



TREATING ENDOMETRIOSIS

A Consensus Document Based on
Discussions with Leading Gynecologists
at The Endometriosis Summit

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INTRODUCTION

Kenny R. Sinervo, MD, MSC, FRCSC

In endometriosis, cells similar to endometrial cells grow outside the uterus, adhering to organs and other structures throughout the abdomen and causing debilitating pain and a host of other symptoms that significantly impact daily activities and quality of life. Although endometriosis affects about 1 in 10 women of reproductive age,¹ awareness of the condition among primary caregivers has remained low, resulting in an average delay in diagnosis of 7-8 years from the onset of symptoms.^{2,3}

The burden of suffering during this delay involves not only the symptoms and their detracting from daily life, but also the insult and frustration of persistently being told, “It’s all in your head.” What’s more, because endometriosis is a progressive disease, delayed diagnosis also allows the disease to become more advanced and symptomatic, impairing fertility and making it more challenging to treat endometriosis to a satisfying, pain-free outcome.

Once patients are diagnosed, doctors often prescribe hormone control, which may improve pain symptoms although it does not treat the disease. Surgical options such as ablation have traditionally been both destructive and ineffective, resulting in continued pain and repeated surgeries. As patients and advocates continue to take their health into their own hands, and minds, a new model has emerged for the treatment of endometriosis, where patients seek (or are referred to) specialists to ensure they get the best care and reduce the chances of needing repeat surgeries. At the same time, surgeons are excising endometriosis using the CO₂ laser, which allows them to thoroughly remove the tissue while preserving underlying structures and maintaining fertility.

In this discussion, specialists in endometriosis share their thoughts on how to improve patient care for endometriosis with better education and awareness, a new model for referral, and comprehensive treatment that includes the best gynecologic surgical technology.⁴⁻⁷ Each have experience with the UltraPulse® DUO CO₂ laser for excision of endometriosis and use it as their primary surgical instrument.

Let's start by asking a question that physicians sometimes struggle to answer clearly: What is endometriosis?

Dr. Sinervo: Endometriosis is a condition in which tissue that is similar to the lining of the uterus but biochemically different, grows outside of the uterus, contributing to pelvic pain and infertility.

Dr. Dulemba: The origin of endometriosis is difficult to pin down. There are many different theories: Müllerian deposition (where cells are deposited during fetal development); metaplasia (where cells change from one cellular type to another); precursor cells (fibroblasts and mesothelial cells) that could develop into glands and stromal cells; or retrograde menstruation into the fallopian tubes and abdominal cavity. All four might contribute, along with other factors. Each of these theories supports the idea that when we eliminate the abnormal tissue, more of that tissue potentially may be present in the future.

Historically, it has been difficult for women with endometriosis to get an early, accurate diagnosis. How do you diagnose the disease?

Dr. Opoku-Anane: It's important to get the earliest diagnosis possible. For most patients who are sick with pelvic pain around the same time every month, suspicion for endometriosis is very high. Pain is often significantly debilitating, causing missed work and school, and it cannot be controlled with NSAIDs. It's also illuminating to know if hormonal suppression, pregnancy, or breastfeeding have improved the pain in the past—if so, it's another indicator of endometriosis.

Dr. Sinervo: By far, the most important thing is to listen to all the different symptoms that the patient is experiencing. Putting those together, we can diagnose endometriosis with very high accuracy.

When patients are under 21, it is most important to assess whether pain is affecting their ability to function normally and go to school or work. At all ages, the constellation of symptoms includes pelvic pain, painful periods, backache, painful intercourse, bladder symptoms, and bowel symptoms like constipation, diarrhea, and intestinal cramping. Patients also can experience fatigue and general malaise. The incidence of asymptomatic endometriosis is not well studied, but about 30% of asymptomatic patients with unexplained infertility are subsequently diagnosed with endometriosis.⁸ It's one of the few causes of pelvic pain that affects multiple body systems—a red flag for a family physician.

Once we suspect endometriosis, ultrasound can show if other diseases are present. Colonoscopy is not helpful for endo involving the bowel, but MRI can have a role in locating endometriosis on the colon. I've performed over 500 bowel resections for endometriosis and treated around 2,000 patients for superficial endo on or near the bowel. Gastroenterologists and general surgeons should be aware that endo can cause bowel obstruction, and those patients need additional treatment from an endometriosis specialist.

Dr. Nutis: Symptoms can also tell us where we might expect to find endometriosis. Patients with suprapubic pressure and urgency might have endometriosis on top of the anterior cul-de-sac, whereas it might be located in the posterior cul-de-sac if patients have inter-posterior pain such as rectal pain, painful bowel movements, pain during intercourse, lower back pain, or pain radiating to the lower extremities.

Dr. Eugenio-Colon: The diagnosis of endometriosis does not usually start with an endometriosis expert. For this reason, the most important people in the treatment of endometriosis are the primary care physicians. Their high degree of suspicion would allow patients to have early intervention by an endometriosis surgeon. This prompt response to the disease would prevent horrible stage 4 endometriosis with involvement of the bowel, bladder, ureter and diaphragm. When patients are dismissed, their symptoms minimized or labeled as “whiny” by their primary OB/GYN, they fall into despair. They start to question their own sanity, which can cause irreparable damage to their psyche. Endometriosis is the only disease in OB/GYN where patients are pushed to be their own advocates.



