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Bariatric Surgery Prior to Total Joint Arthroplasty May Not Provide Dramatic Improvements in Post-Arthroplasty Surgical Outcomes

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ABSTRACT

This study compared the total joint arthroplasty (TJA) surgical outcomes of patients who had bariatric surgery prior to TJA to TJA patients who were candidates but did not have bariatric surgery. Patients were retrospectively grouped into: Group 1 ($n = 69$), those with bariatric surgery >2 years prior to TJA, Group 2 ($n = 102$), those with surgery within 2 years of TJA, and Group 3 ($n = 11{,}032$), those without bariatric surgery. In Group 1, 2.9% (95% CI 0.0–6.9%) had complications within 1 year compared to 5.9% (95% CI 1.3%–10.4%) in Group 2, and 4.1% (95% CI 3.8%–4.5%) in Group 3. Ninety-day readmission (7.2%, 95% CI 1.1%–13.4%) and revision density (3.4/100 years of observation) was highest in Group 1. Bariatric surgery prior to TJA may not provide dramatic improvements in post-operative TJA surgical outcomes.

Obesity (body mass index (BMI) $\geq$ 30 kg/m^2) occurs in 34% [1] of the general United States population. Obesity is the second leading cause of death in this country [2], the leading cause of overall health burden [3], and also a risk factor and moderator in the development of other health conditions. An estimated 55% of patients undergoing total knee arthroplasty (TKA) [4] and 39% of patients undergoing total hip arthroplasty (THA) [5] in the United States are obese. Obesity is associated with higher complication rates (e.g. surgical site infection (SSI), dislocations, and readmissions) [6,7] in patients undergoing total joint arthroplasty (TJA).

Bariatric surgical procedures are an option for weight reduction in patients with BMI $\geq$ 40 kg/m^2 or BMI $\geq$ 35 kg/m^2 and certain co-morbidities [8–10]. Compared to standard weight loss approaches, bariatric procedures lead to significantly higher mean amounts of weight loss [11]. Due to the high prevalence of morbid obesity in TJA patients and recommendations by orthopedic providers for patients to lose weight prior to TJA, bariatric surgery has been considered an option for morbidly obese TJA candidates. However, the relationship between bariatric procedures and TJA has not been thoroughly examined. Three small descriptive studies have evaluated surgically induced weight loss in TJA patients. All studies reported a higher incidence of TJA peri-operative complications despite patients' weight loss [12–14]. No studies, to our knowledge, have evaluated whether bariatric surgery prior to TJA is associated with a different incidence of post-operative complications in comparison to a similar group of patients—morbidly obese TJA patients that have not had bariatric surgery.

The purpose of this study was to compare TJA outcomes (SSI, thromboembolic events, readmissions, early TJA revision, and mortality) of patients who had bariatric surgery prior to TJA patients to those of patients who were candidates for bariatric surgery at the time of their TJA but did not have bariatric surgery.

Methods

Study Design and Sample

A retrospective cohort study was conducted. Inclusion criteria consisted of patients who underwent a primary unilateral TJA for osteoarthritis between 01/01/2005 and 12/31/2011, were 18 years old or over, and had their TJA procedure(s) in 36 hospitals in the two

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largest geographical regions (Southern and Northern California) of an United States integrated healthcare system [15]. Patients who had multiple procedures within 1 year of each other were excluded. Only the first operation of patients with multiple procedures (outside the 1-year window) was included in the sample ($N = 64,854$). After these initial selection criteria, the bariatric surgery history of patients was obtained. A patient was included in the study if she/he: [1] had a bariatric surgery procedure prior to TJA ($N = 171$) or [2] would be considered a candidate for bariatric surgery, using as criteria a BMI $\geq$ 40 kg/m^2 or a BMI $\geq$ 35 kg/m^2 and one other co-morbidity (i.e. diabetes, hypertension, liver disease, and chronic lung disease) in addition to osteoarthritis ($N = 11,032$) [8].

Data Sources

An integrated healthcare system's Total Joint Replacement Registry (TJRR) was used to identify the study cohort of patients with total knee or hip arthroplasty [16,17]. The institutional electronic medical record (EMR) was used to identify the history of bariatric surgery. Detailed information on TJRR coverage, data collection procedures, and quality assurance has been previously published [15–18]. The EMR is composed of several modules and surgical procedures are typically extracted from its operative and inpatient modules. Using *International Classifications of Disease, Ninth Revision* (*ICD9*) procedure codes for bariatric surgery (44.31, 44.38, 44.39, 44.68, 44.95, 44.96, 44.97, 44.98, 44.5, 44.99,44.69, 43.89, 45.50, 45.51, 45.90, 45.91, 43.7, 43.5, 43.6, 44.93, 44.99) in conjunction with *ICD9* diagnoses codes for obesity (278.0, 278.00, 278.01, 278.02, V85.35, V85.37, V85.38,V85.39, V85.4, V77.8) we identified patients who underwent surgery for obesity. Patients who had an *ICD9* diagnostic code for cancer (150.0–159.9, 230.1–230.9) were excluded [19,20].

