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Original article

Congestive heart failure is a risk factor for venous thromboembolism in bariatric surgery

Ivy N. Haskins, M.D., Richard Amdur, Ph.D., Babak Sarani, M.D., F.A.C.S., Khashayar Vaziri, M.D., F.A.C.S.*

Department of Surgery, The George Washington University, Washington, DC

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Abstract

Background: Venous thromboembolism (VTE) is a major complication of bariatric surgery leading to significant morbidity and mortality. We sought to identify predictive factors that increase the risk of deep venous thrombosis (DVT) and pulmonary embolism (PE) using data from the National Surgical Quality Improvement Program (NSQIP).

Methods: Patients undergoing bariatric procedures from 2005–2012 were identified in the NSQIP database. Pretreatment patient characteristics were examined by laparoscopic and open treatment groups using t tests and chi-square regression. Independent associations between patient characteristics and DVT and PE were examined using logistic regression. Logistic regression was also used to examine whether patients who had postprocedure DVT or PE were more likely than those who did not have these events to have additional morbidity and mortality outcomes.

Results: 102,869 patients underwent bariatric surgery (96,085 laparoscopic; 6,784 open) from 2005–2012. Preoperative variables associated with increased risk of DVT in laparoscopic bariatric surgery are male gender, higher BMI, congestive heart failure (CHF), and hypertension (HTN). Preoperative variables associated with increased risk of PE in laparoscopic bariatric surgery are male gender, age greater than or equal to 60, higher BMI, African American race, chronic obstructive pulmonary disease (COPD) and CHF. There are no preoperative variables associated with an increased risk of DVT in open bariatric surgery although there is a trend toward significance with CHF. Finally, higher BMI and CHF is associated with an increased risk of PE in open bariatric surgery.

Conclusions: CHF is a significant risk factor for VTE in bariatric surgery. Surgeons should consider aggressive screening and VTE prophylaxis in patients with CHF and other known risk factors to decrease postoperative morbidity from VTE. (Surg Obes Relat Dis 2015;▮:00–00.) © 2015 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords: Bariatric surgery; Deep venous thrombosis; Pulmonary embolism; Morbidity; Mortality; NSQIP

The prevalence of obesity has risen dramatically in the United States and it is now estimated that 34.9% of Americans are obese [1]. The rise in obesity has led to a similar increase in the number of bariatric surgeries performed annually in the United States [2–5]. These bariatric procedures carry a significant risk, and venous thromboembolism (VTE), including deep venous thrombosis (DVT) and pulmonary embolus (PE), is among the leading causes of morbidity and mortality in bariatric surgery [6].

Factors that increase the risk of VTE have been described by previous authors and include those that contribute to

*Correspondence: Khashayar Vaziri, M.D., F.A.C.S., Associate Professor, Department of Surgery, George Washington University, 2150 Pennsylvania Ave., NW, Suite 6 B, Washington, DC 20037. Office: 202.741.3225. Fax: 202.741.3219.

E-mail: kvaziri@mfa.gwu.edu

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Virchow's Triad [6,7]. Prolonged operative times, advanced age, trauma, malignancy, pregnancy and/or estrogen therapy, hypercoaguable conditions, and obesity have all been identified as risk factors that lead to an increased risk of VTE [6,8]. In the National Surgical Quality Improvement Program (NSQIP), deep venous thrombosis (DVT) includes all new blood clots diagnosed by duplex, venogram, or computed tomography (CT) scan within 30 days of the original operation. Similarly, pulmonary embolism (PE), which is the lodging of blood clot in a pulmonary artery, is diagnosed by V-Q or CT scan or pulmonary arteriogram within 30 days of the original operation. In this study, we sought to identify additional preoperative risk factors associated with increased risk of VTE in patients undergoing bariatric procedures, using data from NSQIP.