Dr. Yeung: For early diagnosis, there needs to be a lower index of suspicion for endometriosis. With early intervention, we can both help pain and preserve fertility, but we continue to see delayed diagnoses, inappropriate treatments and persistent myths. For example, patients are still told that pregnancy is a cure, but the pain comes right back. Twenty-year-olds are told that their only option is hysterectomy, so they think there's no hope. And patients who have had a hysterectomy are told they cannot have endo, although, by definition, endo is outside the uterus. Patients are left doing their own research and advocating for their care. It shouldn't be so difficult, which is why we're teaching students and residents to better serve patients with endo.

Do you look for different characteristics of endometriosis based on the patient's age—for example, a patient in her teens versus a patient in her 40s?

Dr. Nutis: There are some differences, particularly in how patients discuss pain and how well previous treatments have worked. For example, teenagers who have unbearable pain 1 or 2 years after starting their period don't realize they need to see a doctor, and they don't say, "Doctor, these cramps are not normal." Usually, they've been told that it is normal and that their cramps won't be so bad if they take birth control pills.

The timing of intervention plays a role as well. I see many patients have good results from starting treatment for chronic pelvic pain before age 25, but patients who start treatment later usually have less success. Over the years, people get used to dealing with pain and the ways it disrupts their lives, but they are all looking for relief.

Dr. Sinervo: People in their 40s have a much longer history of being in pain. When I ask patients when their pain started, about 80% say it began within the first year or 2 after their first period, so women in their 40s have had symptoms for decades. Patients in their late 30s or early 40s who have never had a surgery may have been on medical suppression for a long time, but that does not prevent the disease from going much deeper over the years. And that makes surgery much more complex.

A diagnosis of endometriosis has traditionally been verified laparoscopically. Is that part of your diagnostic approach? Have some of the patients referred to you for endometriosis already had diagnostic laparoscopy?

Dr. Gargiulo: Let's start by saying that surgical exploration (laparoscopy) is the only way that we can diagnose endometriosis with finality. Indeed, the hesitancy to consider timely laparoscopic surgery in women with clear signs and symptoms of endometriosis often delays sustained symptomatic improvement. However, the days of true "diagnostic" laparoscopy are hopefully forever gone—they belong to a time when pelvic imaging was primitive and clinical experience with this disease was limited. When laparoscopy is planned for women with suspected endometriosis, it is now expected that the surgeon already knows the likely stage and level of surgical complexity before the case is even booked. A competent gynecologic surgeon knows—at a very minimum—if early stage endometriosis (i.e. ASRM stages I and II) or advanced stage endometriosis (i.e. ASRM stages III and IV) is expected, well before surgery takes place. In fact, the timing, equipment, and support teams are planned based on this preliminary knowledge.

This is an important concept that patients need to understand and use in self-advocacy when planning their surgery: advanced endometriosis is never a surprise diagnosis. The only "diagnostic laparoscopy" that is acceptable in modern gynecologic practice is the "negative laparoscopy" (i.e. a planned operative laparoscopy for early-stage endometriosis where, in fact, no endometriosis is found). In contrast, the type of diagnostic laparoscopy that is to be universally condemned, as an insult to the patient and the third-party payer is the laparoscopy where the operator "discovers" unexpected advanced endometriosis and aborts the case (completely or, worse, partially) because of "unexpected" technical challenges.

Dr. Eugenio-Colon: We get cases from some referring physicians who perform a true diagnostic laparoscopy and biopsy one or two sites of suspected pathology, thus providing us with a true pathological diagnosis as well as laparoscopic images from a recent surgery. Unfortunately, in other cases, patients are taken to surgery, where instead of the suspected tissue being biopsied, the tissue is destroyed. Most OB/GYNs believe this is sufficient to treat the patient, and they do not refer for further care. This unfortunately puts the patient at increased future risk because the disease continues to advance unchecked for

years. Lesions of endometriosis are varied in color and depth and only after years of practice and exposure you can truly claim to do an optimal excision.

Dr. Yeung: Tissue diagnosis is the gold standard, but most people go in laparoscopically and ablate endometriosis, so they never produce a specimen. We can't properly categorize the patient's disease without that sample. This is particularly true in cases of atypical endo, which may not appear as black spots—it can be brown, red, white, or appear as blisters or retraction pocket adhesions.

Dr. Nutis: When we understand how endometriosis develops over time, it's clear that there is minimal value in laparoscopic visual diagnosis. Endometriosis causes macroscopic lesions we can easily see, as well as microscopic lesions that take months or years to organize into something visible. If macroscopic lesions exist in one place, additional lesions, some not yet visible, are likely located elsewhere.

People with endometriosis have often had multiple surgeries. Why do some commonly used surgical options for treating endometriosis fail to treat the disease completely the first time?

Dr. Sinervo: Endometriosis has typically been treated surgically with two different approaches. The first is ablation of the disease, where surgeons attempt to destroy the endometriosis with the harmonic scalpel, electrocautery, or laser vaporization. However, these approaches often result in patients having multiple surgeries.

