Robotic radical hysterectomy
A literature review

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Advanced laparoscopic procedures are increas-
ingly being used as an alternative to laparo-
tomy in gynecologic surgery. Several reviews
have been completed that examine the advan-
tages and drawbacks of this technique. Robotic
technology offers the promise of overcoming
many of the shortcomings of laparoscopy, while
preserving classic operative techniques. This
review article summarizes some of the most
recent literature provided in the arena of robo-
tic assisted radical hysterectomy for the treat-
ment of cervical or endometrial cancer.

Key words: Gynecologic surgical procedures -
Hysterectomy - Video-assisted surgery.

For over a century, radical hysterectomy
(RH) has been the treatment of choice
for early stage cervical cancer.1 This proce-
dure has traditionally been performed via
laparotomy. This approach has been associ-
ated with a number of potential complica-
tions and procedure-associated morbidity
including increased blood loss and transfu-
sion rates, wound complications, prolonged
time to recovery, and long-term bladder and
bowel dysfunction.2-7

Laparoscopic RH was first described in
1992 8 and since that date, several reports
elucidate the advantages of laparoscopic
surgery over open surgery. While technical-
ly challenging with a steep learning curve,
clear advantages include decreased operating
time, lower patient morbidity, shorter length
of inpatient hospitalization, less blood loss,
improved cosmesis, and comparable out-
comes to laparotomy with regards to recur-
rence rates and lymph node yield.9-13

Although seemingly more advantageous, the
laparoscopic approach is not without its limi-
tations as well. Shortcomings include limita-
tion to four degrees of motion, rigid instru-
ments, and reduced depth perception. Among
other disadvantages frequently dis-
cussed are surgeons’ positional discomfort,
instrument rigidity, difficulty in achieving
adequate instrument triangulation, and two-
dimensional visualization.

Robotic surgery has emerged as an alterna-
tive option in minimally invasive surgery.
There is increasing evidence supporting the
use of robotic surgery for radical hysterectomy,
which allows a full seven degrees of motion,
employs three-dimensional vision, and reduces
tremor through motion-dampening controls.
The aim of this paper was to review the literature on robotic radical hysterectomy in the treatment of patients with early-stage cervical cancer and to provide updated information to an article previously published.

Methods

A literature search was conducted of all articles published in English from January 1998 to December 2008. Terms searched included “robotic surgery”, “robotic gynecologic surgery”, “robotic oncology”, and “radical robotic hysterectomy”. Articles were selected based on: English language, procedure categorized strictly by a robotic approach, and procedure catalogued as radical hysterectomy type II or III. Articles were excluded if the subject of discussion was focused on robotic surgery performed for benign indications, unspecified surgical details, or unspecified type of tumor.

Radical robotic hysterectomy

A Foley catheter is inserted in the bladder and a V-care (ConMed, Utica, NY) uterine manipulator is placed. Under direct visualization, a 12-mm bladeless trocar is placed 2 cm below the left costal margin at the midclavicular line. This port is used by the assistant during the procedure. Insufflation is completed once placement is confirmed. The abdomen must be fully insufflated before placement of additional trocars. The patient is then placed in steep Trendelenburg. A second 12-mm bladeless trocar is placed in the midline approximately three centimeters above the umbilicus under direct visualization. Three additional robotic trocars are then inserted. The first is placed 15° below and 8 centimeters to the left of the assistant trocar; another 8 centimeters to the right of the umbilical trocar; a third eight centimeters to the right and 15° below the second robotic trocar. The robot is then docked and the camera and robotic arms are appropriately positioned. An EndoWrist Maryland bipolar grasper is installed on the left hand and an EndoWrist monopolar curved scissors on the right hand. Typically, an EndoWrist Cadiere forceps is placed in the fourth arm.

