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Body mass index predicts operative time in elective colorectal procedures

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ABSTRACT

Background: Obesity currently affects more than a third of the United States population and is associated with increased surgical complications. Compared to all other subspecialties, colorectal surgery is the most affected by the increasing trend in obese surgical patients. Operative time has been found to have the greatest impact on hospital costs and physician workload. This study was conducted to determine whether obesity has a direct impact on operative time in elective colorectal procedures using a high-powered, nationally representative patient sample.

Methods: A retrospective analysis was conducted on 45,362 patients who underwent open and laparoscopic ileocolic resections, partial colectomies, and low pelvic anastomoses using American College of Surgeons National Surgical Quality Improvement Program data from 2005–2009. Operative time was the main outcome variable, whereas body mass index (BMI) was the main independent variable. BMI was divided into three classes as follows: normal (<25), overweight and/or obese (25–35), and morbidly obese (>35). A univariate linear model was used to analyze the relationship while controlling for confounding factors such as demographics and preoperative conditions. Statistical significance was established at $P \leq 0.05$.

Results: Morbidly obese patients were found to have longer operative times than did normal patients across each individual colorectal procedure ($P < 0.001$), ranging from a mean difference of 17.8 min for open ileocolic resections to 56.6 min for laparoscopic low pelvic anastomoses with colostomies.

Conclusions: BMI, as an objective measure of obesity, is a direct, statistically significant independent predictor of operative time across elective colorectal procedures.

1. Introduction

Obesity has been cited as one of the major health issues associated with industrialized counties such as the United States, where a third of the population is affected and one in twenty is classified as morbidly obese [1]. Obese individuals have a high body mass index (BMI), a measurement that is partly determined by the patients' total body fat [2]. Consequently, operating on these obese patients can be a challenge for surgeons during open or laparoscopic colorectal procedures. Various studies have established the association of obesity with higher rates of surgical site infections in colorectal procedures [1,3].

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Patients undergoing colorectal procedures present a greater degree of postoperative complications when compared with patients undergoing other surgical procedures [4]. The most prevalent of these complications include surgical site infections, which have been associated with an increased postoperative length of stay, greater costs of care, and higher rates of readmission [5]. Operative time has been identified as a significant predictor of surgical site infections as per the Centers for Disease Control and Prevention National Nosocomial Infections Surveillance index [6]. In addition, studies have demonstrated the impact of longer operative times on increased hospital costs and increased surgical workloads [7–9].

Although a few studies have described an association of BMI and body surface area with operative time in specific colorectal procedures and conditions, they did not analyze other colorectal procedures or compare both laparoscopic cases and open cases [10,11]. Furthermore, there have been no prior studies on whether BMI independently predicts operative time in colorectal procedures. We have queried the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database to more accurately analyze the relationship between obesity and operative time across multiple colorectal procedures and to highlight the importance of an increasing trend in obesity on increased time of work for colorectal surgeons.

2. Methods

2.1. Data collection

The ACS-NSQIP database was evaluated in a retrospective outcome analysis to select patients who underwent nonemergent colorectal procedures. Using NSQIP Participant Use Files data from the years 2005–2009, 54,084 patients were selected based on Current Procedural Terminology coding criteria. Surgical procedures of interest included the following three most commonly performed procedures (open and laparoscopic procedures are listed, respectively, in parentheses): ileocolic resections (44,160; 44,205), partial colectomies (44,140; 44,204), and low pelvic anastomoses (44,145/44,146; 44,207/44,208). BMI in kilogram per square meter was calculated using height and weight data. A new variable was created to divide BMI into three classes as follows: normal (<25), overweight and/or obese (25–35), and morbidly obese (>35). Operative time was defined in minutes beginning with the initial skin incision and ending with application of postoperative dressing and served as the primary outcome variable, whereas BMI was the primary predictor variable. Results were reported as mean ± standard error. Exclusion criteria included both missing data (534 patients) and presence of outliers (8188 patients) in potential predictor variables as well as in the outcome variable, leading to a final sample of 45,362 patients for data analyses. Of those patients, when classified by BMI, 15,639 patients were normal, 24,146 patients were overweight and/or obese, and 5577 patients were morbidly obese. When classified by surgical procedure, there were 10,643 patients who had undergone ileocolic resections (6458 for open and 4185 for laparoscopic), 23,583 patients who had undergone partial colectomies (14,155 for open and 9428 for laparoscopic), and 11,136 patients who had undergone low pelvic anastomoses (6702 for open and 4434 for laparoscopic).

2.2. Statistical analysis

The effect of potential predictor variables on operative time was determined via a univariate analysis of variance. The variables used in the analysis are identified (Table 1). Of these variables, BMI, surgical procedures, age, gender, race, diabetes mellitus, dyspnea, financial status before illness, financial status before surgery, ventilator dependence, ascites, esophageal varices, congestive heart failure, previous angioplasty, previous cardiac surgery, angina, rest pain, renal failure, history of transient ischemic attacks, disseminated cancer, wound infection, chronic steroid use, weight loss, chemotherapy, radiotherapy, pregnancy, and systemic sepsis were identified as statistically significant predictor variables of operative time.

Discrete predictor variables significant in the univariate analysis were converted to continuous ones to be used in

Table 1 – List of potential predictor variables of operative time.

BMI	Surgical procedures	Age	Gender	Race	Diabetes mellitus	Alcohol use	History of stroke
Dyspnea	Financial status before illness	Financial status prior to surgery	Ventilator dependence	COPD history	Pneumonia	Esophageal varices	CNS tumor
Congestive heart failure	History of myocardial infarction	Previous angioplasty	Previous cardiac surgery	Angina	Hypertension	Rest Pain	Disseminated cancer
Acute renal failure	Dialysis	Impaired sensorium	Coma	Hemiplegia	Paraplegia	Quadriplegia	Wound infection
Chronic steroid use	Weight loss	Bleeding disorders	Blood transfusions before surgery	Chemotherapy	Radiotherapy	Pregnancies	Operations a month before surgery
Ascites	Revascularization history		History of transient ischemic Attacks		Cigarette smoking		Systemic sepsis

CNS = central nervous system; COPD = chronic obstructive pulmonary disease.