ORIGINAL ARTICLE

Increased Admission for Alcohol Dependence After Gastric Bypass Surgery Compared With Restrictive Bariatric Surgery

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Importance: We demonstrate that patients who have undergone gastric bypass surgery (GBS) have a higher risk of inpatient care for alcohol dependence than those who have undergone restrictive surgery. This highlights a need for health care providers to be aware of this so that early detection and treatment can be put in place.

Objective: To evaluate inpatient care for alcohol abuse before and after GBS compared with restrictive surgery (vertical banded gastroplasty and gastric banding).

Design: Retrospective population-based cohort study including all patients who underwent GBS, vertical banded gastroplasty, and gastric banding in Sweden from 1980 through 2006. The relative risk of inpatient care for alcohol abuse was studied before and after surgery.

Setting: All hospitals in Sweden performing bariatric surgery.

Participants: A total of 11 115 patients older than 18 years (mean [SD] age, 40.0 [10.3] years; 77% women) who underwent a primary gastric bypass procedure, vertical banded gastroplasty, and gastric banding during the study period.

Main Outcome Measures: Inpatient care for alcohol abuse, substance abuse, depression, and attempted suicide.

Results: Mean follow-up time was 8.6 years. Before surgery, there was no difference in inpatient treatment of alcohol abuse among patients who underwent gastric bypass or a restrictive procedure (incidence rate ratio, 1.1; 95% CI, 0.8-1.4). After surgery, there was a 2-fold increased risk of inpatient care for alcohol abuse among patients who had GBS compared with those who had restrictive surgery (hazard ratio, 2.3; 95% CI, 1.7-3.2).

Conclusions and Relevance: Patients who had undergone GBS had more than double the risk of inpatient care for alcohol abuse postoperatively compared with patients undergoing a restrictive procedure, highlighting a need for healthcare professionals to be aware of this for early detection and treatment.

JAMA Surg. 2013;148(4):374-377

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THE LIFETIME HISTORY OF SUBstance use disorders has been reported to be as high as 32.6% among candidates for bariatric surgery. Yet, at the time of preoperative assessment, very few (1.7%) report a current substance use disorder.[1] Few studies have examined people's risk of developing substance use disorders after bariatric surgery. In light of the preoperative lifetime rates of substance use disorders, candidates for bariatric surgery might be at risk of relapse to past substance use disorders. Recently, the postoperative emergence of substance use disorders was revealed in a prospective study. At 6 to 10 years after gastric bypass surgery (GBS), only a small percentage (2.9%) of patients who underwent bariatric surgery had developed alcohol problems.[2] A recent publication reported that 2% to 6% of individuals who were admitted to a substance treatment program had a bariatric surgical history.[3] The aim of this study was to assess the incidence of inpatient treatment for alcohol abuse and substance abuse in all patients who had undergone a primary gastric bypass procedure or restrictive surgery (gastric banding and vertical banded gastroplasty) in Sweden between 1980 and 2006. We also studied the incidence of attempted suicide and depression in both surgical groups.

METHODS

DESIGN

This was a nationwide, population-based cohort study of patients in Sweden who underwent GBS or restrictive surgery from January 1, 1980, to December 31, 2006. In Sweden, all residents are assigned a unique personal identity number, allowing individual and correct linkages between registers.[4] Using the Swed-

ish version of the Classification of Surgical Procedure (NOMESKO) codes relating to bariatric surgery (4751, 4753, JDF00, JDF01, JDF10, JDF11, JDF20, or JDF21) with a confirmatory diagnosis of obesity from the *International Classification of Diseases, Eighth, Ninth*, and *Tenth Revisions* (*ICD-8*, *ICD-9*, and *ICD-10*) (277.99, 259X, 278A, E66.0, E66.1, E66.8, or E66.9), we identified all patients undergoing a primary gastric bypass procedure, gastric banding, or vertical banded gastroplasty according to the nationwide Swedish Patient Register between 1980 and 2006. Patients who had more than 1 bariatric surgical procedure were excluded. The number of hospitalizations, according to the *ICD-8*, *ICD-9*, or *ICD-10*, for the following diagnoses was obtained from the Patient Register: depression (*ICD-8* and *ICD-9*: 300 and 790.2; *ICD-10*: F32-F39), substance abuse (excluding alcohol abuse) (*ICD-8* and *ICD-9*: 304; *ICD-10*: F11-F16), attempted suicide (*ICD-8* and *ICD-9*: E95 and E98; *ICD-10*: X60-X84 and Y10-Y34), and alcohol abuse (*ICD-8* and *ICD-9*: 303; *ICD-10*: F10).

The distribution of the types of surgery was uneven during the study period, with more gastric bypass procedures being performed toward the end of the study period. The *ICD-10* codes were introduced in Sweden in 1997. To account for the uneven distribution of cases and possible change in coding procedure, we also studied the period from 1980 through 1996 and from 1997 through 2006.

DATA SOURCES

Data were used from the Patient Register, Total Population Register, Causes of Death Register, Population and Housing Census, and Longitudinal Integration Database for Health Insurance and Labor Market Studies.