Using the da Vinci® robotic surgical system, a type III radical hysterectomy is performed in a similar fashion to the traditional open technique. Initially, the round ligaments are transected bilaterally. The peritoneum is incised over the psoas muscle immediately lateral to the infundibulopelvic ligament and the ureters are identified. Suspicious-appearing lymph nodes are then removed and sent for frozen pathology, as the procedure is aborted in the presence of metastatic disease. Next, the paravesical and pararectal spaces are identified and exposed. The uterine vessels are identified and transected at the point of origin from the iliac vessels. The bladder is then mobilized inferiorly. The ureters are freed from their medial attachments to the peritoneum and then dissected off the parametrium down to their insertion into the bladder. The vesicouterine ligament is divided at its lateral aspect and the bladder is further mobilized to provide ample vaginal margins.

Results

Using the inclusion criteria noted above, ten articles were identified. A total of 298 patients were included from those articles. In 2006, Sert and Abeler published the first case of a robotic radical hysterectomy in a patient with cervical cancer. The operative time was 7 hours and 25 minutes. Total estimated blood loss was 200 mL. No residual tumor was noted in the surgical specimen. Fifteen pelvic lymph nodes were retrieved and none contained metastatic disease. Four weeks after the surgery, the patient was noted to be doing well.

In September 2007, Sert and Abeler published a small series comparing 7 patients who underwent robotic radical hysterectomy with 8 patients (1 patient was excluded from the analysis because of equipment failure) who underwent radical hysterectomy by laparoscopy. In the robotic surgery group, 3 patients had stage IA2 and 4 patients had...
stage IB1 cervical cancer. This was similar to the laparoscopy group in which 2 patients were stage 1A1 and 5 patients were stage 1B1. The mean age and mean Body Mass Index (BMI) between the two groups were similar. Mean operation (console) time for the robotic surgery group was 241 (range 160-445) minutes. The mean operative time for the laparoscopy group was 300 (range 225-375) minutes. There was no statistical difference in surgery time between the two groups (P=0.165). The most significant findings were less bleeding (P=0.038) and shorter hospital stay (P=0.004) in the robotic surgery group. Postoperative complications included lymphocyst formation in two patients in the robotic surgery group and three patients in the laparoscopy group. In addition, one patient in the laparoscopy group developed a compartment syndrome that necessitated bilateral fasciotomy. This was the first case-control study completed that demonstrated results comparing total laparoscopic versus robotic laparoscopic radical hysterectomy. With minimal differences noted between the two techniques in terms of outcome, the authors site the clear benefit of the robotic technique with regards to three-dimensional visibility and improved surgical precision.

A third review on robotic radical hysterectomy was published in February 2008. The cervical cancer staging breakdown of the ten patients reviewed included one patient with stage IA2 disease and nine patients with stage IB1 disease. Six patients had squamous cell carcinoma and 4 patients had adenocarcinoma of the cervix. All operations were completed robotically with no conversions to laparotomy. The mean patient age was 49.9 years and the mean BMI was 23.6 kg/m². The mean docking time, from examination under anesthesia to complete docking of the robot, was 26 minutes. The mean operative time, from docking to undocking, was 207 minutes. The mean estimated blood loss was 355 ml. The mean number of lymph nodes retrieved was 27.6 and the average length of hospital stay was 7.9 days. No intraoperative complications occurred however; one patient developed a postoperative pneumonia. The median follow-up period was nine months and no relapses were documented at the time of article publication. These authors were able to successfully demonstrate the safety and effectiveness of robotic radical hysterectomy as an alternate to the laparoscopic approach.

Magrina et al. published a comparison of perioperative results of patients undergoing radical hysterectomy by robotics, laparoscopy, and laparotomy. Patients were treated during a 41-month period. The robotic surgery group comprised 27 patients; 18 with cervical cancer and 9 with endometrial cancer. The laparoscopic surgery group evaluated 31 patients; 18 with cervical cancer and 13 with endometrial cancer. The laparotomy group included 35 patients; 21 with cervical cancer and 14 with endometrial cancer. There were no statistically significant differences among the 3 groups with respect to mean patient age or BMI. The mean operating times for the patients undergoing robotic, laparoscopic, and laparotomy radical hysterectomy were 189.6, 220.4, and 166.8 minutes respectively; the mean blood loss was 133.1, 208.4, and 443.6 mL, respectively; and the mean length of hospital stay was 1.7, 2.4, and 3.6 days, respectively. These differences were statistically significant amongst the groups (P<0.001). No conversions to laparotomy occurred in the robotic surgery group or the laparoscopic surgery group. Intraoperative complications occurred in three patients: one patient in the laparoscopic group had a rectotomy secondary to an endometriotic lesion of the rectal wall and two patients in the laparotomy group had excessive bleeding. No patients in the robotic surgery group had intraoperative complications. No statistically significant differences occurred among the three groups in postoperative complications. At a mean follow up of 31.1 months, none of the patients with cervical cancer had experienced recurrence.

