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Bariatric Surgery Prior to Total Knee Arthroplasty is Associated With Fewer Postoperative Complications

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ABSTRACT

This study used a national database to compare 90 day postoperative complication rates between three groups of patients who underwent total knee arthroplasty (TKA): (1) non-obese patients (n = 66,523), (2) morbidly obese patients who did not have bariatric surgery (n = 11,294) and (3) morbidly obese patients who underwent bariatric surgery prior to TKA (n = 219). Morbidly obese patients who underwent bariatric surgery prior to TKA had reduced rates of major (OR 0.45, $P = 0.001$) and minor (OR 0.61, $P = 0.01$) complications compared to morbidly obese patients who did not have bariatric surgery. Bariatric surgery prior to TKA appears to be associated with less risk of postoperative complications, although not to the same level as non-obese patients.

Obesity has been well established as a significant health hazard leading to concerning and potentially preventable increases in morbidity and mortality [1,2]. The obesity epidemic continues to grow not only in the United States but also in both developed and developing countries worldwide [1]. From 2009 to 2012, the age-adjusted prevalence of obesity (body mass index, BMI ≥30.0) in US adults 20 years and older was 35.3%, an increase of 4.9% from 10 years prior [3]. Obesity contributes to a host of significant chronic medical problems, with increased rates of diabetes mellitus [4–8], cardiovascular disease [4,6,7,9–12], hypertension [4,6,13–15], hyperlipidemia [4–7,10,13,15,16], obstructive sleep apnea [4,6], cerebrovascular disease [4,7,9,15,17,18] and gall bladder disease [4,16,19] among others. Additionally, obesity has been widely recognized as a risk factor for the development of osteoarthritis, with the knee being one of the most commonly affected joints [20,21]. A systematic review and meta-analysis assessing the relationship between BMI and knee osteoarthritis demonstrated a nearly three-fold increased risk of developing osteoarthritis of the knee in patients who are overweight or obese compared to normal weight patients [22]. An alternative study reports a four-fold increased risk of osteoarthritis in obese males and a five-fold increased risk of osteoarthritis in obese females [23].

Over the past several decades, the incidence of total joint arthroplasty has increased roughly in parallel with the rising rate of obesity, highlighting the more frequent need for operative interventions as increasing numbers of overweight and obese patients suffer from advanced osteoarthritis [24]. Obese patients represent a sizable and growing proportion of the patients who undergo total knee arthroplasty (TKA). In 2005, the average BMI of patients undergoing TKA was 32.6, an increase from 30.8 in 2000 and 30.2 in 1995 [25]. Several studies have demonstrated an increase over the past decade in the proportion of TKA patients who are obese at the time of surgery [25,26]. Although percentages vary slightly between several studies, approximately 60% of patients undergoing TKA are obese at the time of surgery [26,27]. A Canadian registry study demonstrated a 19-fold increase in the need for TKA in patients with a BMI of 35–39.9 kg/m^2 and a 32-fold increase in the need for TKA in patients with a BMI of greater than 40 kg/m^2 [28]. Obese patients have been demonstrated to experience worse outcomes compared to non-obese patients following TKA in some studies. A recent study found that, in comparison to TKA patients with a BMI <30, obese patients undergoing TKA had increased infection rates, higher rates of revision surgery and lower functional outcome scores [24]. Numerous studies have confirmed these findings of increased complication rates and overall worse outcomes in obese patients undergoing TKA [27,29–32]. Additionally, obesity has also been associated with longer hospital stays and increased health care costs in patients undergoing TKA [26]. Some conflicting evidence exists debating the effect of obesity on postoperative complications and outcomes after TKA, as several studies have failed to demonstrate significant differences in outcomes and complication rates between obese and non-obese patients receiving TKA [33–36].

Bariatric surgery, including both gastric bypass and gastric (lap) banding techniques, is an increasingly utilized and effective method to achieve significant long-term weight loss [37]. Although nonoperative weight loss interventions are typically initial options for most obese patients, bariatric surgery can result in greater weight loss than nonoperative strategies and can often result in reductions in the comorbidities commonly associated with obesity, such as diabetes and hypertension

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Table 1
ICD9 and CPT Codes Used to Define Postoperative Complications.

Description	CPT/ICD-9 Code
Major complications	
Pulmonary embolism	ICD-9 415.1, 415.11, 415.19
Deep vein thrombosis	ICD-9 453.4, 453.40, 453.41, 453.42
Diagnosis of postoperative infection	ICD-9 998.51, 998.59, 711.96, 996.66, 996.67, 996.69
Postoperative irrigation and debridement	CPT 10180, 20000, 20005, 27310, 29871
Acute myocardial infarction	ICD-9 410.00-410.02, 410.10-410.12, 410.20-410.22, 410.30-410.32, 410.40-410.42, 410.50-410.52, 410.60-410.62, 410.70-410.72, 410.80-410.82, 410.90-410.92
Respiratory failure	ICD-9 518.0, 518.51, 518.52, 518.81, 518.82
Cerebrovascular accident	ICD-9 430, 431, 432.0, 432.1, 432.9, 433, 433.0, 433.00, 433.01, 433.1, 433.10, 433.11, 433.2, 433.20, 433.21, 433.3, 433.30, 433.31, 433.8, 433.80, 433.81, 433.9, 433.90, 433.91, 434, 434.0, 434.00, 434.01, 434.1, 434.10, 434.11, 434.9, 434.90, 434.91
Minor Complications	
Stiffness and/or manipulation under anesthesia	ICD-9 718.46, 718.56, CPT 27570
Stiffness requiring lysis of adhesions	CPT 29884
Urinary tract infection	ICD-9 098.0, 098.1, 098.10, 098.19, 599.0, 996.64
Pneumonia	ICD-9 480.0-480.9, 481, 482.0-482.9
Acute renal failure	ICD-9 584.5-584.9, 580.0-580.9, 586
Postoperative blood transfusion	CPT 36430, ICD-9 V58.2, 990.0, 990.2, 990.3, 990.4

