

## MASTER CLASS

## 'Minimal' Minimally Invasive Surgery



BY CHARLES E. MILLER, M.D.

So, is it time for an old dog to learn a new trick? That's exactly what I thought to myself as I attended a program on laparoscopic single-site surgery during the annual meeting of the AAGL.

After performing operative laparoscopy for more than a quarter of a century, I questioned whether I was truly ready to convert my mid-umbilical "closed" technique to a larger infraumbilical "open" technique. At the end of the day, I pondered, are 5-mm lateral incisions really not cosmetic? Once in the abdominal cavity, could I really retrain myself to use

articulating instrumentation? Does single-port surgery offer the same triangulation of instrumentation as conventional laparoscopic surgery, or for that matter, robotic-assisted surgery?

As you read this latest edition of the Master Class in Gynecologic Surgery, authored by an excellent young physician, Dr. Kevin J. Stepp, I am sure you will contemplate issues similar to these. Nevertheless, this truly is exciting, thought-provoking technology that is "all the buzz" in minimally invasive surgery.

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serves as the director of gynecologic surgical education for the MetroHealth/Cleveland Clinic obstetrics and gynecology residency program. In 2009, he performed the world's first single-surgeon, single-incision robotic-assisted laparoscopic hysterectomy. ■

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## Laparoscopic Single-Site Hysterectomies

For more than 20 years now, surgeons have been exploring minimally invasive techniques to decrease the complications of traditional abdominal hysterectomy.

Although two-thirds of all hysterectomies in the United States still are performed through a large abdominal incision, we know that minimally invasive hysterectomy provides women with a faster recovery, less pain, a quicker return to normal activities, and fewer complications.

Gynecologic surgeons who have embraced laparoscopy for patients who are not candidates for a vaginal hysterectomy have improved their laparoscopic skills notably over the last 10-

15 years. The laparoscopic techniques themselves, however, have remained relatively unchanged since laparoscopic hysterectomy became an option.

From my standpoint as a minimally invasive gynecologic surgeon, I view conventional laparoscopic hysterectomy as a wonderful option for women who do not qualify for a vaginal approach. But on the flip side, I see further progress to be made since the surgery still requires several small incisions and ports, each of which increases the potential morbidity from bleeding, nerve injuries, or port-site hernias and hematomas, and each of which diminishes the cosmetic outcome that many women desire.

This next frontier for women needing hysterectomy—the next logical step in the development of minimally invasive surgery—may have recently arrived. It is a new laparoscopic approach, most commonly called single-incision laparoscopy or laparoendoscopic single-site surgery (LESS), that involves a single umbilical incision and the use of one special port through which three to four traditional or slightly modified hand instruments can be passed.

Numerous terms have been used over the years to describe single-incision laparoscopic surgery, from keyhole surgery to transumbilical endoscopic surgery to

embryonic natural orifice transluminal endoscopic surgery. Just recently, a multispecialty, industry-sponsored consortium published a white paper/consensus statement saying that the term laparoendoscopic single-site surgery "most accurately conveys the broad philosophical and practical aspects of the field" (Surg. Endosc. 2009 Dec. 9;doi:10.1007/s00464-009-0688-8).

While LESS will likely be the term used most often in print, I still often use the term "single-incision laparoscopic surgery" in my discussions with patients.

Urologists are among the specialists who have reported a significant increase in the use of LESS in the past several years; successes for partial nephrectomy, pyeloplasty, renal biopsy, and numerous other procedures have been described.

In gynecologic surgery, we are building on this experience. We have a unique advantage, though, in that we have access to the uterus through the vagina. Using a uterine manipulator gives us an extra hand, in essence making a single-incision approach much easier for us than it is for other specialists.

My initial experience and that of other gynecologic surgeons suggests that single-incision laparoscopy is feasible and well tolerated and leaves no visible physical scar. Depending on the specific anatomy of each patient's umbilicus, we can often hide the incision completely in its natural creases. And just as—if not more—importantly, we may further reduce the potential morbidity associated with the use of multiple laparoscopic trocars.

