

GYNECOLOGY

Characteristics associated with prolonged length of stay after hysterectomy for benign gynecologic conditions



Surbhi Agrawal, MD; Ling Chen, MD, MPH; Ana I. Tergas, MD, MPH; June Y. Hou, MD; Caryn M. St. Clair, MD; Cande V. Ananth, PhD, MPH; Alfred I. Neugut, MD, MPH; Dawn L. Hershman, MD; Jason D. Wright, MD

BACKGROUND: Length of stay after surgery has become an important quality measure for many common surgical procedures and is now also tied to reimbursement. Currently, little is known about the perioperative factors that contribute to prolonged hospital length of stay in women who undergo hysterectomy for benign conditions.

OBJECTIVE: We performed a population-based analysis to investigate the association between perioperative factors and prolonged length of stay in women who undergo minimally invasive, abdominal, and vaginal hysterectomy.

STUDY DESIGN: We used the National Surgical Quality Improvement Program database to identify women from 2006–2015 who underwent benign hysterectomy. The primary outcome was length of stay >75th percentile. Demographic, preoperative, intraoperative, and postoperative factors were analyzed to determine individual predictors of prolonged length of stay. Model fit statistics were used to assess the importance of each group of perioperative factors on prolonged length of stay.

RESULTS: We identified a total of 157,589 women, including 83,172 (52.8%) of whom underwent minimally invasive hysterectomy, 45,149 (28.6%) of whom underwent abdominal hysterectomy, and 29,268 (18.6%) of whom underwent vaginal hysterectomy. The 75th percentile for length of stay was 1 day for minimally invasive, 3 days for abdominal, and 2 days for vaginal hysterectomy. The measured factors accounted for 11.0% of the ability to predict a prolonged length of stay for minimally invasive, 20.3% for abdominal, and 16.2% for vaginal hysterectomy. Intraoperative factors were the most important contributors to length of stay for minimally invasive and abdominal hysterectomy; demographic factors dominated for vaginal hysterectomy.

CONCLUSION: The most important perioperative factors that contributed to prolonged length of stay for hysterectomy were, in large part, not modifiable and suggest that targeted interventions to reduce length of stay will be challenging.

Key words: benign condition, hysterectomy, length of stay

Hysterectomy is 1 of the most commonly performed procedures in women in the United States.¹ Although the number of hysterectomies performed each year is decreasing because nonsurgical methods are used more frequently, >400,000 hysterectomies are still performed annually.² Nonmalignant conditions, such as leiomyoma, abnormal bleeding, and endometriosis, account for most cases.

Length of stay (LOS) after surgery has become an important quality measure for many common surgical procedures and is also tied to reimbursement.³ Previous studies have suggested that a number of factors drive LOS after surgery including not only the occurrence of complications but also underlying clinical and demographic factors.^{4–6} Understanding the

drivers of LOS is of great importance to help develop strategies to reduce LOS.

Currently, little is known about the perioperative factors that contribute to prolonged hospital LOS in women who undergo hysterectomy for benign conditions. To date, most studies have focused on the influence of the route of the hysterectomy on LOS and have demonstrated shorter LOS for vaginal and minimally invasive approaches, compared with laparotomy.^{7,8} Additionally, several reports have demonstrated that shortened LOS and same-day discharge are safe after hysterectomy, particularly in women who undergo minimally invasive surgery.^{9–11}

Given the limited data that describes factors that drive LOS after hysterectomy, we performed a population-based analysis to examine the association among demographic factors, preoperative conditions, intraoperative care, and postoperative complications with LOS. Specifically, we sought to identify potentially modifiable factors that drive LOS to facilitate the development of targeted interventions to reduce LOS.

Methods

We used data from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) Participant Use Data File. NSQIP collects >300 variables on demographic characteristics, perioperative conditions, and outcomes of patients who undergo major surgical procedures in inpatient and outpatient services. Data are extracted from medical charts by certified surgical clinical reviewers under an 8-day cycle sampling system. Participating hospitals submit data for 42 of the 46 8-day cycles throughout the year to minimize selection bias. Interrater reliability auditing is conducted regularly to assess the quality of data.

We identified women who underwent hysterectomy for nonmalignant conditions from 2006–2015. Patients were stratified by route of hysterectomy as having undergone a minimally invasive hysterectomy, which included a laparoscopic or robotic-assisted procedure, abdominal hysterectomy, or vaginal hysterectomy. Patients with gynecologic malignancies, unknown preoperative

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AJOG at a Glance

Why was this study conducted?

This study was performed to understand the demographic, preoperative, intraoperative, and postoperative factors that contribute to prolonged length of stay (LOS) for women who undergo hysterectomy for benign indications.

