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Risk factors for prolonged hospitalization after gynecologic laparoscopic surgery

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Abstract

Objective—To determine perioperative risk factors for prolonged hospitalization after gynecologic laparoscopic surgery.

Methods—Data on patients who underwent gynecologic laparoscopic surgery at a single academic institution from January 2000 to January 2009 were evaluated. Patient demographics, clinical history, intraoperative data, and postoperative adverse events were analyzed. Logistic regression analysis identified significant predictors of prolonged hospitalization (hospital stay > 48 hours after surgery). A risk score was created from the analysis to predict prolonged hospitalization.

Results—Eight hundred seven patients were included. The median body mass index was 26.5 kg/m² (range, 14.2–72.3 kg/m²), and the median age was 49 years (range, 12–88 years). Four hundred fifty-nine patients (56.9%) underwent surgery for benign conditions, and 348 (43.1%) underwent surgery for malignant disease. A total of 78 patients (9.7%) had a prolonged hospitalization. Independent predictors of prolonged hospitalization were age > 54 years ($P < 0.0001$), operative blood loss > 120 mL ($P < 0.0001$), intraoperative or postoperative blood transfusion ($P = 0.0237$), and early postoperative complication ($P < 0.0001$). Having a prior laparoscopy was associated with a shorter hospital stay ($P = 0.0276$). The risk score showed how changes in perioperative factors change the risk of prolonged hospitalization.

Conclusion—Factors such as age, blood loss, perioperative blood transfusion, and postoperative complications are associated with prolonged length of stay after laparoscopic surgery, while

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Conflict of Interest Statement

The authors do not have any conflicts of interest.

having a prior laparoscopy is associated with a shorter hospital stay. A clinical scoring system can be used to estimate probability of prolonged hospitalization after gynecologic laparoscopic surgery.

Keywords

Minimally invasive surgery; Prolonged hospitalization; Gynecologic laparoscopic surgery; Clinical scoring system

Introduction

Annually, 46 million surgical procedures are performed in the United States [1]. Strategies in the health care system are continually being developed to evaluate surgical outcomes, aiming to reduce costs, improve the quality of care, and decrease patient morbidity and mortality [2–4].

Fast-track surgeries, widely studied by general surgeons, are based on a coordinated multidisciplinary approach in the perioperative period and are designed to accelerate the period of convalescence after surgery and reduce morbidity. This multidisciplinary approach incorporates surgeons, anesthesiologists, nurses, and physical therapists as active participants in the care of surgical patients and is based on evidence from studies of minimally invasive surgery, anesthesia, analgesia, nutrition, ambulation, and reduction of surgical stress [5]. Proper implementation of these methods of enhancing recovery and reducing morbidity can result in shorter hospitalizations and avoid prolonged hospital stays [6].

In gynecology, laparoscopic surgery has several advantages compared to laparotomy. These include reduction of postoperative pain, shortened hospital stay, faster return to daily activities, and improved cosmetic outcomes without compromise of the overall success of the procedure [7,8]. Minimally invasive approaches such as laparoscopic surgery have been associated with higher surgical costs but lower costs overall because of shorter hospital stays [9]. However, prolonged hospitalization does occur after gynecologic laparoscopic surgery. Identifying factors associated with prolonged hospitalization could lead to improved perioperative care and further lowering of costs. Given the obvious costs associated with the technology of minimally invasive surgery, the benefit of laparoscopy as it relates to cost would certainly be lost if the patient stays in the hospital the same amount of time as they would have had they had the procedure performed by laparotomy.

The purpose of this study was to identify perioperative risk factors for prolonged hospitalization after gynecologic laparoscopic surgery and to devise a clinical scoring system to predict the probability of prolonged hospitalization.

Methods

After Institutional Review Board approval, data were abstracted from the medical records of all patients who underwent gynecologic laparoscopic surgery for benign conditions or malignant disease at The University of Texas MD Anderson Cancer Center from January 2000 to January 2009. Patients who were hospitalized prior to surgery, had their surgery converted to laparotomy, or underwent emergent surgery were excluded from the analysis. There were a total of 16 surgeons included in our analysis. Of the 16 surgeons, 4 were surgeons specializing in benign gynecologic conditions and the remaining 12 were designated as gynecologic oncology surgeons. The demographic data extracted included patient age, weight, height, body mass index (BMI), ethnicity, smoking history, past medical

history, number of comorbid conditions, need for intraoperative or postoperative blood transfusion, preoperative hemoglobin level, anemia, history of radiation therapy, history of chemotherapy, prior surgery, gynecologic diagnosis, and cancer stage (for patients with malignant disease).