ETHICS

The regional ethics committee in Stockholm, Sweden, approved the study.

STATISTICAL ANALYSIS

Incidence rate ratios were calculated preoperatively. The person was considered as having an event if the diagnosis in question was detected in the Patient Register from the date of that person's 18th birthday to the date of surgery or pseudo-surgery. The participants were followed up with regard to inpatient diagnosis in the Patient Register from age 18 years until the date of death, date of emigration, or end of the study period (December 31, 2006), whichever came first. In the analyses of postoperative morbidity, a person was considered to have an event at the first time he or she was diagnosed in the Patient Register after surgery. Person-time at risk was calculated accordingly. In Cox proportional hazards regression analysis, the postsurgical hazard ratio (HR) was adjusted for age at surgery or pseudo-surgery, preoperative occurrence of the same diagnosis, socioeconomic position, and education level. Education was categorized as follows: less than 10 years, 10 to 12 years, or 13 years or more. Socioeconomic position was categorized as follows: unskilled workers, skilled workers, and nonmanual workers. STATA software (version 10; StataCorp LP) was used for all statistical analyses.

RESULTS

PARTICIPANTS

A total of 11 115 patients underwent a primary gastric bypass procedure, gastric banding, or vertical banded gastroplasty during the study period. The mean (SD) follow-up time was 3.8 (4.5) years for the GBS cohort and 11.5 (6.0) years for the restrictive cohort. Some characteristics of the 2 cohorts are presented in **Table 1**.

Table 1. General Characteristics of the Gastric Bypass and Restrictive Surgery Cohorts[a]

Characteristic	Gastric Bypass Cohort	Restrictive Cohort
Total	4161 (37)	6954 (63)
Female sex	3139 (75)	5409 (78)
Age, mean (SD), y	40.2 (10.1)	40.0 (10.4)
Socioeconomic position		
Nonmanual workers	1107 (27)	1921 (28)
Skilled workers	767 (18)	1180 (17)
Unskilled workers	2287 (55)	3853 (55)
Education level,[b] y		
<10	947 (23)	1845 (27)
10-12	2508 (60)	4006 (58)
≥13	693 (17)	1075 (15)

[a] Values are presented as number (percentage) unless otherwise indicated. The restrictive surgery cohort included vertical banded gastroplasty and gastric banding.
[b] Data missing on 41 individuals.

RISK OF DEPRESSION, SUBSTANCE AND ALCOHOL ABUSE, AND ATTEMPTED SUICIDE IN THE GBS AND RESTRICTIVE SURGERY COHORTS

Preoperative and postoperative risk estimates in the GBS and restrictive procedure cohorts are presented in **Table 2**. Before surgery, there was a significantly increased risk of inpatient care for depression in the GBS cohort. This was true for the entire cohort and for women. For men, there was no difference. Postoperatively, similar results were seen. There was a significantly increased rate of inpatient care with a diagnosis of substance abuse for the GBS cohort (both men and women) before and after surgery. Before surgery, suicide attempt was significantly more common in the GBS cohort and for women. After surgery, it was increased in both men and women. There was no difference in inpatient care with an alcohol diagnosis before surgery between the GBS cohort and the restrictive cohort. After surgery, the risk estimates were significantly increased for both men and women (Table 2).

The risk of hospitalization after surgery was increased in the GBS cohort before (HR, 2.7; 95% CI, 1.4-5.4) and after (HR, 1.8; 95% CI, 1.2-2.8) the introduction of the *ICD-10*.

DISCUSSION

This study indicates that patients who have undergone GBS as a treatment for obesity are more likely to have been hospitalized with an alcohol-related diagnosis than patients who have undergone restrictive surgery as a treatment for obesity. This is true for both men and women.

Table 2. Preoperative IR per 10 000 Person-Years, IRR, and Postoperative HRs of Depression, Substance Abuse, and Suicide Attempt for the Gastric Bypass and Restrictive Surgery Cohorts, Stratified by Sex[a]

	Preoperative IR		Preoperative IRR (95% CI)			Postoperative HR (95% CI)		
Diagnosis	Gastric Bypass Surgery Cohort	Restrictive Surgery Cohort	All Participants	Men	Women	All Participants	Men	Women
Depression	17.9	16.0	1.1 (1.0-1.3)	0.7 (0.5-1.1)	1.2 (1.0-1.4)	1.3 (1.0-1.7)	1.5 (0.9-2.7)	1.3 (1.0-1.7)
Substance abuse	4.7	2.8	1.7 (1.2-2.5)	2.3 (1.0-5.1)	1.6 (1.1-4.1)	2.6 (1.7-4.0)	3.6 (1.6-7.9)	2.4 (1.5-4.1)
Suicide attempt	14.3	12.5	1.1 (1.0-1.4)	0.9 (0.6-1.5)	1.2 (1.0-1.4)	1.9 (1.4-2.5)	2.0 (1.5-2.6)	2.0 (1.5-2.6)
Alcohol abuse	4.7	4.4	1.1 (0.8-1.4)	0.7 (0.5-1.1)	1.4 (0.9-2.1)	2.3 (1.7-3.2)	1.8 (1.2-2.8)	2.6 (1.8-3.8)

Abbreviations: HR, hazard ratio; IR, incidence rate; IRR, incidence rate ratio.
[a]The restrictive surgery cohort included vertical banded gastroplasty and gastric banding.