The second surgical treatment for endometriosis is excision, a process where instead of trying to destroy the disease, we cut it out. We can choose from several tools, including cold scissors, monopolar energy, harmonic scalpel, or CO₂ laser. Cold scissors cause more bleeding compared to the other modalities, which can increase the presence of blood in the tissues, in turn causing fibrosis.

Using monopolar cautery for cutting risks energy spread beyond the point of contact. Working around the ureters, bowel, bladder, and ovaries is difficult because we can't predict how deeply that energy will penetrate and damage those tissues. That concern is even greater with the harmonic scalpel. The CO₂ laser cuts efficiently while significantly reducing these risks.

Dr. Gargiulo: I am part of a generation of reproductive surgeons who were trained in classic pelvic microsurgery before transitioning to laparoscopy.

Principles of classic microsurgery (which was an open surgery technique) were simple and have been irrefutably validated:

- 1) minimal tissue handling
- 2) hemostasis
- 3) avoidance of tissue desiccation & hypoxia.

- Antonio Gargiulo

As I have developed my minimally invasive armamentarium to translate these microsurgery principles to laparoscopy, I have always avoided what I believe to be a suboptimal choice: electrocautery. I recognize that this choice is not shared by most surgeons in gynecology; monopolar and bipolar electrocautery are currently the most commonly used thermal energy tools in pelvic laparoscopy.

These instruments are not part of the classic pelvic microsurgery armamentarium for a reason: the lateral thermal spread of monopolar (and to a much lesser extent, bipolar) electrocautery is so vast that it can easily spread outside the optical field of the microsurgeon. Indeed, lateral thermal spread of up to 1 cm is described for monopolar electrocautery, particularly when delayed thermal spread tissue damage is quantified histologically.⁹ That is why I do not consider monopolar energy the safest tool in endometriosis surgery.



Our intent in these operations is to be radical in our excision, while preventing damage to vital reproductive organs.

- Mario Nutis

The CO₂ laser is, in my view, a much safer energy choice, by virtue of the fact that its lateral thermal spread in adjacent tissues is virtually nonexistent (less than 1/30 the spread of other instruments such as the ubiquitous monopolar cautery tool).¹⁰⁻¹⁹ If disease in the pelvis forces us to operate in close proximity to reproductive organs or vital organs, it's incumbent upon the surgeon to use an energy that does not put the patient at risk—it's as simple as that. The only tool that surpasses the flexible CO₂ laser in terms of preventing lateral tissue damage would be cold shears, which is what we used in microsurgery and classic open endometriosis surgery (both options are now obsolete in the treatment of endometriosis). The drawback of cold incision in laparoscopy is that the surgical field becomes rapidly obscured by blood oozing from the capillary flow. CO₂ laser energy seals capillary flow, contributing to improved visibility in laparoscopic surgery.

You mentioned the drawbacks of the harmonic scalpel, electrocautery, and hot and cold scissors for the excision of endometriosis. In recent years, a breakthrough in CO₂ laser technology has changed the way all of you perform the procedure. Can you explain how excision with the UltraPulse DUO CO₂ laser is different?

Dr. Sinervo: The greatest advantages of the UltraPulse DUO laser are its controlled depth of penetration and its ability to simultaneously coagulate small blood vessels. As we pass over the tissue that we're excising, the depth of penetration is only a few hundred microns, so we can safely work over the ureters or shave endometriosis off the bowel with less risk of bleeding than we have with cold scissors or the deeper penetration of monopolar energy.²⁰⁻²² There is no energy spread beyond the beam's point of contact.

Because the energy simultaneously stops the bleeding on small blood vessels, there is also less negative effect on the vascularity that tissue needs for healing. Better tissue healing lowers the risk of adhesion formation during the healing process.

Dr. Nutis: The low thermal spread and minimal tissue damage make CO₂ the only energy I use to treat endometriosis on the bowel. Monopolar or bipolar energy would likely cause bowel perforation. I use it with the robot and 3D cameras, so I can get into hard-to-reach spaces and see every trace of endometriosis.

Dr. Gargiulo: By using the CO₂ laser Drop-in™ Guide with the robot, I have a triple instrument—a cutter, a coagulator and a very good dissector with a small, cold tip—and I think that's priceless. In terms of ergonomics and precision, it's just a fantastic tool that becomes more enabling with every new case. In particular, the fact that the laser's dissecting tip remains cold even while the laser is activated is a feature that is absolutely unique in the realm of laparoscopic instrumentation.

I often explain to my trainees that I approach the use of the flexible CO₂ laser as I imagine a Chinese master musician approaches the erhu, the two-string, deceptively simple "Chinese violin." (In fact, it is not a violin at all—it is made of python skin.) Although the instrument only has two strings, it can create a huge range of shades of sound based on its physical properties. Indeed, it would be reductive to say that this laser works both as a cutter and a coagulator. In reality, it provides a continuum of tissue effects that are difficult to describe in words. That is why, no matter

A laser fiber is a very different instrument from a line-of-sight laser, in that the surgeon quickly learns to intuitively change the distance and angle to the target tissue in order to modify tissue effect without changing energy settings.

- Mona Orady

how well informed surgeons are when they come to a case observation, they are invariably surprised by its versatility.