The intraoperative data extracted included complexity of surgery (low, intermediate, or high), estimated operative blood loss, operative time, indication for surgery (benign condition or malignant disease), and intraoperative complications. Low-complexity procedures included diagnostic and second-look laparoscopy. Intermediate-complexity procedures included simple hysterectomy, oophorectomy, bilateral tubal ligation, and ovarian cystectomy. High-complexity procedures included radical hysterectomy, lymph node dissection, splenectomy, and bowel resection. Intraoperative complications were categorized as vascular (e.g., bleeding), gastrointestinal (e.g., bowel injury), urinary (e.g., ureteral or bladder injury), or other (e.g., nerve injury, uterine perforation from manipulator). The postoperative data extracted were postoperative complications within 30 days, and length of hospital stay. The early postoperative complications were categorized as cardiovascular, gastrointestinal, respiratory, renal, reoperation, or other if they did not fit into these 5 latter categories.

The study's primary outcome of interest was length of hospital stay. It has always been our general department practice that all surgeons who perform laparoscopy discharge their patients within 24–48 hours or by postoperative day 2. Therefore, length of hospital stay was categorized as normal (discharge within 48 hours after surgery or by postoperative day 2) or prolonged (discharge > 48 hours or > postoperative day 2). The rationale for using 48 hours as our definition was based on the fact that many patients undergoing laparoscopic surgery who do not experience any complications are not discharged home the following day after surgery for a variety of reasons, such as transportation, or distance to their homes from our medical center. Therefore, in order to avoid categorizing those patients under “prolonged length of stay” when the reason was not medical, we set the 48-hour time frame as our definition.

Distributions of patients with normal and prolonged hospitalizations were compared with Fisher's exact test or the Kruskal-Wallis test for categorical data and the Wilcoxon rank sum test for continuous data. We then employed multiple logistic regression analysis to identify potential prognostic factors for prolonged hospital stay. The receiver operating characteristics curve (ROC) was used to identify the optimal cutpoint for continuous variables. A saturated model was constructed including factors with p -values < 0.20 on univariate analysis, and then factors were removed from the model with backward elimination until all remaining factors were significant at the 0.05 level. Adjusted odds ratios and corresponding 95% confidence intervals for prolonged hospitalization are presented for each factor remaining in the model. $P < 0.05$ was considered statistically significant. All analyses were performed with SAS 9.1 for Windows (Copyright © 2002–2003 by SAS Institute Inc, Cary, NC).

A scoring system to predict prolonged hospitalization after gynecologic laparoscopic surgery was developed using the same model used by Kondalsamy-Chennakesavan and colleagues [10]. The background of a patient, with coefficients from the multivariate model, was scaled using a factor of 2 and rounded to the nearest integer. Points of prolonged hospital stay for each of the variables were determined by these rounded integers. A sum of all these points formed the overall risk of prolonged hospitalization. This scaling and rounding was used as a trade-off between accuracy and simplicity to make the model useable in a clinical setting similar to the method used by Kondalsamy-Chennakesavan [10].

The probability of having a prolonged hospital stay was given by the following formula derived from the multivariate model:

$$\text{risk of prolonged hospitalization} = \frac{100}{1 + e^{-(\text{constant coefficient}) - \left(\frac{\text{risk score}}{2}\right)}}.$$

Results

A total of 807 patients met the criteria for inclusion in the study. The full demographics and clinical characteristics are included in the Supplementary Table. The median BMI was 26.5 kg/m² (range, 14.2–72.3 kg/m²), and the median age was 49 years (range, 12–88 years). Four hundred fifty-nine patients (56.9%) underwent surgery for benign conditions, and 348 (43.1%) underwent surgery for malignant disease. Sixty-three patients (7.8%) had low-complexity surgery, 640 (79.3%) had medium-complexity surgery, and 104 (12.9%) had high-complexity surgery.

A total of 78 patients (9.7%) had a prolonged hospital stay. Of the 459 patients who underwent surgery for a benign condition, 38 (8.3%) had prolonged hospitalization. Of the 348 patients who underwent surgery for malignant disease, 40 (11.5%) patients had a prolonged hospital stay. There was no statistically significant association between benign disease and length of hospitalization (OR= 0.70, 95% CI 0.44–1.11, P = 0.1273).

