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A Cost Analysis of Postoperative Management in Endometrial Cancer Patients Treated by Robotics Versus Laparoscopic Approach

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A cost analysis of postoperative management in endometrial cancer patients treated by robotics versus laparoscopic approach

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ABSTRACT

Objective. The purpose of this study is to compare postoperative pain management and costs in endometrial cancer patients who had a robotic-assisted or laparoscopic-assisted hysterectomy.

Methods. This is a retrospective cohort study of all endometrial cancer patients from 9/2005 to 6/2010 who had a completed robotic-assisted or laparoscopic-assisted hysterectomy. All surgeries were performed by gynecologic oncologists on the da Vinci S surgical system. Demographic data, patient-recorded pain scores, pain-management interventions, and postoperative pain medication costs were compared. Data was analyzed using Student's t-tests and Pearson's χ^2 tests in SPSS.

Results. Two-hundred fifteen (101 robotic and 114 laparoscopic) patients met the inclusion criteria. There were no significant differences between the groups in age, BMI, clinical stage, comorbidities, lymph nodes retrieved, and the number of narcotic vs. non-narcotic drug interventions administered. Robotic patients had a lower number of initial drug interventions (21 vs. 52; $P<.001$) and total drug interventions (162 vs. 219; $P<.001$) than laparoscopic patients. Robotics had a lower initial pain score (2.1 vs. 3.0; $P=.012$). There was a 50% reduction in the pain medication cost on the day of surgery for robotic patients ($12.24 vs. $24.45; $P<.01$), and a 56% cost reduction for the rest of their length of stay ($3.63 vs. $8.17; $P<.01$).

Conclusion. Endometrial cancer patients who have robotic surgery experience less initial postoperative pain and have fewer drug interventions. The cost associated for their pain management represents a savings of greater than 50%. These factors demonstrate the value of robotic surgery in regard to postoperative pain management by delivering higher quality care at a lower cost.

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Introduction

Since the FDA approval of the da Vinci robotic surgical system for gynecologic oncology in 2005, numerous studies in the field have supported this technology when compared to traditional laparoscopic surgery. It has been shown that robotic procedures for women with endometrial cancer offer shorter hospitalizations, less blood loss, shorter operative times, lower transfusion rates, and lower incidences of postoperative complications [2,8–12]. Gynecologic oncologists have also recognized that it provides patients with additional options for minimally invasive surgery, particularly those who are morbidly obese [1,2] and those with significant adhesions due to endometriosis [3]. The manual dexterity afforded by robotic instruments has simplified laparoscopic suturing enabling procedures such as a complicated myomectomy, radical hysterectomy, and radical trachelectomy to be performed [4–7].

While many gynecologic oncologic surgeons have observed that robotic surgery leads to less postoperative pain and minimal analgesia, such opinions have remained mostly anecdotal and experience-based. Additionally, many critics of robotic surgery have raised concern regarding the widespread use of this technology. A significant obstacle has been cost. Therefore, we have reported a retrospective comparison of postoperative pain and pharmacotherapeutic pain management, along with a cost analysis, in endometrial cancer patients who had either a laparoscopic-assisted or robotic-assisted hysterectomy.

The purpose of this study is to determine the effect that the type of minimally invasive surgery—whether traditional laparoscopy or robotics—has on patients' postoperative pain and analgesic requirement. Primary outcome measures included patient-recorded pain scores and nursing pain management interventions. Secondary outcome measures included the cost of postoperative pain medication.

Materials and Methods

This is a retrospective cohort study of all patients diagnosed with endometrial cancer who had a completed robotic-assisted (R) or

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laparoscopic-assisted (L) hysterectomy from 9/2005 to 6/2010. All surgeries were performed by one of three board-certified gynecologic oncologic surgeons who completed the same training on the da Vinci S surgical system at the Lehigh Valley Health Network (LVHN) in Allentown, PA.

Demographic data reviewed included age and body mass index [BMI defined as weight (kg)/height (m^2)]. For the purpose of analysis that may affect the level of pain postoperatively, the following variables were also reviewed: clinical stage of endometrial cancer, total nodes along with total pelvic and total para-aortic nodes, and medical co-morbidities limited to hypertension, Diabetes mellitus and asthma.

