

GYNECOLOGY

Trainee participation and perioperative complications in benign hysterectomy: the effect of route of surgery



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BACKGROUND: Intraoperative trainee involvement in hysterectomy is common. However, the effect of intraoperative trainee involvement on perioperative complications depending on surgical approach is unknown.

OBJECTIVE: To estimate the effect of intraoperative trainee involvement on perioperative complication after vaginal, laparoscopic, and abdominal hysterectomy for benign disease.

METHODS: Patients undergoing laparoscopic, vaginal, or abdominal hysterectomy for benign disease from 2010 to 2012 were identified from the American College of Surgeons National Surgical Quality Improvement Program database. Patients with and without trainee involvement were compared with regard to perioperative complications. Complications that occurred from the start of surgery to 30-days postoperatively were included. Perioperative complications were defined via the use of the validated Clavien-Dindo scale with \geq grade 3 complications defined as major and \leq grade 2 complications defined as minor. Major complications included myocardial infarction, pneumonia, venous thromboembolism, deep or organ space surgical-site infection, stroke, fascial dehiscence, unplanned return to the operating room, renal failure, cardiopulmonary arrest, sepsis, intubation greater than 48 hours, and death. Minor complications included urinary tract infection, blood transfusion, and superficial wound infection. To estimate the effect of trainee involvement depending on route of surgery, a stratified analysis was performed. Bivariable analysis and adjusted multivariable logistic regression were used.

RESULTS: We identified 22,499 patients, of whom 42.1% had trainee participation. Surgical approaches were vaginal (22.7%), abdominal (47.1%), and laparoscopic (30.2%). The rate of major complication was 3.2%, and minor complication was 7.2%. In bivariable analysis, trainee involvement was associated with major complications in vaginal hysterectomy (3.3% vs 2.3%, $P = .03$), but not laparoscopic (3.0% vs 2.9%, $P = .78$) or abdominal hysterectomy (4.4% vs 3.6%, $P = .07$). Trainee involvement was also associated with minor complication in vaginal (7.3% vs 5.4%, $P = .007$), laparoscopic (5.9% vs 4.3%, $P < .001$), and abdominal hysterectomy (14.1% vs 9.2%, $P < .001$). In a multivariable analysis in which we adjusted for age, body mass index, medical comorbidity, American Society of Anesthesiologists score, and surgical complexity, the association between trainee involvement in vaginal hysterectomy and major complication persisted (adjusted odds ratio 1.45, 95% confidence interval 1.03–2.04); however, when operative time was added to the model, there was no longer an association between trainee involvement and major complication (adjusted odds ratio 1.26, 95% confidence interval 0.89–1.80).

CONCLUSION: Surgical approach influences the relationship between trainee involvement and perioperative complication. Operative time is a key mediator of the relationship between trainee involvement and complication, and may be a modifiable risk factor.

Key words: hysterectomy, perioperative complication, surgical approach, trainees, vaginal hysterectomy

The top hospitals in national rankings, such as *U.S. News and World Reports*, are large academic institutions with training programs.¹ Large academic institutions are believed to provide high-quality care as the result of expertise of staff, experience with difficult and rare cases, the constant questioning and reevaluation present in a learning environment, and complex patient populations.^{2,3} Conversely, patients often perceive trainee involvement in surgery as a potential detriment to high-quality

care.^{4,5} The evidence, however, regarding trainee participation in medical care, and specifically in surgical procedures, is mixed. Studies across a large number of elective surgical procedures and specialties have found that trainee participation in the operating room is safe, with no changes in major complication rates,^{6–8} whereas one study of trainee participation in emergent surgery found an association with major complications.⁹

Gynecologic surgical training may differ from surgical training in other surgical subspecialties; therefore the results from other surgical programs may not be applicable to gynecology. Approximately 500,000 hysterectomies are performed in the United States each year, making it a representative procedure to examine the effect of trainee participation in gynecology.¹⁰ Laparoscopic

hysterectomy also is becoming more common, and vaginal hysterectomy is becoming less common.^{10,11} Resulting differences in trainee experience may lead to different effects of trainee participation on perioperative complications, depending on the surgical approach.

We examined the effect of trainee participation during hysterectomy performed for benign conditions on perioperative complications and evaluated whether the effect of trainee participation differs by surgical approach.

Materials and Methods

Patients who underwent hysterectomy for benign disease from January 2010 through December 2012 and who were recorded in the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database were included in this study. Primary

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Current Procedural Terminology (CPT) codes were used to identify patients who underwent hysterectomy and to classify patients by route of surgery (Supplemental Table 1). CPT codes that include hysterectomy along with other procedures, such as lymphadenectomy, which would indicate the hysterectomy was being performed as treatment for a malignancy, were not included. Patients also were excluded if an *International Classification of Diseases*, 9th Revision code for malignancy was recorded.

