Effect of Bariatric Surgery on Emergency Department Visits and Hospitalizations for Atrial Fibrillation

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Atrial fibrillation (AF) and obesity are major health problems in the United States. However, little is known about whether bariatric surgery affects AF-related morbidities. This study investigated whether bariatric surgery is associated with short-term and long-term changes in the risk of emergency department (ED) visits or hospitalizations for AF. We performed a self-controlled case series study of obese adults with AF who underwent bariatric surgery by using population-based ED and inpatient databases in California, Florida, and Nebraska from 2005 to 2011. The primary outcome was ED visit or hospitalization for AF. We used conditional logistic regression to compare each patient's risk of the outcome event during sequential 12-month periods, using presurgery months 13 to 24 as a reference period. Our sample consisted of 523 obese adults with AF who underwent bariatric surgery. The median age was 57 years (interquartile range 48 to 64 years), 59% were female, and 84% were non-Hispanic white. During the reference period, 15.9% (95% confidence interval [CI] 12.7% to 19.0%) of patients had an ED visit or hospitalization for AF. The risk remained similar in the subsequent 12-month presurgery period (adjusted OR [aOR] 1.29 [95% CI, 0.94 to 1.76] p = 0.11). In contrast, the risk significantly increased within 12 months after bariatric surgery (aOR 1.53 [95% CI 1.13 to 2.07] p = 0.006). The risk remained elevated during 13–24 months after bariatric surgery (aOR 1.41 [95% CI, 1.03 to 1.91] p = 0.03). In conclusion, this population-based study demonstrated that bariatric surgery was associated with an increased risk of AF episodes requiring an ED visit or hospitalization for at least 2 years after surgery among obese patients with AF. **(Am J Cardiol 2017;120:947–952)**

Atrial fibrillation (AF) affects 3 to 6 million US adults.[1,2] Health care utilizations for AF contribute to the public health burden, accounting for 479,000 hospitalizations and $6 billion direct costs annually.[3] The United States has also experienced an obesity epidemic, with 35% to 40% of adults being obese.[4] Although there are potential pathophysiologic mechanisms that link obesity to increased morbidity in patients with AF, data are scarce on the role of weight reduction in AF-related morbidities. Within the limited literature, nonsurgical weight management has been shown to result in improved AF symptoms and less frequent AF episodes.[5] Bariatric surgery is known to be the most effective method to achieve substantial and sustained weight loss, and has been associated with a lower risk of incident AF.[6,7] However, bariatric surgery also leads to enhanced sympathetic tone, electrolyte disturbances, and anemia.[8] These factors may have a negative impact on AF-related morbidities. In this context, we aimed to determine whether, in obese patients with AF, bariatric surgery affects the risk of ED visits or hospitalizations for AF.

Methods

This study was a self-controlled case series study of obese patients with AF using the data from the Healthcare Cost and Utilization Project (HCUP) State Emergency Department Databases (SEDD) and State Inpatient Databases (SID).[9,10] The study design allows each patient to function as his or her own control. This study performed intraperson comparisons in patients who experienced both the exposure (bariatric surgery) and the outcome (ED visit or hospitalization for AF), and therefore control group was not necessary.[11] All time-invariant covariates (e.g., patient characteristics and genetics) are implicitly controlled, thereby minimizing confounding by unmeasured variables.[11] The present study meets the requirements of the self-controlled case series design as the exposure is transient and discrete and the outcome is an acute event.[11]

We analyzed the data from HCUP SEDD and SID in 3 states (California, Florida, and Nebraska) from 2005 to 2011. HCUP is the largest longitudinal hospital care data warehouse available in the United States and provides all-payer, encounter-level information.[9,10] The SEDD records all ED visits (including treat-and-release encounters and transfers) from short-term, acute-care, nonfederal hospitals in participating states.[9] The SID captures all inpatient discharges from short-term, acute-care, nonfederal, general, and other specialty hospitals, including data of hospitalizations through the ED.[10] Taking the data together, we were able to identify all ED visits

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regardless of disposition and all hospitalizations regardless of the source of hospitalization.[9,10] We chose these 3 states because data from these states have unique patient identifiers. This allowed us to perform longitudinal patient follow-up across the study years in geographically disperse populations. Details of the study design, databases, and statistical analysis methods have been published elsewhere.[9,10,12–14] The institutional review board of Massachusetts General Hospital approved this study.

