

Benign GYN Surgical Outcomes in an Academic Teaching Hospital: Robotic Assisted Laparoscopic Hysterectomy versus Conventional Laparoscopic Hysterectomy

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Objective: Worldwide robotic procedures are gaining acceptance, and it has been well documented that the daVinci surgical system used for hysterectomies is a safe, feasible technique with similar outcomes when compared with conventional laparoscopic hysterectomies. Information regarding the utilization of conventional and robotic laparoscopic hysterectomies, patient characteristics, surgeon characteristics and surgical outcomes at our hospital is important to our quality of patient care and resident education. The objective of this study was to compare patient selection, surgeon experience, intra-operative and post-operative parameters of conventional versus robotic-assisted (daVinci) laparoscopic hysterectomy.

Methods: We conducted a retrospective chart review of all total laparoscopic hysterectomies (TLH; conventional and robotic) performed for benign indications at Mission Hospital in Asheville, NC, in 2012. One hundred and thirteen cases were identified through the Mission EHR procedure schedules; the surgical techniques were verified via the operative reports. Cohorts were compared using Chi square analysis for categorical variables and t-test or Mann-Whitney U for continuous variables.

Results: Of the 113 cases identified, 100 met criteria for analysis: 51 in the robotic TLH (RA-TLH) group and 49 in the conventional TLH (C-TLH) group. Both groups were similar in BMI, previous surgeries, indications for surgery, and concurrent surgeries. Patients undergoing RA-TLH were older and had larger uteri with fibroids. There were significantly more private community doctors working alone on RA-TLH (78.4%) than on C-TLH (40.8%), and significantly more faculty and residents performing C-TLH (46.9%) than RA-TLH (11.8%). Operative time was significantly longer for RA-TLH (181.2 ± 48.1) than C-TLH (157.0 ± 50.1). There were no significant differences in post-operative pain control or length of hospital stay. Of the 51 patients with RA-TLH, there was 1 ileus and 1 post-op pelvic infection. Of the 49 patients with C-TLH, there was 1 post-op pelvic infection, 1 bowel perforation, and 3 patients were seen in the ER for pain.

Conclusions: RA-TLH and C-TLH compared well on post-operative outcomes and complications. The RA-TLH surgeries, performed most often by private physicians, were longer. However, they were performed on women with larger uteri with fibroids. The cost effectiveness of these surgeries needs to be examined. The percentage of teaching cases at the hospital should be increased.

Keywords: Robotics, Laparoscopy, Hysterectomy

Introduction

Being the most common gynecologic surgery, approximately 615,000 hysterectomies are performed annually in the US.¹ One in nine women will undergo hysterectomy in their lifetime.² Hysterectomies are performed for gynecologic malignancies or for a variety of non-cancerous conditions including: symptomatic fibroids, pelvic organ prolapse, abnormal uterine bleeding, endometriosis, premalignant neoplasia, and chronic pelvic pain.¹ Methods of hysterectomy

include: total vaginal (TVH), total abdominal (TAH), laparoscopic assisted vaginal (LAVH), laparoscopic supracervical (Lsc SCH), and total laparoscopic (TLH). TLH may be performed via a convention approach (C-TLH) or robotically assisted (RA-TLH).¹

The TVH is now considered the “gold standard” for most women requiring a hysterectomy for benign conditions. However, a number of conditions may inhibit the use of TVH due to needing better visualization and/or access to the pelvic cavity such as: large pelvic organs, extensive adhesions, poor uterine descensus, or concerns for undiagnosed malignancy and adnexal pathology.¹

Numerous studies have demonstrated that when a TVH is not feasible, the TLH is the “gold standard” as there is less morbidity when compared with the TAH.²⁻³ Compared to the TAH, TLH results in decreased blood loss, post-operative pain, rate of infections, and shorter lengths of hospital stay with quicker recovery.⁴

C-TLH was introduced in 1988; the daVinci surgical system used for RA-TLH was FDA approved in 2005 and available in our region since 2006. Worldwide robotic procedures are gaining acceptance, and it has been well documented that the daVinci surgical system used for RA-TLH is a safe, feasible technique with similar outcomes when compared with C-TLH.² RA-TLH as compared to C-TLH results in similar outcomes generally and better outcomes for complex surgeries while improving visualization of the pelvic cavity, allowing for enhanced instrumentation, and providing better ergonomics.⁵ However, a recent synthesis of data on RA-TLH versus C-TLH for benign indications demonstrated an increase in operative time and overall cost for the robotic hysterectomies but with no difference in long-term outcomes.⁵⁻⁶

At the inception of this project, however, very few studies had looked at benign cases. Most studies were utilizing no more than two surgeons, with the exception of one multicenter study, and it appears none are looking at cases with resident surgeons. Information regarding the utilization and outcomes of C-TLH and RA-TLH at our hospital is important to the quality of patient care and resident education.

