Perioperative Outcomes in Robotic-Assisted Versus Conventional Laparoscopic Treatment of Endometrial Cancer

Abstract

Objective: To compare perioperative outcomes of robotic-assisted (RALS) versus conventional laparoscopic surgery (CLS) in endometrial cancer.

Methods: This is a retrospective analysis of a prospectively maintained database of procedures performed from January 2009 to January 2014 by a single surgeon experienced in both minimally invasive techniques. One hundred and five patients underwent surgical staging of endometrial cancer via either conventional or robotic-assisted laparoscopy. Characteristics such as age, body mass index (BMI), prior abdominal surgery, number of comorbidities, stage of disease, and extent of surgery were compared. Outcomes, including estimated blood loss (EBL), operating room time (ORT), length of stay (LOS), number of lymph nodes resected, conversion rates, and intra-operative and postoperative complications were analyzed.

Results: Fifty-seven patients received RALS; 48 had CLS. RALS patients had a higher mean BMI (38.1 ± 11.8 vs. 30.1 ± 7.5 kg/m²; p=0.0003) and more comorbidities. Median ORT was longer for RALS patients [277 (135-660) vs. 223.5 (120-547) minutes; p=0.0012]. RALS ORT remained significantly longer for BMI ≥ 25 to <30, and appeared near significance in the BMI<25 and BMI>35 groups. Only in the BMI ≥ 30 to <35 group there was no apparent difference in the ORT. Among patients with endometrioid adenocarcinoma histology, ORT was longer in the RALS group [273 (135-660) vs. 222 (120-420) minutes; p=0.0018]. There was no difference in EBL or LOS between the two surgical approaches.

Conclusions: In our experience, perioperative outcomes of endometrial cancer staging are comparable between RALS and CL. Furthermore, the overall ORT is significantly longer in the RALS group. Further studies of patients stratified by BMI are needed.

Keywords: Endometrial cancer; Perioperative outcomes; Robotic-assisted laparoscopy; Conventional laparoscopy

Introduction

Endometrial cancer is the most common gynecologic cancer in the United States. In 2015, approximately 54,870 new cases of uterine cancer are estimated to be diagnosed and about 10,170 deaths are projected [1]. The mean age of diagnosis is 63 years with a lifetime risk of approximately 2.7% [2]. The majority of uterine cancer is diagnosed at an early stage with an overall five-year survival of approximately 74-90% [3].

Minimally invasive techniques have taken a leading role in the treatment of gynecologic cancers. The introduction of robotic-assisted laparoscopic surgery (DaVinci®, Intuitive Surgical, CA) has brought a new wave of innovations to the surgical arena. Most advantages are its use in surgically-challenging cases, such as patients with prior abdominal surgeries, obesity, or severe adhesive disease [4]. Major institutions have included robotic-assisted laparoscopic surgery (RALS) as an option in the
treatment of malignancies, and the technique is now available in the majority of teaching institutions.

One reason for the sudden institutional uptake of RALS is the long learning curve associated with conventional laparoscopic surgery (CLS). RALS addresses common problems of CLS, such as fatigue and muscle strain, that are minimized by having the surgeon sit ergonomically at a console, improved imaging and instrument control, by eliminating 2-D imaging and counterintuitive hand movements. Several studies have described the large number of surgeries needed to become proficient in CLS for treatment of gynecological cancers [5,6].

There is limited data comparing outcomes of RALS to CLS for treatment of endometrial cancer. Most studies have compared RALS to laparotomy [7-13]. In addition, most studies comparing the various surgical techniques include several surgeons, whose potential differences in skill level may introduce a confounding variable into results.

Recently, RALS has come under scrutiny: it has been reported that laparotomy and CLS are more cost-effective, while the literature showing surgical benefits of RALS over CLS in endometrial cancer is limited [14-18].

There has been an exponential increase in the use of RALS for gynecological surgeries since its FDA approval in 2005. In all specialties, studies should define any scenarios, including patient characteristics and procedure types, in which RALS provides clear benefits [18]. Such information will allow appropriate treatment choices to be made, for the physical health of patients and financial wellbeing of the healthcare system. We report the experience of a single surgeon with robotic-assisted versus conventional laparoscopy in early and advanced stage endometrial cancer and compare perioperative outcomes, including intraoperative and postoperative complications, as well as oncologic outcomes such as lymph node sampling.

