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Obesity and its implications for morbidity and mortality after cholecystectomy: A matched NSQIP analysis

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ABSTRACT

Background: The risks from super obesity (SO) following cholecystectomy have not been studied.
Methods: NSQIP analysis of patients undergoing cholecystectomy from 2005 to 2011. Non-obese (NO) patients (BMI 18.5–30) were matched 1:1 by age, sex, race and comorbidities to morbidly obese (MO) (BMI 35–50), and separately to SO (BMI≥50) individuals. Clavien 4 complications and 30-day mortality were compared.
Results: 13780 MO and 1410 SO patients were matched to NO patients. Obese patients were more likely to present with chronic (CC) rather than acute cholecystitis (AC). Compared to NO patients, Clavien 4 complications were significantly increased among SO patients overall especially with AC where rate of open surgery was significantly higher.
Conclusion: SO patients have an increased risk of serious morbidity after cholecystectomy especially with AC where rate of open surgery remains high. Aggressive recommendation for cholecystectomy to reduce presentation with AC and increase likelihood for laparoscopic surgery may be beneficial in SO patients.

1. Introduction

Obesity is an increasing health care problem worldwide and it is known that even a modest increase in body weight increases risk of gallstone disease and its complications.[1] Since its introduction in the late 1980s, laparoscopic cholecystectomy is the gold standard treatment for patients with symptomatic cholelithiasis.

Studies have demonstrated the safety of laparoscopic cholecystectomy in obesity.[2] While most studies have noted a complication rate comparable to non-obese (NO) patients, some have noted an increase in the rate of wound infection and conversion to open surgery with increased BMI.[3] Most of these studies have variably defined obesity and studied small number of patients making it impossible to obtain the power to study super-obesity (SO). A recently performed National Surgical Quality Improvement Project database (NSQIP) analysis only studied inpatients with acute cholecystitis.[4] Additionally due to relative rarity of other indications for cholecystectomy including biliary dyskinesia, pancreatitis, perforated cholecystitis, and fistula, studies have not addressed the relationship of obesity to these conditions.

NSQIP offers an opportunity to study the effect of increasing obesity severity on outcomes after cholecystectomy. We used NSQIP to study the disease presentation and outcomes in patients undergoing cholecystectomy. We hypothesized that obesity is associated with specific disease presentation as well as increased risk of serious post-operative morbidity and mortality.

2. Methods

This is a retrospective study of patients undergoing cholecystectomy using the NSQIP database. The program systematically collects prospective data on 135 preoperative and intraoperative variables, as well as 30-day postoperative morbidity and mortality.

The study was limited to adults 18 years of age and older who underwent a cholecystectomy between January 1, 2005 and December 31, 2011. The initial dataset was obtained by using the following primary CPT codes: (1) 47562; laparoscopic cholecystectomy (LC) (2) 47563; LC with cholangiography (3) 47564; LC

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with exploration of common bile duct (CBD) (5) 47600; cholecystectomy (OC) (6) 47605; OC with cholangiography (7) 47610; OC with exploration of CBD (8) 47612; OC with exploration of CBD with choledochoenterostomy (9) 47620; OC with exploration of CBD with transduodenal sphincterotomy or sphincteroplasty, with or without cholangiography (10) 47620; OC with exploration of CBD; with transduodenal sphincterotomy or sphincteroplasty, with or without cholangiography. Next we restricted the dataset to patients with the following final post-operative diagnoses[1] acute cholecystitis with or without CBD stone[5] biliary colic with or without CBD stones[2] chronic cholecystitis with or without CBD stones[3] perforated cholecystitis[4] cholangitis[6] biliary dyskinesia and other unspecified gall bladder disorders[7] pancreatitis[8] fistula of the gallbladder, or gallstone ileus[9] abdominal pain[10] sepsis. About 8% of the patients had a missing final diagnosis. These patients were excluded. We assessed additional procedure codes and excluded patients undergoing unrelated procedures (like splenectomy, bariatric surgeries, mastectomy, gynecologic surgeries). Finally we excluded patients with missing information on BMI.

Our primary predictor variable was BMI, which was studied as follows: 18.5–30 (non-obese), 35–49.9 (morbidly-obese; MO) and 50 and over (super-obese). All comparisons were made to NO patients. Baseline demographics and preoperative characteristics were initially compared between various categories of BMI in the unmatched cohort. Patient demographics included age (analyzed as a continuous variable), gender, and race (categorized as white, black, or other). Preoperative risk factors analyzed included: diabetes mellitus (DM; treated with oral agents or insulin), hypertension requiring medication, cardiac risk factors (includes congestive heart failure within 30 days before surgery, history of myocardial infarction (MI) 6 month prior to surgery, previous percutaneous coronary intervention, previous cardiac surgery, and history of angina 1 month before surgery), pulmonary risk factors (includes smoking history within 1 year before the operation, history of severe chronic obstructive pulmonary disease, current pneumonia), renal risk factors (includes current use of dialysis or acute renal failure), and neurological risk factors (includes history of transient ischemic attack or cerebrovascular accident with or without neurological deficit). Inpatient versus outpatient treatment was also studied.

