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Robotic Radical Hysterectomy Versus Total Laparoscopic Radical Hysterectomy With Pelvic Lymphadenectomy for Treatment of Early Cervical Cancer

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ABSTRACT

Background and Objectives: To compare intraoperative, pathologic and postoperative outcomes of robotic radical hysterectomy (RRH) to total laparoscopic radical hysterectomy (TLRH) in patients with early stage cervical carcinoma.

Methods: We prospectively analyzed cases of TLRH or RRH with pelvic lymphadenectomy performed for treatment of early cervical cancer between 2000 and 2008.

Results: Thirty patients underwent TLRH and pelvic lymphadenectomy for cervical cancer from August 2000 to June 2006. Thirteen patients underwent RRH and pelvic lymphadenectomy for cervical cancer from April 2006 to January 2008. There were no differences between groups for age, tumor histology, stage, lymphovascular space involvement or nodal status. No statistical differences were observed regarding operative time (323 vs 318 min), estimated blood loss (157 vs 200 mL), or hospital stay (2.7 vs 3.8 days). Mean pelvic lymph node count was similar in the two groups (25 vs 31). None of the robotic or laparoscopic procedures required conversion to laparotomy. The differences in major operative and postoperative complications between the two groups were not significant. All patients in both groups are alive and free of disease at the time of last follow up.

Conclusion: Based on our experience, robotic radical hysterectomy appears to be equivalent to total laparoscopic radical hysterectomy with respect to operative time, blood loss, hospital stay, and oncological outcome. We feel the intuitive nature of the robotic approach, magnification, dexterity, and flexibility combined with significant reduction in surgeon's fatigue offered by the robotic system will allow more surgeons to use a minimally invasive approach to radical hysterectomy.

Key Words: Robotic radical hysterectomy, Laparoscopic radical hysterectomy, Cervical cancer.

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INTRODUCTION

Open radical hysterectomy has been the standard treatment for early stage cervical cancer for decades. Recent advances in laparoscopic instrumentation, however, have made it possible to safely perform radical hysterectomy laparoscopically. The first total laparoscopic radical hysterectomy (TLRH) with pelvic and paraaortic lymphadenectomy was performed by Nezhat et al in June of 1989.[1,2] Since then, TLRH with pelvic or paraaortic lymph node dissection, or both, has gained acceptance as a feasible alternative to an open radical hysterectomy. Numerous authors have published their experience with TLRH, firmly establishing its safety and feasibility.[3–11] Though no randomized trials have been performed, existing data suggest that the cure rate for laparoscopic radical hysterectomy is similar to that seen for the open procedure.[10]

Despite the advantages of conventional laparoscopy over laparotomy (shorter hospitalization, faster bowel function recovery, less postoperative pain, decreased overall cost), it is not without drawbacks. First, the surgeon operates in an awkward and uncomfortable position at the operating table, using a flat, 2-dimensional image. Second, the majority of the instruments used are nonarticulating with an ergonomically inadequate handle design, which makes performance of fine movements exceedingly difficult.[12,13] Third, though not clearly defined for laparoscopic radical hysterectomy, advanced laparoscopic surgery is associated with a significant learning curve,[14] mostly due to the counterintuitive nature of the operation.

Recently, computer enhanced technology (robotics) has been introduced into laparoscopic surgical practice. The advantages offered by this new technology include a 3-dimensional magnified field, tremor filtration, and 5 or 6 degrees of instrument mobility inside the body, thus significantly reducing the ergonomic problems associated with the conventional laparoscopic approach. There is convincing evidence that the intuitive nature of the robotic system provides an additional advantage in terms of the learning curve.[15]

The initial development of the robotic system was intended for remote surgery as a telesurgical mentoring system that would allow an experienced surgeon to provide guidance during a procedure taking place in a different location. The early robotic systems used for telementoring or telesurgery, however, had technical difficulties associated with signal latency and network instability. With advances in signal transmission technology, the earlier problems associated with remote communications are being resolved, expanding the role of robotics in telementoring and allowing inexperienced surgeons to adopt minimally invasive techniques safely while minimizing the risk of serious complications during their learning curve.

Clinical applications for robotic systems have been evolving rapidly and are now used widely in various surgical fields. Comparative studies of robotically assisted and standard laparoscopic prostatectomies, colon resections, and Nissen fundoplications show that the robotic technique is feasible, safe, and improves the surgeon's dexterity and flexibility without compromising patient care.[16–18]

In this study, we conducted a comparative analysis of our data from early cervical cancer patients who underwent TLRH versus those who had RRH with respect to intraoperative, pathologic, and postoperative outcomes.

MATERIALS AND METHODS

Study Design

This was a prospective nonrandomized analysis of all cases of RRH performed for cervical cancer at Mount Sinai Medical Center, New York. The collected data were compared with a set of 30 cases of TLRH performed for cervical cancer at the same institution from August 2000 to June 2006. Starting in 2006, the robotic-assistance approach was offered to all patients for whom a laparoscopic approach was deemed appropriate. All patients were appropriately counseled and written informed consent was obtained. Institutional Review Board approval was obtained.