Exposure of Interest

Bariatric surgery was the exposure of interest. Patients were grouped into (1) those that had the surgery >2 years prior to their TJA, (2) those who had the surgery within 2 years prior to TJA, and (3) those who did not have bariatric surgery but could be considered candidates. Two years was used as the cut off to stratify the patients who underwent bariatric surgery because maximum weight loss and stabilization is typically achieved 2 years after surgery [21].

Outcomes of Interest

Outcomes evaluated included: SSI (deep (1 year) and superficial (30 days)) [22], deep vein thrombosis (90 days) [23], pulmonary embolism (90 days) [23], revision (all-cause, septic (ever)), revision density (all-cause (ever)), and mortality (30 days, 90 days) after TJA surgery. Composite complication indexes (inclusive of SSI, thrombo-embolic events, revision, and mortality) of surgical outcomes (occurring within 30 days, 90 days, and 1 year) were also evaluated. Inpatient readmissions (30 days and 90 days) were evaluated for a subset of the sample (years 2009–2011).

Covariates

Patient characteristics (gender, age, race), procedure type (hip or knee arthroplasty), general health status as defined by the American Society of Anesthesiologist (ASA) score [24], BMI at TJA, and co-morbidity profile at TJA as defined by the Elixhauser co-morbidity algorithm [25], were obtained from the TJRR.

Statistical Analysis

Given the small sample size of Groups 1 and 2, we only report descriptive statistics. Means and standard deviations were calculated for continuous variables and frequencies and proportions were used to describe categorical variables. The cumulative incidence of outcomes evaluated was calculated as the number of events over the number of cases, confidence intervals were calculated. Revision/100 person years of observation (revision density) was calculated as the number of revision procedures divided by the entire follow-up time for the group. Revision/100 person years was also calculated by bariatric surgery group and then stratified by age group. Between 3% (patients who did not have bariatric surgery and those with bariatric surgery >2 years prior to TJA) and 7% (bariatric surgery within 2 years) of patients did not have complete 1-year follow-up. These patients contributed information for the time they had complete information (mean 122 days).

Results

A total of 11,032 TJA patients fit the criteria for bariatric surgery but had not undergone the procedure, 69 patients that had bariatric surgery >2 years prior to TJA and 102 had it within 2 years of TJA. There was a higher proportion of females and younger patients who had bariatric surgery (in both groups) compared to those without surgery. There was a higher proportion of TKA as opposed to THA patients in the group who had their bariatric surgery >2 years before TJA (89.9%) than in groups with TJA within 2 years (70.6%) of bariatric or those who were candidates for bariatric surgery (76.3%). Both groups of patients with bariatric surgery (33.3% bariatric within 2 years and 37.3% bariatric >2 years) had a lower prevalence of ever having had diabetes compared to patients who did not have bariatric surgery (47.2%) (Table 1). At the time of TJA, patients with bariatric surgery had a better general health status (ASA 1 and 2, 55.1% in bariatric within 2 years vs. 68.6% in bariatric >2 years) than in those with no bariatric surgery (39.1%). Length of stay of stay was similar between groups, ranging from 2.7 days (SD = 0.8) in patients with bariatric surgery >2 years prior to TJA to 3.0 days (SD = 1.5) in patients without bariatric surgery. The distributions of co-morbidities prevalence in the study groups at the time of TJA can be seen in Table 2.

In patients who had bariatric surgery >2 years since TJA, 2.9% had complications within 1 year post-operative compared to 5.9% in patients with bariatric surgery within 2 years of TJA and 4.1% in the patients who did not have bariatric surgery. Readmissions within 90 days was highest in patients with bariatric surgery >2 years since surgery (7.2%), followed by patients with no bariatric surgery (5.9%), and then patients who had bariatric surgery within 2 years of TJA (2.5%). No deep vein thrombosis, pulmonary embolisms, or deaths within 90 days post-operative occurred in patients with bariatric surgery. In patients with bariatric surgery (>2 years 1.5% vs. within 2 years 1.0%) the incidence of deep SSI was similar to the cases with no bariatric surgery (1.2%) (Table 3).

Patients who had bariatric surgery >2 years before TJA had a revision density of 3.4/100 years of observation, which was higher than in patients with bariatric surgery within 2 years of TJA (2.7/100 years of observation) and those without bariatric surgery (1.0/100 years of observation). When evaluating revision density by age (Table 4), both groups of patients with bariatric surgery had higher revision densities in the 50- to 59-year-old groups than patients without bariatric surgery. In the 40- to 49- year-old and 60- to 69-year-old groups those with bariatric surgery within 2 years of TJA (5.4/100 years of observation and 1.4/100 years of observation, respectively) also had a higher revision density than those without surgery (2.0/100 years of observation and 0.9/100 years of observation, respectively).

Discussion

In a cohort of patients with bariatric surgery prior to TJA we found a low incidence of post-operative TJA complications. The incidence of complications was comparable between patients with bariatric surgery prior to TJA and those who were candidate for bariatric