Patient-recorded pain scores, nursing pain management interventions, and postoperative pain medication costs (of day 0 and day 1) were compared. Pain scores and nursing interventions were analyzed for five intervals over a 24-hour postoperative period, beginning once the patient entered the floor. Only the 24-hour postoperative period was analyzed because the majority of both robotic and laparoscopic patients were discharged after one day. The patient-recorded pain scale utilized was a verbal-numerical scale ranked from 0-10, where 0 indicated no pain and 10 indicated the most severe pain. Nursing interventions were categorized as either a drug or non-drug intervention to further help characterize the level and quality of pain. Examples of non-drug nursing pain management interventions included the use of cold and hot applications. Drug interventions were subcategorized as narcotic or non-narcotic. Data was analyzed using Student's t-tests and Pearson's χ^2 tests in SPSS. The standard value for statistical significance ($P<0.05$) was used for all statistical tests. The Institutional Review Board approved this study.

Results

From September 2005 to June 2010, two hundred fifteen patients were reviewed for comparison in this study. One-hundred one (101) patients with endometrial cancer who completed a robotic-assisted hysterectomy and 114 patients who completed a laparoscopic-assisted hysterectomy were included in the study groups.

Table 1
Patient Demographics.

	Robotic (n = 101)	Laparoscopic (n = 114)	*p* value
Age (y)			
Mean	61.8	63.6	.241
SD	11.7	11.3	
BMI (kg/m²)			
Mean	35.3	33.5	.173
SD	9.6	8.3	
Clinical Stage			
IA	38	28	
IB	34	58	
IC	9	16	
IIA	4	2	
IIB	6	3	
IIIA/IIIB/IIIC	9	5	
IVA/IVB	0	1	
Total Nodes			
n	31	53	.322
Mean	18.6	16.5	
SD	10.1	7.3	
Total Pelvic Nodes			
Mean	14.1	12.2	.141
SD	7.3	4.7	
Total Periaortic Nodes			
Mean	4.6	5.3	.440
SD	3.5	3.8	
Comorbidities			
Hypertension	33	61	
Diabetes mellitus	12	20	
Asthma	1	3	

Table 2
Frequency of Postoperative Pain Management Interventions.

	Robotic (n = 101)	Laparoscopic (n = 114)	*P* value
INITIAL INTERVENTION			
Narcotic drug interventions	17	43	
Non-narcotic drug interventions	4	9	.860
Total drug interventions	21	52	
Non-drug interventions	32	12	<.001
2ND INTERVENTION			
Narcotic drug interventions	33	42	
Non-narcotic drug interventions	12	10	.383
Total drug interventions	45	52	
Non-drug interventions	10	7	.344
3RD INTERVENTION			
Narcotic drug interventions	25	31	
Non-narcotic drug interventions	11	12	.796
Total drug interventions	36	43	
Non-drug interventions	8	9	.911
4TH INTERVENTION			
Narcotic drug interventions	30	29	
Non-narcotic drug interventions	10	14	.448
Total drug interventions	40	43	
Non-drug interventions	14	7	.130
5TH INTERVENTION			
Narcotic drug interventions	11	19	
Non-narcotic drug interventions	9	10	.458
Total drug interventions	20	29	
Non-drug interventions	5	5	.592
Total narcotic drug interventions over 24 hour period	**116**	**164**	
Total non-narcotic drug interventions over 24 hour period	**46**	**55**	**0.473**
Total drug interventions over 24 hour period	**162**	**219**	
Total non-drug interventions over 24 hour period	**69**	**40**	<.001

There was no significant difference between the two groups in age, BMI, lymph nodes retrieved, and co-morbidities (Table 1). Robotic patients had a lower number of initial drug interventions (21 vs. 52; $P<.001$) for both narcotic and non-narcotic drug choices. In addition, total drug interventions were significant during the course of the first five pain interventions reviewed (162 vs. 219; $P<.001$) (Table 2). No significant differences were seen between the second (45 vs. 52, $P=0.344$), third (36 vs. 43, $P=0.911$), fourth (40 vs. 43, $P=0.130$), and fifth (20 vs. 29; $P=0.592$) interventions as studied.