Materials and Methods

This is a retrospective analysis of a prospectively maintained database from January 2009 to January 2014 of conventional laparoscopy (CL) and robotic-assisted laparoscopy (RALS) performed for the surgical staging of endometrial carcinoma. Institutional review board approval was obtained and data were collected from two urban university-affiliated community hospitals in the aforementioned time period. The same board-certified gynecologic oncologist performed the surgeries with the assistance of a fellow in minimally invasive gynecologic surgery and a resident.

Demographic data included age, race, body mass index (BMI, calculated as weight in kilograms/square of height in meters), and previous abdominal or pelvic surgical procedures. Surgical data included a description of the procedure performed; estimated blood loss (EBL) as the amount of fluid in the suction canister at the end of the procedure, minus the total amount of irrigation; operative time (ORT), defined as starting at the first surgical incision to the completion of all skin closures; intraoperative complications; postoperative complications; and length of stay (LOS) as measured in days, with patients discharged the day of surgery considered to have a LOS of 1 day. In all cases, the postoperative course was monitored for 30 days. Parameters such as the hospital length of stay (LOS) and postoperative complications were collected.

The surgical device used for RALS was the DaVinci® surgical platform (Intuitive Surgical, Ca). Within each group (CLR or RALS), techniques and instrumentation were uniformly employed. Complete details on surgical techniques and instrumentation have been published elsewhere [19-21].

The Wilcoxon rank sum test was used to compare median ORT, EBL and LOS between CLS and RALS groups overall and within the endometrioid and serous/clear cell histological subgroups. The Wilcoxon rank sum test was also used to compare median ORT between the CLS and RALS groups after stratification by BMI. The Fisher’s exact test was used to compare intraoperative and postoperative complications between the CLS and RALS groups. All statistical analyses were performed using SAS Version 9.2 (SAS Institute Inc., Cary, NC). For all estimates, the threshold for statistical significance was set at the 0.05 level of significance.

Results

One hundred five patients underwent minimally invasive endometrial cancer staging during the study period and were included; among them were 57 RALS and 48 CLS patients. The procedures included total hysterectomy, bilateral salpingo-oophorectomy, with or without pelvic and para-aortic lymphadenectomy, cystoscopy, and treatment of any associated pathology such as adhesions or endometriosis. Pelvic and para-aortic lymphadenectomy and partial omentectomy were performed based on the pre-operative histology and grade of the tumor as well as intra-operative determination of the depth of myometrial invasion [22].

As shown in Table 1, mean BMI in both treatment groups was above the obesity weight status; however, in the RALS group, it was significantly higher than in the CLS group (38.1 ± 11.8 vs. 30.1 ± 7.5; p=0.0003). The two groups were similar in age (RALS vs. CLS, 60.3 ± 10.2 vs. 63.1 ± 11.1, p=0.18). Each patient was categorized as having either 0-2 or ≥ 3 co-morbidities, with more RALS patients falling into the ≥ 3 category (p=0.0156). Thirty (54%) patients in the RALS group had undergone previous abdominal surgery versus 24 (55%) of the CLS patients; in this regard, the groups were statistically equivalent (p=0.92).

FIGO grade, stage, and histologic type of endometrial cancer are reviewed in Tables 1 and 2. The proportion of endometrioid to serous/clear cell histology was the same in both groups (p=0.9570), with endometrioid histology predominant at 83%. Pelvic lymphadenectomy was performed in 38/57 (66.7%) cases in the RALS group and 31/48 (64.58%) of the CLS group. Para-aortic lymphadenectomy was performed in 18/57 (31.6%) of the RALS group and 12/48 (25%) of the CLS group. There was no significant difference in mean number of lymph nodes resected in cases that had both pelvic and para-aortic lymph node resection between
Median ORT was significantly longer in the RALS group than in the CLS group [277 (135-660) vs. 223.5 (120-547) minutes; p=0.0012]. After stratifying both groups by BMI, ORT remained significantly longer for RALS vs. CLS when BMI was ≥ 25 and <30 [293 (171-453) vs. 222(120-268) minutes; p=0.0151]; in addition, longer ORT for RALS appeared to approach significance in both the BMI<25 and BMI>35 categories as well. Only in the BMI ≥ 30 and <35 group was there no appearance of a difference (see Table 3).