Patient Population

Selection criteria for TLRH and RRH were the same and included all women with newly diagnosed invasive cervical cancer stages IA1 to IIA who desired a laparoscopic approach, after providing informed consent. Patients were not considered for the laparoscopic approach if they had metastatic disease beyond the uterus, a cervical lesion of more than 4cm in size, a uterus size of more than 12cm, inadequate bone marrow, or compromised renal and hepatic function, or if they were pregnant. Prior surgical history or body weight did not contraindicate a laparoscopic approach.

Data Collection

Clinical data for both the laparoscopic groups and the robotic groups were analyzed by a review of patients' medical records and operation reports. All patients were staged according to the International Federation of Gynecology and Obstetrics (FIGO) criteria. All patients had a computerized tomography (CT) scan of the abdomen and pelvis done preoperatively to evaluate lymph node status and potential extrapelvic and extraabdominal disease. Intraoperative and postoperative data including patient characteristics, operation details, histological data, and follow-up information were recorded.

Blood loss was measured as a sum of suctioned fluids and weighed sponges. Duration of surgery was defined from the time of skin incision to the closure of the skin incision. Robotic docking time was recorded as the time to attach the robotic arms to the trocars and insertion of robotic instruments. All complications were defined as intra- or postoperative. Postoperative complications included those occurring during the same hospitalization or within 30 days following discharge.

Surgeons

Perioperative workup and postoperative care were provided by a gynecologic oncology service run by a fellow. All surgeries were performed by a gynecologic oncology fellow and a mentoring gynecologic oncology attending physician with experience in advanced laparoscopy. The fellow at the beginning of his or her training participated as first assistant. As the fellow became more experienced and skilled, the fellow's role transitioned to a primary surgeon with an attending surgeon or junior fellow acting as a first assistant under the attending physician's supervision.

The da Vinci robot is an integrated computer based system, consisting of 3 interactive robotic arms, a camera arm and a remote control console with 3-dimensional visual capabilities. The motions of the surgeon at the console unit are replicated by the robotic arms placed within the patient. During robotic surgery, an assistant is available at the operating table. The assistant performs robot-related tasks, including alignment and exchange of robotic instruments, operative maneuvers with conventional instruments such as organ manipulation, tissue countertraction, suction and irrigation, and any necessary alterations in the position of the intrauterine manipulator. The presence of the scrubbed assistant is also crucial in the event that an emergency conversion to a laparotomy is required.

Robotic Laparoscopic Radical Hysterectomy Surgical Technique

The technique of total laparoscopic hysterectomy and bilateral pelvic lymphadenectomy using harmonic shears has been previously described[10,19] and served as the basis for the robotic procedure. After patients received appropriate preoperative counseling and gave their written informed consent, a standard outpatient mechanical bowel preparation was prescribed. Perioperative prophylactic antibiotics were given. The procedure was performed with the patient under general endotracheal anesthesia in the dorsal lithotomy position with adjustable Allen stirrups and lower extremity compression devices for deep venous thrombosis prophylaxis. Betadine solution was applied topically, and sterile drapes were placed in the usual sterile fashion. A Foley catheter was placed into the bladder before the procedure was started; the catheter was drained by gravity for the duration of the surgery. An intrauterine manipulator was placed, if possible.

Traditional diagnostic laparoscopy was performed first to assess for feasibility of the intended procedure, as well as to detect intraabdominal metastatic disease. A multipuncture operative video laparoscopy technique was used. Any lesions that appeared potentially malignant were evaluated and biopsied. The procedure was terminated if metastatic disease was detected, and confirmed by frozen section evaluation, outside of the pelvis (eg, in the omentum, bladder, liver, or bowel), in the uterine adnexa, or if the tumor extruded through the uterine wall into the peritoneal cavity. If none of the above were found, the laparoscopic equipment was removed. A standard 12-mm trocar placed at the umbilicus was used for camera placement, 2 working robotic arms were attached to 8-mm reusable trocars placed bilaterally, and ancillary 10-mm trocars were placed in the suprapubic region and the left or right upper quadrant. The robotic ports were placed 1cm to 2cm below and 8cm to 10cm lateral to the intraumbilical trocar, so as to enable optimal movement of the robotic arm and to minimize the risk of collision **(Figure 1)**.

The whole procedure is performed using the robotic monopolar electrosurgical scissors placed through the right port, and the fenestrated bipolar forceps placed through the left robotic port. Conventional instruments used are the Nezhat–Dorsey SmokEvac suction irrigator pump, probe (Bard Inc, Murray Hill, NJ), grasping forceps and bipolar forceps as needed, as well as harmonic shears (Ethicon Endo-Surgery Inc, Blue Ash, OH) or a LigaSure vessel sealing device (ValleyLab, Boulder, CO).