The objective of this project was to compare patient characteristics, surgeon experience, intra-operative parameters, post-operative parameters, and cost-effectiveness of conventional laparoscopic hysterectomy versus robotic-assisted (daVinci) laparoscopic hysterectomy.

Methods

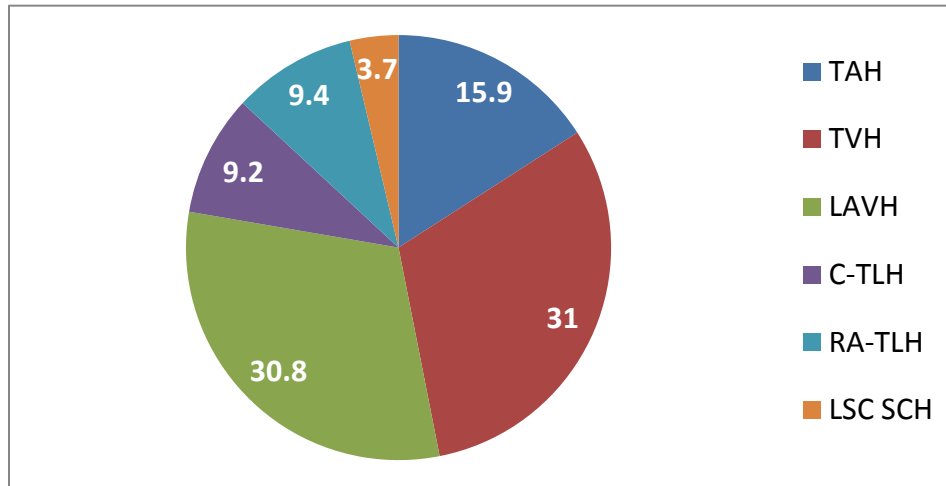
Using a retrospective cohort study design, we conducted a chart review of all total laparoscopic hysterectomies to compare conventional (C-TLH) and robotic (RA-TLH) performed at Mission Hospital in Asheville, NC in 2012. Data collected included: patient characteristics, surgeon experience and both intra-operative and post-operative parameters. Patient characteristics included age, gravidity and parity, BMI, history of prior abdominopelvic surgery, and indication for current surgery. Surgeon characteristics included whether the primary surgeon was a Mountain Area Health Education Center (MAHEC) faculty working with a resident, a community faculty working with a resident, or a private community doctor without a resident assistant. Intra-operative parameters included: concurrent surgeries performed, length of operation, estimated blood loss (EBL), uterine weight and complications (bowel, ureter or bladder injury, blood transfusion, conversion to laparotomy, and other). Post-operative parameters included length of stay (LOS), pain medication doses, complications (infection, ileus, cuff dehiscence, hematoma evaluation, and blood transfusion), and readmission within 30 days.

Cohorts were compared using Chi square or Fisher exact test analysis for categorical variables and t-test or Mann-Whitney U for continuous variables. The primary outcome was length of surgical procedure. A sample size of 100 surgeries was required for a 15 min difference in operative time (power = 0.80, 2-tailed Mann-Whitney test, $p < 0.05$). This project was approved by our hospital IRB.

Results

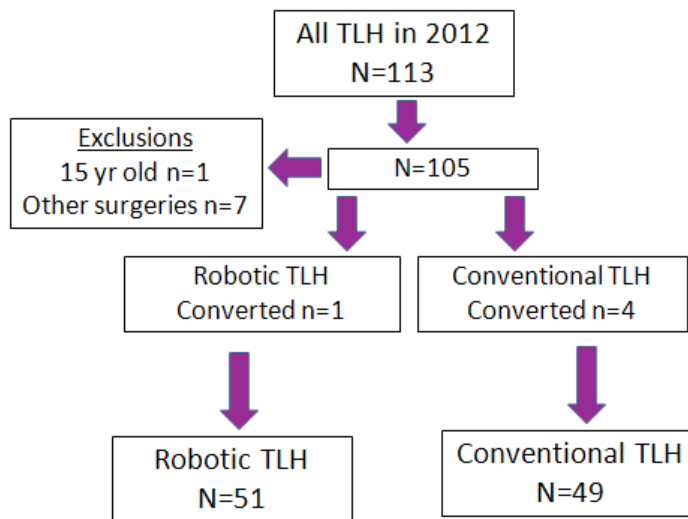
Of the 545 hysterectomies performed by generalist obstetrician gynecologists at Mission Hospital in 2012, 113 (18.6%) were coded TLHs (see Figure I).