Dr. Dulemba: Cold cutting with scissors may increase bleeding, which may then distort some peritoneal surfaces. "Hot" scissors may increase thermal spread and potentially damage surrounding tissue more than the laser, in my opinion.

I don't have to worry about those things with the CO₂ laser. It works best in my opinion for visualizing endometriosis as the case progresses. I also have more accurate, precise control with the CO₂ laser than I do with scissors. Even cutting with very high power, there is very little thermal spread. When I move quickly with the CO₂ laser, penetration is barely a cell. If I want to go deeper, I can go a little slower, but it's very controlled. I rarely need to use a backstop, and I can go over a blood vessel or the bladder, ureter, or bowel without inadvertently damaging it.

Dr. Caceres : Without the UltraPulse DUO, I wouldn't do the type of advanced surgery for endometriosis that I do today. The use of monopolar energy in delicate areas such as the ureter would be concerning, and using the UltraPulse DUO allows me to get closer to the area of dissection and complete the excision of lesions. The laser's coagulation effect on very small vessels is a significant benefit over cold scissors as well. Less bleeding may lead to less adhesive disease, less pain, and better fertility.²³⁻³⁴

How do you determine which endometriosis patients should have surgery with the UltraPulse DUO?

Dr. Eugenio-Colon: We use the UltraPulse DUO laser 99% of the time. There is no other tool I trust better in my hands than a CO₂ laser to excise endometriosis. The response of the tissue with the use of the laser is phenomenal. The laser is able to aid in the excision of lesions that are close to very delicate structures. I recently talked to a patient who had been in a wheelchair during her period because she could not stand up straight, and now she's started running and doing yoga and she's able to enjoy sex again.

The UltraPulse DUO modality has no equal in surgery. While performing surgery on teens with very subtle disease, it's important to excise the affected areas without damage or char to surrounding structures. This also plays an important role in minimizing future adhesion formation.

Dr. Sinervo: I use UltraPulse DUO laser for every one of my patients. When I'm in a situation where I can't use my laser, I feel like I'm at a disadvantage. Even when I'm doing a hysterectomy on a patient with minimal endo, I often use the laser to take down the bladder or help with any adhesions because it's extremely efficient and effective with minimal bleeding. I can work right at the junction between normal tissue and lesions, with minimal risk of injury to underlying tissues because I can be so precise in applying the energy.

Dr. Morozov: I prefer to use the CO₂ laser in every case. If I treated endometriosis on the bowel or uterus with a harmonic scalpel, the potential thermal spread would be orders of magnitude greater. An experienced surgeon who knows the anatomic landmarks can safely be more aggressive with the laser. This becomes very important with the treatment of endometriosis, which is notoriously difficult to treat for many reasons, including its proximity to vital structures.

Dr. Caceres: For patients who need surgery for endometriosis, I almost always do excisional surgery with the UltraPulse DUO. I've never understood the debate between excision and ablation because in stage 3 or 4 endometriosis, we can't ablate nodules that are deeply infiltrated or those that are over the bowel, ureter, or uterus. It would be impossible to do that without injury to those structures. A lot of general gynecologists don't recognize deeply infiltrating endometriosis, so they cauterize on the uterosacral ligaments, but the actual lesion is below that.

During excision of deeply infiltrating lesions with the UltraPulse DUO, I can do wide laser vaporization down to the normal tissue. I can feel where that firm nodularity meets the soft, normal tissue, and then make sure to excise all of the abnormal endometriosis. The laser also helps the excision process almost proceed in layers until the nodules are removed and normal tissue is exposed.



Ablation also leaves the fibrotic disease behind, so patients will still have pain.

- Aileen Caceres

Do you use the laser differently based on the stage of the disease or the location of the cells you need to remove?

Dr. Sinervo: The settings that I use for the CO₂ laser do not vary significantly. I routinely set it to 12 to 20 watts with approximately 125 to 150 millijoules of energy per pulse. In cases of very deeply infiltrated stage 4 disease where I want to cut tissue more rapidly, I increase it to 20 watts, but I rarely go higher because I can control my technique very well at these settings. I feel that I have the same consistent energy level with predictable penetration throughout the cutting process. That's a contrast to other energy sources that are more likely to damage nerves that are important to bladder and/or bowel function, such as the inferior hypogastric nerves, which are very close to the uterosacral ligaments. With the CO₂ laser, I only excise the tissue that needs to be excised, and not any healthy tissue, thus minimizing the risk of problems for patients in the future.

Dr. Caceres: Generally, I proceed with the CO₂ laser at a setting that is dependent on the tissue area that I am resecting. For instance, for lesions near the uterosacral ligaments, I proceed with a setting of 7-10 watts. If the lesion is deeper or denser, then I proceed with increasing to 10-12 watts on the UltraPulse DUO. In cases of deeply infiltrating lesions on or near the ureter, I utilize a lower setting such as 3-4 watts with continuous wave. Because I am able to control the speed and depth of the laser, I can deliver the best resection of endometriosis without damaging nerves that are important in bladder or bowel function.

How has the UltraPulse DUO CO₂ laser helped make surgery safer, with less risk to structures such as the fallopian tubes or the bowels?

