

Assessing Trainee Impact on Operative Time for Common General Surgical Procedures in ACS-NSQIP

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OBJECTIVE: To examine the effect of surgical trainee involvement on operative time for common surgical procedures. Laparoscopic appendectomy, laparoscopic cholecystectomy, and open inguinal hernia repair comprise 17.7% of the total cases sampled in the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database. These cases are commonly performed by residents at varying levels of surgical training.

STUDY DESIGN: A cross-sectional study was performed using American College of Surgeons National Surgical Quality Improvement Program data from 2005 through 2008 selecting patients undergoing laparoscopic appendectomy, laparoscopic cholecystectomy, and open inguinal hernia repair. The primary outcome was operative time and predictive variables were resident involvement and training level. Linear regression analysis was used to compare operative times between cases performed by an attending alone and those assisted by junior (postgraduate year 1-2) or senior (postgraduate year 3-5) trainees, adjusting for patient and operative factors.

RESULTS: A total of 115,535 surgical cases were included, with 65,364 (59%) performed with junior or senior surgical residents. Resident participation was associated with higher operative times with no significant differences between the junior and senior cohorts; this effect persisted after controlling for potential confounding factors. Operative time increased by 16.6 minutes (95% confidence interval, 16.2-17.0) for junior residents and also by 16.6 minutes (95% confidence interval, 16.2-16.9) for senior residents.

CONCLUSIONS: Surgical trainees' participation in common surgical procedures is associated with an increase in total oper-

ative time, with no difference between trainee seniority levels. This finding may be significant in assessing the impact of residency training programs on hospital efficiency. (J Surg 69: 149-155. © 2012 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: surgical training, postgraduate medical education, resident, trainee, operative time, National Surgical Quality Improvement Program, ACS-NSQIP, laparoscopic appendectomy, laparoscopic cholecystectomy, inguinal hernia repair

COMPETENCY: Practice Based Learning and Improvement, Systems Based Practice, Patient Care

INTRODUCTION

Postgraduate training programs in general surgery employ a number of different measures to ensure surgical competency upon completion of a surgical residency. Previous investigators have identified surgical case completion time as a potential proxy for technical proficiency among trainees. Laparoscopic procedures in particular have been the subject of intense scrutiny, with a number of studies comparing completion times at various levels of training, both within surgical skills laboratories¹⁻¹² and in the operating room (OR). Although there is concern that task completion times may not predict proficiency,^{13,14} this measure has persisted as an objective and quantitative assessment of technical skill in surgery. In the United States, this emphasis has culminated in a requirement for surgical trainees to complete a standardized laparoscopic skills course (which includes multiple timed exercises) as a requirement for board certification in general surgery.¹⁵

Despite continued emphasis on benchmarking proficiency using completion times, there are limited data about the variation of operative times in postgraduate surgical training programs at academic medical centers. Over the course of 5 or more years of training, residents in general surgery develop competence in performing a broad variety of procedures, but it remains unclear if this

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is broadly reflected in the time consumed to perform cases as a senior resident, as compared with junior residents. Previous investigations have generally concentrated on the performance of relatively small surgeon cohorts and single institutions.¹⁶⁻²⁰ The present study seeks to compare the operative times in a natural practice environment, according to the presence and seniority of a surgical resident in the OR and using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) participant use file.

METHODS

Data Acquisition

Since 2004, ACS-NSQIP has provided validated clinical outcomes data following general and select subspecialty surgical procedures at collaborating hospitals. ACS-NSQIP employs a systematic sampling strategy that permits detailed qualitative comparisons between procedures and among participating institutions. Data items collected comprise patient risk factors, preoperative and operative information, and perioperative and postoperative outcomes that occur within 30 days of the index procedure. On-site audit programs standardize data collection and ensure data consistency and reliability.²¹ Within the ACS-NSQIP database, the most frequently encountered surgical procedures—as reflected by primary procedure code—include laparoscopic cholecystectomy (LC, 6.7% of all cases sampled), laparoscopic appendectomy (LA, 4.8% of cases), and open repair of inguinal hernia (OHR, 4.0% of cases).

In the present study, cases were included with primary procedure American Medical Association Current Procedural Terminology (CPT) codes for LA (44970), LC (47562, 47563, and 47564), and OHR (49525, 49505, and 49520) from nationwide ACS-NSQIP data collected from 2005 through 2008. The range of operative times reported within this data set was reviewed and cases with operative times less than the first percentile and greater than the 99th percentile were discarded; this effectively excluded 2,517 cases with operative times within the following ranges: 1-16 and 136-1,491 minutes for LA; 1-18 and 196-785 minutes for LC; and 1-18 and 164-1,482 minutes for OHR. The level of the most senior surgical trainee was also recorded and cases were subgrouped according to the procedure performed and the seniority levels reported. Data on surgical patient comorbidities were also collected, including American Society of Anesthesiologists Physical Status Classification (ASA class), obesity (defined as body mass index greater than 30), and other preoperative clinical diagnoses, including diabetes (requiring oral or insulin therapy), and septic conditions (including systemic inflammatory response syndrome, sepsis, and septic shock). In addition to operative time (total time elapsed from skin incision to skin closure) and trainee participation, the cases were also designated as emergent or nonemergent, and inpatient or outpatient. Finally, the number of simultaneous procedures (performed under the same anesthetic) was tabulated for each case.

Data Analysis

A descriptive analysis was performed using variables of gender, race, age, ASA class, obesity, as well as clinical diagnoses and case characteristics (see above). Summary statistics for both patient and case characteristics were calculated for each procedure, with comparisons across the seniority level of the most senior participating resident, using Pearson χ^2 for categorical outcomes and the Kruskal-Wallis test for nonnormally distributed continuous variables. For adjusted analysis of operative times associated with varying levels of resident participation, a multiple linear regression analysis was performed. The demographic (gender, race, age, ASA class, obesity), clinical (diabetes, septic conditions), and case characteristics (resident seniority, emergent, inpatient, number of concurrent procedures) variables were controlled for in this multivariate analysis. Odds ratios for were calculated using the “attending alone” category as the reference group, which was then used to calculate adjusted case completion times for each procedure at each level of resident seniority. All statistical analyses were performed using Stata MP, version 11 (College Station, Texas).

RESULTS

Patient Demographics

The study population composed of 30,039 (26%) laparoscopic appendectomies, 57,462 (50%) laparoscopic cholecystectomies, and 28,034 (24%) open inguinal hernia repairs. Cases were performed on a total of 55,938 male and 59,596 female patients and the average patient age was 47.4 (SD 18.1) years. Comparison of patient demographics revealed significant differences in age, race, and gender between the resident participation groups (Table 1). Trainees were involved in a greater proportion of procedures performed on young patients (p range, 0.781 to < 0.001) and Black patients ($p < 0.001$). Significant differences in patient sex were confined to LA, with residents involved in more appendectomies performed on males ($p = 0.019$). There were also differences in the rates of preoperative comorbidities. Patients undergoing operations assisted by residents had lower overall ASA class (p range, 0.001 to < 0.001) and were less likely to be diabetic (p range, 0.263 to < 0.001); there were significant but inconsistent trends observed in the distributions of patients with septic conditions and obesity.

Case Characteristics

Overall, a total of 45,016 (39%) cases were completed by attending surgeons without a surgical trainee present—“attending alone,” 24,183 (21%) were performed with the participation of a junior trainee—with “junior” defined as a resident in the first or second postgraduate year; 41,181 (36%) were performed with the participation of a senior trainee—a “senior” resident in the third to fifth postgraduate years. The remaining 5,155 cases (4.5%) were performed with more senior trainees (reported as

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