In June 2008, Fanning et al. reviewed their experience with twenty patients who underwent class III robotic radical hysterectomy with the diagnosis of stage IB-IIA cervical cancer. The median age of these patients was 44 years and median weight was 69.9
Sixty-five percent of the patients had significant medical comorbidities including hypertension, chronic obstructive pulmonary disease, and cardiac disease. Forty percent of these patients had a prior history of abdominal surgery. There were no conversions to laparotomy or conventional laparoscopy. Median surgery time was 390 minutes. The authors noted that the median time for the last five cases was 270 minutes, consistent with improved skill developed with experience. Median blood loss was 300 mL. No patients required blood transfusions. The median lymph node count was 18. All patients were discharged the day after surgery. Authors reported a cystotomy as their only intraoperative complication. This was ultimately repaired using the robot. The only postoperative complication was a ureterovaginal fistula which was treated conservatively with a stent. Three patients received radiotherapy and within a mean follow up period of two years, 90% of patients were free of disease.

Boggess et al. examined 51 patients with early stage cervical cancer who underwent robotic assisted hysterectomy (RAH), compared to 49 historic controls who underwent open (ORH) type III radical hysterectomy in the treatment of early-stage cervical cancer. There were no differences with regard to patient demographics. There were significant differences between the groups with regard to operative blood loss (P<0.0001), operative time (P=0.0002), and lymph node retrieval (P=0.0003), all of which were in favor of the RAH cohort. There were significantly fewer complications in the RAH group. All patients with RAH were discharged on postoperative day one, compared with a 3.2-day average hospitalization for the ORH cohort.

Subsequently, Ko et al. published their experience with robotic radical hysterectomy (RAH) in comparison to the short-term surgical outcomes of an ORH. This publication included 16 patients who had a robotic radical hysterectomy and 32 controls who underwent a radical hysterectomy by laparotomy. Patients were included if they had stage IA1 to IIA squamous cell carcinoma or adenocarcinoma of the cervix. The mean age was 42.3 years and the mean BMI was 27.6. The groups did not differ significantly in age, body mass index, stage, or histology. The mean operative time was significantly longer for RAH than ORH (4:50 vs. 3:39 h, P=0.0002). The mean estimated blood loss was significantly less for RAH than ORH (81.9 vs. 665.6 mL, P<0.0001). No intra-operative complications occurred within the RAH and one ureteral transection in the ORH group. No conversions to laparotomy were required in the robotics group. Mean length of stay was significantly shorter for the RAH group (P<0.0001).

In 2008, an article was published comparing 30 cases of laparoscopic radical hysterectomy versus 13 cases of radical robotic hysterectomy. There were no differences between groups for age, tumor stage, tumor histology and 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). None of the robotic or laparoscopic procedures required conversion to laparotomy. Two cystotomies were described as intra-operative complications. Postoperative complications included: one case of postoperative ileus, prolonged urinary retention, vaginal lymph drainage and a case of colitis due to clostridium difficile. All patients were disease free at the time of their last follow up.

In 2009, the largest analysis to date was completed evaluating the short and long term morbidity data related to robotic assisted laparoscopic radical hysterectomies. The review included 80 women; 64 with cervical cancer (stage 1A1 N=4, stage 1A2 N=10, stage 1B1 N=44, and stage 2A N=6) and 16 with stage 2 endometrial cancer. Four women initially staged as 1A1 cervical cancer had a radical hysterectomy after final pathology review due to difficulties in the preoperative staging (adenocarcinoma and/or multifocality and/or intracervical lesions proximal to cone specimens). The procedures were performed by either of three surgeons (surgeon A, N=38; surgeon B, N=22; surgeon C, N=20). Median age was 48 years and median body mass index
was 24.4 kg/m². Sixteen women had a history of one or more previous laparotomies. In eleven women adhesiolysis added a median time of 20 min to the procedure. Time for surgery significantly improved as more procedures were completed by each surgeon. Median blood loss during surgery was 150 mL.