We took the following steps to identify all obese adult patients who underwent bariatric surgery and had an ED visit or hospitalization for AF in the databases from the 3 states. First, we identified adult patients (age ≥18 years) with a diagnosis code for obesity and hospitalized for bariatric surgery, by using the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* procedure codes for bariatric surgery (43.89, 44.31, 44.38, 44.39, 44.50, 44.68, 44.69, 44.93, 44.95, 44.99, 45.51, and 45.90),[12–15] and the *ICD-9-CM* diagnosis codes for obesity (278.0 to 278.1, V77.8, V85.3x, and V85.4).[12–15] Patients with gastrointestinal cancer (diagnosis codes 150.0 to 159.9) were excluded.[12–14] Patients who underwent bariatric surgery between January 1, 2007, and December 31, 2009, were included to accommodate the 2-year periods before and after the surgery. Second, among these obese patients who underwent bariatric surgery, we further identified those with at least 1 ED visit or hospitalization for AF between January 1, 2005, and December 31, 2011, by using the *ICD-9-CM* diagnosis code for AF (427.31) in the primary diagnosis field.[16] The exclusion criteria were as follows: patients who lived outside the 3 states, died during hospitalization for bariatric surgery, died in-hospital during the 2-year postsurgery period, or had multiple bariatric surgeries during the study period.

Baseline patient characteristics were recorded during the index hospitalization for bariatric surgery. Data of demographics such as age, sex, and race or ethnicity, primary insurance type, quartiles for estimated household income, season of bariatric surgery, state (California, Florida, and Nebraska), *ICD-9-CM* diagnosis, ED disposition, and procedures were obtained from the databases.

The primary outcome measure was a composite of ED visit or hospitalization for AF during a 4-year period (i.e., 2-year period before and 2-year period after bariatric surgery). The secondary outcome measures were (1) ED visit for AF and (2) hospitalization for AF, assessed separately. To compare each patient's risk of outcome event during sequential 12-month periods, adjusted odds ratios (aORs) were calculated using a conditional logistic regression model—with presurgery period 13 to 24 months as a reference—for presurgery months 1 to 12, postsurgery months 0 to 12, and postsurgery months 13 to 24. Each patient was matched to his or her own reference period.

To examine the robustness of our findings, we performed several sensitivity analyses. First, we repeated the analysis stratified by age group (18 to 56 vs ≥57 years based on the median age) and sex. Second, we performed the primary analysis model in a subgroup of patients who had at least 1 health care utilization for any reason during postsurgery 25 to 36 months. This sensitivity analysis addressed the possibility of loss to follow-up (e.g., out-of-hospital deaths, moving out of the study states). This subgroup analysis ensured that these patients were both alive and living within the study states at least until 2 years after surgery and would have been recorded in the databases if they had the primary end point during the study period. Lastly, to identify transient postoperative changes in the outcomes, we also calculated the proportion of an outcome event for the 2 years before and after bariatric surgery in 3-month intervals. Presurgery months 22 to 24 was used as a reference period for this analysis. A 2-sided p-value <0.05 was considered statistically significant in the present study, and results are presented with a 95% confidence interval (CI). Statistical analyses were performed with SAS version 9.4 (SAS Institute, Cary, NC).

Results

We identified 543 obese patients who underwent bariatric surgery between January 1, 2007, and December 31, 2009, and also had at least 1 ED visit or hospitalization for AF between January 1, 2005, and December 31, 2011. We excluded patients who had multiple bariatric surgeries (10 patients) and who died in-hospital within 2 years after the surgery (10 patients). Thus, the analytic cohort comprised a total of 523 patients. The characteristics at the time of bariatric surgery are summarized in Table 1.

As shown in Table 2, 15.9% (95% CI, 12.7% to 19.0%) of patients had an ED visit or hospitalization for AF during the reference period (13 to 24 months prior to bariatric

Table 1
Baseline characteristics of obese patients with atrial fibrillation who underwent bariatric surgery

Characteristics	n = 523
Age (yr), median (IQR)	57 (48–64)
Female sex	306 (59.0%)
Race/ethnicity*	
Non-Hispanic white	409 (83.6%)
Non-Hispanic black	24 (4.9%)
Hispanic	42 (8.6%)
Other	14 (2.9%)
Primary insurance	
Medicare	163 (31.2%)
Medicaid	18 (3.4%)
Private	292 (55.8%)
Other	50 (9.6%)
Quartiles for median household income of patient's ZIP code	
1 (lowest)	98 (19.1%)
2	153 (29.8%)
3	142 (27.7%)
4 (highest)	120 (23.4%)
Season of bariatric surgery	
January–March	118 (22.6%)
April–June	129 (24.7%)
July–September	148 (28.3%)
October–December	128 (24.5%)
State	
California	319 (61.0%)
Florida	191 (36.5%)
Nebraska	13 (2.5%)

Data were expressed as numbers (percentages), unless otherwise indicated. IQR = interquartile range.

* Analyzed for 489 (93.5%) patients with race/ethnicity data. Race/ethnicity data were not available in Nebraska.