Methods

All bariatric surgical procedures from 2005-2012 were identified in the NSQIP database using Current Procedural Terminology (CPT) codes. Open bariatric surgery cases, namely vertical banded gastroplasty (CPT 43842), gastric restrictive procedure other than vertical banded gastroplasty (CPT 43843), and gastric bypass with Roux-en-Y gastroenterostomy (43846), and laparoscopic bariatric surgery cases, namely gastric bypass with Roux-en-Y gastroenterostomy (CPT 43644), gastric restrictive procedure (CPT 43645), adjustable gastric band (CPT 43770), and sleeve gastrectomy (CPT 43775), were included. Association of all possible preoperative variables, as limited by the NSQIP database, with postoperative VTE within 30 days of surgery was identified within these groups. Age was recoded as a binary variable based on the established increased risk of VTE in patients ages 60 years and older [9,10]. To control for the variation in pretreatment characteristics, such as body mass index (BMI) and patient co-morbidities, we used multivariate models to determine the independent preoperative predictors of DVT and PE. Stepwise logistic regression was used with a threshold of $P < .20$ for model entry. Variables that made model entry included gender, age ≥ 60, BMI (kg/m^2), race, COPD, CHF, HTN, and DM (diabetes mellitus). Any covariates that were associated with either DVT or PE were considered for entry in these models to minimize the effect of potential confounding variables. Stepwise logistic regression and chi-square analysis was then used to investigate the association between VTE and postoperative morbidity and mortality. SAS version 9.2 was used for all data analysis with $P < .05$ being significant.

Results

A total of 102,869 bariatric surgery cases were available for analysis from the NSQIP database from the years 2005–2012. A total of 96,085 patients underwent laparoscopic bariatric surgery and a total of 6,784 patients underwent open bariatric surgery during this time period. Within this cohort, a total of 272 patients were diagnosed with a DVT (40 open, 232 laparoscopic) and 196 patients were diagnosed with a PE (37 open, 159 laparoscopic), and 50 patients had both within 30 days from their original operation, for an overall incidence of .45%. Compared with those who underwent open bariatric surgery, the laparoscopic group was significantly younger (mean age 45 versus 46.1 yrs, $P < .0001$), more often female (79.2% versus 75.3%, $P < .0001$), and had a lower BMI (45.9 versus 48.6 kg/m^2, $P < .0001$). Patients in the laparoscopic group were also less likely to smoke (11.3% versus13.1%, $P < .0001$), less likely to have co-morbid conditions including COPD (1.6% versus 3.4%, $P < .0001$), CHF (0.1% versus 0.3%, $P = .0009$), hypertension (52.7% versus 56.1%, $P < .0001$, or diabetes mellitus (DM) (27.3% versus 31.8%, $P < .0001$). The laparoscopic group also had a significantly shorter length of hospital stay (2.1 versus 3.6 days, $P < .0001$) (Table 1). The preoperative patient characteristics of history of myocardial infarction (MI) and previous percutaneous coronary intervention (PCI) were not included in this analysis as patient information was not coded for these variables in $>20{,}000$ patients in this cohort.

Laparoscopic bariatric surgery

96,085 patients underwent laparoscopic bariatric surgery from the years 2005 to 2012. Male gender, higher BMI, CHF, and HTN were independently associated with an increased risk of postoperative DVT (Table 2). Male patients were 1.88 times more likely to develop a DVT in this group compared to female patients ($P < .0001$). A higher BMI was associated with 1.03 times the risk of developing a DVT ($P < .0001$). Similarly, patients with CHF and HTN were 4.64 and 1.50 times more likely to develop a DVT in this group than patients without these co-morbid conditions ($P = .004$ and $P = .008$, respectively). Age ≥ 60, African American race, COPD, and DM were not significantly associated with DVT.

Male gender, age ≥ 60, higher BMI, African American race, COPD, and CHF were independently associated with an increased risk of postoperative PE, while DM did not increase the risk of PE (Table 3). Male patients were 1.65 times more likely to develop a PE in this group compared to female patients ($P = .004$). Similarly, African American patients were 1.64 times more likely to develop a PE in this group compared to non-African American patients ($P = .004$). Patients with COPD and CHF were 2.36 and 6.03 times, respectively, more likely to develop a PE in this group compared with patients without these co-morbidities ($P = .02$ and $P = .014$, respectively).

Open bariatric surgery

6,784 patients underwent open bariatric surgery from the years 2005 to 2012. No preoperative patient characteristics

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