Robotic Hysterectomy

BY JAVIER MAGRINA, M.D.

Since the first published report of a robotic hysterectomy appeared in 2001, we have gained enough experience to know that next to vaginal hysterectomy—which I believe is still the preferred approach whenever possible, the robotic approach is the next best technique that gynecologic surgeons can offer patients.

The robotic system we use today—the da Vinci surgical system—was designed to overcome the surgical limitations of conventional laparoscopy. Indeed, it has.

My colleagues and I at the Mayo Clinic, and others elsewhere, have seen similar operating times, reduced blood loss, and shorter hospitalization for both simple and radical hysterectomies as compared with the laparotomy approach. We have experienced firsthand the increased accuracy and precision that robotics promised. Suturing is easier with robotics than with laparoscopy. The advantages of robotics—such as improved dexterity, three-dimensional vision, and vocalized voice commands—are particularly useful in suturing and tying ligations.

With the development of the Zeus system, surgeons gained two more robotic arms (in addition to the laparoscope-operating arm) as well as some of the other advantages afforded by robotics, such as articulating tips and a downsizing of movement. The Zeus system was designed to overcome the surgical limitations of conventional laparoscopy, and it is the only robotic system manufactured for laparoscopic procedures.

In an evolution that reflects likely future changes as well, a second generation of the da Vinci system, released in 2006, has longer instruments, lighter arms, and increased flexion-extension and lateral excursion, among other improvements.

Instrumentation and Process

We now refer to the approach as "robotic" hysterectomy rather than "robotic-assisted" laparoscopic hysterectomy because—although a surgical assistant is still needed for several laparoscopic functions, such as suction and irrigation—the procedure is, with these latest advancements, largely robotic in nature.

With most hysterectomies, as with most pelvic operations, four trocar sites are used: three for the robotic arms (one of which is for the laparoscope) and one for the assistant, who will manually perform suction, irrigation, vessel sealing, tissue retraction, and specimen retrieval. When we have a patient with cancer, obesity, or a large uterus, we add a fourth robotic arm. This additional arm allows for the added retraction of tissues.

We use the open Hasson technique to place a 12-mm robotic trocar (the rest of the three trocars, nonlatching, umbilical area for the laparoscope. Two 8-mm robotic trocars are then placed bilaterally, 10 cm to the right and left of the umbilicus. This placement provides an operative field that extends, in most patients, from the lower pelvis up to the inferior mesenteric artery.

For the assistant, a 10-mm trocar is placed 3 cm cranial and right between the umbilicus and the left robotic trocar. Through this port, the assistant performs the functions that are not yet available robotically: vessel sealing, suction, irrigation, tissue retraction, specimen retrieval, and the introduction and retrieval of sutures and needles. When a fourth robotic arm is used, that trocar is placed 10 cm lateral and 1 cm caudal to the right robotic trocar.

The robotic tower with three arms is situated between the patient’s legs. We have noticed that if the column is parked very close to the patient’s perineum, there is inadequate space for the scrub nurse to mobilize and manipulate a vaginal probe, maintain the pneumoperitoneum during vaginal incision, and retrieve specimens vaginally. Ideally, the robotic column should rest at about the level of the patient’s feet and not any closer.

The middle robotic arm is attached to the robotic trocar where the laparoscope has been inserted. A monopolar spatula, or scissors, is inserted through the right lateral trocar, and a plasma kinetic dissecting forceps is inserted through the left lateral trocar. When needed for suturing, a needle-holder replaces the spatula. When a fourth robotic arm is used, a robotic instrument called a Progarp is used.

The surgeon sits, unscrubbed, on a console that in our operating suite is about 12 feet away from the patient. Here the surgeon can manipulate the robotic arms that maneuver the instruments and the laparoscopic camera, as well as communicate verbally with the assistant. When the surgeon is playing the role of assistant and the trainee is at the console, the surgeon can direct the trainee by means of telestration to pinpoint anatomical structures and planes of dissection, or to indicate areas of potential vascular injury that extend, in most patients, from the lower pelvis up to the inferior mesenteric artery.

