SCIENTIFIC ARTICLE

The Impact of Obesity on Complications of Elbow, Forearm, and Hand Surgeries

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Purpose To compare the rates of postoperative complications in obese and nonobese patients following elbow, forearm, and hand surgeries.

Methods This case-control study examined 436 patients whose body mass index (BMI) was over 35 and who underwent hand, wrist, forearm, or elbow surgery between 2009 and 2013. Controls were patients (n = 433) with a BMI less than 30 who had similar surgeries over the same period, and who were frequency-matched by type of surgery (ie, bony, soft tissue, or nerve), age, and sex. Postoperative complications were defined as infection requiring antibiotic or reoperation, delayed incision healing, nerve dysfunction, wound dehiscence, hematoma, and other reoperation. Medical comorbidities (eg, hypertension, diabetes, stroke, vascular disease, kidney disease, and liver disease) were recorded. Chi-square analyses were performed to explore the association between obesity and postoperative complications. Similar analyses were performed stratified by surgery type and BMI classification. Logistic regression modeling was performed to identify predictors of postoperative complications accounting for surgery type, BMI, the presence of comorbidities, patient age, and patient sex. This same model was also run separately for case and control patients.

Results The overall complication rate was 8.7% with similar rates between obese and nonobese patients (8.5% vs 9.0%). Bony procedures resulted in the greatest risk of complication in both groups (15% each group). Multivariate analysis confirmed surgery type as the only significant predictor of complications for nonobese patients. However, among obese patients, both bony surgery and increasing BMI were associated with greater complication rates.

Conclusions Not all obese patients appear to be at any higher risk for complications after elbow, forearm, and hand surgery compared with nonobese patients. However, there appears to be a dose-dependent effect of BMI among obese patients such that increasing obesity heightens the risk of complications, especially for those with a BMI greater than 45. *(J Hand Surg Am. 2014;39(8):1578–1584.*

Type of study/level of evidence Prognostic II.

Key words Obesity, surgery, complications, BMI.

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Obesity is an emerging epidemic in the United States. Currently, over 35% of adults nationwide are considered obese (body mass index [BMI] $\geq$ 30), and the national prevalence of obesity has been climbing steadily since 1980.[1] Owing to the increasing prevalence of marked obesity, the World Health Organization and the National Institutes of Health have stratified obesity by BMI, and others have further differentiated class III obesity (originally BMI $\geq$ 40) to now specifically include extreme obesity (BMI 45−49.9) and super obesity (BMI $\geq$ 50).[2] In 2008, data indicated that the medical costs to treat obesity reached $147 billion in the United States.[3]

Obesity has been linked to increased predisposition to multiple orthopedic disorders, including hip and knee osteoarthritis, low back pain, and carpal tunnel syndrome and to complications following orthopedic procedures.[4,5] This includes greater rates of infection, more frequent need for revision surgery after total knee arthroplasty and acetabular fracture fixation, and difficulty achieving fracture union.[6−8] Obesity is also associated with negative functional outcomes and longer hospital stays following arthroscopic rotator cuff repairs.[9]

Despite this evidence of adverse outcomes and increased complication rates among obese orthopedic patients, the risk of postoperative complications following surgery for elbow, forearm, and hand conditions is unknown.[10] Considering the unique characteristics of these surgeries including immediate ambulation, short duration of common procedures, and limited subcutaneous fat in these areas, we questioned whether complications following these surgeries would differ from other orthopedic surgeries in obese individuals. The purpose of this case-control investigation was to compare the rates of postoperative complications experienced by obese and nonobese hand, wrist, forearm, and elbow surgical patients. We tested the null hypothesis that obese patients would experience similar complication rates compared with nonobese patients following operations on the elbow and distally.

MATERIALS AND METHODS

This case-control study compared severely obese (BMI $\geq$ 35) hand, forearm, and elbow surgical patients to a nonobese (BMI $<$ 30) surgery patient control group undergoing similar surgeries. After receiving approval from our institutional review board, cases were identified using electronic anesthesia records from preoperative assessments in our institution from 2009 to 2013. All procedures were performed by 1 of 5 fellowship-trained orthopedic hand surgeons (including R.P.C.). Our patient groups excluded patients with BMI greater than 30 but less than 35. This was chosen a priori to increase the differentiation between the groups based on the presumption that BMI in each group would skew toward normal away from the high and low extremes and minimize the chance of misclassification of patients owing to minor weight fluctuation around a BMI of 30 (Fig. 1). Other exclusion criteria were patients younger than 18 years, patients undergoing surgery proximal to the elbow, patients concurrently undergoing more than 1 type of surgery (eg, bony, soft tissue, or nerve), and any patient without postoperative care at our institution. Surgeries coded with a primary procedure of irrigation and debridements were also excluded owing to difficulty in determining whether sequential trips to the operating room or persistent infection was expected or represented a complication. A total of 435 hand, wrist, forearm, and elbow procedures on patients with a BMI of 35 or greater were included. The control group comprised 433 patients with BMI less than 30 who had a hand, wrist, forearm, or elbow surgery over the same time period and were frequency-matched to the obese group by type of surgery (ie, bony, soft tissue, and nerve), age, and sex in decreasing order of priority.

The medical records of both groups were reviewed to document the incidence and type of postoperative complications. Reviews were performed by 4 researchers (D.A.L., J.G.S., G.R.L., U.C.O.), none of whom were the surgeon of record, after a priori agreement on the definition of a complication. For confirmation, a second member of the research team reviewed the record of any patient experiencing a complication. Complications were defined as clinical signs of infection requiring antibiotic prescription (by the operating surgeon or primary care physician), delayed incision healing, nerve symptoms, wound dehiscence, hematoma, and reoperations for these or other reasons. Patient-reported medical comorbidities (eg, hypertension, diabetes, stroke, vascular disease, kidney disease, and liver disease) were also recorded.

Data analysis

There was a fixed number of patients in the obese cohort (n = 435). An a priori sample size analysis was performed during the design of this study to determine whether we would need to increase our number of control patients beyond a 1:1 ratio to adequately power our study. Assuming complications to be a rare event (2% estimated), we determined that 376 patients in each group (1:1) were sufficient to