



## Original article

## Physical Well-Being and Route of Benign Hysterectomy

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## A B S T R A C T

**Objectives:** We sought to determine if there is an association between preoperative risk factors as defined by the American Society of Anesthesiologists (ASA) physical status score and the route of hysterectomy for benign indications.

**Methods:** In this retrospective cohort study, the American College of Surgeons National Surgical Quality Improvement Project database was used to determine the route of hysterectomy, using Current Procedural Terminology codes, and associated ASA class. The analysis included abdominal, vaginal, total laparoscopic, and laparoscopic assisted vaginal routes of hysterectomy. Routes of hysterectomy were also grouped as either abdominal or minimally invasive for analysis. Multinomial logistic regression was used to model route of hysterectomy as a function of patient covariates, including ASA class, age, race and ethnicity, and body mass index.

**Results:** The analysis included 117,919 patients from the National Surgical Quality Improvement Project database. Patients with ASA classification of III or IV to V had significantly decreased odds of undergoing a minimally invasive approach for hysterectomy (odds ratio [OR], 0.81 [95% confidence interval (CI)], 0.77–0.85; and OR, 0.42 [95% CI, 0.37–0.48], respectively). Secondary outcome analysis revealed that a body mass index of more than 30 kg/m<sup>2</sup> was associated with significantly lower odds of undergoing a minimally invasive hysterectomy (OR, 0.87; 95% CI, 0.85–0.89). With respect to race/ethnicity, all non-White groups had decreased odds of undergoing a hysterectomy via a minimally invasive approach. Age 75 years or older was correlated with an increased likelihood of minimally invasive hysterectomy (OR, 1.18; 95% CI, 1.10–1.26).

**Conclusions:** Patients with increased preoperative risk as defined by a high ASA classification are less likely to undergo a hysterectomy using a minimally invasive route for benign indications.

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First developed in 1942, the American Society of Anesthesiologists physical status (ASA PS) classification system now includes six categories of PS, with categories I through V representing increasing levels of patient impairment; with I being a healthy patient and V being a patient who is not expected to survive without the procedure (Table 1; Dripps, 1963). The ASA PS class is reported for patients before the administration of anesthesia, and assesses the degree of systemic disease and physiologic reserve before surgical intervention (“ASA classification system,” n.d.; Fitz-Henry, 2011). It is used worldwide as a predictor of morbidity and mortality in the

preoperative assessment of surgical patients (Daley et al., 1997; Khuri et al., 1997; Miller, 2009). Using the ASA PS in this manner has proven effective as a reliable independent predictor of medical complications and mortality in multiple specialties, including gynecology (Hackett, De Oliveira, Jain, & Kim, 2015).

Hysterectomy remains the second most common major surgical procedure in the United States behind only the cesarean section (Falcone & Walters, 2008). Over the past several decades, there have been marked changes in the approach of this procedure (Jeppson et al., 2015; Kovac, 2014). Surgeons today have the option of performing a hysterectomy via a total vaginal, laparoscopic-assisted vaginal, total laparoscopic (including robotic assisted), or total abdominal approach.

The question regarding route of hysterectomy has been one of much debate and research. According to the American College of Obstetricians and Gynecologists the vaginal approach should be

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**Table 1**  
American Society of Anesthesiologists Physical Status Classification System\*

| Classification | Definition   | Examples   |
|----------------|--|--|
| ASA 1          | Healthy  | Healthy, nonsmoking, no or minimal alcohol use   |
| ASA 2          | Mild systemic disease  | Smoker, social alcohol drinker, pregnancy, 30 kg/m <sup>2</sup> < BMI < 40 kg/m <sup>2</sup> , well-controlled DM/HTN  |
| ASA 3          | Severe systemic disease  | Poorly controlled DM or HTN, COPD, BMI ≥ 40 kg/m <sup>2</sup> , moderate reduction of ejection fraction, history (>3 months) of MI, CVA, TIA, or CAD/stents. |
| ASA 4          | Severe systemic disease that is a constant threat to life              | recent (<3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC     |
| ASA 5          | Not expected to survive without operation                              | Ruptured abdominal/thoracic aneurysm, massive trauma,  |
| ASA 6          | Declared brain-dead, whose organs are being removed for donor purposes |  |

Abbreviations: BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; DIC, disseminated intravascular coagulation; DM, diabetes mellitus; HTN, hypertension; MI, myocardial infarction; TIA, transient ischemic attack.

