MASTER CLASS

Robotic Myomectomy: The Time Has Come

CHARLES E. MILLER, M.D.

In the last edition of the Master Class in gynecology, Dr. Javier Magrina, professor of ob.gyn. and director of female pelvic medicine and reconstructive surgery at the Mayo Clinic in Scottsdale, Ariz., ably described the benefits and technique of robotic-assisted hysterectomy.

In this second installment on robotic-assisted surgery, I have asked Dr. Arnold P. Advincula, clinical associate professor of ob.gyn. at the University of Michigan, Ann Arbor, to discuss robotic-assisted laparoscopic myomectomy.

Other than laparoscopic tubal anastomosis, there is no procedure in minimally invasive gynecologic surgery that is more dependent on the ability to be facile with laparoscopic suturing techniques than laparoscopic myomectomy. Certainly, the physician's need to visualize the repair on a television screen while using limited wrist motion for suture placement limits the vast majority of gynecologists from routinely and effectively performing this procedure.

Dr. Advincula holds several departmental positions at the University of Michigan. He is the director of the minimally invasive surgery and chronic pelvic pain program, the director of the minimally invasive surgery fellowship, and the codirector of the university's endometriosis center. Dr. Advincula is also a member of the board of trustees of the AAGL and is associate editor of the journal The Female Patient, coeditor of the Journal of Robotic Surgery, and a member of the editorial board of the International Journal of Gynecology & Obstetrics.

Dr. Advincula not only is an avid clinical researcher and educator, having published nearly 50 articles in peer-reviewed journals, but also is a fixture on both the national and international lecture circuits on the topic of minimally invasive gynecologic surgery. ■

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Robot-Assisted Laparoscopic Myomectomy

BY ARNOLD P. ADVINCULA, M.D.

Hysterectomy has been a first natural and successful application for robotics in gynecologic and reproductive care, but it is also now clear that robot-assisted laparoscopic myomectomy takes full advantage—even more so—of what robotic technology brings to the table.

Conventional laparoscopic myomectomy has been so challenging that relatively few gynecologic surgeons have been willing and/or able to move away from the traditional open approach for treating symptomatic leiomyomata. Laparotomy thus has remained the standard for myomectomy, leaving many women with a limited number of minimally invasive options if they want to preserve their uterus or fertility, and leaving our health care system shouldering millions of dollars in costs associated with invasive approaches.

It is interesting to note that the total direct cost of treating uterine fibroids in 2000 was estimated at $2.1 billion. Most of the cost, the authors wrote, resulted from inpatient care, particularly hysterectomy (Am. J. Obstet. Gynec. 2006;195:955-64).

With all that robotics offers to us, I believe this is about to change.

The Rationale

Two prospective trials have shown less postoperative morbidity and faster recovery with laparoscopic myomectomy. Yet the endoscopic management of leiomyomata is so technically challenging that the majority of cases are still performed via laparotomy. (Few would challenge the notion, I believe, that it is one of the more challenging procedures in minimally invasive surgery.)

The complexity of dissection and, in particular, the complexity of repair with multilayer-sutured closures present challenges that not only require advanced laparoscopic skills but also are associated with a steep learning curve. These challenges have consistently raised concerns about whether laparoscopy increases conversion rates and whether it can lead to uterine rupture.

There also are longstanding, published limitations placed on the kinds of tumors that can be treated with conventional laparoscopy in order to minimize the risk of conversion to laparotomy. It is often stated that cases involving fibroids greater than or equal to 5 cm, intramural fibroids, an anterior location, and preoperative use of GnRH agonists are too difficult to handle laparoscopically and are likely to increase the conversion rate (Human Reprod. 2001;16:1726-31).

Current robotic technology essentially erases almost all of the limitations of conventional laparoscopy. The features of the technology—improved dexterity and precision of the instruments as well as the three-dimensional imaging—allow the endoscopic approach to be more accurately modeled after (and reflective of) traditional open techniques.

The da Vinci surgical system, which is the only Food and Drug Administration–approved robotic device for use in gynecologic surgery, provides us with a means to overcome the difficulties associated with hysterotomy, enucleation, repair, and extraction that we encounter with the conventional laparoscopic management of fibroids.