Figure I. Methods of Hysterectomies for Benign Conditions during 2012



We used 101 cases for analysis, as 12 were excluded (see Figure II).

Figure II. Flow Diagram of Included Patients



Patients were significantly older in the RA-TLH group than patients in the C-TLH group (see Table 1). They did not differ significantly with regard to BMI or previous surgeries. However, the rates of cesarean deliveries and total abdominal surgeries in the RA-TLH group exceeded the rates of the C-TLH group substantially. The majority had undergone previous laparoscopic surgery.

Table 1. Patient Characteristics and Surgical History by Type of TLH

| Patient Characteristics | Robotic N = 51 Mean ± SD | Conventional N = 49 Mean ± SD | p |
|---|--------------------------------|-------------------------------------|-------|
| Age | 43.9 ± 8.2 | 38.6 ± 9.0 | 0.003 |
| BMI | 31.0 ± 7.3 | 32.1 ± 8.1 | 0.493 |
| Previous Abdominal Surgeries | Robotic N = 51 N (%) | Conventional N = 49 N (%) | p |
| Cesarean Deliveries Median (minimum – maximum) | 15 (29.4) | 9 (18.4) | 0.244 |
| Open abdominal | 3 (5.9) | 4 (8.2) | 0.712 |
| Total open abdominal | 17 (43.3) | 11 (22.4) | 0.245 |
| Laparoscopic | 30 (58.8) | 27 (55.1) | 0.840 |

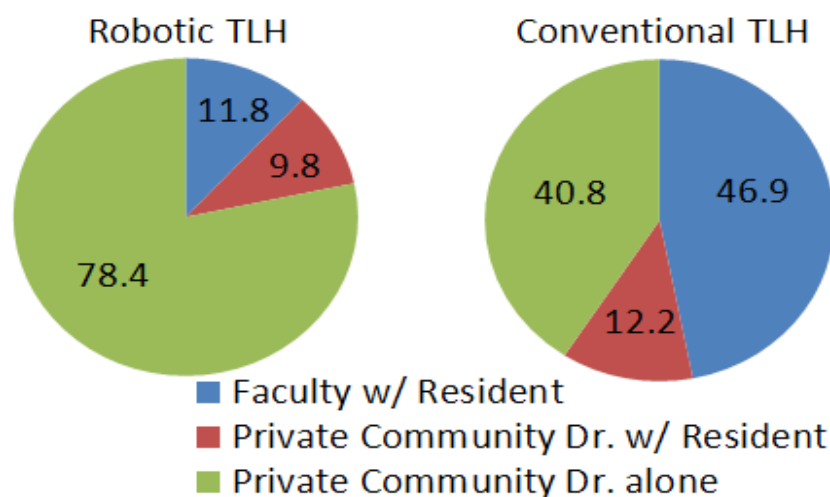
Note. Percentages of previous abdominal surgeries add up to greater than 100% due to multiple surgeries per person.

T-test analysis for data presented as mean ± standard deviation;

Chi square analysis for data presented as N (%).

As shown in Figure III, there was a significant difference in the surgeon characteristics by type of surgery. The majority of RA-TLHs were done by private, community doctors who did not have residents working with them, as compared to C-TLHs (p=0.0001).

Figure III. Surgeon Characteristics by Surgery Type



The majority of patients had diagnoses of abnormal uterine bleeding. Patients undergoing RA-TLH were significantly more likely than patients in the C-TLH group to have a diagnosis of uterine fibroids (see Table 2).

Table 2. Patients' Medical Reasons for Surgery by Type of TLH

| Indications for Surgery | Robotic N = 51 N (%) | Conventional N = 49 N (%) | p |
|---------------------------|----------------------------|---------------------------------|--------------|
| Abnormal uterine bleeding | 41 (80.4) | 37 (75.5) | 0.556 |
| Endometriosis | 3 (5.9) | 2 (4.1) | 0.680 |
| Uterine Fibroids | 27 (47.1) | 9 (18.4) | 0.001 |
| Ovarian pathology | 6 (11.8) | 3 (6.1) | 0.324 |
| Incontinence/Prolapse | 2 (3.9) | 3 (6.1) | 0.675 |
| Other | 35 (68.6) | 37 (75.5) | 0.508 |

Note. Percentages exceed 100% due to multiple diagnoses;
Chi square analysis for data presented N (%).