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or vaginal fornix. A vaginal probe that is inserted into the vagina by the scrub nurse is used to identify where the vagina joins the cervix and to define the level of incision on the vagina.

A vessel-sealing device is used to coagulate and transect the ureteric arteries and the cardinal ligaments. At that point—the vagina is transected im-
mediately distal to the cervix and the uterus is detached and removed, along with the ovaries in most cases, through the vaginal opening. (When the ovaries are not removed, they are left attached to the lateral flaps of the specimen.) The scrub nurse holds the labia majora to the midline over the surgical instrument used to remove the uterus, and that is enough to maintain the pneumoperitoneum.

Inflation of a sterile occluding balloon with 60 mL of saline is used to maintain the pneumoperitoneum after removal of the specimen vaginally.

The right monopolar spatula is then removed and re-
placed with a needle-holder, and the vaginal cuff is closed with a 15-cm precut 0 continuous polyglycolic absorbable suture starting at the right angle and going to-
ward the midline. A similar 15-cm suture is applied from the left to the midline until it meets the other suture. The uterosacral ligaments are incorporated at each vaginal an-
gle and at the midline in order to support the vagina. We use a LapraTy suture clip at each end of the sutures to eliminate the need for intracorporeal knot tying.

Using these sutures is most helpful. A su-
ture that is 30 cm long simply takes too long to pull through the tissues. In general, the use of smaller, short-
er sutures is essential in robotic surgery.

For robotic hysterectomies as well as any other robot-
ic gynecologic surgery, I also advise using slow, deliber-
ate, precise movements. Such pacing alleviates the risk of bleeding, which dramatically slows the procedure down when it occurs.

At the end of the procedure, the robotic arms are dis-
engaged from the trocars, the robotic column is moved away, and the fascia at the umbilical site is closed. The oth-
er trocar sites require closure of only the skin. We always perform a cystoscopy after injection of intravenous indi-
go carmine to ensure that there are bilateral ureteral jets and no injury to the bladder.

When we plan to send the patient home on the day of the robotic hysterectomy—something we started doing when we observed how well patients were faring with this approach—we modify the anesthesia regimen some-
what.

We give each patient dexamethasone preoperatively, ap-
ply an abdominal binder behind her ear, and administer two additional medications to prevent nausea. Zofran (ond-
danestron) and aprepitant. Then, at the end of the hys-
terectomy, we inject both the right and the left pelvic plexus (sympathetic and parasympathetic) with a cocktail of morphine, vasopressin, and Marcaine (bupivacaine). We also infiltrate the trocar sites with Marcaine, and be-
fore the patient is awakened from anesthesia, we admin-
ister intravenous ketorolac. When she is awake, the pa-
tient will then have minimal postoperative discomfort.

Additionally, normal saline (200 mL) is left in the blad-
er at the end of the cystoscopy so that the patient will have the urge to empty her bladder in the next hour rather than being too deep and not going to the bathroom for 3 to 5 hours to empty her blad-
der before being able to go home.

In our preoperative discussions with patients, we do in-
form them that the incisions are placed a little higher than with conventional laparoscopy. Only once has one of our pa-
ients expressed cosmetic concern and opted for a la-
paroscopic approach with suprapubic trocar placement.

Hysterectomy has been a natural beginning application for robotic technology in gynecologic surgery. Experience with the robotic system has made us more comfortable with other gynecologic procedures because the same instrumentation and usually the same port placement are used.

Patient Outcomes

In a series of 91 consecutive patients who underwent ro-
botic simple hysterectomy at Mayo (with or without salp-
ingo-oophorectomy or concomitant appendectomy) be-
tween March 2004 and December 2005, we had no con-
versions to conventional laparoscopy or laparo-

Our one intraoperative complication was an en-
terotomy that was repaired robotically in a patient with extensive pelvic adhesions. (We have learned that complications can be repaired robotically without having to convert to laparotomy.)

