Focal adenomyosis treated by wedge resection of the diseased myometrium, with subsequent closure of the remaining myometrial defect using a barbed V-Loc delayed absorbable suture in layers.
A patient with severe adenomyosis requests uterine-sparing surgery

Combined laparoscopy and, when necessary, minilaparotomy is the authors’ preferred technique. It can relieve many symptoms of adenomyosis with a low complication rate, and preserve, even improve, fertility.

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How would you address this patient’s disruptive symptoms, while affirming her long-term plans by choosing the proper intervention?

Adenomyosis is characterized by endometrial-like glands and stroma deep within the myometrium of the uterus and generally is classified as diffuse or focal. This common, benign gynecologic condition is known to cause enlargement of the uterus secondary to stimulation of ectopic endometrial-like cells.1-3 Although the true incidence of adenomyosis is unknown because of the difficulty of making the diagnosis, prevalence has been variously reported at 6% to 70% among reproductive-aged women.4,5

In this review, we first examine the clinical presentation and diagnosis of adenomyosis. We then discuss clinical indications for, and surgical techniques of, adenomyomectomy, including our preferred uterine-sparing approach for focal disease or when the patient wants to preserve fertility: video laparoscopic resection with or without robotic assistance, aided by minilaparotomy when indicated.

Treatment evolved in a century and a half

Adenomyosis was first described more than 150 years ago; historically, hysterectomy was the mainstay of treatment.2,6 Conservative surgical treatment for adenomyosis has been reported since the early 1950s.5-8 Surgical treatment initially became more widespread following the introduction of wedge resection,

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The authors report no financial relationships relevant to this article.

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which allowed for partial excision of adenomyotic nodules.9

More recent developments in diagnostic technologies and capabilities have allowed for the emergence of additional uterine-sparing and minimally invasive surgical treatment options for adenomyosis.3,10 Although the use of laparoscopic approaches is limited because a high level of technical skill is required to undertake these procedures, such approaches are becoming increasingly important as more and more patients seek fertility conservation.11-13

How does adenomyosis present?

Adenomyosis symptoms commonly consist of abnormal uterine bleeding and dysmenorrhea, affecting approximately 40% to 60% and 15% to 30% of patients with the condition, respectively.14 These symptoms are considered nonspecific because they are also associated with other uterine abnormalities.15 Although menorrhagia is not associated with extent of disease, dysmenorrhea is associated with both the number and depth of adenomyotic foci.14

Other symptoms reported with adenomyosis include chronic pelvic pain, dyspareunia, as well as infertility. Note, however, that a large percentage of patients are asymptomatic.16,17

On physical examination, patients commonly exhibit a diffusely enlarged, globular uterus. This finding is secondary to uniform hyperplasia and hypertrophy of the myometrium, caused by stimulation of ectopic endometrial cells.2 A subset of patients experience significant uterine tenderness.18 Other common findings associated with adenomyosis include uterine abnormalities, such as leiomyomata, endometriosis, and endometrial polyps.

Two-pronged route to diagnosis and a differential

Histology

Adenomyosis is definitively diagnosed based on histologic findings of endometrial-like tissue within the myometrium. Historically, histologic analysis was performed on specimens following hysterectomy but, more recently, has utilized specimens obtained from hysteroscopic and laparoscopic myometrial biopsies.19 Importantly, although hysteroscopic and laparoscopic biopsies are taken under direct visualization, there are no pathognomonic signs for adenomyosis; a diagnosis can therefore be missed if adenomyosis is not present at biopsied sites.1 The sensitivity of random biopsy at laparoscopy has been found to be as low as 2% to as high as 56%.20

Imaging

Imaging can be helpful in clinical decision making and to guide the differential diagnosis. Transvaginal ultrasonography (TVUS) is often the first mode of imaging used for the investigation of abnormal uterine bleeding or pelvic pain. Diagnosis by TVUS is difficult because the modality is operator dependent and standard diagnostic criteria are lacking.5

The most commonly reported ultrasonographic features of adenomyosis are21,22:
- a globally enlarged uterus
- asymmetry
- myometrial thickening with heterogeneity
- poorly defined foci of hyperechoic regions, surrounded by hypoechoic areas that correspond to smooth-muscle hyperplasia
- myometrial cysts.

Doppler ultrasound examination in patients with adenomyosis reveals increased flow to the myometrium without evidence of large blood vessels.