The American College of Surgeons NSQIP database is a national surgical quality improvement program. Participation is voluntary, and participating institutions are able to track their own risk-adjusted outcomes after surgery. Trained clinical reviewers prospectively collect variables such as patient demographics, operative variables, and postoperative outcomes for 30 days after surgery. Periodic auditing ensures high-quality data, including for data points that occur after hospital discharge. Details of methods of data collection and reliability have been reported previously.¹²

Demographic variables abstracted included age, race, and body mass index. Patient-related preoperative variables abstracted included hypertension requiring medication, diabetes mellitus requiring insulin or oral therapy, smoking in the last year, American Society of Anesthesiologists (ASA) score, and major medical comorbidity divided into the categories of neurologic, cardiac, pulmonary, and infectious. Major cardiac comorbidity was defined as congestive heart failure in the month before surgery, myocardial infarction 6 months before surgery, history of peripheral vascular disease, history of percutaneous cardiac intervention, or previous cardiac surgery. Major pulmonary comorbidity was defined as history of severe chronic obstructive pulmonary disease or pneumonia in the last 30 days. Major neurologic comorbidity was defined as history of stroke with or without neurologic deficit or history of transient ischemic attack. Major infectious morbidity was defined as preoperative sepsis, or a preoperative open wound. Definitions of

these patient history variables, such as the criteria for history of myocardial infarction or stroke, were per the NSQIP data participant use file.¹³

Operative variables abstracted included operative time, surgical approach, trainee involvement, and surgical complexity. Trainee involvement was defined as trainee intraoperative involvement as coded in the NSQIP database. Trainees were further classified as either residents or fellows on the basis of postgraduate year. Residents were defined as postgraduate year 1–4 and fellows were defined as postgraduate year 5 and greater. Surgical complexity was defined by the work relative value unit (wRVU), which is an estimate of the amount of physician work per CPT code defined by Medicare. The wRVU for each procedure is the sum of the assigned value to each CPT code for the procedure; thus, greater wRVU is associated with increased surgical complexity.

Perioperative surgical complications were defined as complications that occurred from the start of surgery up to 30 days postoperatively. Major complications were defined as grade 3 or greater on the validated Clavien-Dindo grading scale.¹⁴ Minor complications were defined as grade 2 or less. Major complications included myocardial infarction, pneumonia, venous thromboembolism, deep or organ space surgical-site infection, stroke, fascial dehiscence, unplanned return to the operating room, renal failure, cardiopulmonary arrest, sepsis, intubation greater than 48 hours, and death. Minor complications included urinary tract infection, blood transfusion, and superficial wound infection. Intraoperative complications such as accidental puncture or laceration are not recorded in the NSQIP database and thus were not included in the definition of perioperative complication. Specific definitions of the diagnostic criteria for each of these complications can be found in the NSQIP data participant use file.¹³

This was a secondary analysis cohort study of prospectively collected surgical-quality data. The primary outcome was major perioperative complication and secondary outcome was minor

perioperative complication. Patients with intraoperative trainee participation were compared with those without with respect to outcomes. For bivariable analysis, 2-tailed t-tests were used for continuous variables and Pearson χ^2 tests for categorical variables. Stratified analysis was performed by surgical approach, given the association between surgical approach and both trainee involvement and complications. Associations between trainee participation and complications were analyzed by the use of binary logistic regression to examine for potential confounding. Confounders were selected on the basis of known associations with complications in the literature.^{15–19} A *P* value of less than .05 was considered significant for all analyses. SPSS version 20.0 (IBM Corp, Armonk, NY) was used for all analyses. The Institutional Review Board of University of North Carolina at Chapel Hill declared this study exempt from formal review because it does not constitute human subjects research.

Results

We identified 22,499 patients who underwent hysterectomy for benign disease. Demographic and operative characteristics of the overall study population are provided in Table 1. Patients with intraoperative trainee involvement represent a population at greater risk of complication with older age, greater surgical complexity scores based on work relative value units, and greater rates of comorbidities (hypertension, pulmonary and neurologic comorbidities, and ASA score ≥ 3).

Overall, 42.1% (*n* = 9471) of patients had intraoperative trainee involvement in their hysterectomy. Of the 9471 hysterectomies with trainee participation, 8375 (88.4%) had data available for postgraduate year of the highest-level trainee involved. This was a fellow in 14.5% (*n* = 1375) and a resident in 73.9% (*n* = 7000). Surgical approach was 22.7% vaginal (*n* = 5112), 47.1% abdominal (*n* = 6803), and 30.2% laparoscopic (*n* = 10,584). Rates of trainee involvement differed depending on surgical approach with trainee involvement in 45.1% (*n* = 4272)

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