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Tailoring surgical approach for elective ventral hernia repair based on obesity and National Surgical Quality Improvement Program outcomes

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Abstract

BACKGROUND: Obesity's influence on postoperative complications in either laparoscopic ventral hernia repair (LVHR) or open ventral hernia repair (OVHR) has yet to be defined. Although 30-day postoperative complications increase with higher body mass index (BMI), we propose LVHR minimizes surgical site infections (SSIs) and surgical site occurrences (SSOs) for given BMI categories.

METHODS: Retrospective review of the American College of Surgeons National Surgical Quality Improvement Program database (2009 to 2012) for patients aged 18 years or more undergoing elective ventral hernia repair. Exclusion criteria included immunosuppression, disseminated malignancy, advanced liver disease, or pregnancy. Patients were stratified by BMI (20 to 25, 25 to 30, 30 to 35, 35 to 40, and >40 kg/m^2), and 30-day SSOs evaluated across BMI groups for LVHR vs OVHR.

RESULTS: A total of 106,968 patients met inclusion criteria, with 60% patients obese. LVHR decreased SSO for all patients (odds ratio, .4; confidence interval, .19 to .60). Obesity classes I/II/III have increased odds of superficial SSI, deep SSI, and dehiscence for OVHR compared with LVHR. Only obesity class III has increased odds of organ space SSI and reoperation for OVHR vs LVHR ($P < .05$).

CONCLUSIONS: Obese patients are over-represented in VHRs. Thirty-day postoperative wound complications increase with higher BMI. LVHR minimizes both SSIs and SSOs, especially in higher obesity classes.

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Elective ventral hernia repair (VHR) remains one of the most common general surgery procedures, with nearly 348,000 performed in 2006. Estimates predict this number to continue to increase annually at a rate of 1% to 2%.[1,2] As is consistent with the environment of care in 21st century medicine, increasing scrutiny is being applied to the outcomes and resultant quality of surgical approaches. In 2007, the Centers for Medicare & Medicaid Services (CMS) initiated the Physicians Quality Reporting System (PQRS). Initially, it was elective, and physicians were incentivized to report their patients' outcomes to quality databases. In 2015, the PQRS ceased the incentive payments and began penalizing physicians for failures of quality. General surgeons must comply with the PQRS as part of the General Surgery Measures Group. Included in the list of procedures for the General Surgery Measures Group are VHRs. The PQRS reports surgeon-specific, risk-adjusted odds ratio (OR) for experiencing an adverse outcome. However, obesity is not included as a variable in the case-mix risk adjustment.[3]

Obesity continues to be a national epidemic, with roughly one-third of the US population obese.[4] It is well accepted that obesity increases the overall risks of cardiovascular disease, diabetes, malignancy, and orthopedic injuries, whereas decreasing life expectancy in the general population. Obese surgical patients experience increased postoperative respiratory, cardiovascular, and infectious morbidity compared with normal weight (NLWT) cohorts.[5] Newer studies are divided on the true risk obesity imparts on surgical outcomes across all body mass index (BMI) classes.[5,6] It is well documented in open VHRs (OVHRs) that obesity increases the risk of postoperative complications, primarily infections.[5] With the advent of laparoscopic approaches, effort has been concentrated on determining the efficacy and safety of laparoscopic VHRs (LVHRs), compared with traditional OVHR.[7–11] Recent Cochrane review in 2011 showed no difference in recurrence rates (relative risk, 1.22; confidence interval [CI], .62 to 2.38), and LVHR conferred a 4-fold decrease in wound infection risk (relative risk, .26; CI, .15 to .46).[12]

Although LVHR has been shown to decrease infectious complications in BMI greater than 30 kg/m^2, the relationship between classes of obesity and early postoperative complications has yet to be defined, specifically for BMI extremes. Given the new PQRS mandate, this information will be extremely influential in patient outcomes and surgeon-specific outcomes reporting. We propose that LVHR minimizes infectious complications for each given BMI category over OVHR. In addition, we propose that LVHR decreases all complications that would increase the risk of long-term mesh infection.

