10 mm are suggestive of pelvic congestion and the findings may be confirmed with pelvic venography. Treatment options for pelvic varicosities remain controversial and include ligation of abnormal veins, salpingo-oophrectomy, or hysterectomy, all of which can be performed laparoscopically. Treatment of pelvic varicosities associated with chronic pelvic pain is controversial, however, and has been supported only by observational data [7,62].

### **Laparoscopic conscious pain mapping**

For patients without an apparent cause of pain, laparoscopic pain mapping is a procedure that allows for patient identification of painful pelvic or abdominal sites. Reports of using local anesthesia for diagnostic endoscopy of the abdominal cavity date back at least as early as Short's [63] report in 1925. With conscious pain mapping, women receive sufficient analgesia and sedatives to allow placement of ports and instruments without significant discomfort, but can be awakened to report consciously the effects of traction and palpation of intra-abdominal structures in real time. In theory, this approach allows for more selective removal of only demonstrably tender tissue.

Careful patient selection is critical, with contraindications including high-risk anesthetic profile, obesity, strong preoperative suspicion for severe intra-abdominal adhesions, or history of psychiatric disorders. Before the procedure, the patient should be counseled thoroughly on the conditions to expect. She should be advised the pain mapping stops at any time discomfort becomes excessive, and that she then receives adequate pain relief or general anesthetic. The use of a standardized pain assessment instrument, such as a verbal 10-point scale for elicited pain intensity, should be reviewed with the patient before the start of the surgery.

Intraoperatively, the patient is first oriented to the Trendelenburg's position as a gentle introduction to the procedure. Low-dose fentanyl (50 µg) dosed intermittently during the procedure gives adequate baseline pain relief. Propofol can be given to provide deeper level of sedation during initial trocar placement. The authors have found dexmedetomidine, a  $\alpha_2$  agonist, can be titrated to provide readily reversible sedation and analgesia. Generous umbilical and suprapubic field blocks through the entire thickness of the abdominal wall are critical to avoid confounding of results by abdominal wall irritation; the authors use 1% lidocaine buffered 9:1 with 0.9% bicarbonate. Smaller trocars between the ranges of 2 to 5 mm are optimal for patient comfort. Lidocaine gel should be used to

anesthetize the urethra before catheterizing the bladder. A paracervical block allows insertion of a uterine manipulator; however, there is concern this may limit the mapping by anesthetizing the uterus. To minimize patient discomfort from carbon dioxide irritation one author has suggested a total volume limit for carbon dioxide of 1 L and intra-abdominal pressures of 10 mm Hg if possible [64].

Once the trocars are in place, mapping should be conducted in a systematic fashion, by first palpating a usually insensitive structure, such as the small intestine or rectosigmoid intestine, to establish a baseline response to manipulation. Examination should proceed in an orderly sequence including the broad ligament, the uterine ligaments, the adnexa, the uterus, and the appendix, while having the patient verbalize the level of pain at each point of palpation. Once the mapping is complete, a decision should be made whether any relevant tissues should be removed (the adnexa, the appendix, ligaments, adhesions, or peritoneal lesions). The extent of surgery should be agreed on in preoperative discussion with the patient of anticipated findings.

In published small case series, success rates for completion of pain mapping range from 70% to 100% [65–67]. Findings include tender endometriosis lesions and adhesions; focal visceral discomfort of the uterus, bladder, adnexal structures, and their supporting ligaments; and generalized visceral sensitivity of the peritoneal lining. Postoperative improvement has ranged from 44% to 94% in different series [66,67]. Without the benefit of randomized controlled trials, one cannot come to any conclusions about the absolute benefit of pain mapping. Conscious pain mapping is a procedure that deserves further investigation because it has potential to improve diagnostic precision.

## Summary

Historically, the increased use of laparoscopy has shown that tissue changes, such as endometriosis, are more common in women with pelvic pain than in their asymptomatic counterparts. Surgical treatment of this and other pathologies associated with chronic pelvic pain, however, has led to less complete relief than clinicians hope. To devise a more effective treatment plan, future research has to provide a better understanding of laparoscopic findings and their relation to the physiologic changes involved in the chronic pain state. Only then will clinicians be able to integrate medical and surgical interventions aimed at visceral pathology.

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