Comparison of outcomes after laparoscopic versus open appendectomy for acute appendicitis at 222 ACS NSQIP hospitals

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Background. *The benefit of laparoscopic (LA) versus open (OA) appendectomy, particularly for complicated appendicitis, remains unclear. Our objectives were to assess 30-day outcomes after LA versus OA for acute appendicitis and complicated appendicitis, determine the incidence of specific outcomes after appendectomy, and examine factors influencing the utilization and duration of the operative approach with multi-institutional clinical data.*

Methods. *Using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database (2005–2008), patients were identified who underwent emergency appendectomy for acute appendicitis at 222 participating hospitals. Regression models, which included propensity score adjustment to minimize the influence of treatment selection bias, were constructed. Models assessed the association between surgical approach (LA vs OA) and risk-adjusted overall morbidity, surgical site infection (SSI), serious morbidity, and serious morbidity/mortality, as well as individual complications in patients with acute appendicitis and complicated appendicitis. The relationships between operative approach, operative duration, and extended duration of stay with hospital academic affiliation were also examined.*

Results. *Of 32,683 patients, 24,969 (76.4%) underwent LA and 7,714 (23.6%) underwent OA. Patients who underwent OA were significantly older with more comorbidities compared with those who underwent LA. Patients treated with LA were less likely to experience an overall morbidity (4.5% vs 8.8%; odds ratio [OR], 0.60; 95% confidence interval [CI], 0.54–0.68) or a SSI (3.3% vs 6.7%; OR, 0.57; 95% CI, 0.50–0.65) but not a serious morbidity (2.6% vs 4.2%; OR, 0.86; 95% CI, 0.74–1.01) or a serious morbidity/mortality (2.6% vs 4.3%; OR, 0.87; 95% CI, 0.74–1.01) compared with those who underwent OA. All patients treated with LA were significantly less likely to develop individual infectious complications except for organ space SSI. Among patients with complicated appendicitis, organ space SSI was significantly more common after laparoscopic appendectomy (6.3% vs 4.8%; OR, 1.35; 95% CI, 1.05–1.73). For all patients with acute appendicitis, those treated at academic-affiliated versus community hospitals were equally likely to undergo LA versus OA (77.0% vs 77.3%;* P = .58*). Operative duration at academic centers was significantly longer for both LA and OA (LA, 47 vs 38 minutes [*P < .0001*]; OA, 49 vs 44 minutes [*P < .0001*]). Median duration of stay after LA was 1 day at both academic-affiliated and community hospitals.*

Conclusion. *Within ACS NSQIP hospitals, LA is associated with lower overall morbidity in selected patients. However, patients with complicated appendicitis may have a greater risk of organ space SSI after LA. Academic affiliation does not seem to influence the operative approach. However, LA is associated with similar durations of stay but slightly greater operative times than OA at academic versus community hospitals. (Surgery 2010;148:625-37.)*

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Appendectomy accounts for approximately 1 million hospital days annually.[1] It is the most common emergent operative procedure performed worldwide.[1] In 2006, 341,000 appendectomies were performed among inpatients admitted both electively and emergently at nonfederal hospitals, and appendicitis accounted for 318,000 discharges from short stay hospitals.[2,3] During their lifetime, 6–7% of individuals will develop acute appendicitis.

Since McBurney introduced the appendectomy in 1894, appendectomy has become the standard of care for the treatment of acute appendicitis. The first laparoscopic appendectomy was performed in 1981 by Semm, a German gynecologist.[4] Despite the disease burden associated with appendicitis, most comparative studies of laparoscopic versus open appendectomy have been either case series or small, single-health system randomized controlled trials, or were conducted utilizing administrative data and thus have focused on inpatient outcomes.[5-9] Furthermore, the risk of specific complications after laparoscopic appendectomy and the benefit of laparoscopic appendectomy for patients with complicated appendicitis, specifically, remains unclear.

The objective of this study was to assess the risk factors, indications, and 30-day outcomes associated with laparoscopic versus open appendectomy utilizing prospectively collected, risk-adjusted data from American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) hospitals. Outcomes were examined for all patients with acute appendicitis as well as a subset of patients with complicated appendicitis. Furthermore, we aimed to determine if specific complications were more likely to occur after laparoscopic versus open appendectomy for acute appendicitis, and specifically after complicated appendicitis. Finally, we examine how academic affiliation influences duration of stay as well as the utilization and duration of operative approach.

METHODS

Data acquisition. Originally developed within the Veterans Health Administration System in 1991, the NSQIP was expanded to the private sector by the ACS in 2004. The ACS NSQIP provides validated, risk-adjusted outcomes affording hospitals the ability to conduct in-depth, blinded quality comparisons with the other participants.[10] The first 40 cases performed within consecutive 8-day cycles are sampled from general surgery, vascular surgery, and specific subspecialty procedures. Surgical Clinical Reviewers abstract medical records and personally communicate with patients to obtain comprehensive clinical data. Patient demographics, preoperative risk factors and laboratory values, operative information, as well as perioperative and postoperative outcomes within 30 days of the index operation are collected. On-site audit programs standardize data collection and ensure data consistency and reliability.[11-13]

Patients ≥16 years of age who had undergone an appendectomy based on primary Current Procedural Terminology (CPT) codes and had a postoperative diagnosis of acute appendicitis based on the *International Classification of Disease Diagnosis Codes* (9th edition [ICD-9]) were identified from the ACS NSQIP database from January 1, 2005, through December 31, 2008. The ACS NSQIP does not abstract preoperative diagnoses, imaging results, or pathology results. Thus, postoperative diagnosis was utilized as a surrogate for indication. Because the population of interest is patients with acute appendicitis, patients were required to have both undergone an appendectomy and have a postoperative diagnosis of acute appendicitis to be included. Patients who underwent an incision and drainage of an appendiceal abscess (CPT codes 44900 and 44901) or an appendectomy concurrent with another major procedure (CPT code 44955) were not included. Disease severity was classified as simple versus complicated appendicitis according to the presence or absence of generalized peritonitis or abscess according to ICD-9 codes (Appendix). High-risk patients were excluded, including those with preoperative ventilator dependence, a designation of American Society of Anesthesiology (ASA) class 5, preoperative septic shock, or total dependent functional status.

Outcomes. The primary outcomes of interest were 30-day (1) overall morbidity; (2) serious morbidity; (3) surgical site infection (SSI); and (4) serious morbidity/mortality. Morbidity and mortality outcomes within the ACS NSQIP are evaluated irrespective of whether the adverse event occurred during the index hospitalization, after the patient was discharged, or after the patient was readmitted to another hospital. Overall morbidity was defined as having documentation of a serious morbidity or ≥1 of the following ACS NSQIP postoperative complications: superficial SSI, deep SSI, pneumonia, unplanned intubation (without preoperative ventilator dependence), peripheral neurologic deficit, urinary tract infection, and deep vein thrombosis. Serious morbidity/mortality was defined as having documentation of mortality or ≥1 of the following ACS NSQIP postoperative