In parallel to the findings of drug interventions, the patient-recorded pain scale mirrored similar statistical significance. The robotic cohort had a lower initial patient-recorded pain score (2.1 vs. 3.0; $P=.012$). No significant differences were seen between the

Table 3
Average Patient Recorded Pain Scores.

	Robotic (n = 101)	Laparoscopic (n = 114)	*P* value
Initial pain score			
Mean	2.1	3.0	
SD	2.48	2.61	0.012
2nd pain score			
Mean	2.8	2.5	
SD	2.65	2.65	0.396
3 rd pain score			
Mean	2.2	2.2	
SD	2.38	2.47	0.929
4th pain score			
Mean	2.8	3.1	
SD	2.32	2.63	0.566
5th pain score			
Mean	2.3	2.6	
SD	2.52	2.54	0.504

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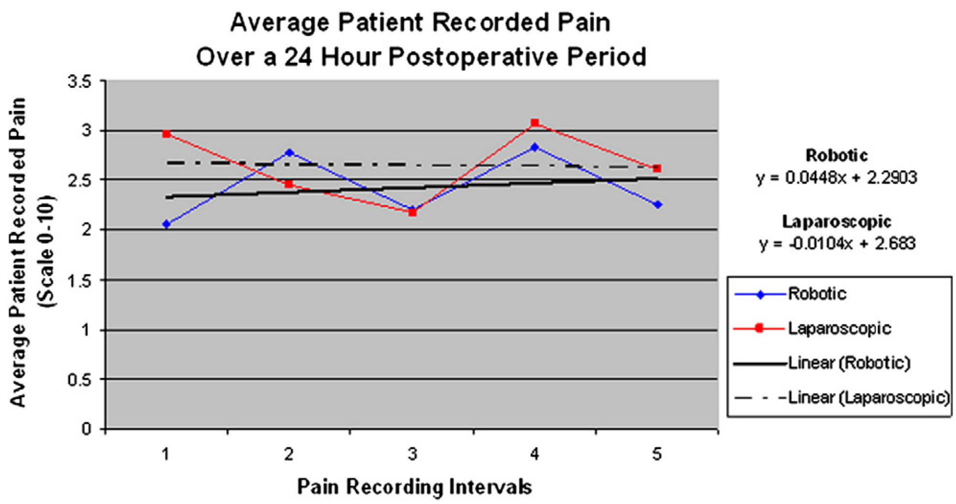

Fig. 1. Average Patient Recorded Pain over Time.

second (2.8 vs. 3.5; P = 0.396), third (2.2 vs. 2.2 P = 0.929), fourth (2.8 vs. 3.1; P = 0.566), and fifth (2.3 vs. 2.6; P = 0.504) interventions (Table 3, Fig. 1).

There was a 50% reduction in the postoperative pain medication cost on the day of surgery for robotic patients ($12.24 vs. $24.45; P<.01), and a 56% cost reduction for the rest of their length of stay ($3.63 vs. $8.17; P<.01) (Fig. 2).

Discussion

The Lehigh Valley Health Network (LVHN) robotic surgery program began in June 2008 with the first gynecologic oncology case at LVHN being performed on June 3, 2008. Since then LVHN has performed over 1000 robotic procedures, including hysterectomies for both benign and oncologic indications. As the demand for robotic surgery increases, hospitals including LVHN will have to continually evaluate the role of robotic surgery and the comparative effectiveness of this technology.

In the setting of gynecologic oncology, while robotic hysterectomy generally requires more operative time than laparotomy, it has been shown to be equivalent to or superior to laparoscopy in terms of operative time [2,8,9]. Robotic surgery is also associated with significantly less blood loss, fewer complications, and a shorter length of stay [2,8–12]. The Robotic Surgery Program at LVHN has also experienced these same outcomes when compared to laparoscopy for gynecologic oncology patients.

In our study, endometrial cancer patients who have robotic surgery experience less initial postoperative pain. A possible explanation for this outcome is that the stability of the trocars used in robotic surgery reduces the degree of intraoperative trauma to the tissue. As patients experience less pain, one of two scenarios occurs: they consume less postoperative pain medication in total, or they consume less potent—and less expensive—pain medication. These scenarios were confirmed in our study, which showed that robotic surgery patients have fewer drug interventions to manage their pain and the cost associated in delivering that care represents a savings of greater than 50% when compared to a laparoscopic cohort. These factors demonstrate the value of robotic surgery in regard to postoperative pain management by delivering higher quality care at a lower cost.