Dr. Yeung: The CO₂ laser's precision and low depth of penetration make it possible. For example, there is no more refined, precise tool than a non-contact CO₂ laser for cutting endometriosis lesions or releasing adhesions from the delicate surface of the fallopian tubes. Scissors will cut too deep, and monopolar energy will make the tissue over the fallopian tubes retract. The CO₂ laser is such a beautiful tool—there's little thermal spread, and tissues remain in their natural position. The CO₂ laser is also an unparalleled cutting tool to shave endo off the bowel. Even bowel surgeons ask me to do it with our laser instead of them using scissors.

Dr. Caceres: I have been using the CO₂ laser for over 4 years, and the results have been impressive in terms of tissue handling and dissection on delicate tissue such as the fallopian tubes. Surgery is safer because I have better control of tissue, and the results of dissection of deep pelvic endometriosis are unparalleled. Our urologist asks me to dissect endometriosis off the ureter with the CO₂ laser.

What outcomes do you tell patients to expect from CO₂ laser surgery, in terms of symptomatic improvement and fertility?

Dr. Gargiulo: I have always actively sought out technology that offers an advantage to my patients. I stumbled on robotic surgery fifteen years ago, at the top of my conventional laparoscopy game, and have never looked back. I did not plan a conventional laparoscopic case ever again. I have had the same epiphany with the flexible CO₂ laser, which I have consistently used for over a decade. I will literally not book a case if the laser is not available. Of course, every surgeon could say that of her/his favorite tool, but my choices are corroborated by continued positive feedback in my fertility practice as well as my pelvic pain practice.

I would say that the remarkable reduction in postoperative pain in my endometriosis excision patients is the most striking effect of the laser choice.

Even though this does not immediately reflect on patients' clinical performance, it provides important knowledge to them about the extent of their disease.

Another important aspect has been the lack of cautery effect on my pathology specimens, allowing clear reading of endometriosis presence in relatively small excision specimens that would normally be hard to interpret.

- Vadim Morozov

Dr. Opoku-Anane: Based on research, 20%-40% of patients require repeat surgery for endometriosis within 5 years.³⁵ In my practice, I see a far lower rate of repeat surgery. CO₂ laser excision is providing a longer duration of pain relief compared to other modalities.³⁶⁻³⁷ We are able to remove more of the endometriosis compared to ablation with less bleeding and adhesions. Patients go home the same day, and their recovery time is roughly 2 weeks, mainly for fatigue.

Dr. Sinervo: After surgery, we expect to see endometriosis have little or no impact on fertility. The likelihood of spontaneous pregnancy is about 80-85% in stages 1 and 2, 70-75% with stage 3, and 50-60% with stage 4 disease in our clinic,³⁸ which is on par with other centers and studies.³⁹ It's almost the same rate of fertility that you would have in the general population.

We have our own database of thousands of patients who we have followed for up to 20 years. In that database, we've found that the likelihood of having recurrent disease has been less than 10%, and fewer than 15% of patients have needed more than one surgery when the endometriosis was completely excised. The main reason for re-operation has been concomitant adenomyosis, where the tissue lining the uterus grows into the muscle wall, causing pelvic pain. We often see older patients who have adenomyosis after excisional surgery showing no evidence of endometriosis, and hysterectomy is usually performed.

As experts in the treatment of endometriosis, you are uniquely positioned to evaluate how the health care system serves patients with this condition. One conclusion you've shared is that women need to be referred to an experienced endometriosis surgeon earlier in their disease process. How important is it for general gynecologists to refer patients with endometriosis, rather than perform surgery themselves?

Dr. Orady: I think that to ensure endometriosis is diagnosed early, we need to address a lapse in education at all levels: primary care, pediatrics, and OB/GYN. And once it's diagnosed, not all gynecologists should treat endometriosis. It takes time and dedication to know the nuances of this disease and become very good at this surgery so we can preserve fertility and accomplish pain control. Most gynecologists don't have this level of specialization. OB/GYNs in particular don't have the necessary time to learn about endometriosis.

Dr. Dulemba: I want general gynecologists to refer patients as soon as they diagnose or suspect endometriosis and before they treat the patient medically or surgically. If they under-treat the disease, it becomes more difficult for the patient and doctor to adequately treat it later, particularly if previous surgery has caused fibrosis and changed the appearance of the lesions.

The first surgery is the key. It's fresh, undisturbed tissue, which can be treated as thoroughly and delicately as possible, and the patient will have the best opportunity to live symptom- or disease-free.

Dr. Yeung: Generalists are good at what they do on a regular basis, but volume matters. It's hard to be

Most gynecologists should refer patients to an expert with a multidisciplinary team, including other surgical specialties, rather than try to treat endometriosis alone with limited experience.

- Patrick Yeung Jr.

good at treating endo if you do it once a month. Advanced endometriosis does require a team, as do cases involving the bowel, bladder, or ureters. Specialists also are also important in atypical or subtle cases because we can recognize and treat those forms of endo. It takes a trained eye to use near contact laparoscopy to look closely, carefully and systematically, recognizing typical and atypical endometriosis. We have to see all of it to remove all of it, and that requires instruction and experience. Given the range of cases where expertise matters, we could make an argument that endo should only be addressed by centers of excellence, particularly when surgery is involved.