## History and Instrumentation

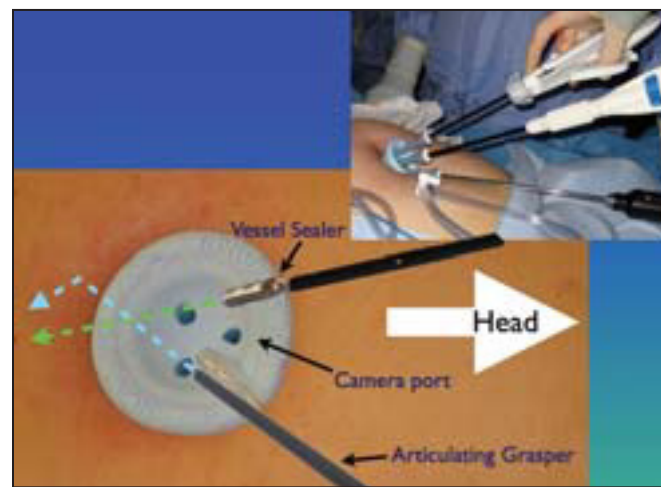
Laparoscopic hysterectomy using a single umbilical puncture was first reported by Dr. Marco A. Pelosi and Dr. Marco A. Pelosi III in 1991 (N.J. Med. 1991;88:721-6). The instrumentation they used for their laparoscopic-assisted vaginal hysterectomies was primitive, compared with the currently available

ports, instruments, and optics, however, and the technique did not catch on. Single-incision total laparoscopic hysterectomy as we know it today really came about in 2007, when Dr. Homero Rivas, a general surgeon who was performing single-incision laparoscopic cholecystectomy at the University of Texas Southwestern Medical Center at Dallas, traveled to Mexico where his brother is a gynecologist. There, with his brother's guidance, Dr. Rivas successfully performed a hysterectomy using single-incision laparoscopy.

Single-incision laparoscopy was really taking off in general surgery and urology at about this time. Many minimally invasive surgeons saw it as a bridge to an experimental approach called natural orifice transluminal endoscopic surgery (NOTES), which uses natural orifices for access to the abdominal viscera and which might, they believed, represent the ultimate approach to minimally invasive surgery.

Single-incision laparoscopy rapidly became more than a bridge to NOTES, however. It came into its own, surpassing NOTES as a technique with lasting and broad acceptance—and one without the limitations or surgical difficulties of NOTES. Nephrectomies, splenectomies, appendectomies, and a host of other procedures were performed using single-incision laparoscopy.

Like Dr. Rivas and other general and gynecologic surgeons who began using the technique several years ago, I began my experience with single-incision total laparoscopic hysterectomy utilizing articulating surgical equipment that had been around for years. (I started using the technique in 2008.) In the past few years, laparoscopic equipment has been modified and refined in ways that have



For work on the right side, the articulating instrument is placed through the left cannula on the multichannel port.

made the technique even easier and achievable by more surgeons. Articulating laparoscopic graspers, endoshears, and graspers all are commercially available.

I believe that single-incision laparoscopic hysterectomy is easiest when articulating instruments and a flexible-tip scope are used, although some surgeons are using higher-angled scopes (30 or 45 degrees) and prototype instruments that are angled rather than having the capability to articulate. (An array of bent laparoscopic instrumentation should be commercially available early this year.)

The goal, of course, is to avoid the crowding or clashing of instruments—commonly called "sword fighting"—that can come with inserting several instruments through a single port and at a single trajectory. As with any laparoscopic surgery, one needs appropriate triangulation in order to have enough intracorporeal working space with access to the tissue.

I have used a specialized 5-mm Olympus flexible scope with a reticulating camera tip. With its hysteroscopelike controls, the instrument can flex to angles greater than 90 degrees in any direction. By flexing the camera tip, I can increase my working space and deflect the camera out of the operative field to prevent my hands and instruments from clashing.

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To effectively use an articulating instrument such as a grasper, I find it is best to work “across” the patient. For work on the right side, this means inserting the articulating instrument through the left cannula on the port. The instrument will cross the pelvis and articulate back toward the midline. The straight vessel-sealing device is then placed through the remaining cannula.

A wider array of articulating laparoscopes and instruments should soon be available. Most, if not all, major manufacturers of laparoscopic equipment now have divisions on single-incision laparoscopy. (In December, the Millennium Research Group, a medical technology market research group, predicted that more than 20% of all laparoscopic procedures will be done through a single-port approach by 2014.)

Four companies currently market multichannel ports that can be inserted into the base of the umbilicus. The differences in the ports are subtle, and one’s choice is a matter of personal preference.