3-dimensional (3-D) ultrasonography. Integration of 3-D ultrasonography has allowed for identification of the thicker junctional zone that suggests adenomyosis. In a systematic review of the accuracy of TVUS, investigators reported a pooled sensitivity and specificity for 2-dimensional ultrasonography of 83.8% and 63.9%, respectively, and a pooled sensitivity and specificity for 3-dimensional ultrasonography of 88.9% and 56.0%, respectively.22

Magnetic resonance imaging (MRI) is also used in the evaluation of adenomyosis. Although MRI is considered a more accurate

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diagnostic modality because it is not operator
dependent, expense often prohibits its use in
the work-up of abnormal uterine bleeding
and chronic pelvic pain.2,23

The most commonly reported MRI find-
ings in adenomyosis include a globular or
asymmetric uterus, heterogeneity of myo-
metrial signal intensity, and thickening of the
junctional zone24 (FIGURE 1). In a systematic
review, researchers reported a pooled sen-
sitivity and specificity of 77% and 89%, re-
spectively, for the diagnosis of adenomyosis
using MRI.25

Approaches to treatment
Medical management
No medical therapies or guidelines specific
to the treatment of adenomyosis exist.9 Of-
ten, nonsteroidal anti-inflammatory drugs
(NSAIDs) are employed to combat cramping
and pain associated with increased prosta-
glandin levels.26 A systematic review found
that NSAIDs are significantly better at treat-
ing dysmenorrhea than placebo alone.26

Moreover, adenomyosis is an estrogen-
dependent disease; consequently, many
medical treatments are targeted at suppress-
ing the hypothalamic–pituitary–ovarian axis
and inducing endometrial atrophy. Medica-
tions commonly used (off-label) for this ef-
fect include combined or progestin-only oral
contraceptive pills, gonadotropin-releasing
hormone (GnRH) agonists, levonorgestrel-
releasing intrauterine devices, danazol, and
aromatase inhibitors.

Use of a GnRH agonist, such as leupro-
lide, is limited to a short course (<6 months)
because menopausal-like symptoms, such as
hot flashes, vaginal atrophy, and loss of bone-
mineral density, can develop.16 Symptoms of
adenomyosis often return upon cessation of
hormonal treatment.1

Novel therapies are under investiga-
tion, including GnRH antagonists, selective
progesterone-receptor modulators, and anti-
platelet therapy.27

Although there are few data showing
the effectiveness of medical therapy on ad-
enomyosis-specific outcomes, medications
are particularly useful in patients who are
poor surgical candidates or who may prefer
not to undergo surgery. Furthermore, medica-
tal therapy has considerable use in conjunc-
tion with surgical intervention; a prospective
observational study showed that women
who underwent GnRH agonist treatment
following surgery had significantly greater
improvement of their dysmenorrhea and
menorrhagia, compared with those who un-
derwent surgery only.28 In addition, preop-
erative administration of a GnRH agonist or

FIGURE 1 MRI suggests adenomyosis

Left: Asymmetrical thickening of the myometrium. Right: Hyperintense foci within the uterine body.
danazol several months prior to surgery has been shown to reduce uterine vascularity and, thus, blood loss at surgery.\textsuperscript{29,30}

**Surgery**

The objective of surgical management is to ameliorate symptoms in a conservative manner, by excision or cytoreduction of adenomyotic lesions, while preserving, even improving, fertility.\textsuperscript{3,11,31} The choice of procedure depends, ultimately, on the location and extent of disease, the patient’s desire for uterine preservation and fertility, and surgical skill.\textsuperscript{3}

Historically, hysterectomy was used to treat adenomyosis; for patients declining fertility preservation, hysterectomy remains the definitive treatment. Since the early 1950s, several techniques for laparotomic reduction have been developed. Surgeries that achieve partial reduction include:

**Wedge resection of the uterine wall** entails removal of the seromuscular layer at the identified location of adenomyotic tissue, with subsequent repair of the remaining muscular and serosal layers surrounding the wound.\textsuperscript{3,32} Because adenomyotic tissue can remain on either side of the incision in wedge resection, clinical improvement in symptoms of dysmenorrhea and menorrhagia are modest, and recurrence is possible.\textsuperscript{7}

**Modified reduction surgery.** Modifications of reduction surgery include slicing adenomyotic tissue using microsurgery and partial excision.\textsuperscript{33}

**Transverse-H incision of the uterine wall** involves a transverse incision on the uterine fundus, separating serosa and myometrium, followed by removal of diseased tissue using an electrosurgical scalpel or scissors. Tensionless suturing is used to close the myometrial layers in 1 or 2 layers to establish hemostasis and close the defect; serosal flaps are closed with subserosal interrupted sutures.\textsuperscript{34} Data show that, following surgery with this technique, 21.4% to 38.7% of patients who attempt conception achieve clinical pregnancy.\textsuperscript{7}

Complete, conservative resection in cases of diffuse and focal adenomyosis is possible using the triple-flap method, in which total resection is achieved by removing diseased myometrium until healthy, soft tissue—with normal texture, color, and vascularity—is reached.\textsuperscript{3} Repair with this technique reduces the risk of uterine rupture by reconstructing the uterine wall using a muscle flap prepared by metroplasty.\textsuperscript{7} In a study of 64 women who underwent triple-flap resection, a clinical pregnancy rate of 74% and a live birth rate of 52% were reported.\textsuperscript{7}

**Minimally invasive approaches.** Although several techniques have been developed for focal excision of adenomyosis by laparotomy,\textsuperscript{7} the trend has been toward minimally invasive surgery, which reduces estimated blood loss, decreases length of stay, and reduces adhesion formation—all without a statistically significant difference in long-term clinical outcomes, compared to other techniques.\textsuperscript{35-39} Furthermore, enhanced visualization of pelvic organs provided by laparoscopy is vital in the case of adenomyosis.\textsuperscript{3,31}

**How our group approaches surgical management.** A challenge in laparoscopic surgery of adenomyosis is extraction of an extensive amount of diseased tissue. In 1994, our group described the use of simultaneous operative laparoscopy and minilaparotomy technique as an effective and safe method, after appropriate imaging.