Intraoperative variables analyzed included anesthesia time, performance of laparoscopic surgery and performance of a biliary anastomosis. No CPT codes exist for conversion from laparoscopy to open surgery; this was not analyzed. Patients who developed serious post-operative complications were identified using Clavien-Dindo 4 criteria; to meet these criteria, complications must have lead to organ dysfunction requiring intensive care unit management (included are septic shock, renal dysfunction requiring dialyses, pulmonary embolism, MI, cardiac arrest, mechanical intubation and reintubation).[6] Clavien 5 complication, mortality, was defined as death within 30 days of surgery. Differences in the rate of return to the operating room, and length of stay (LOS) were also analyzed.

One: one coarsened exact matching (CEM) was used to match obese patients who underwent cholecystectomy with NO patients based on result of unmatched clinical characteristics. CEM which is a type of “monotonic imbalance bounding” matching technique, is a relatively new technique of matched analysis and is considered superior to other matching techniques (e.g. propensity score matching) eliminating the need for multiple iterations of matching and balance assessment.[7] After CEM, statistical analyses were done to test for an association between obesity and various other preoperative, intraoperative and postoperative variables. Bivariate associations were evaluated using chi-square tests for pairs of dichotomous or categorical variables and Student's t-tests for continuous variables that were normally distributed. Wilcoxon rank-sum tests and Kruskal-Wallis equality-of-populations tests were used to examine differences in central tendency for variables that did not follow a normal distribution. Finally a multivariable logistic regression was used to assess the odds of Clavien 4 complications while controlling for BMI and preoperative sepsis. A $p < 0.05$ was considered significant. All analyses were performed using STATA (Version 12, College Station, Texas).

3. Results

There were 73540 patients who underwent cholecystectomy and met inclusion criteria. The unmatched comparisons between the obese and NO patients are shown in Table 1. Comparing demographics, MO patients were noted to be significantly younger, have a higher proportion of females and blacks compared to NO patients. The percentage of patients with DM, hypertension, and renal comorbidities was significantly higher and cardiac and neurologic comorbidities significantly lower in the MO patients. Additionally a significantly greater percentage of MO patients were treated as inpatients compared to NO patients. Similar trends were noted in the SO patients, with a significantly older age, percent females and blacks compared to NO patients. The comorbidity distribution trends were similar with a significantly greater percent of patients with DM, and hypertension, and significantly lower percentage of patients with cardiac and neurological comorbidities. Additionally, proportion of patients with SO who were treated as inpatient was significantly greater than NO patients.

Table 2 summarizes clinical characteristics after CEM. A total of 13,780 NO patients were matched on age, gender, race, DM, hypertension, cardiac, renal and neurologic risk factors and hospitalization status to 13,780 MO patients. Compared to NO patients, there were a significantly greater proportion of patients with chronic cholecystitis, significantly less proportion with acute cholecystitis and dyskinesia among MO, with all other diagnoses being comparable. Separately, 1410 patients without obesity were subsequently matched on age, race, gender, DM, and hypertension, and cardiac and neurological risk factors to 1410 SO patients. On bivariate analyses the proportion of patients with acute cholecystitis and dyskinesia was noted to be significantly less, and the proportion with biliary colic and sepsis significantly greater among SO compared to NO patients.

Intraoperative characteristics of the matched cohort of patients undergoing cholecystectomy were compared next. Comparing NO and MO patients, the proportion of patients undergoing laparoscopic surgery was significantly lower among MO patients. This difference persisted and increased with increasing acuity of presentation from dyskinesia to fistula (difference in laparoscopic surgery for biliary colic was not significant). Anesthesia time was significantly prolonged by about 8 min comparing NO to MO patients regardless of indication; this difference was most for patients with fistula (17.7 min). When these relationships were explored in SO patients, it was noted that the percentage of SO patients undergoing laparoscopic surgery was 4% less than NO patients; this difference was highest for patients with fistula (~13%) followed by dyskinesia (~13%), and acute cholecystitis where the percentage of patients undergoing laparoscopic surgery was ~11% less than NO patients. Similarly anesthesia time was significantly prolonged by more than 30 min comparing SO to NO patients; this difference was most for patients with fistula and acute cholecystitis (~52 min), followed by biliary colic (39 min), chronic cholecystitis and dyskinesia.

Finally, postoperative outcomes in the matched group of obese patients were compared. Comparing NO to MO patients, postoperative outcomes including LOS were noted to be comparable.