One conversion to laparotomy was performed in the RALS group. In that case, during pelvic lymphadenectomy, a patient with BMI of 45.8 kg/m² received a right external vein injury due to monopolar electrosurgical sparking; after a failed attempt to repair the injury robotically the procedure was converted to laparotomy [23]. One RALS patient with multiple co-morbidities suffered postoperative complications and prolonged hospitalization (LOS=21 days). She was first diagnosed with acute respiratory distress syndrome requiring intensive care unit treatment, and subsequently had pneumonia, a small bowel ileus, and urosepsis. These complications were managed medically.

Discussion
Surgical staging for endometrial cancer was traditionally
Table 3 Differences in ORT after BMI stratification.

<table>
<thead>
<tr>
<th>BMI &lt;25 (RALS N=13; CLS N=7)</th>
<th>Conventional laparoscopy ORT, minutes</th>
<th>Robotic-assisted laparoscopy ORT, minutes</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>224 [147-547]</td>
<td>278 [212-366]</td>
<td></td>
<td>0.1697</td>
</tr>
<tr>
<td>BMI ≥ 25 and &lt;30 (RALS N=14; CLS N=10)</td>
<td>222 [120-268]</td>
<td>294 [171-453]</td>
<td>0.0151</td>
</tr>
<tr>
<td>BMI ≥ 30 and &lt;35 (RALS N=9; CLS N=7)</td>
<td>228 [215-420]</td>
<td>239 [206-443]</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Table 4 Complications.

<table>
<thead>
<tr>
<th>Intraoperative Complications</th>
<th>Conventional laparoscopy</th>
<th>Robotic-assisted laparoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transection of left genitofemoral nerve</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Obturator nerve transection</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ureteral injury</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Right external iliac vein injury</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sigmoid thermal injury</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Cystotomy</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Postoperative Complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARDS, SBO, Urosepsis, Pneumonia</td>
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<td></td>
</tr>
<tr>
<td>Small bowel obstruction (SBO)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hydronephrosis (Ureteral Stricture)</td>
<td>1</td>
<td></td>
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<tr>
<td>Pelvic Hematoma</td>
<td>1</td>
<td></td>
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<tr>
<td>Vaginal cuff deshiscence</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Laparotomy conversions</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 Differences in ORT after BMI stratification. Table 4 Complications.

performed via laparotomy. With the advent of laparoscopy, novel instrumentation and new techniques, surgical staging for endometrial cancer has now evolved into a minimally invasive approach.

Laparoscopy has now become the standard of care for endometrial cancer surgery and its advantages over laparotomy are well documented [10,24]. The largest randomized study to date, comparing laparoscopy to laparotomy, the GOG Lap2 study, gave us an insight into the advantages of conventional laparoscopy over laparotomy when treating endometrial cancer [10,25,26]. The results showed that laparoscopic surgery is feasible and safe. Mean operative time was significantly longer in the CLS group, however the length of stay was significantly lower compared to laparotomy. The conversion to laparotomy occurred in 25.8% of cases, primarily because of poor exposure, and was dependent on BMI (17.5% among patients with a BMI of 25 or less, 26.5% among patients with a BMI of 34-35, and 57.1% among patients with a BMI greater than 40). Complication rates were similar regardless of the surgical approach [25,26].

It has been widely believed that the most likely candidates to benefit from minimally invasive techniques are the surgically challenging patients. Most endometrial cancer patients fit this description due to associated obesity, and subsequently, multiple co-morbidities. As obesity rate increases in the United States, endometrial cancer can also be expected to rise, making it vital to understanding the benefits of different minimally invasive surgical approaches.