Adhesions were lysed first to restore normal anatomy, and the undersurfaces of the diaphragm, liver, gallbladder, stomach, omentum, and large and small bowel were examined visually, when possible. The paraaortic lymph nodes were inspected, followed by the pelvic lymph nodes. Proceeding with a radical hysterectomy requires that 6 avascular pelvic spaces be developed and that the bladder and rectum be mobilized. Traditionally, we start

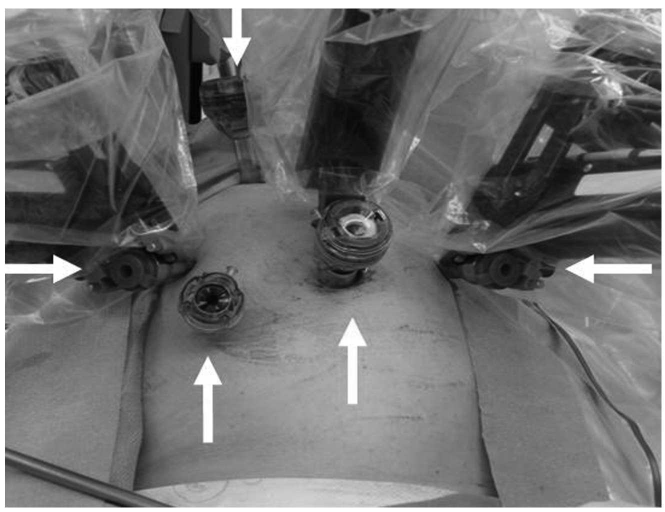

Figure 1. Trocar placement for robotic radical hysterectomy and bilateral pelvic lymphadenectomy. The arrows mark the locations of the trocars. A 12-mm camera trocar is placed at the umbilicus, 2 working robotic arms are attached to 8-mm reusable trocars placed bilaterally, and additional ancillary 5-mm to 10-mm trocars are placed in the suprapubic region and the left upper quadrant. The camera port and each working robotic port are placed in a way that allows for optimal robot arm movement and minimizes risk of collisions.

out by dissecting the rectovaginal space. The uterus is sharply anteverted by using an intrauterine manipulator, and the peritoneum between the uterosacral ligaments is incised by using monopolar scissors; the rectum can then be brought down gently away from the vagina. A moistened sponge on a sponge-forceps is placed in the posterior vaginal fornix to facilitate visualization and development of this surgical plane **(Figure 2)**.

The surgeon subsequently began the pelvic wall dissection. After round ligaments on either side of the uterus were desiccated and cut with the monopolar scissors, the anterior leaf of the broad ligament was opened bilaterally. The bladder flap was developed using both blunt and sharp dissection. The bladder was gradually dissected away from the cervix and vagina with a moistened sponge on a sponge-forceps placed in the anterior vaginal fornix to facilitate development of the vesicovaginal space **(Figure 3)**.

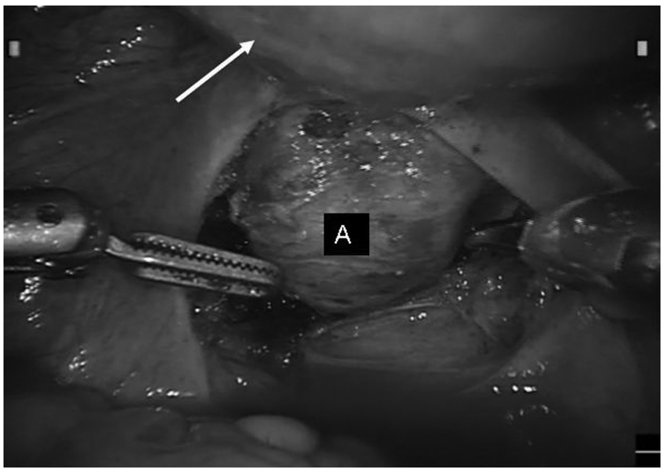

Figure 2. Development of the rectovaginal space (A). The posterior vaginal fornix is placed on tension (marked by the arrow), and a moistened sponge on sponge-forceps is placed in the vagina to facilitate delineation of the tissue planes.

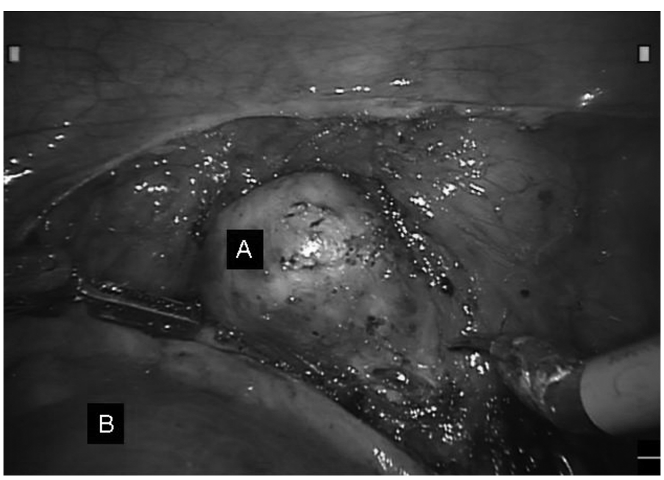

Figure 3. Development of the vesicovaginal space (A). The uterus (B) is pushed cephalad into the abdominal cavity to facilitate visualization.