Men who have undergone GBS are more likely to attempt suicide than men who have undergone restrictive surgery.

Among the strengths of the present study are the nationwide coverage, large sample size, and completeness of Swedish register data, as well as the fact that all Swedes are covered by a national health care system providing affordable access to relatively homogeneous care. These advantages reduce selection bias and facilitate generalization. On the other hand, the study also has several weaknesses. In-hospital register data are limited by risks of misclassification and underreporting at the time of hospital discharge, as not all diagnoses may be recorded. Furthermore, there were no data regarding outpatient care, which may also contribute to underestimation of the incidence rates. Moreover, the Patient Register does not include information on weight or weight changes after surgery, and many patients underwent gastric banding and vertical banded gastroplasty, which have been discontinued. Last, the proportion of patients receiving GBS has increased over time, and therefore the median follow-up time of this group is shorter than for those operated on with a restrictive procedure. It might be possible that both the rates of alcohol abuse and the use of gastric bypass have increased over time in Sweden. However, data from the Swedish National Institute of Public Health do not support that there has been an increase in alcohol-related admissions in Sweden from 1998 to 2008. The *ICD* classification that we used changed in 1997, which might result in different coding practices. In an attempt to compensate for this, we studied our main finding (increased risk of alcohol abuse) before and after the introduction of the *ICD-10* coding and found an increased risk both before and after the introduction of the *ICD-10*.

It has been reported that deaths caused by accidents and suicide are 1.58 times higher in patients who have undergone GBS compared with a nonoperated on obese control group.[4] We found that before surgery, GBS candidates had an increased risk of hospitalization for a suicide attempt compared with patients undergoing restrictive surgery. This was not true for men. After surgery, an increased risk of suicide was also found in men who had undergone GBS. It is possible that this increase is linked to the increased risk of alcohol abuse for both men and women.

The most striking finding of this study was that patients who had undergone GBS were significantly more likely to develop alcohol abuse than those who had undergone a restrictive procedure. One previous study that prospectively assessed alcohol abuse reported low rates after bariatric surgery.[2] The response rate, however, was only 28%, which leaves the actual rate of alcohol abuse in question. In a recent prospective study, 1945 patients who underwent bariatric surgery had a significantly increased risk of alcohol use disorder 2 years after surgery compared with the year before surgery. This was associated with male sex and undergoing GBS.[5] It has previously been demonstrated that after gastric bypass, patients reach greater peak alcohol levels and take longer to reach zero alcohol levels after alcohol consumption compared with nonoperated on obese controls and compared with before surgery.[6,7] Several physiological causes explain this alteration in alcohol metabolism after GBS. After GBS, an important source of alcohol dehydrogenase, the stomach, is bypassed, resulting in less alcohol being degraded before it enters the intestine.[8] This is in contrast with most restrictive procedures in which the stomach is left intact, and a recent publication has demonstrated that there is a normal alcohol metabolism after gastric banding and sleeve gastrectomy.[9] Most patients who undergo gastric bypass are women, and sex clearly plays a role in alcohol metabolism, with men having higher alcohol dehydrogenase activity in the liver than do women.[10] After surgery, women in our study tended to have a higher HR than did men. Rapid emptying of liquids from the gastric pouch enables rapid absorption of alcohol into the jejunum.[11] Taken together, these physiological events may explain why patients who have undergone gastric bypass are at a higher risk of developing alcohol abuse after GBS. However, addiction transfer cannot be ruled out. Despite this increased risk, patients should not be dissuaded from gastric bypass since the improvement in their metabolic status is significant.[12]

In summary, this large population-based cohort study has suggested that patients treated with gastric bypass are more likely to be hospitalized for alcohol abuse than those who undergo a restrictive procedure, which may be due to altered alcohol metabolism after gastric bypass.

Accepted for Publication: September 18, 2012.
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Author Contributions: Drs Östlund, Marsk, Stockeld, Lagergren, Rasmussen, and Näslund had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Lagergren, Rasmussen, and Näslund. *Acquisition of data:* Lagergren, Rasmussen, and Näslund. *Analysis and interpretation of data:* All authors. *Drafting of the manuscript:* Östlund and Näslund. *Critical revision of the manuscript for important intellectual content:* Backman, Marsk, Stockeld, Lagergren, Rasmussen, and Näslund. *Statistical analysis:* Östlund, Marsk, and Näslund. *Obtained funding:* Lagergren and Näslund. *Administrative, technical, and material support:* Lagergren and Rasmussen. *Study supervision:* Lagergren, Rasmussen, and Näslund.
Funding/Support: The Swedish Research Council, the Swedish Cancer Society, and the Stockholm County Council supported this study.
Conflict of Interest Disclosures: None reported.

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