Postoperatively, one patient with cardiomy-
opathy required admission to intensive care for 24 hours to treat exacerbation of heart failure, and an-
other patient required admission for vaginal cuff abscess. Three patients were readmitted for ileus, pneumonia, and colitis. The mean estimated blood loss was 79 mL, and the mean hospital stay was 1.3 days. (Indications in the patients, whose mean age was 50 years, included menometror-
 rhagia in 43% and ovarian neoplasm in 20%.)

In the evaluation of robotic surgery and analy-
sis of the experience, it is important to break down the total process into several components: docking time (the time required to attach the robotic arms to the trocars), console time (the sur-
geon’s time dedicated exclusively to performing the hysterectomy), and total operating time (from incision to closure).

For surgeons who haven’t used the robotic sys-

tem, a common misconception is that it takes a long time to set up for each procedure. In our se-
ries, however, the mean docking time was only 2.9 minutes.

The mean console time was 79 minutes, and the total mean operating time was 122 minutes, which was 14 minutes shorter than conventional la-
paroscopy. A mean of 43 minutes was required for setup and close, which included trocar placement, exploration, and the removal of trocars, closure, and cystoscopy. (The time for setup and close has not been reported before in laparoscopic surgery.)

Our surgical time was minimized by having a dedicated robotic team and by using certain sur-

gical strategies, such as the use of only three in-
struments (monopolar spatula, bipolar grasper, and needle-holder) for the entire procedure—a practice that also reduces cost—and the use of precut, short sutures and suture clips. The opti-
mal robotic team can comprise two surgeons or one surgeon and one assistant, as well as at least two nurses who are well versed in the robotic in-
strumentation and system. The assistant also plays a major role in fixing any malfunctions of the robotic instruments or arms, and in switching robotic instruments.

Console time clearly decreased over time as we performed more simple hysterectomies. It was not significantly affected by the performance of an appen-
dectomy, but it was affected by uterine weight and the ly-
sis of adhesions. In our practice, we prefer a vaginal ap-
proach for the larger uterus that requires more mor-
cellation. In general, our threshold for the robotic ap-
proach is a uterus of 12-14 weeks’ gestational size.

All of these findings—from reduced operating times to shorter hospitalizations and fewer complications—have applied to our experience with robotic radical hystere-
tomy as well. In one analysis of 16 patients undergoing robotic radical hysterectomy, we found that total oper-
ating time was 66 minutes shorter than it had been for laparoscopic radical hysterectomy.

An increased body mass index did not prolong operat-
ing times in any of our patient groups. In fact, we have noticed that for patients who are obese, surgical time is longer with laparoscopy than with robotics. This reflects one of the advantages of the robotic approach: It bypasses the fulcrum effect, which is inherent to conventional la-
paroscopy and which is especially challenging in patients with a thick abdominal wall. Surgeons using the articu-
lated instrumentation of a robotic system will use the same manual effort regardless of how thick the abdom-
inal wall is.

The lack of tactile feedback is viewed by some as a lim-
itation of robotics, but after a short time of practice, it is easily compensated for by the depth of perception that three-dimensional vision affords.

In addition, the articulation of the instruments facili-
tates dissection of the tissues and suturing, such as clo-
sure of the vaginal cuff in hysterectomies. And as with other gynecologic surgeries, the downsizing of the sur-
geon’s movements in a 3:1 or 5:1 ratio leads to increased accuracy and precision. (In such downsizing, when the surgeon’s hand moves 3 cm or 5 cm, the tip of the in-
strument moves only 1 cm.)

We still believe that when the hysterectomy can be per-
fomed vaginally, the vaginal approach is preferable to ro-
botics or to laparoscopy. This is because any study that has compared vaginal hysterectomy with another ap-
proach has demonstrated a faster operating time with the vaginal procedure, as well as lower cost.

When a patient is not a candidate for a vaginal hys-
terectomy, or when the gynecologist is not comfortable with the approach, however, then the robotic approach is indeed preferable to conventional laparoscopy.

DR. MAGRINA reports no financial disclosures.