Dr. Morozov: Generalists are thrown into a system where they get 12 to 15 minutes to see a new patient. That's not enough to address 20 years of chronic pelvic pain from endometriosis. If the doctor diagnoses cancer, the patient has to go to GYN oncologist, but the same isn't true for endometriosis. The system needs to change. If endometriosis is diagnosed or suspected, the patient needs to be referred to somebody who can handle it.

Dr. Eugenio-Colon: Endometriosis is a very complex disease, especially when treating an endometrioma where a simple cystectomy/cystostomy will not suffice. Endometriosis surgery should only be performed by doctors that have extensive experience with endometriosis and/or advanced training in minimally invasive gynecology.

Dr. Caceres: A lot of patients are mismanaged by generalists, which leads to frustration. They are told, "Your disease was treated, so I don't know why you're still having pain." And the surgery may have actually worsened the disease by creating more adhesion and pain. Patients have multiple surgeries, they're still in pain from either endometriosis or from multiple surgeries, and their doctor does surgery yet again. The goal should be to reduce the number of surgeries, and the way to do that is to refer to someone with expertise in managing endometriosis.

This is true for stage 1 or 2 endometriosis, when generalists can miss the subtle lesions, but the need for referral is especially strong when a patient is diagnosed with advanced disease, including preoperative diagnosis or intraoperative recognition of deeply infiltrating endometriosis or adherence to the pelvic sidewall or posterior uterus. These cases are well beyond a generalist's expertise, and treatment will not benefit the patient.

For example, if a less experienced surgeon drains an endometrioma and excises the cyst wall, that surgeon could remove normal ovarian tissue and/or leave the ovary stuck, risking decreased ovarian reserve. We need to ensure that all of these patients receive a referral as early as possible.

- Aileen Caceres

Dr. Gargiulo: "I am not angry! I am Italian." So goes my favorite cheesy t-shirt poking fun at my national stereotype. So please take the following words kindly. There is ample space for surgical mediocrity in endometriosis surgery. I sarcastically tell my patients that the current status of endometriosis surgery reminds me of H.C. Andersen's famous folktale, "The Emperor's New Clothes." Since there is often no tangible endpoint for this surgery, a patient can go in and out of surgery and be told that surgery took place, without the ability to see what was done—and what was left undone. To make a practical point: endometriosis surgery is not like a hysterectomy where we remove the uterus and the patient can independently verify that with ultrasound.

For decades, inexperienced surgeons have offered ineffective partial surgery to patients with endometriosis, specifically because the endpoint of surgery is not clearly defined. As a result of this practice—which is ongoing—many patients still have symptoms after surgery and are destined to have surgery again and again. Their doctors

often don't even look for deep, infiltrating endometriosis with tools like high-specificity MRI or high-specificity ultrasound; they literally just rely on a superficial pelvic exam. Poor preoperative preparation is the consequence of a limited set of operative skills: if the only plan is to burn superficial endometriosis, looking for deep disease does not serve a purpose. But superficial ablation of endometriosis is like using a sledgehammer to flatten the top of an iceberg. We all know what happens next.

Lucky patients eventually get referred to a surgeon specializing in endometriosis. When unlucky ones go back to the same doctor complaining of pain, the doctor will ask, "Are you going through a rough time?" or "Do you have a family history of fibromyalgia?" Most are told "It's all in your head," and the harder the surgical case, the more doctors tell them that. In most cases, these patients are experiencing pain that results entirely from stricture of their pelvic organs from chronic inflammation related to endometriosis. The assumption of emotional or psychological causes has to stop.

Ultimately, in this type of patient-centered medicine and precision surgery, the space for surgical mediocrity in our hospital has got to shrink. Surgeons and their professional groups need to work with hospitals to better define who should and should not be doing surgery for endometriosis. The issue is simple: true endometriosis surgery is excisional and is overall complex. Hence, privileges should only be given to high-volume surgeons with extensive training and proven credentials.

There is clear precedent: only trained gynecologic oncologists can perform a radical hysterectomy in American hospitals. Why should every single gynecologist who has operating privileges at any hospital do a stage IV endometriosis case? Gynecologic oncologists are the

Department heads need to put their foot down and say, "If you don't have laparoscopic hysterectomy privileges, you cannot do complex endometriosis cases here."

- Jose Eugenio-Colon

first to admit that stage IV endometriosis is at least as complex as a radical hysterectomy. There needs to be an industry standard for proving that we know how to perform endometriosis surgery and we've had enough training, mentorship, and cases.

Generalists refer to you for your experience and expertise, as well as the advanced surgery you perform. Some of you influenced your hospital's decision to purchase the UltraPulse DUO CO₂ laser. In addition to the clinical advantages you've mentioned, were your hospitals also looking for efficiency or cost-effectiveness in a prospective purchase?

Dr. Sinervo: Institutions of course want clinical advantages as well as purchases that make good financial sense. I operate on patients 4 days a week, completing about 400 cases per year. I could easily expect that the UltraPulse DUO would last at least 5 years. So the cost of the purchase, maintenance, and fibers over 5 years is weighed against the revenues from 2,000 cases. I'm not a medical economist, but I think that compares well to forms excision, so it seems like a cost-efficient way to do it.