The majority of patients underwent concurrent surgeries at the time of their hysterectomy; there were no significant differences in types of concurrent procedures (see Table 3). Few women underwent concurrent surgery for incontinence or pelvic reconstruction (6% per group).

Table 3. Concurrent Surgeries Performed by Type of TLH

| Concurrent Surgeries | Robotic N = 51 N (%) | Conventional N = 49 N(%) | P |
|------------------------------------|----------------------------|--------------------------------|-------|
| Ovarian | 26 (51.0) | 23 (46.9) | 0.686 |
| Lysis of Adhesions | 11 (21.6) | 9 (18.4) | 0.689 |
| Cystoscopy | 14 (27.5) | 19 (38.8) | 0.229 |
| Incontinence/Pelvic Reconstruction | 3 (5.9) | 3 (6.1) | 1.00 |
| Other | 2 (3.9) | 3 (6.1) | 0.675 |
| Any | 32 (62.7) | 36 (74.5) | 0.665 |
| Median (minimum – maximum) | 1 (0-4) | 1 (0-3) | |

Note. Percentages exceed 100% due to multiple diagnoses;
Chi square analysis for data presented N (%).

Intra-operative parameters were significantly different between RA-TLH and C-TLH. The RA-TLH resulted in slightly less estimate blood loss; although no one in either group required intra-operative blood transfusions. Uterine weights were significantly greater in the RA-TLH group with almost 1 in 4 exceeding 250 grams as compared to 1 in 25 in the C-TLH group ($p=0.005$; see Table 4). There were no intraoperative complications in either group.

Table 4. Intra-operative Parameters by Type of TLH

| | Robotic N = 51 Med (Min-Max) | Conventional N = 49 Med (Min-Max) | P |
|-------------------------------------|------------------------------------|---|--------------|
| EBL | 50 (10-550) | 87.5 (5-500) | 0.049 |
| Uterine Weight | 144 (32-783) | 106 (41-592) | 0.001 |
| Uterine wgt > 250 gms | 12 (23.5) | 2 (4.1) | 0.005 |
| Intraoperative complications | 0 | 0 | |

Note. Mann-Whitney test analysis for data presented as Medians and Range [Med(Min-Max)]

On average, the length of the actual procedures were slightly longer among those in the RA-TLH group as compared to those in the C-TLH group ($p=0.016$; see Figure IV). No differences were observed in post-operative outcomes. On average, patients stayed in the hospital for one day. However, two post-operative complications were reported among RA-TLH patients as compared to 5 among C-TLH patients; the only bowel perforation and three ER admissions within 30 days were among the women undergoing C-TLH (see Table 5). No differences were observed in post-operative pain medication across medication types and opioid equivalents (see Table 6).

Figure IV. Length of Surgery by Type of TLH

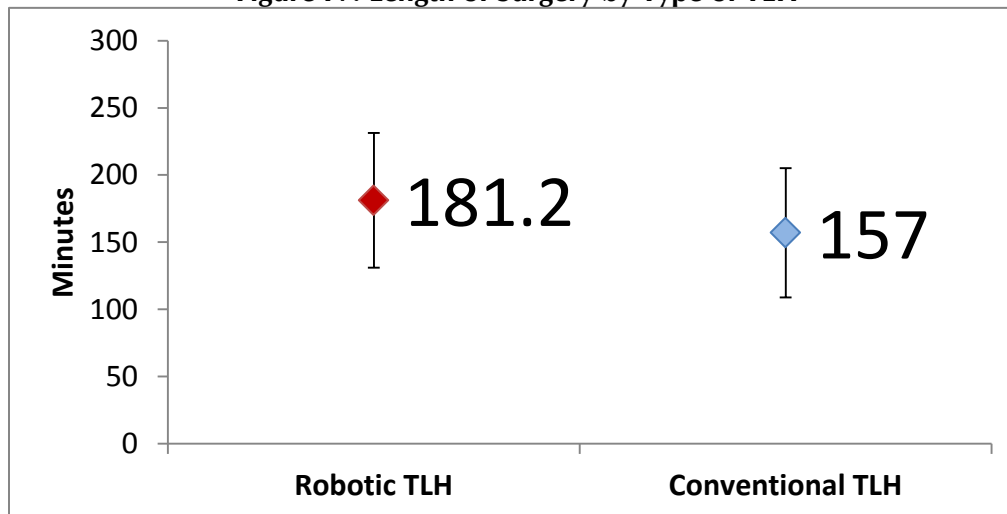


Table 5. Post-operative Outcomes by Type of TLH

| Post-operative Parameters | Robotic N = 51 Med (Min-Max) | Conventional N = 49 Med (Min-Max) | p |
|---------------------------|---------------------------------------|--|-------|
| Length of Stay in Hours | 24:42 (19:42-51:14) | 25:47 (4:18-53:58) | 0.209 |
| Complications | N(%) | N(%) | p |
| Ileus | 1 (2) | 0 | |
| Post-op pelvic infection | 1 (2) | 1 (2) | |
| Bowel perforation | 0 | 1 (2) | |
| ER for pain w/in 30 days | 0 | 3 (6.2) | |
| Any | 2 (3.9) | 5 (10.2) | 0.264 |