The posterior leaf of the broad ligament was opened using monopolar scissors and forceps and the paravesical and pararectal spaces were developed using gentle blunt dissection. In cases where ovarian preservation was indicated or desired, the uteroovarian ligament and the proximal portion of the fallopian tube were coagulated and divided. If the adnexa were to be removed, the infundibulopelvic ligament was isolated, desiccated and divided using the bipolar forceps and scissors. The paravesical space was developed by placing tension on the umbilical ligaments with sharp, blunt dissection performed with scissors, forceps, and suction irrigator. The dissection was continued inferiorly to the iliac vessels, after which the obturator space was developed. The structures surrounding the obturator space, including the obturator internus muscle and pubic bone, were examined visually and care was taken to avoid injury to the obturator nerve and vessels that traverse this area.

After development of the paravesical and pararectal spaces, the pelvic lymphadenectomy can be performed. Pelvic lymphadenectomy involves removal of the lymph node packets from the common iliac vessels and external iliac vessels down to the level of the deep circumflex iliac veins **(Figure 4)**. The obturator nerve was identified, and the obturator fossa nodes and the hypogastric lymph nodes were completely removed and sent for pathological examination. At this point, the medial umbilical ligament was suspended with upward tension, and the origin of the uterine artery from the hypogastric artery was identified **(Figure 5)**. The uterine artery was desiccated and divided at its origin with bipolar forceps and monopolar scissors as shown in **Figure 6**. The uterine vein was likewise identified, desiccated, and cut. The uterine vessels were placed on medial tension, and the ureter was unroofed using the curved tip of the monopolar scissor out of the tunnel **(Figure 7)**, and then the surrounding tissues were coagulated and divided **(Figure 8)**. The uterosacral ligaments, cardinal ligaments, and a portion of the paracolpos were then divided with the bipolar forceps and scissors, enabling complete mobilization of the uterus. A circumferential incision was made into the vagina using monopolar scissors to ensure an adequate margin **(Figure 9)**. The uterus was separated completely from the vagina and

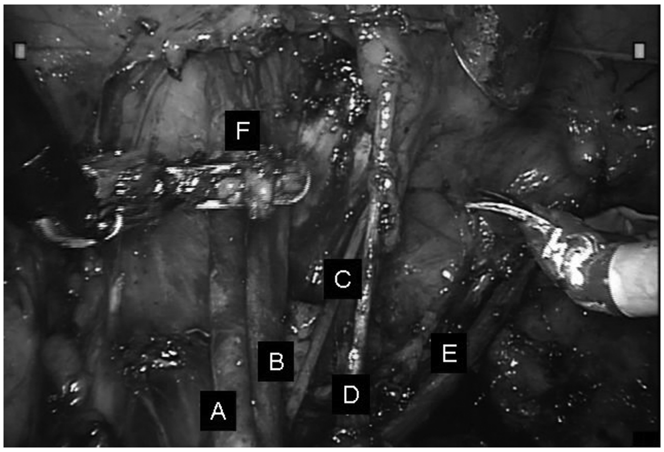

Figure 4. Left pelvic lymphadenectomy. Lymph node packets (F) are removed from the left common external iliac artery (A) and vein (B). The left obturator nerve (C), the left obliterated umbilical artery (D), and the left ureter (E) are identified. The obturator fossa nodes and the hypogastric nodes are completely removed.

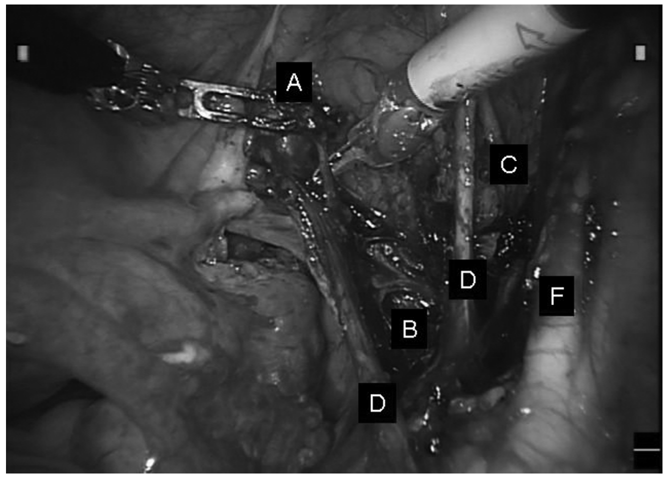

Figure 6. The right uterine artery (A) is coagulated and divided at its origin by using bipolar forceps and monopolar scissors. The right pararectal (B) and paravesical (C) spaces are fully developed; and the right ureter (D), right umbilical (E), and right external iliac artery (F) are visible.

