[Original Research]

CHEST

Reduced Risk of Acute Exacerbation of COPD After Bariatric Surgery

A Self-Controlled Case Series Study

Tadahiro Goto, MD, MPH; Yusuke Tsugawa, MD, MPH, PhD; Mohammad Kamal Faridi, MPH; Carlos A. Camargo Jr, MD, DrPH; and Kohei Hasegawa, MD, MPH

BACKGROUND: Obesity is common among individuals with COPD and associated with increased COPD morbidities. However, little is known about the impact of weight reduction on COPD-related outcomes in patients who are obese.

METHODS: Using the population-based ED and inpatient sample in three US states (California, Florida, and Nebraska), we performed a self-controlled case series study of 481 adults who were obese (40-65 years of age) with COPD who underwent bariatric surgery. The primary outcome was an ED visit or hospitalization for acute exacerbation of COPD (AECOPD) from 2005 through 2011. We compared each patient's risk of the outcome during sequential 12-month periods using presurgery months 13 through 24 as the reference period.

RESULTS: During the 13 to 24 months before bariatric surgery (ie, reference period), 28% (95% CI, 24%-32%) of patients had an ED visit or hospitalization for AECOPD. In the subsequent 12-month presurgery period, the risk did not change materially (31%; 95% CI, 27%-35%), with an adjusted OR (aOR) of 1.16 (95% CI, 0.88-1.53; $P = .29$). By contrast, during the first 12 months after bariatric surgery, the risk declined significantly (12%; 95% CI, 9%-15%; aOR, 0.35; 95% CI, 0.25-0.49; $P < .001$). Likewise, in the subsequent period of 13 to 24 months after bariatric surgery, the risk remained significantly low (13%; 95% CI, 11%-17%; aOR, 0.39; 95% CI, 0.28-0.55; $P < .001$).

CONCLUSIONS: The risk of an ED visit or hospitalization for AECOPD substantially decreased after bariatric surgery in patients who are obese. This observation suggests the effectiveness of substantial weight reduction on COPD morbidity. CHEST 2017; ■(■):■-■

KEY WORDS: acute exacerbation of chronic bronchitis; bariatric surgery; COPD; obesity

ABBREVIATIONS: AECOPD = acute exacerbation of COPD; aOR = adjusted OR; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; SEDD = State Emergency Department Databases; SID = State Inpatient Databases

AFFILIATIONS: From the Department of Emergency Medicine (Drs Goto, Camargo, and Hasegawa and Mr Faridi), Massachusetts General Hospital, Boston, MA; the Department of Health Policy and Management (Dr Tsugawa), Harvard T. H. Chan School of Public Health, Boston, MA; the Division of General Internal Medicine and Primary Care (Dr Tsugawa), Brigham and Women's Hospital, Boston, MA; and the Harvard Medical School (Drs Camargo and Hasegawa), Boston, MA.

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CORRESPONDENCE TO: Tadahiro Goto, MD, MPH, Department of Emergency Medicine, Massachusetts General Hospital, 125 Nashua St, Ste 920, Boston, MA 02114-1101; e-mail: tag695@mail.harvard.edu

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COPD and obesity are important public health problems in the United States, where 6% of US adults have COPD[1] and 35% are obese.[2] Emerging evidence indicates that, among individuals with COPD, obesity is not only prevalent (35%) but also associated with worse COPD-related outcomes, such as a higher risk of severe acute exacerbation of COPD (AECOPD).[3] Therefore, obesity is a common and potentially reversible risk factor for COPD control.