The University HealthSystem Consortium (UHC) recommends certain Imperatives for Quality (IQ) to aid a healthcare system in achieving targeted quality, safety and cost pressure points. By maximizing certain imperatives, such as Capacity Management and Core Measures/Consumer Assessment of Healthcare Providers, and reducing others, such as Cost, Hospital-Acquired Conditions and Mortality, hospitals can effectively measure their overall quality performance. By participating in IQ Reporting, hospitals can then benchmark themselves against top performers and focus on accountability, networking, and ultimately improvement. It is recommended that

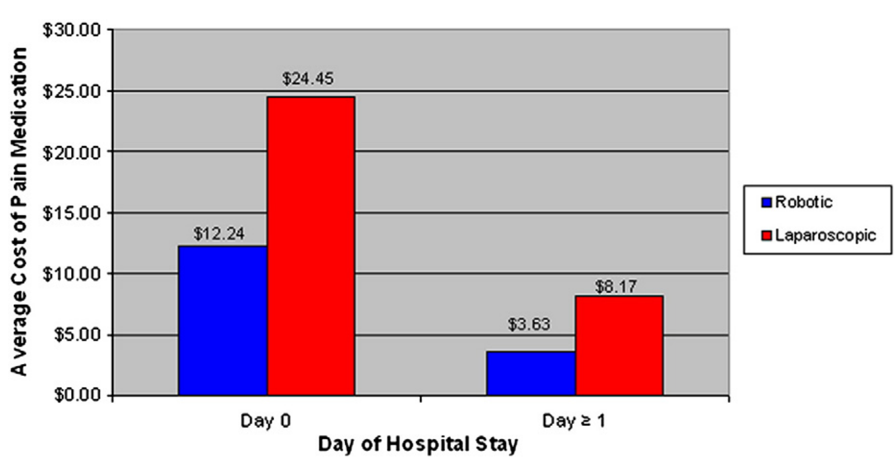

Fig. 2. Average Pain Medication Cost During Patient Hospital Stay.

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reporting to national databases and benchmarking of quality/cost outcomes be implemented to maximize the value of robotic surgery.

Our study has limitations including selection bias and its retrospective design. Relying on the accuracy of written records can miss certain aspects of true pain assessment. In addition, the pain scale can vary from time of assessment and differences in baseline pain tolerances between patients. Differences in patients who are selected for laparoscopic-assisted cases versus robotic-assisted may have underlying characteristics that were not considered in parameters we have chosen to review. There may be additional factors that could contribute to differences in postoperative pain. Laparoscopic procedures have 3–4 trocar entry sites, with trocars ranging from 5–11 mm in size. Conversely, robotic procedures have 4–5 trocar entry sites with trocars ranging from 8.5-11 mm. We were unable to record trocar placement due to such variability in trocar number and size for both robotic and laparoscopic procedures. We also evaluated the use of Marcaine. One of the three surgeons routinely uses Marcaine for all robotic and laparoscopic ports. We further analyzed this surgeon's robotic and laparoscopic cohorts to determine if there was any difference in his patients' postoperative pain scores, pain management interventions, or pain medication costs. No significant differences were identified.

It should also be noted that while our findings were statistically significant, the actual differences in postoperative patient-recorded pain, nursing interventions, and postoperative pain medication costs were minor. While these results may not necessarily translate into true financial savings for an institution, value is added from increased patient satisfaction scores and patient-recorded quality of life surveys, such as Press Ganey. Further research is needed to address patient satisfaction due to less postoperative pain. Additionally, the scope of these results is limited in nature. All conclusions reached about cost savings should be confined to the topic of postoperative pain management and should not be inferred as an overall cost savings for robotic surgery.

It is our hope that this retrospective study will serve as the basis for further prospective studies evaluating how robotics is changing the practice of gynecologic surgery.

Conflict of interest statement

There are no conflicts of interest for this manuscript.

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