After multivariate analysis, independent risk factors predictors of prolonged hospitalization were age > 54 years, operative blood loss > 120 mL, blood transfusion(s), and postoperative complications (Table 1). Having prior laparoscopy was associated with shorter hospital stay. Results of multiple logistic regression analyses for the risk factors with the clinical risk scores are shown in Table 2. We did not find surgical complexity to be among the significant prognostic factors for increased length of stay in our multivariate analysis. Furthermore, we performed the analysis excluding low complexity procedures, and found the same multivariate model with very similar risk estimates. We noted similar results when excluding the low complexity procedures. The constant coefficient of this multiple logistic regression analyses was −3.9127. The relationship between the overall risk score and the probability of prolonged hospital stay is shown in Figure 1.

Discussion

In this study, 9.7% of patients undergoing gynecologic laparoscopic surgery had hospital stay > postoperative day 2. Independent predictors of prolonged stay were age > 54 years, operative blood loss > 120 mL, perioperative blood transfusion, and postoperative complications. Having prior laparoscopy was associated with shorter hospital stay. Interestingly, BMI, prior surgery, and medical comorbidities were not independent predictors of prolonged hospital stay. We also looked at the length of hospitalization to see if there is any temporal relationship. In other words was length of stay influenced by the earlier years versus later years in our study. A Cochran-Armitage test by each year did not show a significant difference (P=0.83), concluding there is no temporal relationship from our analysis.

This study has several strengths. First, to our knowledge, this is the first study to look exclusively at risk factors for prolonged hospitalization after gynecologic laparoscopic surgery. Furthermore, these risk factors were used to create a quantitative scoring system to predict the probability of prolonged hospital stay. For example, let us assume that a 65-year-old woman is undergoing total laparoscopic hysterectomy and staging for endometrial

cancer. From that procedure, the patient loses 400 mL of blood and requires transfusion of 2 units of blood. Based on this information, the sum of the risk scores according to the information in Table 2 is 7 points. Use of Figure 1 or placing the risk score of 7 into the equation $100/(1 + e^{(3.9127 - (RS/2))})$ shows that this patient has a greater than 40% probability of prolonged hospitalization. However, if the surgical team were to limit operative blood loss to no more than 120 mL, and avoid blood transfusions, the risk score would be 2 with the probability of prolonged hospital stay decreased to approximately 5%. Therefore, this patient would have a very favorable outlook of having a routine discharge within 48 hours. This tool will be helpful clinically since Figure 1 can be used as a nomogram. Simply adding the risk score (Table 2) can quickly give the clinician instant quantitative probability of a patient having prolonged hospitalization (Figure 1). This will further help with patient preoperative and/or perioperative counseling and give estimation of hospitalization length after laparoscopic surgery. A weakness of this study is that it is a retrospective single-institution analysis, which can limit the overall external validity. It would be helpful to have data and analysis from multiple institutions on factors leading to prolonged hospitalization after laparoscopy. In addition, we did not include robotic surgery, and thus we do not know whether these risk factors and the clinical scoring system can be applied similarly to robotic surgery.

The importance of length of hospitalization in laparoscopic surgery is that it drives cost-effectiveness. In a study by Bell et al. [11], laparoscopic and robotic hysterectomy and lymphadenectomy were more cost-effective than laparotomy for endometrial cancer staging. The total cost was \$12,943 for laparotomy, \$8,212.00 for robotic surgery, and \$7,569.90 for laparoscopic surgery ($P = 0.0001$). Interestingly, the biggest contributor to increased total cost in this analysis was length of hospital stay. The average length of stay was 2.0 days for laparoscopy, compared to 4.0 days for laparotomy [11].

A study by Barnett et al. [9] produced similar results. In this study, the authors used a decision model to compare costs associated with robotic, laparoscopic, and open hysterectomy in the treatment of endometrial cancer [9]. Three different models were created for the cost analysis. Across all 3 models, laparoscopy was the least expensive surgical approach; however, in one of the models, open laparotomy was least expensive if hospital stay after surgery was less than 2.9 days.

Only one group to our knowledge has published data on risk factors for prolonged hospitalization after laparoscopic surgery, and such risk factors were not the primary end point of their study. In a retrospective analysis of 803 total laparoscopic hysterectomies from 1996 to 2006, the average length of hospital stay was 1.37 days [12]. Longer stay was not associated with BMI, age, parity, or uterine size. However, it was associated with increasing duration of surgery and operative blood loss. Furthermore, duration of surgery, operative blood loss, and hospitalization were all decreased with increasing surgeon experience [12].

