Clinical Study

Comparison between Robot-Assisted Laparoscopic Hysterectomy and Total Laparoscopic Hysterectomy: A Cohort Study

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Objective. To compare the operative outcomes in patients who underwent robot-assisted total laparoscopic hysterectomy (RLH) versus total laparoscopic hysterectomy (TLH). **Study Design.** Retrospective chart review. All women who underwent RLH in hospital A and TLH in hospital B by a single surgeon were included. **Results.** 136 patients were included (73 in the RLH group and 63 in the TLH group). There were no conversions to laparotomy in the RLH group versus 7 (11.1%) in the TLH group ($P = 0.004$). The mean induction time was significantly greater (by 6 minutes) for RLH, independent of docking time, as compared to TLH ($P < 0.001$). Total procedure time was significantly less in the RLH group (82 minutes) as compared to TLH (108 minutes) ($P = 0.001$). Mean blood loss was less for RLH (46 mL) as compared to TLH (114 mL) ($P < 0.001$). A greater number of patients who underwent RLH were discharged on postoperative day 0 as compared to those receiving TLH ($P = 0.055$). **Conclusion.** RLH is a safe alternative to TLH and may offer some operative advantages, including fewer conversions to laparotomy, reduced procedure time, less blood loss, and earlier discharge.

1. Introduction

Hysterectomy is one of the most common surgical procedures performed in the United States, with more than 600,000 completed annually [1]. This procedure may be performed transabdominally (by open or laparoscopic technique), or transvaginally, with the open abdominal route considered to be the most invasive and most morbid. The laparoscopic approach is associated with shorter hospital stay, decreased wound morbidity, and less pain [2, 3]. Despite this fact, still around 65–70% of hysterectomies are performed through an abdominal incision [1]. Our study aimed to compare operative outcomes of the minimally invasive interventions of robot-assisted total laparoscopic hysterectomy (RLH) to straight stick total laparoscopic hysterectomy (TLH) at 2 community hospitals.

2. Materials and Methods

This study was approved by the Synergy Medical Institutional Review Board and the Institutional Review Boards

at each hospital. Patients who underwent RLH or TLH between January 2007 and December 2008 at two tertiary referral teaching hospitals were followed, and outcomes were recorded as part of a retrospective chart review. All procedures were performed by a single surgeon (J. Hines). Patients were divided into 2 groups. Group 1 patients underwent surgery at hospital A and received RLH. This was the start of the gynecologic robotic program at this institution, and these patients represented early cases. Group 2 patients underwent surgery at hospital B, which did not have a robot, and received TLH. Patients were not randomized, but underwent surgery at a particular hospital based on their insurance provider. Patient demographics and diagnoses were noted.

Operative times were recorded on the anesthesia record. Total room time was defined as the time the patient entered the operating room until they left the room (“wheels in” to “wheels out”). Total induction time was defined as the time the patient entered the room until the time when uterine manipulator was inserted (this did not include docking time). The total procedure time was defined as the time from

the insertion of the uterine manipulator until the closure of all incisions and completion of cystoscopy. The estimated blood loss (EBL) was calculated by subtracting the volume of fluid used for irrigation from the volume of fluid in the suction canister.

In both groups, the hysterectomy procedure performed was the American Association of Gynecologic Laparoscopists (AAGL) type IVE, which includes the complete removal of the uterus and cervix, with or without concomitant removal of the ovaries, and laparoscopic closure of the vaginal cuff [4]. The patient's arms were wrapped in padding and tucked at their side in the natural position. Shoulder straps with adequate padding were used to maintain the patient from slipping down the table while in the Trendelenburg position. The V-care Uterine Manipulator (ConMed Corporation, Utica, NY, USA) was used in both groups. At the completion of the procedure, the uterus was delivered from the vagina with or without morcellation. It is part of our routine to perform cystoscopy after intravenous injection of indigo carmine to ensure the integrity of the ureters at the end of each procedure. The preoperative and postoperative management was similar in terms of bowel preparation and medications.

As for the RLH, the procedure was performed employing a total of 4 trocar incisions to accommodate 2 robotic instrument arms, a camera arm, and a 10–12 mm assistant port. A fenestrated bipolar instrument was used in the left robotic arm and monopolar shears in the right. Interrupted figure of eight stitches using 0-polyglactin 910 suture on a CT-2 needle (Ethicon, Cincinnati, OH, USA) was used to close the vaginal cuff.

The TLH was performed using 4 trocar incisions to allow for an umbilical camera port, 2 lateral 10–12 mm operative ports, and a 5 mm suprapubic port to aid in the vesico-uterine dissection. The harmonic device (Ethicon, Cincinnati, OH, USA) was used to secure the pedicles, perform the vesico-uterine dissection, and create the colpotomy. Interrupted figure of eight stitches with 0-polyglactin 910 suture was used to close the vaginal cuff, employing the autosuture endo stitch device (Covidien, Norwalk, CT, USA).