However, few studies have examined the impact of weight reduction on COPD-related outcomes in patients who are obese.[4,5] A small single-arm before-after trial of 28 adults who are obese with COPD reported that nonsurgical weight loss interventions reduced BMI and improved patient outcomes, such as exercise tolerance and clinical scores.[5] Although this report suggests a potential role of weight reduction in chronic COPD symptom management among patients who are obese, little is known about the effectiveness of weight reduction in COPD morbidities, such as risks of AECOPD.[3,4] As supported by a body of evidence[6] and the national guidelines for obesity treatment,[7] bariatric surgery is the most effective and reliable method to achieve substantial and persistent weight loss for patients who are morbidly obese. Accordingly, epidemiologic studies have used bariatric surgery as an instrument to examine a causal effect of weight reduction on various health conditions (eg, asthma).[8,9]

In this context, we hypothesized that bariatric surgery is associated with a reduced risk of ED visits and hospitalizations for AECOPD among patients who are obese. A better understanding of the role of large and sustained weight reduction on COPD morbidity would inform strategies to optimize COPD control among patients who are obese.

Methods

Design and Setting

This is a self-controlled case series study using data from the Healthcare Cost and Utilization Project State Emergency Department Databases (SEDD) and State Inpatient Databases (SID) of three geographically dispersed US states (California, Florida, and Nebraska) from January 1, 2005, through December 31, 2011. Details of the methods may be found in e-Appendix 1 and e-Tables 1-6. Additional details of the SEDD and SID can be found elsewhere.[10] This study design relies on within-person comparison in a population of subjects with both the exposure (bariatric surgery) and outcome of interest (AECOPD).[8,9] The institutional review board of Massachusetts General Hospital approved this study (No. 2013P002545).

Study Population

First, we identified all adults aged ≥ 40 years with at least one ED visit or hospitalization for AECOPD from January 1, 2005, through December 31, 2011. ED visits and hospitalizations for AECOPD were identified by using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnostic code for COPD in the primary diagnosis field, and primary diagnosis of respiratory failure and a secondary diagnosis of COPD.[11] The use of these ICD-9-CM codes to identify AECOPD has a high specificity and positive predictive value (both > 90%).[12,13] We excluded patients > 65 years of age because many bariatric programs have established cutoff levels for age at 65 to 70 years.[7]

Next, among these patients with COPD, we further identified patients with a concurrent diagnosis of obesity who underwent a bariatric surgery between January 1, 2007, and December 31, 2009, to accommodate analyses of the 2-year presurgery and 2-year postsurgery periods. According to the literature,[14] we used the ICD-9-CM procedure codes for bariatric surgery with the ICD-9-CM diagnostic code for obesity but without a diagnostic code for cancer. We also excluded patients who had multiple bariatric surgeries during the study period, those who died at hospitalization for bariatric surgery or died in the hospital during the postsurgery period, or who were out-of-state residents.

Outcome Measures

The primary outcome measure was a composite of ED visit or hospitalization for AECOPD. The secondary outcome measures were separate analyses of the two components: ED visit (without resulting hospitalization) and hospitalization for AECOPD.

Statistical Analysis

To compare each patient's risk of the outcomes during sequential 12-month periods—with the presurgery months 13 to 24 as the reference period—we fit conditional logistic regression models to compute ORs for the presurgery months 1 to 12, postsurgery months 0 to 12, and postsurgery months 13 to 24. Because each patient was matched to his/her own reference period, ORs from the conditional logistic regression model are equivalent to having person fixed effects in the model; hence, the estimates are adjusted ORs (aORs).

To determine the robustness of our inference, we performed a series of sensitivity analyses. First, we stratified the analysis by sex and major race/ethnicity group. Second, we stratified the analysis by history and/or concurrent diagnosis of asthma because patients with both asthma and COPD (ie, asthma-COPD overlap) may have a different pathobiology and risk of AECOPD.[8,15] Third, we modeled the outcomes as count variables (ie, frequency of outcome events). Fourth, to address the potential issue of loss to follow-up (eg, emigration from the three states, out-of- hospital deaths), we performed a subgroup analysis that is limited to those who had any ED visit or hospitalization—regardless of reason—after ≥ 2 years from their bariatric surgery. This analysis ensured that all patients were alive within the study state until at least 2 years after their bariatric surgery. Finally, to address the possibility that a reduced risk of AECOPD is associated with elective surgery and perisurgical COPD management rather than bariatric surgery per se, we repeated the analysis using three separate obese populations who underwent an elective nonbariatric surgery—cholecystectomy, hysterectomy, or hip replacement.