\* Modified from ASA House of Delegates release on October 15, 2014

considered when feasible (Committee on Gynecologic Practice, 2009; Committee on Gynecologic Practice, 2017). Minimally invasive routes, which include vaginal and laparoscopic techniques, have demonstrated improved outcomes including decreased blood loss, perioperative complications, postoperative pain, and duration of hospital stay (Gendy, Walsh, Walsh, & Karantanis, 2011; Johnson et al., 2005; Nieboer et al., 2009). With these data, we believe the patients most likely to benefit from minimally invasive techniques would be those with significant comorbidities and lower overall health assessments. To date, several studies have examined the association between route of hysterectomy and specific medical comorbidities; however, to the knowledge of the authors, no study has examined an association with overall patient health through ASA PS rating and route of hysterectomy (Cohen, Vitonis, & Einarsson, 2014; Jacoby et al., 2009; Mikhail et al., 2015).

We hypothesize that an inverse association exists between the increasing ASA PS score and the likelihood of hysterectomy for benign indications being performed using a minimally invasive technique. The purpose of this study was to estimate the association of patient health, using the ASA PS classification system as a validated marker of patient health, with decision for route of benign hysterectomy using data gathered from the American College of Surgeons National Surgical Quality Improvement Project (NSQIP) database.

## Material and Methods

### Data

Data were obtained from the American College of Surgeons NSQIP Participant User File. Patients undergoing hysterectomy between 2005 and 2014 for benign indications were identified through Current Procedural Terminology (CPT) codes for hysterectomy and *International Classification of Disease, 9th Revision*,

*Clinical Modification* codes for benign uterine pathology, as described. The cohort was then stratified by hysterectomy approach using corresponding CPT codes: total abdominal hysterectomy (TAH; CPT codes 58150, 58152, 58180, 58200), total vaginal hysterectomy (TVH; CPT codes 58260, 58262, 58263, 58267, 58270, 58275, 58280, 58285, 58290, 58291, 58292, 58293, 58294), laparoscopic-assisted vaginal hysterectomy (LAVH; CPT codes 58550, 58552, 58553, 58554), and total laparoscopic hysterectomy (TLH; CPT codes 58570, 58571, 58573). In accordance with institutional guidelines, this study was exempt from institutional review board review.

### Covariates

Covariates of interest identified within the database included patient age, race, and ethnicity (White non-Hispanic, Black non-Hispanic, Hispanic, Asian, or unknown race), ASA classification system (ASA I, II, III, or ≥IV), and body mass index (BMI). These covariates were used in regression models to control for their effect on the performance of various operative approaches for hysterectomy.

### Statistical Analysis

Summary statistics of patients were computed and are presented stratified by surgical approach. The primary outcome in this study was type of surgery. We first modeled this outcome as a dichotomous variable representing open versus a minimally invasive approach (TVH, LAVH, or TLH) as a function of patient-related covariates. We then modeled treatment approach as a four-level categorical variable using multinomial logistic regression, controlling for patient age, race/ethnicity, BMI, and ASA classification. Results of the multinomial logistic regression were used to estimate the predicted probability of undergoing each type of operative approach, isolating the effect of each covariate individually while holding the other covariates constant at their median values. Data were analyzed with STATA software (version 12.1; StataCorp, College Station, TX) and graphs were constructed using R software (version 3.2.1, [www.r-project.org](http://www.r-project.org), Vienna, Austria). Statistical significance was defined by a *p* value of less than .05.

## Results

### Patient Population

The overall cohort consisted of 117,919 patients: 38,293 underwent TAH, 22,772 underwent TVH, 22,282 underwent LAVH, and 34,572 underwent TLH. Mean ages between groups ranged between 47 and 52 years (Table 2). With the exception of TAH, the majority of patients within each group were of White non-Hispanic race/ethnicity. The mean BMI within each group was approximately 30 kg/m<sup>2</sup> (Table 2), and the majorities of patients within each group were assigned an ASA classification of II.

### Multivariable Logistic Regression

Using multivariable logistic regression to determine the factors associated with undergoing a minimally invasive approach (defined as TVH, LAVH, or TLH), several associations were identified. Patients with ages over 75 years had significantly higher odds of undergoing a minimally invasive approach as compared with those less than 75 years of age (odds ratio [OR], 1.18; 95%

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