Laparoscopic vs Open Appendectomy in Obese Patients: Outcomes Using the American College of Surgeons National Surgical Quality Improvement Program Database

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BACKGROUND: Although open and laparoscopic appendectomies are comparable operations in terms of outcomes, it is unknown whether this is true in the obese patient. Our objective was to compare short-term outcomes in obese patients after laparoscopic vs open appendectomy.

STUDY DESIGN: Using the American College of Surgeons National Surgical Quality Improvement Program database (2005−2009), 13,330 obese patients (body mass index ≥30) who underwent an appendectomy were identified (78% laparoscopic, 22% open). The association between surgical approach (laparoscopic vs open) and outcomes was first evaluated using multivariable logistic regression. Next, to minimize the influence of treatment selection bias, we created a 1:1 matched cohort using all 41 of the preoperative covariates in the National Surgical Quality Improvement Program database. Reanalysis was then performed with the unmatched patients excluded. Main outcomes measures included patient morbidity and mortality, operating room return, operative times, and hospital length of stay.

RESULTS: Laparoscopic appendectomy was associated with a 57% reduction in overall morbidity in all the obese patients after the multivariable risk-adjusted analysis (odds ratio = 0.43; 95% CI, 0.36−0.52; $p < 0.0001$), and a 53% reduction in risk in the matched cohort analysis (odds ratio = 0.47; 95% CI, 0.32−0.65; $p < 0.0001$). Mortality rates were the same. In the matched cohort, length of stay was 1.2 days shorter for obese patients undergoing laparoscopic appendectomy compared with open appendectomy (mean difference 1.2 days; 95% CI, 0.98−1.42).

CONCLUSIONS: In obese patients, laparoscopic appendectomy had superior clinical outcomes compared with open appendectomy after accounting for preoperative risk factors. (J Am Coll Surg 2012;215: 88–100. © 2012 by the American College of Surgeons)

Appendectomy is one of the most common surgical procedures.[1,2] With obesity rates in the United States exceeding 30% of the population, it is important that we identify appendectomy techniques that reduce length of stay (LOS) and morbidity in the obese patient. Open and laparoscopic approaches are both well-established surgical techniques for appendectomy, yet remarkably, despite >50 randomized trials comparing the 2 approaches, the optimum technique is still not completely established.[3] Although laparoscopic appendectomy shows some advantages with regard to reduced wound infections, reduced pain, and shorter hospital stay, it is associated with longer operative times and increased organ space surgical site infection (SSI) rate, and is therefore still not the gold standard. Laparoscopic appendectomy has been recommended in the obese patient,[3] however, the evidence supporting this recommendation is limited and based on 2 retrospective studies,[4,5] 2 administrative database studies,[6,7] and a subset analysis of 2 randomized trials in which the one study looked at obese patients (body mass index [BMI] ≥30),[8] but the other also included overweight patients (BMI >25).[9] Three of the

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Abbreviations and Acronyms

ACS = American College of Surgeons
BMI = body mass index
CEM = Coarsened Exact Matching
LOS = length of stay
NSQIP = National Surgical Quality Improvement Program
SSI = surgical site infection

studies showed similar overall complication rates between open and laparoscopic techniques.[4,8,9] Clarke and colleagues[8] showed similar operative times, LOS, and pain medications usage. Enochsson and colleagues[9] showed longer operative times with the laparoscopic approach and less pain. Both studies contained small numbers of patients and are therefore not truly representative of outcomes in the obese patient.[8,9] The 2 administrative database studies[6,7] were not audited and suffered from selection bias of the surgical technique, and both selected patients according to the discharge ICD-9 codes instead of using actual calculated BMI values. As a consequence, both administrative database studies had a percentage of obese patients considerably lower than expected if an actual calculated BMI had been used. Despite the severe obesity epidemic predicted worldwide, there are no adequate studies looking at the optimum surgical approach in the obese patient with appendicitis.

The objective of this study was to assess the risk factors and 30-day outcomes associated with laparoscopic vs open appendectomy in the obese patient using data from the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database.[10,11] Outcomes were examined for all obese patients undergoing appendectomy as the primary surgical procedure, as well as separately for obese patients categorized as having either uncomplicated and complicated appendicitis. We aimed to determine if specific complications (eg, sepsis, pulmonary embolism) were more likely to occur after laparoscopic vs open appendectomy in this obese subset. In addition, outcomes were determined specifically for those patients classified as morbidly obese (BMI ≥40) and super morbidly obese (BMI ≥50). Finally, we examined the association between each operative approach and operative time and duration of hospital stay.

METHODS

Data acquisition

This study was performed using 2005 to 2009 data from the Public Use File of the ACS NSQIP. The study population consisted of obese patients 16 years of age or older who had a postoperative diagnosis of acute appendicitis based on the ICD-9 and had undergone an open or laparoscopic appendectomy based on primary Current Procedural Terminology codes. The World Health Organization's definition of obesity was used and only patients with a BMI ≥30 were included.

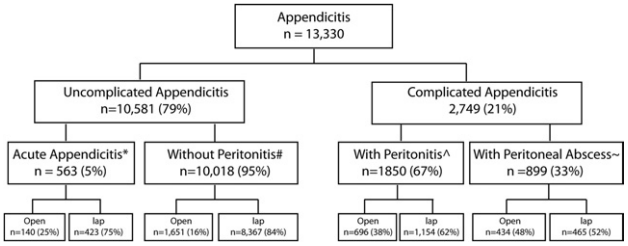

Figure 1. Subclassification of the Obese Patients after Appendectomy Based on the Postoperative Diagnosis Using ICD-9-CM Codes.*Acute appendicitis (ICD-9 code: 540). #Acute appendicitis without peritonitis (ICD-9 code: 540.9). ^Acute appendicitis with peritonitis (ICD-9 code: 540.0). ~Acute appendicitis with peritoneal abscess (ICD-9 code: 540.1).

Patients were required to have both undergone an appendectomy as the primary surgical procedure and had a postoperative diagnosis of appendicitis to be included in this study. Obese patients with the following ICD-9 codes were included: 540: acute appendicitis; 540.0: acute appendicitis with generalized peritonitis; 540.1: acute appendicitis with peritoneal abscess, and 540.9: acute appendicitis without peritonitis. Patients who had "appendicitis unqualified" (ICD-9 code 541), "other appendicitis " (ICD-9 codes 542), "hyperplasia of appendix" (ICD-9 code 543), and "other and unspecified diseases of appendix" (ICD-9 code 543.9) were not included.

In this aggregate cohort, 2 surgical treatment groups were identified. The first group was patients who underwent an open appendectomy and were identified using a Current Procedural Terminology code of 44950, 44955, or 49960. The other group underwent a laparoscopic appendectomy and consisted of patients who had a Current Procedural Terminology code 44970 or 44979 recorded as their principal operative procedure. An intention-to-treat method was used to analyze the patients in the laparoscopic appendectomy group that were converted to an open appendectomy. Only 28 (0.2%) patients fell into this category.

The patients were classified as having either uncomplicated or complicated appendicitis based on the presence or absence of peritonitis and/or peritoneal abscess according to the ICD code recorded in the patients' postoperative diagnosis (Fig. 1). Patients were categorized as morbidly obese if the BMI was ≥40 and super morbidly obese if their BMI was ≥50 (Fig. 2).

Outcomes

The primary outcomes of interest were 30-day overall morbidity; serious morbidity; and mortality. Criteria defining