Key Findings

The measurable factors accounted for 11.0% of the ability to predict a prolonged length of stay for minimally invasive, 20.3% for abdominal, and 16.2% for vaginal hysterectomy. Intraoperative factors were the most important contributors to length of stay for minimally invasive and abdominal hysterectomy.

What does this add to what is known?

The most important perioperative factors that contribute to prolonged length of stay for hysterectomy are in large part not modifiable and suggest that targeted interventions to reduce length of stay will be challenging.

conditions, or missing LOS were excluded from the analysis.

For each patient, NSQIP records the LOS and defines it as the length of hospitalization from the date of surgery until discharge. For each route of hysterectomy, we determined the distribution of the LOS. *Prolonged LOS* was defined as having an LOS longer than the 75th percentile.

Four groups of explanatory variables were examined. Demographic variables included year of surgery, age (<50, 50–59, 60–69, ≥70 years), and race (white, black, other). Preoperative variables included body mass index (normal, <25 kg/m²; overweight, 25 to <30 kg/m²; obese ≥30 kg/m²), diabetes mellitus (insulin dependent, noninsulin dependent), functional status (independent, partially, or totally dependent), history of severe chronic obstructive pulmonary disease, bleeding disorder, and American Society of Anesthesiologists classification score (none, 1, 2, 3, 4–5). Patients with missing data were coded as unknown. The intraoperative variable was the total operation time in minutes. Postoperative variables included the occurrence of a wound infection, pneumonia, pulmonary embolism, other deep vein thrombosis or thrombophlebitis, urinary tract infection, sepsis, and reoperation within 30 days.

Bivariate analyses were conducted to compare the distributions of each variable based on whether a patient was

classified as having a prolonged LOS. In these analyses, χ^2 tests were used to compare categorical variables; the nonparametric Wilcoxon rank-sum test was used to compare continuous variables. To determine the association of each variable with prolonged LOS while accounting for other covariates of interest, we fit multivariable logistic regression models to examine the association of the 4 groups of variables and prolonged LOS (denoted as full model). Results are reported as odds ratios with 95% confidence intervals.

To further evaluate the contribution of each group of variables (demographic, preoperative, intraoperative, and postoperative conditions) to prolonged LOS, several reduced models were compared with the null model and full model to examine measures of predictive power and goodness-of-fit statistics, including C-statistics, pseudo- R^2 , likelihood ratio test (LRT), and Akaike information criterion (AIC). C-statistic is the area under the receiver operating characteristic curve. It ranges from 0–1; a value closer to 1 indicates high prediction. We calculated the increase and reduction in ability to predict the outcome by comparing C-statistics of reduced models with 1 group of variables to the null model and the reduced model omitting 1 group of variables with the full model.

The likelihood-based pseudo- R^2 is a generalized R^2 measure with higher

values that suggest a better model fit. In LRT, the model with 1 group of variables was compared with the null model; a higher LRT indicated a greater importance of that group. The model that omitted 1 group was compared with the full model; a higher LRT indicated a greater importance of the omitted variables. AIC showed the trade-off between the goodness-of-fit and parsimony. In the model that included 1 group of variables, a lower AIC indicated a higher importance of the group; in the model that omitted 1 group, a higher AIC indicated a greater importance of the group of variables that were omitted. All analyses were performed with SAS software (version 9.4; SAS Institute Inc, Cary, NC). All statistical tests were 2-sided. A probability value of <.05 was considered statistically significant.

Results

A total of 157,589 women were identified: 83,172 (52.8%) who underwent minimally invasive hysterectomy (Table 1); 45,149 (28.6%) who underwent abdominal hysterectomy (Table 2), and 29,268 (18.6%) who underwent vaginal hysterectomy (Table 3). The 75th percentile for LOS was 1 day for minimally invasive, 3 days for abdominal, and 2 days for vaginal hysterectomy.

For women who underwent minimally invasive hysterectomy, earlier year of operation, advanced age (≥60 years), and nonwhite race were predictive of LOS >75th percentile ($P<.05$ for all; Table 4). Preoperative conditions (such as insulin and not insulin dependent diabetes mellitus, nonindependent functional status, chronic obstructive pulmonary disease, a bleeding disorder, and American Society of Anesthesiologists class ≥3) were also associated with a prolonged LOS ($P<.05$ for all). Last, a longer operative time and all postoperative complications were associated with a prolonged LOS ($P<.05$ for all).

Among women who underwent abdominal hysterectomy, similar trends were noted in the perioperative period (Table 4). When vaginal hysterectomy was examined, year of surgery after 2007 was less likely to result in a prolonged LOS ($P<.05$ for all). Other demographic

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