The Setup

The da Vinci system comprises a surgeon's console, a vision system that provides three-dimensional imaging through a 12-mm endoscope, and a patientside cart with robotic arms and various EndoWrist instruments.

At the console, the surgeon controls the instruments, the camera, and an energy source, all via a stereoscopic viewer, hand manipulators, and foot pedals. One of the robotic arms holds the endoscope while the other two or three arms hold the instruments.

The instruments come in either 8- or 5-mm sizes and possess 7 degrees of movement, a range that replicates or surpasses the human hand's full range of motion.

Overall, the technique itself for robot-assisted laparoscopic myomectomy does not differ significantly from what is done in conventional laparoscopy, except that the critical steps of hysterotomy, enucleation, and repair are dramatically facilitated while the surgeon adheres to the principles of open surgery.

The bottom line is that robotics affords us the ability to perform the procedure as if it were being done as an open procedure, with the only change being the route of access.

We first place a 12-mm port at or above the umbilicus, depending on the size of the uterus, to accommodate the endoscope and camera arm. As a general rule, I advise leaving at least a handsbreadth distance (approximately 8-10 cm) between the endoscope and the top of an elevated uterus or leiomyoma during bimanual examination, with the patient under anesthesia.

This spacing is important during myomectomy because the enucleation process will result in the leiomyoma projecting out toward the endoscope. By leaving an adequate working space at the beginning, we are able to compensate for a loss of optical working distance and maintain our ability to manipulate our instruments.

We then place an 8-mm port in the left and right lower quadrants, placing them more cephalad and lateral in the case of larger uteri or leiomyomata. These ports will mount directly to the operating robotic arms.

A fourth trocar (a 12- to 15-mm port that will facilitate the introduction of suture as well as instrumentation used for retraction, suction/irrigation, and other tasks of the assistant) can be placed between the camera port and either the left or right lower-quadrant port.

Just as with robotic hysterectomy, a fourth robotic arm can be added for patients who are obese or have a large uterus; this can be used for added retraction of tissues.

The key point to be made about setup is that the ports must be placed far enough away from each other and from the target tissue to avoid instrument-arm collisions.

We recommend that all patients undergo radiologic imaging prior to myomectomy. In our practice, we favor MRI for assessing the size, number, and location of the fibroids as well as for ruling out adenomyosis and for planning the location(s) of the hysterotomy incision. All of this information is particularly helpful given the absence of haptic (tactile) feedback with the robotic approach.

The Technique

Prior to hysterotomy, a dilute concentration of vasopressin is injected into the myometrium surrounding the myoma, as an adjunct for hemostasis. Once adequate blanching is noted, we begin each case with either a bipolar Maryland forceps or Gyrus ACMI Inc.'s PK dissecting forceps on the left arm, and hot shears or a permanent cautery hook (both monopolar devices) on the right arm. Our hysterotomy can be made in either a horizontal or vertical axis because we will be less limited with robotic instruments than we would be in a conventional laparoscopy.

The fibroid can then be enucleated while the bedside assistant provides additional traction/countertraction with a conventional laparoscopic tenaculum or corkscrew. An alternative is to use the fourth robotic arm with an EndoWrist tenaculum. Care must be taken to avoid excessive traction during the enucleation phase in order to maintain hemostasis and to not prematurely avulse the fibroid. Patience is key.

The removed fibroid is placed in the posterior cul-de-sac—or in one of the paracolic gutters if it is larger—for retrieval at the end of the surgery. When we remove multiple and smaller fibroids, it is important to maintain a myoma count. Tagging each of them with long suture can be helpful for retrieval at the end of the case.

At this point, we usually exchange our instruments for a large needle driver on the left arm and a mega needle driver with a high-force grip and integrated cutting mechanism on the right arm. We typically incorporate a multilayer closure for the myometrium, using either interrupted sutures of 0-Vicryl on CT-2 needles cut to 6 inches, or running sutures of 0-Vicryl on CT-2 needles cut to 11 inches.

With the increased articulation and dexterity of our instruments, our ability to repair a defect is affected much less by the orientation of the incisions or the location than it would be in conventional laparoscopy.