The two Food and Drug Administration–approved multichannel ports that are most commonly used today are the SILS port by Covidien, and the TriPort now distributed by Olympus. Each consists of a retractor component that is placed through the fascia and individual valves or ports where laparoscopic instruments and scopes can be inserted simultaneously. Each of these multichannel ports has three inlet ports—one that holds a 12-mm instrument and two for 5-mm instruments.

Like the other instrumentation available for single-incision laparoscopy, the multichannel ports are in their infancy. All are in their first generation and are being revised by their manufacturers. The first of the second-generation ports should become available early this year.

### Technique and Surgical Pearls

Overall, there is not much difference between the LESS approach and conventional laparoscopy, and the new approach should be performed in a manner that is similar to the conventional laparoscopic technique with which one is most familiar.

Entering the abdomen is performed in the traditional open laparoscopy technique described by Hassan. Although standard single-channel ports generally

require a 5- to 10-mm incision (or a 15-mm incision for the Hassan entry technique), the multichannel ports used for single-incision laparoscopy require a slightly larger incision. I generally recommend a 20- to 25-mm incision.

In patients with a deeper umbilicus, I make a midline incision through the base of the umbilicus. In thinner patients with a flat umbilicus, I use a semicircular incision around the base of the umbilicus. In either case, making the incision in keeping with the natural folds of the umbilicus enables one to minimize or eliminate any visible scar in the abdomen.

With the TriPort, the inner ring is loaded into the transducer, and inserted into the fascial incision by advancing a lever with one’s thumb. The plastic is repeatedly pulled up and the ring is advanced until it is firmly in place against the patient’s abdomen. The port is then clamped into place so that it sits snugly against the inner abdominal peritoneum.

In obese patients, I recommend suturing the peritoneum to the fascia to prevent the inner ring from slipping into the preperitoneal space as the case progresses.

In patients for whom I use a semicircular incision, the fascial opening can be extended bilaterally to facilitate easy placement of either the SILS port or the TriPort by using S hooks to expand the incision.

To insert the SILS port, the port is grasped with a Kelly clamp and placed into the fascia so that it sits flat on the abdominal surface with the inner ring inside the peritoneal cavity. Individual canulas are then placed in the holes of the SILS port.

The camera (a flexible-tip camera in this case) is inserted into the port, and the tip flexed, to assess the abdomen and pelvis. One can achieve the best, unobstructed views of the pelvis—and avoid instrument clashing—when the camera tip is placed toward the anterior abdominal wall and deviated downward toward the pelvis. As the surgery proceeds, one can obtain excellent views by simply adjusting the flexible-tip camera.

In a total laparoscopic hysterectomy, I have found that it is easier to begin with the primary surgeon standing near the patient’s left shoulder to address the left side first. The uterine manipulator will deflect the uterus cephalad and toward the operator, placing the right utero-

ovarian ligaments under tension.

With use of the reticulating grasper, the utero-ovarian ligament is elevated, which provides easy access for a straight vessel-sealing device. At this point the camera is best positioned providing views from the right lower quadrant looking anteriorly. (This is accomplished by lowering the camera toward the patient’s chest and deflecting the camera tip inferiorly and medially.)

A vessel-sealing device of your choice can then be used to cross-clamp, seal, and transect the utero-ovarian, round, and broad ligaments. The bladder flap can be developed with either a hook cautery, scissors, or a vessel-sealing device. Often, the small vaginal branches of the uterine vessels will become compressed across the top of the manipulator cuff—be sure to use the vessel-sealing device to control this.

For the colpotomy, I generally use the monopolar hook with 40- to 50-W pure cutting. The disposable hook electrode is advantageous for LESS because it can be bent. By moving the flexible-tip camera, one can adequately visualize the entire colpotomy. I also use the uterine manipulator to advantage—applying upward pressure usually provides adequate views of all the cervical-vaginal attachments.

Once the uterus is detached, it generally can be delivered vaginally. When necessary, morcellation can be accomplished either vaginally (with or without a mechanical morcellator) or with a morcellator placed through the port in the umbilicus.

Suturing presents the biggest challenges. Even those who have mastered suturing in conventional laparoscopy will face a learning curve. The vaginal cuff can be closed intracorporeally using one conventional needle driver and one reticulating grasper, but it can also be facilitated with a commercial suturing device and extracorporeal knot tying. (This latter option may be advisable during the learning curve.)

When extracorporeal knot tying is used, be careful to prevent the suture from getting wrapped around the other instruments, especially if using the TriPort.