In a retrospective analysis by Chi et al., 1451 laparoscopic procedures from 1991 to 2000 were analyzed to determine risk factors for complications [13]. The complications were graded according to the Memorial Sloan-Kettering Cancer Center Surgical Secondary Events Grading System [14]. In this multivariate analysis, older age, previous radiation therapy, and malignancy were associated with increased risk of complications. Unfortunately, no data on length of hospitalization were published. In our study, we found that older age was associated with prolonged hospitalization, but previous radiation therapy and malignancy were not significant risk factors.

Interestingly, in our study, BMI was not an independent predictor of prolonged hospital stay. In gynecologic surgery, there is debate about whether BMI has an impact on complications

and length of hospitalization. Camini et al. found no difference in the length of stay according to BMI for patients undergoing gynecologic laparoscopic surgery for uterine fibroids, endometriosis, endometrial cancer, and benign adnexal masses [15]. Heinberg et al. similarly found that BMI had no effect on length of hospital stay in patients undergoing total laparoscopic hysterectomy [16]. In contrast, in an analysis of patients undergoing laparoscopic surgery for benign adnexal masses, Thomas et al. found a significantly higher length of hospital stay in obese women (BMI ≥ 30 kg/m²). Mean hospitalization was 1.07 days in obese women vs. 0.51 days in nonobese women ($P = 0.04$) [17]. Given the majority of evidence thus far and our results, we believe that BMI should not be considered a risk factor for prolonged hospitalization after laparoscopy.

It was not surprising that previous surgery history was not a risk factor for prolonged hospitalization or complications after laparoscopic surgery as reported by some prior studies [18–20]. Furthermore, in our analysis, previous abdominal laparoscopic surgery had a favorable outcome on having a routine stay postoperatively. We speculate this may be due to the fact that these patients had a successful laparoscopic surgery prior and so naturally their second laparoscopic surgery done in our institution was predictively more feasible.

In conclusion, our study found that the clinical risk factors that contribute to prolonged hospital stay after gynecologic laparoscopic surgery are age > 54 years, operative blood loss > 120 mL, perioperative blood transfusion, and postoperative complication. Most of these risk factors are related to operative and postoperative factors. Having prior laparoscopy was associated with shorter hospital stay. We did not find medical history, surgical history, BMI, or social factors (ethnicity, smoking) to be associated with prolonged hospital stay after gynecologic laparoscopy. By identifying these risk factors, we derived a clinical scoring system that can be used to predict the probability of prolonged hospitalization after gynecologic laparoscopy. Clinically, knowing the probability of prolonged hospitalization after laparoscopic surgery can be helpful in patient counseling and communication about length of hospital stay. Finally, knowing the probability of prolonged hospitalization can help the health care team in management choices after laparoscopy as patients with prolonged hospitalization may be at higher risk of postoperative morbidity such as atelectasis and deep venous thrombosis (DVT). These patients may benefit from postoperative care similar to laparotomy patients such as anticoagulation prophylaxis, and incentive spirometry to prevent atelectasis. We anticipate that the validity of this clinical scoring system can be confirmed in future prospective studies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Highlights

- Nearly 10% of patients have prolonged hospitalization after laparoscopic surgery
- A clinical scoring system can be used to predict risk of prolonged hospitalization

Fig. 1. Probability of prolonged hospital stay (post-operative day 2) after gynecologic laparoscopic surgery.

Table 1

Results of multivariate analysis of predictors of prolonged length of stay.

	OR	95% CI	p-value
Prior Laparoscopy (yes vs. no)	0.35	0.13 – 0.89	0.0276
Transfusion (yes vs. no)	2.81	1.15 – 6.88	0.0237
Early Post-Operative Complication (yes vs. no)	7.99	4.65 – 13.72	< 0.0001
Age at Diagnosis (>54 vs. 54)	3.15	1.84 – 5.40	< 0.0001
Blood Loss (> 120 mL vs. 120 mL)	3.81	2.21 – 6.56	< 0.0001

OR= odds ratio, CI = confidence interval

Table 2

Clinical scoring system

Variable	Value	No. of risk points assigned
Age	> 54 years	+2
Blood loss	> 120 mL	+3
Blood transfusion	Yes	+2
Postoperative complication	Yes	+4
Prior Laparoscopy	Yes	-2