The authors also noted, time for surgery was significantly related to the body mass index of the patients (P<0.01). Excluding the first 10 procedures for each surgeon (initial learning curve), the median time for surgery (all surgeons together) was 219 minutes for women with the lowest BMI (range 17.5-24.4) and 279 minutes for women with the highest BMI (range 24.8-39.0). The authors did not mention the number of retrieved lymph nodes and that specific effect on the surgical time. Intraoperative complications occurred in 8 women, 10% of them with genitofemoral nerve injury.

All women had the early follow up (1-3 months) and 43 of 46 eligible women (93%) had the long term follow up (>12 months). One woman was lost due to high age, one had moved abroad, and a 72-year-old woman with disseminated endometrial cancer on autopsy died of pulmonary embolism 31 days after surgery. Thirty-three of 80 women (41%) had an uneventful peri/postoperative period, whereas the remainder experienced one or more mild complication. Five women were resutured for vaginal cuff dehiscence. One woman had a ureter stricture temporarily treated with a stent. One woman experienced reversible partial obturator nerve palsy. In two cases the small bowel was incarcerated through the peritoneal opening at the site of the 15 mm trocar despite an intact sutured fascia. Two women had a partial rupture of the rectus muscle close to the site of a previous robotic trocar.

Significantly fewer women had complications when comparing the second and first half of the series of operations for the respective surgeons (28 of 40 compared with 17 of 40, P=0.02). For the latter analyses lymphatic complications were excluded as they were evenly distributed over time among surgeons and were unrelated to the number of retrieved nodes. Three recurrences have been identified after 7, 15 and 14 months respectively. A 65-year-old woman with stage IB1 lymphoepithelioma-like squamous epithelial cancer with no sentinel node procedure had a nodal recurrence in the deep presacral/pararectal area. A 41-year-old woman with stage IB1 medium grade squamous epithelial cancer and postoperative pelvic radiation therapy due to multiple metastatic pelvic nodes had a paraaortic nodal recurrence. No pelvic or paraaortic nodes (benign or metastatic) had detectable uptake of radiotracer and a paraaortic lymph node dissection was not performed. A 26 year old woman with a stage IB1 squamous epithelial cancer and no postoperative radiation therapy recurred with pulmonary metastases.

Lowe et al. published a multi-instructional analysis of 42 patients who underwent a type II or III robotic-assisted radical hysterectomy for cervical cancer. Characteristically none of the surgeons had previously performed a laparoscopic radical hysterectomy prior to implementation of robotics at their respective institutions. Ten patients underwent a robotic assisted type II radical hysterectomy and thirty-two underwent a robotic-assisted type III radical hysterectomy. The median age was 41 and the median BMI was 25.1. The distribution of stage included one patient with stage IA1 disease with vascular space invasion, seven patients (17%) with stage IA2 disease, twenty-eight patients (67%) with stage IB1 disease, and six patients (14%) with stage IB2 disease. One-half of the patients reported a prior abdominal surgery. One or more medical comorbidities such as diabetes, hypertension, chronic obstructive pulmonary disease, and obesity were reported in approximately one third of the patients. The overall median operative time was 215 minutes, for type II procedures was 166 min and for type III the operative time was 216 min. The overall median estimated blood loss was 50 mL, with a mean of 40 mL and 50 mL for type II and III procedures respectively. No patient received a blood transfusion intra-operatively or postoperatively. The overall median lymph node count was twenty-five. The median hospital stay was one day for either hysterectomy type.
Positive lymph nodes were detected in 12% of all patients, including patients from both groups. No positive parametrial or vaginal margins were reported. Adjuvant pelvic radiotherapy or chemoradiation was given to 14% of all patients. Data not analyzed included median tumor diameter, median length of the parametria, median length of the vaginal margin, or number of parametrial lymph nodes. Indwelling bladder catheters were removed by postoperative day seven in all patients but two (4.8%). These two patients received indwelling or self-intermittent catheterization. Bladder dysfunction resolved in one patient by postoperative day 14 and the other by postoperative day 21.