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**Key practice points in managing adenomyosis**

- Adenomyosis is common and benign, but remains underdiagnosed because of a nonspecific clinical presentation and lack of standardized diagnostic criteria.
- Adenomyosis can cause significant associated morbidity: dysmenorrhea, heavy menstrual bleeding, chronic pelvic pain, and infertility.
- High clinical suspicion warrants evaluation by imaging.
- Medical management is largely aimed at ameliorating symptoms.
- A patient who does not respond to medical treatment or does not desire pregnancy has a variety of surgical options; the extent of disease and the patient’s wish for uterine preservation guide the selection of surgical technique.
- Hysterectomy is the definitive treatment but, in patients who want to avoid radical resection, techniques developed for laparotomy are available, to allow conservative resection using laparoscopy.
- Ideally, surgery is performed using a combined laparoscopy and minilaparotomy approach, after appropriate imaging.
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Pathophysiology of adenomyosis

How adenomyosis originates is not fully understood. Several theories have been proposed, however (including, more prominently, the first 2 below):

**Invasion theory.** The endometrial basalis layer invaginates and invades the myometrium\(^1,2\) (FIGURE); the etiology of invagination remains unknown.

**Reaction theory.** Myometrial weakness or dysfunction, brought on by trauma from previous uterine surgery or pregnancy, could predispose uterine musculature to deep invasion.\(^3\)

**Metaplasia theory.** Adenomyosis is a result of metaplasia of pluripotent Müllerian rests.

**Müllerian remnant theory.** Related to the Müllerian metaplasia theory, adenomyosis is formed de novo from 1) adult stem cells located in the endometrial basalis that is involved in the cyclic regeneration of the endometrium\(^4-6\) or 2) adult stem cells displaced from bone marrow.\(^7,8\)

Once adenomyosis is established, it is thought to progress by epithelial–mesenchymal transition,\(^2\) a process by which epithelial cells become highly motile mesenchymal cells that are capable of migration and invasion, due to loss of cell–cell adhesion properties.\(^9\)

**FIGURE** Competing theories of adenomyosis pathogenesis

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**FAST TRACK**

Our preferred approach to provide symptom relief and to preserve fertility is laparoscopic wedge resection without robotic assistance (with minilaparotomy for larger adenomyomas)

alternative to laparotomy in the treatment of myomectomy\(^4\); the surgical principles of that approach are applied to adenomyomectomy. The technique involves treatment of pelvic pathology with laparoscopy, removal of tissue through the minilaparotomy incision, and repair of the uterine wall defect in layers.

In 57 women who underwent this procedure, the mean operative time was 127 minutes; average estimated blood loss was 267 mL.\(^4\) Overall, laparoscopy with minilaparotomy was found to be a less technically difficult technique for laparoscopic myomectomy; allowed better closure of the uterine defect; and might have required less time to perform.\(^3\)

We therefore advocate video laparoscopic wedge resection with or without robotic assistance, aided by minilaparotomy when necessary for safe removal of larger adenomyomas, as the preferred uterine-sparing surgical approach for focal adenomyosis or when the patient wants to preserve fertility (FIGURE 2). We think that this technique allows focal adenomyosis to be treated by wedge resection of the diseased myometrium, with subsequent closure of the remaining myometrial defect using a barbed V-Loc (Medtronic, Minneapolis, Minnesota) delayed absorbable suture in layers (FIGURE 3). Minilaparotomy can be utilized

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**FIGURE 2** Wedge resection of focal adenomyosis

The authors’ preferred uterine-sparing surgical approach to focal adenomyosis, or when a patient wants to preserve fertility.

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**FIGURE 3** Surgical wedge resection and closure
when indicated to aid removal of the resected myometrial segment.

In our extensive experience, we have found that this technique provides significant relief of symptoms and improvements in fertility outcomes while minimizing surgical morbidity.

**CASE Resolved**

The patient underwent successful wedge resection of her adenomyosis by laparoscopy. She experienced nearly complete resolution of her symptoms of dysmenorrhea, menorrhagia, and pelvic pain. She retained good uterine integrity. Three years later, she and her husband became parents when she delivered their first child by cesarean delivery at full term. After she completed childbearing, she ultimately opted for minimally invasive hysterectomy.

The authors would like to acknowledge Mailinh Vu, MD, Fellow at Camran Nezhat Institute, for reviewing and editing this article.

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