Although RALS has not been compared prospectively to CLS in a randomized trial, RALS seems to have a shorter learning curve and similar benefits [27]. Furthermore, EBL appears lower in the RALS group [28]. Several studies have reported improved ORT and overall outcomes of RALS when compared to CLS for treatment of endometrial cancer [28-30]. Coronado et al. performed a retrospective review of 71 patients undergoing RALS and 84 patients undergoing CLS at a single institution [28]. The majority of their patients, similarly to our cohorts, had endometrioid adenocarcinoma; but in contrast, their surgeries had a lower mean rate of lymph node resection and lower mean BMI. They reported the operative time as the time lapse from when the patient was anesthetized until the end of the surgery, and reported a shorter mean ORT in the RALS group when compared to CLS [189.2 ± 35.4 vs. 218.2 ± 54.3 minutes, p=0.000]. Gehrig et al. performed a retrospective review of 49 obese patients undergoing RALS from 2008-2009 and compared them to a historic cohort of 32 obese patients undergoing CLS from 2004-2005 at a single institution by several surgeons [29]. Similar to our study, the majority of their patients had endometrioid adenocarcinoma and underwent lymph node resection. Although Gehrig et al. did not specify how ORT was determined, they reported a shorter mean ORT in the RALS group when compared to CLS [189 (111-263) vs. 215 (156-324) minutes, p=0.0004], and a lower mean EBL in the RALS group than in the CLS group [50 (25-300) vs. 150 (50-700), p ≤ 0.0001]. Boggess et al. performed a retrospective review of 103 patients that underwent RALS and compared them to a historic cohort of 81 patients that underwent CLS for endometrial cancer by a single surgeon [30]. However, they did not report on endometrial cancer type. The majority of their patients underwent pelvic and para-aortic lymph node resection with an average of 17.4 for pelvic and 6.3 for para-aortic in the laparoscopic group, and 20.5 and 12.0 in the robotic group, respectively. However, their robotic group had a lower BMI than our cohort. In this particular study, the ORT, measured from the time of skin incision to skin closure was reported to have a shorter mean ORT in the RALS group compared to CLS [191.2 ± 36.0 vs. 213.4 ± 34.7 minutes, p<0.0001] [30].

While the aforementioned studies reported improved ORT and other outcomes for RALS when compared to CLS, we found the opposite with respect to ORT, and no difference in other parameters. Our RALS group had a longer ORT than our CLS group [277 (135-660) vs. 223.5 (120-547) minutes, p=0.0012].

It is our belief that the current study provides a more significant
most studies evaluating minimally invasive treatments for endometrial cancer are small, retrospective studies comparing laparotomy to either RALS or CLS [7-9,11,12,32-35]. Our group has previously reported on similar outcomes when comparing RALS with CLS in other types of gynecologic cancer [20,21].

The main limitations of this study are its retrospective nature, and as discussed, its small sample size, especially in the number of comparable patients. Another limitation of the study, is that although a single surgeon performed the cases, fellows and residents were involved given that our practice is in a academic setting. There have been reports of over 26 minutes of total added time for teaching cases versus non-teaching cases [29]. One of this study’s strengths was that it followed results of a single surgeon experienced in both approaches, limiting the effect of different surgeons and their correspondingly different skills.

Given the high incidence of obesity in endometrial cancer, future studies should focus on determining which minimally invasive technique is most beneficial in this sub-group of patients. To date, we are aware of only one study comparing minimally invasive techniques in obese patients, which showed improved outcomes in RALS when compared to CLS [29]. In the current study, when stratifying by BMI, we observed that class III obese patients undergoing minimally invasive surgery have more postoperative complications than their non-obese counterparts, 6 (18%) vs. 1 (2%), p=0.038. This finding is different from Helm et al. who report no association between BMI and postop complications [36]. Although BMI can affect the type of surgery used and the types of complications, currently there are no large prospective studies from single surgeons comparing both. To our knowledge, this is the first report comparing outcomes between RALS and CLS in endometrial cancer staging performed by a single surgeon, with both groups of procedures occurring during the same time period.

In conclusion, there are many reports on improved outcomes with RALS over CLS. However, in the hands of a surgeon experienced in both techniques, we did not find any obvious advantage to RALS when performing surgical staging for endometrial cancer, other than the surgeon’s comfort during the procedure. While the long learning curve associated with conventional laparoscopy has kept many surgeons from embracing minimally invasive surgery, robotic-assisted laparoscopy will allow more surgeons to offer various techniques to their patients.


References