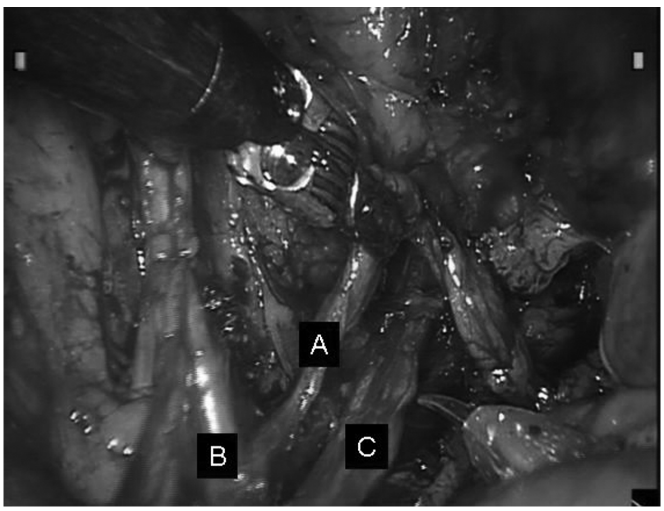

Figure 5. The uterine artery (A) is identified and dissected from the point of its origin at the hypogastric artery (B) traversing over the ureter (C).

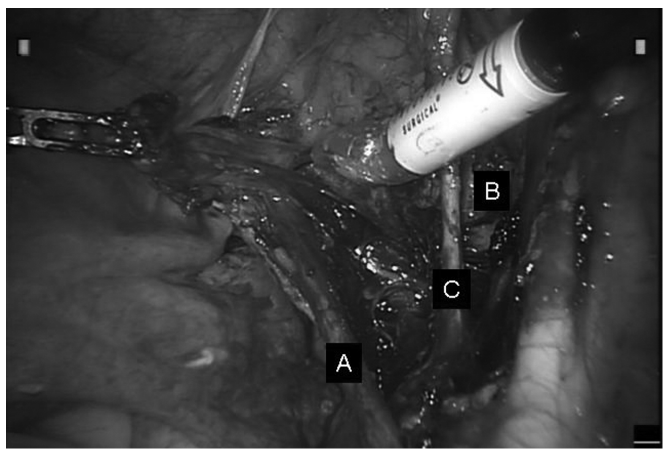

Figure 7. Unroofing of the right ureter (A) using monopolar scissors. The paravesical space (B) and right obliterated umbilical artery (C) are identified.

removed while attached to the uterine manipulator. In some cases, the specimen removal was done vaginally to allow for a superior visualization and delineation of the vaginal margins. The vaginal cuff was closed with interrupted or running 0 Vicryl suture tied intracorporeally or vaginally **(Figure 10)**.

After removal of the specimen and closure of the vaginal cuff, the pelvic cavity was thoroughly evaluated. Both the pelvic and abdominal cavities were irrigated copiously with normal saline **(Figure 11)**. Once the surgeon had ensured hemostasis, Indigo carmine was administered intravenously to assess ureteral and bladder integrity. The rectum was then insufflated with air and evaluated intra-abdominally under saline to rule out any bowel injuries. The bladder was either distended with saline, or cystoscopy was performed to further ensure its integrity. Upon completion of the procedure, the da Vinci system was undocked, all of the instruments were removed, and the trocar sites were closed using a figure-of-eight 0 Vicryl suture and 4–0 Vicryl in a subcuticular fashion.

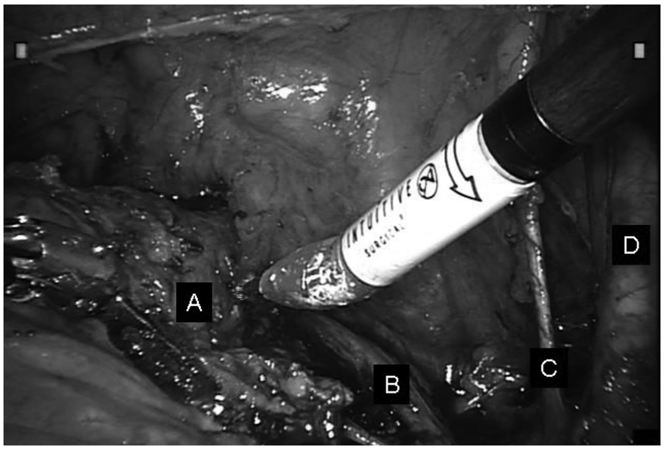

Figure 8. Resection of the right parametrium (A). The right ureter (B), right obliterated umbilical (C), and right external iliac arteries (D) are seen.

Figure 9. Using monopolar scissors, a circumferential incision is made into the vagina assuring adequate margin.

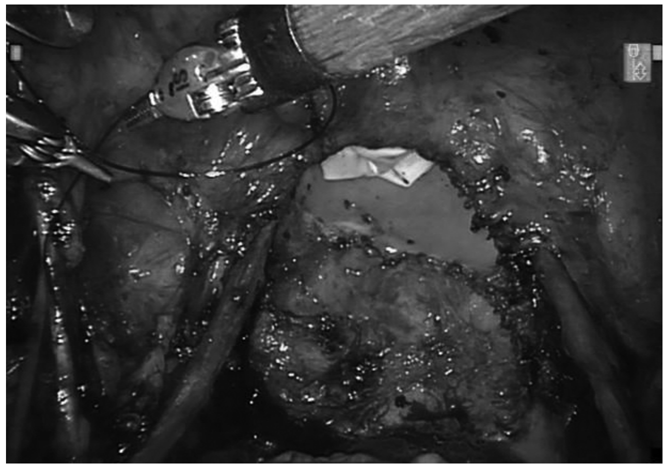

Figure 10. Vaginal cuff closure with intracorporeal tying.