To close the uterine serosa, we use a running baseball stitch with 3-0 Vicryl on an SH needle. If multiple fibroids must be removed, we prefer to repair each uterine

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defect after enucleation before moving on to another tumor. This way, we're taking advantage of the effects of vasopressin at each site. We try to remove as many fibroids as possible through a given hysterotomy.

Before retrieving excised fibroids, the robot-assist device is undocked. Specimens are then retrieved via a tissue morcellator that is placed through the accessory port. Another option is to use the endoscopic port site, but this requires the use of a 5-mm 0-degree laparoscope placed through one of the lateral trocars.

All operative sites are irrigated, hemostasis is ensured under low-pressure settings, and an adhesion barrier is placed over all uterine incisions. We typically apply a slurry of finely chopped Seprafilm as an adhesion barrier (an off-label use).

With robotic myomectomy, as with any of the robotically assisted gynecologic procedures, the importance of the bedside assistant cannot be overestimated. In addition to providing traction/countertraction (we usually don't need to use a fourth robotic arm because our assistants are skilled), the assistant introduces and removes suture, provides irrigation, and manages any accessory port activity (J. Robotic Surg. 2007;1:69-74).

The Patients, the Outcomes

With robotics, there really are not many patients we cannot address. There are no absolute inclusion criteria, and no absolute cutoffs. It's all relative. We determine whether a patient is a candidate for a robotic myomectomy based on the size and mobility of her uterus as well as the size, number, and location of her fibroids.

For example, a patient whose height is 4 feet 10 inches and who is obese with a short truncated torso, a uterus that is not very mobile, and an 8-cm fibroid located over the broad ligament may be a poorer candidate than would a taller patient of average weight with an 8-cm intramural fibroid in a uterus that is extremely mobile. This is where the art of medicine comes into play.

Overall, however, the robotic approach overcomes challenges like obesity, and puts us at a greater advantage as surgeons—giving us an ability to suture more effectively and to approach complex pathology much more aggressively—than does conventional laparoscopy.

It takes some time to get used to the dramatic paradigm shift of operating remotely from the patient through a robotic interface. Learning to overcome the lack of tactile feedback is also part of the learning curve. The key is to not attempt more than you can handle early in the learning process. Then, as your experience grows, your ability to tackle complex gynecologic pathology will come. In other words, start with a symptomatic 4- to 5-cm fundal subserosal fibroid before approaching the 10-cm broad-ligament fibroid.

We started doing robotic myomectomies in 2001. In our first published series of 35 cases, the mean myoma weight was 223.2 g. The mean number of myomas removed was 1.6, and the mean diameter was 7.9 cm. The average estimated blood loss was 169 mL and no blood transfusions were necessary. Three of the cases were converted to laparotomy, two because of the absence of tactile feedback and a third because of cardiogenic shock secondary to vasopressin (J. Am. Assoc. Gynecol. Laparosc. 2004;11:511-8).

Since that early experience, we have not had to convert a patient to a laparotomy secondary to an absence of tactile feedback.

When we later compared surgical outcomes with those of traditional laparotomy through a retrospective case-matched analysis of 58 patients, we found that although operative times were significantly longer in the robotic group (a mean of 231 minutes vs. a mean of 154 minutes), postoperative complication rates were higher in the laparotomy group.

In all, there were 14 postoperative complications in 12 patients in the laparotomy group, including wound dehiscence; hematoma; blood loss and anemia requiring transfusion; and deep vein thrombosis followed by respiratory arrest and renal failure. In the robotic group, there were three postoperative complications: aspiration pneumonia, port-site cellulitis, and chest pain.

Estimated blood loss was significantly higher in the laparotomy group than in the robotic group (a mean of 365 mL v. 196 mL), and transfusions were required in two patients who underwent laparotomy. Length of stay was also higher: 3.6 days in the laparotomy group, compared with 1.5 days in the robotic group. (J. Min. Invasive Gynecol. 2007;14:698-705).

We have also analyzed the effects of our experience over time and have presented these data at the AAGL annual meeting in November 2007. We found a notable trend toward both lower blood loss and shorter operative time with experience. Additionally, we evolved from an average length of stay of 1.5 days to a completely outpatient procedure. We even noted an increasing ability to tackle more complex fibroid cases over time, particularly those involving submucosal and deep intramural fibroids.