Due to the small number of cases, a formal learning curve assessment was not performed. Operative and postoperative complications associated with robotic assisted radical hysterectomy were collected and analyzed. Intra-operative complications occurred in two patients (4.8%) and included one conversion to laparotomy to repair a bladder injury adjacent to the trigone and one ureteral injury. Postoperative complications were reported in 12% of the patients and included a deep venous thrombosis (DVT, 2.4%), pyelonephritis (2.4%), prolonged bladder catheterization of 21 days (2.4%), and infection (4.8%). No patients required readmission to the hospital after discharge. No patient experienced a bowel injury or bowel obstruction, incisional hernia or dehiscence, intensive care unit (ICU) admission, symptomatic lymphocyst, or reoperation from a complication of robotic surgery. The conversion rate to laparotomy was 2.8% among all patients.

The last article reviewed included 32 patients in a case matched analysis of robotic radical hysterectomy with lymphadenectomy compared with seventeen patients who underwent laparoscopy and fourteen who had a laparotomy. Histological outcomes regarding stage and cancer type were not statistically different among the groups. The mean age of patients in the robotic cohort was not different from that of the laparoscopic cohort, but was significantly higher than the laparotomy cohort (55 vs. 42 years, P=0.004). There was no difference in age between the laparotomy and laparoscopic groups. BMI was comparable between patients in all three cohorts. Operative time was defined by the anesthesiologist as the time between the insertion of the foley catheter and the closing of the last trocar site. Operative time for the robotic group was 2.4±0.8 hours, which was not significantly different from the laparoscopic group at 2.2±0.7 hours, nor the laparotomy group at 1.9±0.6 hours (P=0.05). The estimated blood loss for patients undergoing robotic hysterectomy was 130±119.4 mL. This was significantly less than the laparotomy group, but not the laparoscopic group. The robotic group had an average of 32.4 total nodes retrieved, as compared to 18.6 and 25.7 nodes retrieved in the laparoscopy and laparotomy cohorts, respectively. The number of nodes retrieved robotically was statistically greater than that retrieved laparoscopically or via laparotomy (P<0.0001, P<0.05).

The overall positive surgical margin rate was 15.6% for the robotic group, 17.7% for the laparoscopic group and 21.4% for the laparotomy group. This was not found to be statistically different across cohorts. The only intraoperative complication was a small cystotomy in a patient with three prior cesarean sections. The cystotomy was recognized and repaired robotically. In the robotic group, there were six cases noted to have postoperative complications, including atelectasis, fever, wound cellulitis, ileus, cuff abscess, and pneumonia. There were two cystotomies in the laparoscopic group that were managed laparoscopically. Other complications included postoperative fever, hypokalemia, ileus, and fistulae formation. The incidence of postoperative complications was less in the robotic cohort at 18.8% than either the laparoscopic cohort at 23.5% or the laparotomy cohort at 28.6%. The overall incidence of complications was 21.9% in the robotic cohort, 35.3% in the laparoscopic cohort, and 28.6% in the laparotomy cohort. While the differences in complication rates were not statistically significant the authors note them to be clinically relevant.

Patients in the robotic cohort experienced significantly shorter hospital stay in compar-
Isterectomia radicale robotica: review della letteratura

Le procedure laparoscopiche hanno avuto un notevole incremento e possono essere un’alternativa agli
accessi laporotomici in chirurgia ginecologica. Numerose review sono state complete per esaminare i vantaggi e gli svantaggi di questa tecnica. La tecnologia robotica è attualmente in grado di offrire interessanti vantaggi chirurgici. Questa review raggruppa i più recenti lavori della letteratura su argomenti di chirurgia robotica assistita per le isterecotomie radicali nel trattamento delle neoplasie dell’utero.

Parole chiave: Procedure chirurgiche ginecologiche - Isterectomia - Chirurgia videoassistita.

References