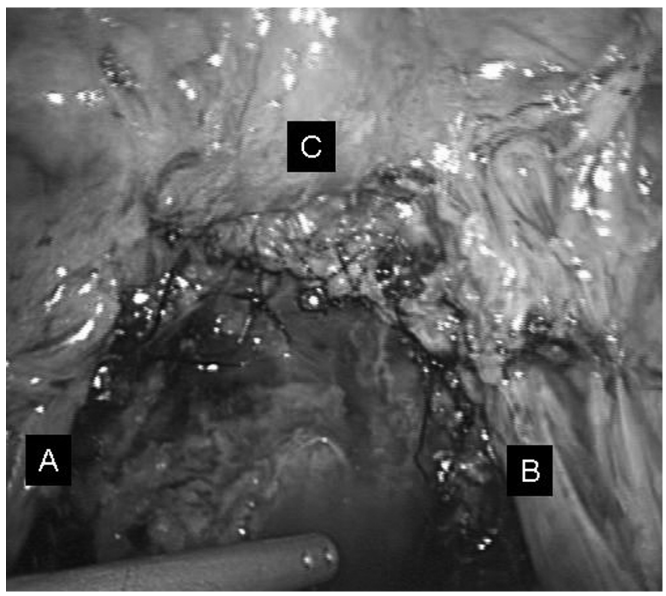

Figure 11. Panoramic view of the pelvis after removal of the specimen and vaginal closure. Both ureters (A and B) have been dissected to the level of the bladder.

Postoperative Care

Postoperatively, early ambulation and oral intake are encouraged. We routinely use subcutaneous heparin, low molecular weight heparin, or pneumatic compression devices until patients are fully ambulatory. The patients were discharged home on the second or third postoperative day with a Foley catheter in place. The catheter was removed in the office 7 to 10 days after the surgery.

Statistical Analysis

Comparative analysis was performed using Statview software (SAS, North Carolina). The outcomes from the laparoscopic radical and robotic-assisted groups were compared using Fisher's exact test and the chi-squared test for categorical variables and 2 sample Student *t* tests for continuous variables. $P < 0.05$ was considered significant in all cases.

RESULTS

A total of forty seven patients met our inclusion criteria and had either TLRH or RRH with pelvic lymphadenectomy performed. RRH was attempted in 17 patients. Upon careful review, four patients in the RRH group were excluded from the analysis. Three of these 4 patients had

Table 1.
Patient Characteristics

	RRH (n = 13)	LRH (n = 30)
Age (years)	54.8 (39–78)	46.8 (29–63)
Preoperative Diagnosis		
Adenocarcinoma	4	8
Adenosquamous	0	2
Glassy cell	0	1
Squamous	9	19
Stage IA1	1	1
IA2	2	8
IB1	8	17
IB2	1	2
IIA	1	2
Lymphovascular Space Involvement	9	16
Positive Pelvic Lymph Nodes	1	3

Table 2.
Clinical Variables and Outcomes

	RRH (n = 13)	LRH (n = 30)	P
Mean Duration of Surgery (minutes)	323 (232–453)	318 (200–464)	NS
Intraoperative Complications	2	2	NS
Mean Estimated Blood Loss (mL)	157 (50–400)	200 (100–500)	NS
Mean Length of Hospital Stay (days)	2.7 (1–6)	3.8 (2–11)	NS
Mean Total Number of Pelvic Nodes (n)	24.7 (11–51)	31 (10–61)	NS
Recurrence (n)	0	0	

only a portion of the entire procedure (pelvic lymphadenectomy, bilateral ureterolysis or part of the parametrial dissection) performed robotically with the majority of the procedure performed laparoscopically. The fourth case was a modified radical hysterectomy. The remaining 13 cases comprised our RRH with bilateral pelvic lymphadenectomy cohort performed between April 2006 and January 2008. TLRH was performed in 30 patients between August 2000 and June 2006.

The patient groups were similar with respect to age. There were no differences in clinical tumor characteristics, such as stage, histology, and lympho-vascular space involvement between the two groups **(Table 1)**. Two patients in the RRH group underwent neoadjuvant chemotherapy, while only one patient in the TLRH group did so.

As shown in **Table 2**, mean operative time, estimated blood loss, and length of postoperative stay were similar between the 2 patient groups ($P > 0.05$). The mean operative time for TLRH with pelvic lymphadenectomy leveled off at 318 minutes and did not significantly decrease over time. A decrease in the estimated blood loss was observed.[10] Mean operative time for RRH changed little over the study period as well **(Figure 12)**. In contrast, the mean time for robotic docking was 12 minutes (range 4–30 min), and decreased as the surgeon gained experience **(Figure 13)**.