More recently, we have begun long-term follow-up of our patients. Preliminary pregnancy data show us that women who have undergone a robot-assisted laparoscopic myomectomy in the past 5 years have indeed become pregnant and have carried their pregnancies through with no complications and no uterine ruptures. ■

Dr. Advincula is a consultant for Intuitive Surgical Inc., Gyrus ACMI, and SurgRx Inc.

A hysterotomy is underway with an EndoWrist cautery hook and Gyrus dissecting forceps.

A fibroid enucleation is facilitated by an EndoWrist tenaculum.

A myometrial defect is repaired with EndoWrist needle drivers and O-Vicryl suture.

Photos courtesy Dr. Arnold Advincula

Low Albumin, Reoperation Found to Raise Risk of Surgical Site Infections

BY JEFF EVANS

Senior Writer

CINCINNATI — Surgical site infections found in deep wounds or in organs or spaces manipulated during an operation might occur more often after general surgical procedures if patients have low blood albumin or are operated on through a previous incision, according to the results of a case-control study.

These new risk factors for surgical site infection (SSI) join old suspects—such as prolonged operative time and chronic obstructive pulmonary disease (COPD)—as independent predictors of any kind of SSI, according to a study presented by Dr. Manjunath Haridas at the annual meeting of the Central Surgical Association.

The risk factors should guide clinicians in their assessment of SSI risk and identify potential targets for intervention to reduce their incidence, said Dr. Haridas, a resident in the department of surgery at Case Western Reserve University, Cleveland.

During 2000-2006, 316 SSIs occurred in 10,253 general surgical procedures performed at one center. Dr. Haridas and his coinvestigator at Case Western, Dr. Mark Malangoni, compared 300 of these patients with SSIs with 300 matched control patients who also underwent surgery but did not develop an SSI (16 patients were excluded because no suitable matches could be found).

The patients, whose mean age was 56 years, underwent operations for the gastrointestinal tract, including the hepatobiliary system and pancreas (39% of patients); hernia repair (19%); and vascular (16%), breast (13%), and extra-abdominal areas (13%). They developed superficial (84%), deep (7%), or organ/space infections (9%).

Multivariate logistic regression revealed that reoperation through a previous incision was independently associated with 2.4-times higher odds of developing an SSI, whereas a prolonged operation (surgery time greater than the 75th percentile), a blood albumin level of 3.4 mg/dL or less, and COPD each were independently associated with 70%-80% greater odds of developing an SSI.

Patients who had either low blood albumin or a reoperation through a previous incision were between two and three times more likely to develop a deep or organ/space SSI than were those in which neither condition occurred. Although the investigators did not record how many SSIs occurred in previously operated wounds that also had previously had an SSI, Dr. Malangoni thought that reoperation through a previously infected wound incision should be avoided. ■

Robotic Hysterectomy Tied To More Cuff Dehiscence

SAVANNAH, GA. — Vaginal cuff dehiscence is more likely to occur following robotic hysterectomy than after other types of total hysterectomy, based on the results of a retrospective review of almost 2,400 cases.

The vaginal cuff dehiscence rate for robotic hysterectomy was 2.87%, compared with 0.47%, 0.13%, and 0.99% for total laparoscopic, vaginal, and total abdominal hysterectomies, respectively, Dr. Mohamed N. Akl reported at the annual meeting of the Society of Gynecologic Surgeons.

Vaginal cuff dehiscence after total hysterectomy is a rare but potentially dangerous complication. To evaluate dehiscence rates, the researchers conducted a retrospective review of all vaginal cuff dehiscence cases requiring surgical closure of the cuff following total hysterectomy (robotic, abdominal, vaginal, and conventional laparoscopic) between Jan. 1, 2000, and Aug. 31, 2007.

Of the 2,399 hysterectomies, 15% were performed robotically, 9% were total laparoscopic procedures, 64% were vaginal, and 12% were total abdominal.

The relative risk of vaginal cuff dehiscence for robotic hysterectomy, compared with vaginal hysterectomy, was 8.8, Dr. Akl, a gynecologist at the Mayo Clinic in Scottsdale, Ariz., said at the meeting, which was jointly sponsored by the American College of Surgeons.

Dr. Akl reported that he had no relevant financial relationships to disclose.

—Kerri Wachter