Dr. Caceres: We wanted the CO₂ laser for the quality of the surgery and the outcomes. In terms of efficiency, dissection and hemostasis take less time compared to other instruments, so in my hands, it does save time. But the most important thing is the ability to perform very safe, effective excision of endometriosis.⁴⁰⁻⁴¹

Dr. Opoku-Anane: I wanted us to be able to provide a safe and fast surgery, which is better for our patients.⁴²⁻⁴³ I knew it would enable us to do more surgeries in a day as well, and that has proven true, which is valuable to the hospital. The company trained a lot of people at our facility, including medical/surgical staff who work in the OR. We started out renting the unit, but my administration saw that surgeons were using it a lot for both GYN and ENT, so they suggested that we purchase it.

Dr. Dulemba: Regardless of cost factor issues, this is the technology I want to use. I want to cut out all the disease, not just burn the surface, so patients have the best opportunity to be symptom-free, and the UltraPulse DUO enables me to excise endometriosis in a more accurate and precise manner. Doing excision with the UltraPulse DUO is not faster than burning (ablating) the surface of endometriosis, because I'm taking the time to get all of the disease, but it's certainly more cost-efficient than leaving potential endometriosis behind and having multiple ineffective surgeries.



How were you initially exposed to the technology? Where did you learn to use the UltraPulse DUO?

Dr. Morozov: I was fortunate to do my fellowship with an endometriosis specialist, so I was exposed to the disease and treatment at that time. If someone is determined to expand their horizons by learning more about endometriosis, there are always courses and training that can, if not make you an expert, then at least push you in the right direction. Conferences are very basic, but multi-day courses and hands on training are available.

Dr. Yeung: I knew the laser had benefits that could not be achieved with other energy modalities, and so I was looking for a training opportunity. After a fellowship in minimally invasive gynecological laparoscopy, I sought out The Center for Endometriosis Care in Atlanta for extra training in how to use the CO₂ laser.

Dr. Opoku-Anane: I was also exposed to the laser through Dr. Sinervo. As part of a fellowship in minimally invasive gynecology, I arranged to go to The Center for Endometriosis Care.

Dr. Eugenio-Colon: I'm one of the lucky few people who were trained by Dr. Sinervo in Atlanta as well. I wish more surgeons would attend the program, and in fact, I encourage all residents who want to treat endometriosis to train on the CO₂ laser.

How can you help ensure that more people with endometriosis get the right surgery? Are any of you involved in teaching others to perform CO₂ laser excision? What's the best way for surgeons to learn?

Dr. Yeung: Broadly, the lack of specialists in endometriosis and inadequate knowledge among generalists reflects a need for residency curriculum changes. Very few residency programs have someone who specializes in endometriosis. I tell our residents and students that their experience of endometriosis is actually very skewed because all they see is commitment to achieving the goal of optimal excision, but that's unique to our center of endometriosis, which is a tertiary referral center.

Dr. Sinervo: I've had about fifteen fellows and dozens of observers over the years. I want them to see the laser's impact on tissue, the efficiency that using the laser provides, and the thoroughness of the excision that we can perform with it to get what I think are the best results. I found that there was a very easy transition to using the CO₂ laser, and I feel that most gynecologists who have had any experience with the laser would be able to transition to it easily.

Dr. Opoku-Anane: We have to begin by teaching residents to see endometriosis. I do a lot of surgery on patients who have been told they don't have endometriosis by gynecologists who are not able to recognize early stage disease laparoscopically. They don't know what it looks like, especially if it's subtle. It might just look like a blood vessel formation on the lining of the pelvis, so it's often missed. It takes time to learn. On our rotation, residents tell me they don't see endometriosis, and I point to it and say, "It's right there."

Dr. Caceres: Identification is not easy. I recently operated on a patient alongside a diligent generalist who saw adhesions on the MRI from the rectum to the posterior cervix and asked for my help. As surgery started, he said, "It's interesting. The bowel and the ovaries are stuck, but there's not really any endo." I explained that the adhesions are the endo. Even some experts will restore the normal anatomy but not recognize the endometriosis. They just see the thickened, fibrotic peritoneum and not the characteristic lesions. Yes, there are powder burns, blue-black lesions, and pocketing, but there are also yellow lesions, white lesions, scarring, clear blisters and surface changes that you can only see three-dimensionally.

Dr. Opoku-Anane: Once residents can identify endometriosis, we train them to get rid of every cell that may potentially harm that patient in the future, and the precision and accuracy of the CO₂ laser gives us the best opportunity to do that. The learning curve is not steep. It's a much higher learning curve to systematically approach a frozen pelvis and safely treat it while preserving anatomy. They need to know the pelvic anatomy and recognize the vascular surgery planes, and then they can gradually grow comfortable and confident with surgery.

It's a common misperception. When surgeons don't see blue/black lesions in the pelvis, they think there is no endo, but it was all adhesive disease. Fertility specialists tell me, "There's all this pelvic adhesive disease, but I didn't see any endo."