Three patients in the RRH group and 6 in the TLRH group underwent paraaortic lymphadenectomy before the hysterectomy due to paraaortic lymph node enlargement detected on preoperative imaging, or cervical lesions with a diameter greater than 2 cm. Metastatic disease was not detected in these 9 patients. Seven patients in the TLRH

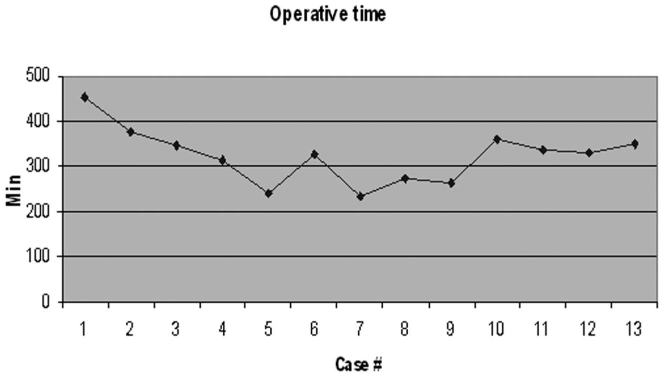

Figure 12. Duration of surgery.

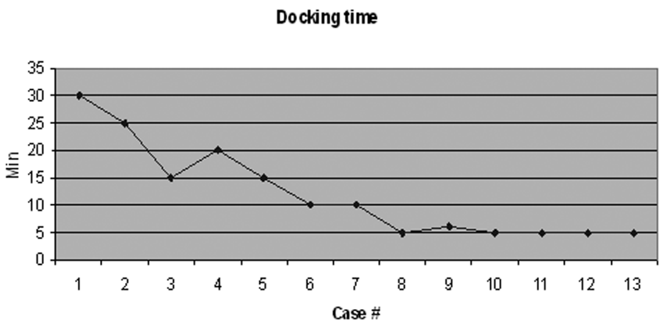

Figure 13. Robot docking time.

group and one patient in the RRH group had ovary-sparing procedures. An appendectomy was performed on one patient each in the RRH and TLRH groups. In addition, 2 patients in the TLRH group underwent umbilical hernia repair and one patient had a Bartholin's abscess excised. None of the patients in either group required conversion to laparotomy. The robotic group had 2 intraoperative incidental cystotomies, which occurred at the time of vaginal transection before specimen removal. One of these patients had extensive endometriosis at the anterior vaginal margin, and the other had vaginal tumor extension with significantly fore-shortened anterior vaginal fornix. In the TLRH group, 2 patients underwent inadvertent cystotomies at the time of laparoscopic bladder dissection of the anterior vagina. The complication was recognized intraoperatively in both cases and repaired laparoscopically.

Both patients had bilateral JJ ureteral stents placed intraoperatively and had an otherwise uncomplicated recovery. Outpatient cystoscopy, cystogram, and stent removal was performed on both patients 10 days later with no long-term sequela. There were no vascular, bowel or ureteral injuries noted in either group.

Postoperative complications in the RRH group included one case of postoperative ileus, prolonged urinary retention, vaginal lymph drainage, and *C. difficile* colitis. The TLRH group had complications including two cases of deep vein thrombosis pulmonary embolism and *C. difficile* colitis and cases of ileus, and prolonged urinary retention **(Table 3)**.

One patient in the laparoscopic group had a positive vaginal margin. The mean yield of the pelvic lymph nodes was 24.7 in the RRH group and 31 in the TLRH group **(Table 2)**. There were no recurrences in either group with a mean follow-up time of 12 months in the RRH group and 29 months in the TLRH group.

DISCUSSION

This study directly compare RRH to TLRH. We did not note a significant difference between RRH and TLRH with respect to operative time, operative blood loss, length of hospital stay, or complication profile. The only intraoperative complication observed in both groups was cystotomy. Along with ureteral injury, these are the most common reported intraoperative complications associated with laparoscopic radical hysterectomy.[20,21] Bladder injuries in the TLRH group were neither related to radical parametrial resection nor to lymph node dissection. Similarly, in the RRH group, cystotomies were not related to the use of the robot system and took place at the time of the vaginal specimen removal. Both patients had vaginal disease involvement significantly complicating the dissection. None of the patients had a recurrence with a mean follow-up of 12 months in the robotic group and 29 months in the laparoscopic group.

Several recent publications strongly demonstrated that computer-assisted surgical approaches are becoming in-

Table 3.
Postoperative Complications

Complication	RRH (N = 13)	TLRH (N = 30)	P
Ileus	1	1	
PE, DVT*	0	2	
Urinary retention	1	1	
Vaginal lymph drainage	1	0	
C. Difficile Colitis	1	2	
Total	4	6	NS

*PE = pulmonary embolism, DVT = deep vein thrombosis.

creasingly feasible. In fact, our evidence, as well as the evidence of others, supports robotic surgery as a more attractive option, both for the surgeon and the patient. However, questions remain, including whether the robot provides any additional benefits to a surgeon who is an experienced laparoscopist and comfortable performing the most advanced gynecologic procedures using traditional laparoscopy, whether there is an advantage for an inexperienced laparoscopic surgeon to use robotic technology compared with traditional laparoscopic instrumentation, and what the learning curve is with either approach.