Data were entered into the SPSS for data analysis, and Student's *t*-test and χ^2 test were used where appropriate.

3. Results

A total of 136 patients were included in this cohort study (73 in the RLH group and 63 in the TLH group). There were no significant differences in demographics between the 2 groups (Table 1). Also noted in Table 1 are indications for hysterectomy which do not add up to 100% because some patients had more than one reason for surgery. All indications were for benign causes.

Surgical variables and outcomes are listed in Table 2. In total, there were 3 complications noted (2.2%), including a retained asepto bulb in the RLH group (1.4%) and 2 cystotomies in the TLH group (3.2%). The mean EBL was significantly less in the RLH group as compared to TLH with 46 ± 52 mL and 114 ± 101 mL, respectively, ($P < 0.001$).

TABLE 1: Patient demographics and indication for hysterectomy.

	RLH group (<i>n</i> = 73)	TLH group (<i>n</i> = 63)	Total (<i>n</i> = 136)	<i>P</i>
Age (yrs)*	46 ± 9	46 ± 9	46 ± 9	0.68
Weight (lbs)*	187 ± 42	179 ± 52	183 ± 47	0.308
BMI (Kg/m ²)*	33 ± 8	31 ± 9	32 ± 8	0.357
AUB, <i>n</i> (%)	60 (82.2)	52 (82.5)	112 (82.4)	0.57
CPP, <i>n</i> (%)	21 (28.8)	20 (31.7)	41 (30.1)	0.424
Fibroids (%)	43 (58.9)	36 (57.1)	79 (58.1)	0.486

* Mean ± SD.

AUB (abnormal uterine bleeding), CPP (chronic pelvic pain).

There were no conversions to laparotomy in the RLH group whereas there were 7 (11.1%) in the TLH group ($P = 0.004$). The reasons for conversion were cystotomy in 2, inability to complete the procedure because of poor visualization in 3, inability to control bleeding in 1, and 1 case of incidental finding of ovarian cancer. All cystotomies were immediately recognized and repaired.

Comparison between the two groups in terms of total room time, induction time, procedure times, and discharge day are listed in Table 3. There were three patients in the RLH group who had transvaginal anti-incontinence surgery after hysterectomy. The time for these procedures was included in surgical times.

4. Discussion

In 1989 Reich introduced the laparoscopic hysterectomy (LH) [5]. Since then, LH has become a common operation, and numerous tools have been developed to assist in the development of a more refined procedure. A trend toward a higher rate of LH was observed in the 1990's. Over a period of seven years, the LH rate increased from 0.3% to 9.9% while the abdominal hysterectomy (AH) rate decreased from 73.6% to 63.0% [1]. Vaginal hysterectomy (VH) remained stable at 23–24%.

When compared to open AH, the laparoscopic route results in a shorter hospital stay, less abdominal wound morbidity, quicker return to normal daily activity, and decreased blood loss, however, at the potential cost of increased surgical time and risk of urinary tract injuries [4, 5]. Benefits of the laparoscopic approach over VH include the ability to survey the pelvis and access more easily to the infundibulo-pelvic ligaments as compared to the vaginal route, especially considering that the ovaries are removed concomitantly in 73% of such procedures [6]. Similar to VH, laparoscopy is highly dependent on the skill and experience of the surgeon.

Straight stick TLH has its own inherent limitations including a 2-dimensional view with four degrees of freedom, and in obese patients, maneuvering the instruments can be very challenging with shearing at the trocar incision sites. The most significant recent addition to the laparoscopic armamentarium is that of robotic assistance which has reduced the limitations encountered with straight laparoscopy. The da vinci robot (Intuitive, Sunnyvale, CA, USA)

TABLE 2: Surgical variables and outcomes.

	RLH group (<i>n</i> = 73)	TLH group (<i>n</i> = 63)	Total (<i>n</i> = 136)	<i>P</i>
Bilateral salpingo-oophorectomy, <i>n</i> (%)	21 (28.8)	18 (28.6)	39 (28.7)	0.566
Unilateral salpingo-oophorectomy, <i>n</i> (%)	11 (15.1)	9 (14.3)	20 (14.7)	0.547
Lysis of adhesions, <i>n</i> (%)	38 (52)	19 (30.1)	57 (41.9)	0.008
EBL (mL)*	46 ± 52	114 ± 101	78 ± 85	<0.001
Conversion, <i>n</i> (%)	0	7 (11.1)	7 (5.1)	0.004
Uterine weight (grams)	151 ± 113	177 ± 160	163 ± 137	0.276
Complications, <i>n</i>	1	2	3	

* Mean ± SD.

TABLE 3: Surgical times and discharge day.