- Jessica Opoku-Anane

Dr. Gargiulo: Residents should review the physics of monopolar and bipolar energy, and then compare them to the physics of how the CO₂ laser works and interacts with water molecules. Once they understand that, the second step has to be a live animal lab, where they can learn how CO₂ laser energy is applied to tissues and how the tissues respond as the surgeon stays in one place, moves across a line or plane, and uses different settings. Over time, it becomes second nature to do lysis of adhesions and then respond to a little bleeder in the tissue we're cutting by defocusing and continuing to fire, thereby coagulating it. You can only learn that on an animal model. Next, those skills can be transferred to surgery and honed through repetition. I think it makes sense for any new users to get comfortable with the laser with a small myomectomy, and then treat stage 1 or 2 endometriosis before trying more advanced cases.

Dr. Morozov: Once residents know the laser's mechanism and the cutting and coagulating functions, and they understand the response, I have them observe and I allow them to use it if they feel comfortable. I control the pedal myself at first. I want them to do is to get a sense of how it's different from what they've used before. The universal response is that it's really cool and it's a good device. They tend to appreciate that it's very

precise, with a very fine cut and little thermal spread.

The residents and fellows appreciate that there is another alternative to what they've learned before, which is usually the harmonic scalpel. We just need more programs to make sure that they're introduced to the technology.

In the future, how do you envision a broadly accepted standard of care for treatment of endometriosis?

Dr. Caceres: The use of UltraPulse DUO CO₂ laser has definitely changed how we manage deeply infiltrating endometriosis. Increased training and experienced hands will provide patients with the best outcomes. I think that future surgeons interested in managing deeply infiltrating endometriosis should undergo additional training in laser surgery, as this technique will continue to change the future of endometriosis surgery.

Dr. Dulemba: In my opinion, in the future, excision will become the standard of care for endometriosis, and using the CO₂ laser will be the instrument of choice. Excision is accepted as the standard of care for the removal of endometriosis, but there are papers stating that ablation is similarly effective in mild to moderate disease. As we move forward, more information may come to light about what stimulates endometriosis. Removing all the cells from all areas and checking those cells for hormone receptors (as is done in breast cancer) may change many myths about endometriosis. Combining surgical removal of all of the disease with understanding what is stimulating the cells' growth in an individual patient will allow for better personalized treatment of endometriosis. Physicians would not ablate breast cancer without finding out the hormone status of the cells, and the same process will be the future for endometriosis. Excision and hormonal receptor status will drive excision to become the standard of care.

Surgeons also will learn to use imaging to strategize about their approach preoperatively, which is important for complex cases.

- Kenny R. Sinervo

Dr. Eugenio-Colon: The UltraPulse DUO technology offers unprecedented precision. When excising lesions of endometriosis off delicate structures, millimeters matter, visualization matters, and most importantly the edges of the excised disease matter. The CO₂ laser allows us to cut on the healthy side of the peritoneum or affected structure just outside of the edge of the disease. Other energy modalities pale in comparison to the degree of flexibility and visualization you can achieve while working with the CO₂ laser.

Dr. Opoku-Anane: I would envision the goal of full surgical excision by providers who do a large number of endometriosis surgeries and are comfortable removing endometriosis, even around important organs. Surgical excision, however, is not sufficient for all patients. They must be treated with a comprehensive holistic approach that often requires expertise from several disciplines and includes medical, surgical, and integrative options.

Dr. Orady: In the future, hopefully endometriosis will be managed in specialized multidisciplinary centers with a high volume of high-quality, minimally invasive surgery for the excision of endometriosis, where tools such as mini-microlaparoscopy, robotic surgery and CO₂ laser are readily available. In addition, as education and awareness increase, the goal is to identify and start managing patients earlier in their journey so as to avoid long-term consequences of endometriosis such as chronic pelvic pain, deep infiltrating endometriosis and infertility. As experts in endometriosis are identified, they can collaborate to standardize care and share their experience in order to learn how to optimize the individualized management of endometriosis and thus lessen the impact on the patient's life.

A combination of meticulous surgical excision with medical management, pain management, physical therapy, psychological support, fertility preservation and management of associated conditions such as irritable bowel syndrome and interstitial cystitis with a multidisciplinary team should become the standard of care.

Dr. Sinervo: Consider the effect of timely diagnosis at the first signs and symptoms of endometriosis and judicious referrals to Centers of Expertise. As we continue to press for formal recognition of endometriosis as a subspecialty and patients continue to advocate for proper care, we hope to see significant decline in the time to diagnosis and eradication of incomplete/improper and potentially harmful surgeries in non-specialist settings.

Sharing of surgical experience and advanced technologies and tools in a group setting such as conferences and mentorship groups can help surgeons continuously hone and advance their skills.

- John F. Dulemba

Risk Information

CO₂ lasers (10.6 μm wavelength) are intended solely for use by trained physicians. Incorrect treatment settings or misuse of the technology can present risk of serious injury to patient and operating personnel. The use of Lumenis CO₂ laser is contraindicated where a clinical procedure is limited by anesthesia requirements, site access, or other general operative considerations. The use of Lumenis CO₂ laser is contraindicated for patients who are not candidates for general surgery, or when local or spinal epidural anesthesia is inappropriate, laparoscopic applications where laparoscopy is contraindicated. Risks may include excessive thermal injury and infection. Read and understand the CO₂ systems and accessories operator manuals for a complete list of intended use, contraindications and risks.



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