[37]. Four prior studies have investigated bariatric surgery for weight loss prior to total joint arthroplasty, with none finding statistically significant reductions in postoperative complications or improvements in postoperative outcomes compared to morbidly obese patients who do not have bariatric surgery preoperatively [38–41]. The goal of this study is to employ a national database to evaluate the association between preoperative bariatric surgery for weight loss and complication rates after TKA.

Materials and Methods

All data were derived from a publicly available database of patients, the PearlDiver Patient Records Database (www.pearldiverinc.com; PearlDiver Inc, Fort Wayne, Indiana). The database contains procedure volumes, demographics, and average charge information for patients with International Classification of Diseases, 9th Revision (ICD-9) diagnoses and procedures or Current Procedural Terminology (CPT) codes. Data for the present study were derived from the Medicare database within the PearlDiver records, which has a total of 135,509,904 individual patient records from 2005 to 2011. Access to the database was granted by PearlDiver Technologies for the purpose of academic research. The database was stored on a password-protected server maintained by PearlDiver. CPT and ICD-9 codes can be searched in isolation or in combination with one another. The search results yield the number of patients with the searched code or combination of codes.

For the purposes of this study, patients who underwent TKA from 2005 to 2011 were identified by CPT code (27447). These patients were then divided into non-obese and morbidly obese cohorts using ICD-9 codes for morbid obesity (278.01) or BMI >40 (V85.4, V85.41–V85.45). The database was then queried for patients who underwent bariatric surgery for weight loss, including laparoscopic banding or gastric bypass, prior to TKA using CPT codes. This resulted in three cohorts: 1) non-obese TKA patients, 2) morbidly obese TKA patients who did not have bariatric surgery and 3) morbidly obese patients who underwent bariatric surgery for weight loss prior to TKA.

Patients in each cohort were queried for basic demographics including gender, age (<65, 65–80, >80) and smoking status. Comorbidities for each cohort were assessed, including diabetes mellitus (DM), obstructive sleep apnea (OSA), hyperlipidemia (HLD), hypertension (HTN), peripheral vascular disease (PVD), congestive heart failure (CHF), coronary artery disease (CAD), chronic kidney disease (CKD), chronic lung disease and chronic liver disease (CLD) using ICD-9 codes for each disease.

Each cohort was then queried for postoperative complications within 90 days after the surgical procedure utilizing ICD-9 and CPT codes. Overall complications were first queried as “major” and “minor” complications to yield the number of unique patients that had at least one of each complication type. Major complications included pulmonary embolism (PE), deep vein thrombosis (DVT), diagnosis of postoperative infection, need for postoperative irrigation and debridement (I&D), acute myocardial infarction (MI), respiratory failure and acute postoperative cerebrovascular accident (CVA). Minor complications included a diagnosis of postoperative stiffness, postoperative stiffness requiring manipulation under anesthesia (MUA), urinary tract infection (UTI), pneumonia, acute renal failure (ARF), acute cholecystitis and need for a postoperative blood transfusion. Postoperative venous thromboembolism (VTE, including PE and DVT), postoperative infection (including diagnosis and/or I&D), postoperative stiffness (including a diagnosis or need for MUA) and medical complications (including MI, respiratory failure, CVA, UTI, pneumonia, ARF and acute cholecystitis) were also separately queried. Table 1 provides the CPT and ICD-9 codes used to define all postoperative complications.

Odds ratios (OR) and 95% confidence intervals (CI) were calculated for each comparison between the three cohorts. Chi square tests were calculated to determine statistical significance, with $P < 0.05$ considered significant.

Results

A total of 78,036 unique patients who underwent TKA were identified from 2005 to 2011, including 66,523 non-obese patients, 11,294 morbidly obese patients who did not undergo bariatric surgery and 219 morbidly patients who underwent bariatric surgery for weight loss prior to TKA. Of the 219 patients who underwent bariatric surgery prior to TKA, 70 had their TKA within 1 year of bariatric surgery, 59 underwent TKA between 1 and 2 years after bariatric surgery and 90 underwent TKA more than 2 years after bariatric surgery. A comparison of each cohort's demographics and medical co-morbidities is provided in Table 2. The groups were demographically different; morbidly obese patients (including those who did and did not have bariatric surgery) were more frequently female than non-obese patients ($P < 0.0001$, Table 2). Patients who underwent bariatric surgery were more frequently under the age of 65 compared to the other cohorts ($P < 0.0001$, Table 2). Patients who underwent bariatric surgery were also more frequently smokers compared to the other cohorts ($P < 0.0001$, Table 2). Morbidly obese patients had significantly higher rates of all medical co-morbidities compared to non-obese patients. The bariatric surgery cohort had significantly higher rates of DM, OSA, PVD, CHF, and CLD compared to those morbidly patients who did not have bariatric surgery.

Morbidly obese patients who underwent bariatric surgery prior to TKA had significantly lower 90-day postoperative major complication rates (9.6% vs 19.0%, OR 0.45, $P = 0.001$) and minor complication