Several gynecologic surgeons have reported their experiences performing tubal reanastomosis,[22] salpingo-oophorectomy,[23] and hysterectomy[24] using an earlier robotic system. Most recently, Nezhat and colleagues[25] and Koh and colleagues[26] reported their experiences performing various advanced gynecologic procedures using the current generation of the da Vinci system. The largest experience using robotic systems for the surgical treatment of gynecologic cancers was reported by J. Magrina of the Mayo Clinic (Scottsdale, AZ). It comprised 142 patients treated surgically with the da Vinci robotic system for various primary and recurrent gynecologic malignancies.[23]

Eight patients in this study underwent RRH. The mean operating time was 218 minutes, estimated blood loss was 176 mL, and the hospitalization time was 1.9 days. The lymph node count was 27.9, with no intraoperative or postoperative complications. The authors concluded that robotic surgery is preferable to conventional laparoscopy for gynecologic oncology procedures because it provides improved dexterity, 3-dimensional viewing, surgical precision with tremor filtration, a comfortable fatigue-reducing console, and greater motion freedom allowed by the robotic instruments, which significantly reduced ergonomic problems associated with conventional laparoscopic equipment.

Boggess[27] reported similar data after performing RRH at the University of North Carolina. The author performed 13 RRH procedures that were compared with 48 historic abdominal radical hysterectomies. Lymph node yield was significantly higher in the robotic group (33 vs. 22), and operative time was similar between the groups. Blood loss as well as transfusion requirements in the robotic group were significantly less than that in the abdominal group. None of the robotic procedures were converted to laparotomy. All patients who underwent robotic RRH were discharged the day after surgery with significantly lower pain medication requirements than patients who underwent an open procedure.

The gynecologic oncology community has been appropriately cautious in accepting laparoscopic procedures, including TLRH, as a standard of care due to a lack of oncological outcome data.[28] Many questions regarding the adequacy of the laparoscopic approach still remain. Data on specimen size, margin adequacy, and parametria appear to be equivalent.[29–31] With the follow-up data in some of the studies approaching or exceeding 5 years, some of these questions are being answered. In none of these studies does the recurrence rate in the laparoscopically managed patients exceed that of the patients who underwent an open procedure.[6,8,20,29,30,32–34]

As was the case with laparoscopy 10 years ago, there is simultaneous excitement and caution in accepting robotics. Safety, feasibility, or survival data are just being accumulated.

Abdominal radical hysterectomy continues to be the most common surgical approach in treatment of an early stage carcinoma of the cervix. The role of laparoscopy in this setting is to offer all of the benefits of a minimally invasive approach, namely faster recovery, decreased blood loss and transfusion rates, and decreased postoperative pain, while maintaining the excellent oncological outcomes of an open approach. While all gynecologic surgeons taking care of patients with early cervical cancer are trained to perform abdominal radical hysterectomy, only a few are comfortable performing the procedure laparoscopically. TLRH is one of the most challenging laparoscopic procedures in gynecologic oncology, requiring significant technical expertise and experience. Because this is a relatively new technique, the number of cases required to obtain proficiency is not known. As more centers perform these procedures, report their experiences, and the technique itself is developed, standardized, and taught systematically, we will better understand the learning curve required for both TLRH and RRH.

The available urological data suggest that the intuitive nature of the robotic approach may provide a significant advantage in terms of its learning curve especially to surgeons with little or no advanced laparoscopic experience. Ahlering and colleagues[15] reported the initial experience of performing robotic-assisted radical prostatectomy by an experienced abdominal surgeon without any laparoscopic experience. It required only 12 cases to achieve proficiency in performing radical prostatectomy with robotic assistance. Robotic-assisted prostatectomy outcomes were comparable to those achieved by a skilled laparoscopic surgeon after 100 cases of laparoscopic radical prostatectomies. As the number of early cervical cancer cases is decreasing, fast acquisition of advanced endoscopic skills is paramount. Therefore, the robotic interface, which allows for significant shortening of the learning curve, may make a minimally invasive approach possible even in centers with very few cases of early cervical cancer.

The robotic systems have their own drawbacks; most commonly mentioned are the absence of tensile feedback, the complexity of the system, the size of the system, and the cost. Robotic technology is developing rapidly, and new instruments, smaller arms, the addition of a fourth arm and tactile feedback are already becoming available. Currently, operations performed with a robot are expensive, but the widespread use of this technology, combined with the shorter hospital stay, hopefully, will lead to an overall, and substantial, decrease in cost.[35]

CONCLUSION

Though robotic technology has revolutionized urologists' treatment of prostate cancer, its use in the treatment of cervical cancer by gynecologic oncologists is still in development. We have found that the substantial magnification, dexterity, and flexibility offered by the robotic system significantly simplify the most difficult stages of radical hysterectomy and pelvic lymphadenectomy, which would enable a greater number of surgeons to perform this procedure laparoscopically. As we continue to develop new surgical techniques, we cannot compromise the patient's safety or oncological outcome, so we should subject these newer approaches to thorough evaluation before they become the standard.

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