A few more tips to shorten the learning curve with single-incision laparoscopic hysterectomy:

- ▶ Don’t hesitate to “pexy” the ovaries, epiploica, uterus, etc., when necessary.
- ▶ Lubricate instruments frequently.
- ▶ Complete one side before moving on to the other side. Anything you can do to minimize instrument changes will improve efficiency and eliminate the need to reposition the camera and instruments. When switching sides, maintain the same instrument configuration.
- ▶ The camera in the vertical position with upward flexion at the tip provides an excellent view of the posterior uterus and cul de sac.
- ▶ The camera in the horizontal position

with downward flexion at the tip provides excellent views of the anterior uterus and bladder flap, and is preferable for viewing the broad ligaments.

### Experience and Outcomes

Since June 2008, I have done more than 90 hysterectomies and 20 other surgeries using the LESS technique. Data from a 5-month period in 2008, involving 22 patients who had LESS surgery (19 of whom had a hysterectomy), show that patients used narcotic pain medications for an average of 2.5 days and any analgesic medication for an average of 5 days. Their length of stay averaged approximately 11.5 hours, and they returned to work after an average of 3.5 days. The average uterine weight was 324 g, and weight was as high as 1,600 g.

Blood loss averaged 50 mL, and the median operative time was 171 minutes. Surgical time was directly related to body mass index and uterine weight, and estimated blood loss increased with increasing uterine weight. Prior laparotomy and the presence of severe adhesions did not affect the length of surgery.



**A reticulating grasper (left) can be used to elevate the utero-ovarian ligament in order to provide access for a straight vessel-sealing device (right).**

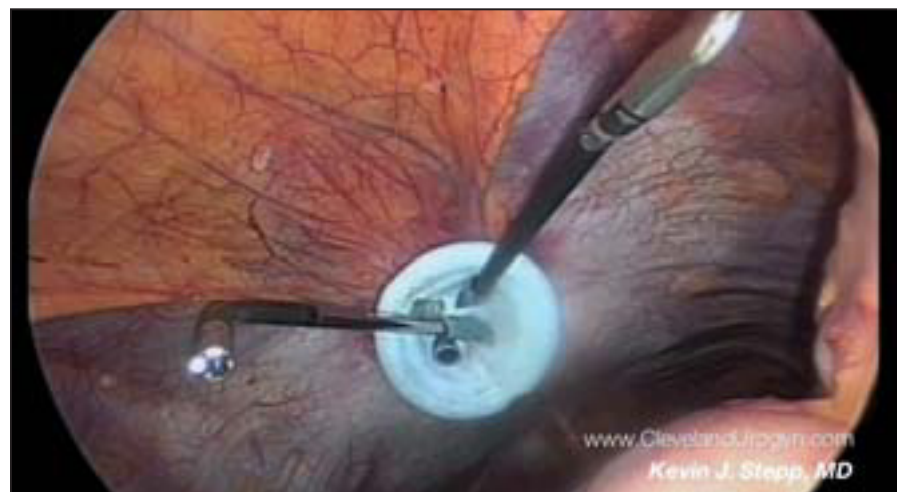
I encountered no intraoperative complications or conversions, although in one patient, morcellation of the 1,600-g uterus was carried out through an additional 15-mm suprapubic incision.

The complications I encountered in this initial group of 22 patients were vaginal bleeding on day 6 in one patient and a suture granuloma 3 weeks postop in another. A third patient had a tubo-ovarian abscess 11 days after surgery; she had a history of sexually transmitted diseases and substance abuse.

These outcomes may be a little better than those of standard laparoscopic surgery—they are at least comparable—and the cosmetic results are certainly superior. It may be difficult to demonstrate statistically significant differences in pain and recovery, at least in smaller populations of patients. I am in the process of doing a comparative study of conventional laparoscopy and LESS, but a larger series will be needed to quantify many of the intraoperative and postoperative benefits.

Laparoscopic surgeons have been driven to learn and offer the technique to reduce the minimal but not insignificant risk of complications associated with each incision. Why would I put four incisions in my patient when I can complete the procedure through just one? ■

DR. STEPP reports that he is a consultant for Covidien and Immersion Medical and has received research funding from Medtronic Inc. To comment, e-mail him at [obnews@elsevier.com](mailto:obnews@elsevier.com).



**Surgical pearl: The gynecologic surgeon can achieve unobstructed views of the pelvis by adjusting the tip of the flexible-tip camera.**