	RLH group (<i>n</i> = 73)	TLH group (<i>n</i> = 63)	<i>P</i>
Total room time (minutes)*	125 ± 23	135 ± 38	0.055
Total induction time (minutes)*	27 ± 8	21 ± 5	<0.001
Total procedure time (minutes)*	82 ± 21	108 ± 33	<0.001
Discharged same day, <i>n</i> (%)	64 (90.1)	44 (69.8)	0.003
Discharged POD 1, <i>n</i> (%)	73 (100)	59 (93.7)	0.044

* Mean ± SD.

has multiple arms, seven degrees of freedom, and a 3-dimension high-definition magnified image, providing the surgeon the potential to complete the most daunting procedure with relative ease and precision. In addition, the instruments are moved easily irrespective of body habitus, with very little if any shearing at the trocar incision sites. The robot also filters out any tremors of the hand and scales surgeon movements to smooth motions. The lack of tactile (haptic) feedback, otherwise provided by the laparoscopic instruments, is replaced by visual feedback and cues. Finally, the surgeon is seated in an ergonomically comfortable console which makes a prolonged case more tolerable.

Robot-assisted laparoscopic hysterectomy has been shown to be safe and effective [7–13]. A study by Payne and Dauterive comparing TLH to RLH noted that the robotic cohort was associated with significantly less blood loss and decreased hospital stay, but longer operative time. The intra-operative conversion rate to the abdominal route from the laparoscopic route dropped when the robot assistance was introduced. Also, there were no postoperative exploratory laparotomies in the robotic cohort as compared to 11% in the straight laparoscopic group [7]. Another study by Shashoua et al. comparing RLH to TLH showed that the RLH group was associated with longer operative times, but shorter hospital stay, decreased narcotic used and decreased EBL.

Our study also shows that RLH may have advantages over TLH. This conclusion is in agreement with the aforementioned studies. Our study is different in that only 1 surgeon performed all the procedures concomitantly. The Payne study was a retrospective chart review that included 100 patients in the TLH group and their first 100 patients in

the RLH group. The Shashoua study was also a retrospective study that included 24 patients in the RLH and 44 in the TLH.

As for the induction time, even though it did not include the docking of the robot, it was longer in the RLH group by an average of 6 minutes. This may be due to the fact that there were 2 different hospitals with different teams. The fact that this was the inception of the gynecologic robotic program may also have played a role in the induction delay. Once things were underway, however, the total room time usage for RLH was less than that of TLH. The reasons for this may include more surgeon control of camera and instruments, less switching of instruments and energy sources, and quicker closure of the vaginal cuff. This is contrasting to the findings in the other studies.

In our study, the mean EBL was 60% less in the RLH group as compared to the TLH group. This may be attributed to the magnified high-definition image with flexibility and maneuverability to cauterize the smallest of vessels. In the study by Payne and Dauterive, RLH was also shown to be associated with less blood loss compared to TLH. The Shashoua study also came to a similar conclusion. Whether or not our observed difference in EBL is clinically significant is a matter of debate. We also understand that the ability to estimate blood loss accurately in the operative field may be flawed with measurement errors especially considering the high-standard deviation and the low blood loss in our study patients.

There were no conversions to laparotomy in the RLH group whereas there was an 11% conversion rate in the TLH group. We believe that the assistance of the robot provides superior maneuverability to tackle more complex procedures and deal with complications. There were more patients with adhesions in the RLH group; however, they were all dissected satisfactorily and the procedure was completed. In Payne's study, the conversion rate to laparotomy dropped from 9% to 4% when robot assistance was added to the program.

Patients in the RLH group tended to be discharged sooner as compared to the TLH group. It is difficult to dissect the reasons behind this difference; however, a few reasons may include surgeon confidence in the safety of the procedure as well as patient pain and nausea control. This finding was also noted in the Shashoua study in addition to decreased narcotic use. In theory, the robotic trocar sites may cause

less pain because there is no shearing force at the skin which occurs in the TLH procedures to obtain the optimal angle. This is especially true in the more obese patients with a thicker subcutaneous layer. It must be noted, however, that the two groups were at two different institutions with variable postoperative protocols and staffing, and drawing conclusions regarding postoperative management may be influenced by this fact.

A meta-analysis of the currently available randomized controlled trials in the Cochrane database on robotic surgery for benign gynaecological disease concluded that, based on the limited evidence, robotic surgery did not benefit women with benign disease in effectiveness or safety [14]. However, the meta-analysis which included a total of 158 patients, was based on only 2 small RCT, one in which the indications were solely urogynecological, and the other had limited access to the data as it was a conference abstract. This makes any conclusions drawn by this meta-analysis limited by the studies that were included.

There are several limitations to our study. The first is the fact that it is retrospective in nature. The other is that it compared surgeries at two institutions with two completely independent teams. This may have affected the surgical times in our study.

In conclusion, our study demonstrates that RLH is a safe alternative to TLH, and may offer some distinct advantages including fewer conversions to laparotomy, reduced procedure time, less blood loss, and earlier discharge from hospital. Studies conducted prospectively with larger cohorts are required to elucidate further the differences between these two procedures.

Disclosure

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