Methods

The National Surgical Quality Improvement Program (NSQIP) database of the American College of Surgeons offers a robust blinded, risk-adjusted database evaluating 30-day postoperative outcomes from 435 sites as of 2013. NSQIP enables national benchmarking of complication rates and surgical outcomes.[13–16]

An institutional review board approved the retrospective review of NSQIP data from 2009 to 2012. All patients aged 18 years or more undergoing *elective* repair of any ventral hernia were analyzed. Operations for inclusion were repair of umbilical, epigastric, Spigelian, and initial and/or recurrent incisional or ventral hernias (reducible, incarcerated and/or strangulated). Specific *Current Procedural Terminology* codes assessed were 49560, 49561, 49565, 49566, 49570, 49572, 49585, 49587, 49590, 49652, 49653, 49654, 49655, 49656, and 49657. Patients who were pregnant, recently immunosuppressed (steroids or chemoradiation), had presence of malignancy, varices or ascites, or required emergency operations were excluded. The exclusion criteria were chosen because of known risk of higher infectious complications and/or knowledge of high risk for laparoscopic procedures with predominant open

operations. Patients were stratified based on the World Health Organization BMI categories of NLWT; overweight; and obesity classes I, II, and III, (BMI: 20 to 25; 25 to 30; 30 to 35, 35 to 40, and ≥ 40 kg/m^2, respectively). Demographic variables included were year of operation, age, sex, race, diabetes, current tobacco use, congestive heart failure, chronic obstructive pulmonary disease, and surgery type (laparoscopic vs open). Postoperative variables of interest included superficial, deep, and organ space surgical site infections (SSIs); wound dehiscence; reoperation; pneumonia; renal failure; sepsis; and death.

Statistical analysis

Categorical variables are reported with counts (percentages). Continuous variables are described with mean (standard deviation) or median (minimum to maximum), as appropriate. Chi-square tests and Kruskal-Wallis tests were used to compare the distributions of baseline characteristics and risk factors by type of surgery. Two-sample *t* tests and Wilcoxon rank sum tests were used to compare the distributions of numerical variables. A logistic regression model was fitted to the data with at least 1 complication, described as surgical site occurrence (SSO) of superficial SSI, deep SSI, organ space SSI, dehiscence, and return to the operating room, as response; and BMI, surgery type, smoking status, and diabetes as covariates. These variables were selected by univariate logistic regression models. Variables with *P* values of less than .15 were included as possible predictors. Backward, forward, and stepwise selection methods agree on the previously mentioned variables. The final model was assessed with deviance residuals, Hosmer-Lemeshow test, and c statistics. ORs and respective CIs are provided. Analyses were performedwith SAS 9.4 (SAS Institute Inc., Cary, NC) and StatXact 10.1 software (Cytel Software Corporation, Cambridge, MA).

Results

There were 106,968 patients for the total data set. The data set was split randomly by group and year into 2 sets evenly: 1 set for model selection and estimation of parameters and the other for validation of the model. Table 1 provides baseline characteristics for OVHR and LVHR groups in the estimation set. Owing to the large sample size, many of the comparisons between baseline characteristics are statistically significant, but they may not be clinically significant. Nearly 60% of patients were obese, with cohort distribution as follows: BMI in the range of 20 to 25 kg/m^2 in 13.5% of patients; BMI 25 to 30 kg/m^2, 29.2%; BMI 30 to 35 kg/m^2, 27.1%; BMI 35 to 40 kg/m^2, 15.8%; BMI greater than 40 kg/m^2, 14.4%. OVHR comprises over three-fourths of cases (76.8%). Rates of LVHR are approximately stable across years, whereas the number of total cases increases each year (2009, 21.6%; 2010, 22.3%; 2011, 23.8%; 2012,