Note. Mann-Whitney test analysis for data presented as Medians and Range [Med(Min-Max)]. Fisher exact test analysis for data presented N (%).

Table 6. Post-operative Pain Control by Type of TLH

| Medication | Robotic N = 51 Median (Min-Max) | Conventional N = 49 Median (Min-Max) | P |
|-----------------|---------------------------------------|--|-------|
| Toradol (mg) | 90 (0-120) | 30 (0-120) | 0.104 |
| Tylenol (mg) | 975 (0-5200) | 1300 (0-7150) | 0.377 |
| Ibuprofen (mg) | 600 (0-3600) | 600 (0-3600) | 0.257 |
| Opioids (equiv) | 13.45 (0-79.57) | 14.41 (0-118.6) | 0.555 |

Discussion

Overall, RA-TLH surgeries were longer but resulted in significantly less estimated blood loss (EBL). Whether the actual differences in length of surgery or EBL were clinically or financially important is unclear. The incidence of post-operative complications did not reach statistical significance, and this is consistent with published syntheses of data.^{2-3,7} But the occurrence of the only bowel perforation in our C-TLH group is clinically meaningful as are the additional post-operative costs of the three women among the C-TLH surgeries who had ER admissions within 30 days.

Utilization of the daVinci system was significantly more common among private physicians operating without residents in our teaching hospital. Limited practice with RA-TLH in residency may compromise the residents' ability to be proficient with this procedure upon graduation. Current data suggests 91 cases are required to obtain proficiency.⁸ While our residents also work with gynecologic oncologists who use the daVinci system for complex pelvic surgeries, including hysterectomy for malignancies, some have the opportunity to obtain the necessary experience to acquire proficiency with the daVinci system, if desired. Whether the overall annual number of benign cases for TLH at our hospital will be sufficient to provide adequate training for residents in both types of TLH and to sustain proficiency of RA-TLH in our community obstetrician gynecologists will remain controversial.

The ACOG Presidential Statement of 2013 said, "the use of expensive medical technology should be questioned when less costly alternatives provide equal or better patient outcomes."⁸ The RA-TLH costs an additional \$2,189 per case, but results in similar reimbursement as the C-TLH.⁹

A formal cost-effectiveness or cost-benefit analysis of RA-TLH versus C-TLH in our hospital would need to address many additional costs and benefits. For example, the additional costs of the post-operative complications – whether or not on aggregate the incidence reached statistical difference. Further, there is the additional time and personnel requirement of RA-TLH for docking and undocking of the daVinci system – both of which limit availability for other surgical procedures. In addition to these extra costs per surgery, maintenance and upgrade costs of the robot and software, and perceived and actual risks of inexperienced or limited skill mastery of surgeons must be weighed against the benefits of improved ergonomics, ability to operate without a MD assistant, professional satisfaction of surgeons, robot availability for oncology cases, patients' perceived value of state-of-the-art surgical options, and the hospitals' perceived value in marketing and recruiting.

Generalizability of the results of this study is limited by the sample size and the inclusion of only one site – the relatively small number of TLH surgeries done by generalist obstetric gynecologists in one year in our teaching hospital. A post-hoc power analysis using the actual difference in length of surgery indicated a power of only 0.638. Further, the study was not powered for differences in secondary outcomes including post-operative complications. We also were unable to obtain detailed information about the degree of involvement of the residents in the procedures; teaching cases typically take longer than non-teaching cases. However, the majority of the teaching cases in the C-TLH group actually had shorter OR times.

In conclusion, robotic hysterectomy with the daVinci system may allow some of our patients, who otherwise would undergo laparotomy, to have minimally invasive surgery. How we at the local level will balance the costs and benefits as well as the training needs of our residents and maintenance of proficiency among obstetrician gynecologists in the region needs to be addressed. Utilization of the daVinci system to perform TLH for benign cases in our system will likely remain as controversial as it is across the nation.¹¹⁻¹⁷

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