
Trends in Use of Bariatric Surgery, 2003–2008

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BACKGROUND: During the past decade, the field of bariatric surgery has changed dramatically. This study was intended to determine trends in the use of bariatric surgery in the United States. Data used were from the Nationwide Inpatient Sample from 2003 through 2008.

STUDY DESIGN: We used ICD-9 diagnosis and procedural codes to identify all hospitalizations during which a bariatric procedure was performed for the treatment of morbid obesity between 2003 and 2008. Data were reviewed for patient characteristics, annual number of bariatric procedures, and proportion of laparoscopic cases. US Census data were used to calculate the population-based annual rate of bariatric surgery per 100,000 adults. The number of surgeons performing bariatric surgery was estimated by the number of members in the American Society for Metabolic and Bariatric Surgery.

RESULTS: For the period between 2003 and 2008, the number of bariatric operations peaked in 2004 at 135,985 cases and plateaued at 124,838 cases in 2008. The annual rate of bariatric operations peaked at 63.9 procedures per 100,000 adults in 2004 and decreased to 54.2 procedures in 2008. The proportion of laparoscopic bariatric operations increased from 20.1% in 2003 to 90.2% in 2008. The number of bariatric surgeons with membership in the American Society for Metabolic and Bariatric Surgery increased from 931 to 1,819 during the 6 years studied. The in-hospital mortality rate decreased from 0.21% in 2003 to 0.10% in 2008.

CONCLUSIONS: In the United States, the number of bariatric operations peaked in 2004 and plateaued thereafter. Use of the laparoscopic approach to bariatric surgery has increased to >90% of bariatric operations. In-hospital mortality continually decreased throughout the 6-year period. (*J Am Coll Surg* 2011;213:261–266. © 2011 by the American College of Surgeons)

Surgery continues to be the only effective sustained weight-loss option for many patients suffering from morbid obesity. During the past decade, the field of bariatric surgery has changed dramatically. First, safety of bariatric surgery has improved with the introduction of the Centers of Excellence concept.¹ Second, the laparoscopic approach to bariatric surgery began to disseminate in 1999 and has now become the preferred approach.² Third, laparoscopic adjustable gastric banding was introduced in the United States in 2001 and continues to gain popularity.³ Fourth, in addition to weight loss, many reports now

document the metabolic benefits of bariatric surgery.⁴ Lastly, recent data also show the long-term survival benefit of bariatric surgery.^{5,6} All of these factors, particularly the increased use of laparoscopic bariatric surgery, might have lowered the threshold for patients' willingness to accept bariatric surgery as an option for the treatment of morbid obesity.

In a population-based study examining the secular trends in bariatric surgery from 1990 to 1997 using data from the Nationwide Inpatient Sample (NIS), the number of bariatric operations performed in the United States increased from 9,189 procedures in 1993 to 12,541 procedures in 1997.⁷ Using the same database, we published a similar population-based study examining the secular trends in the use of bariatric surgery and found that the number of bariatric operations increased from 12,775 procedures in 1998 to 70,256 procedures in 2002.² In this study, we again used administrative data from the NIS to provide updated trends in the use of bariatric surgery for the treatment of morbid obesity during the 6-year period between 2003 and 2008.

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Abbreviation and Acronyms

ASMBS	= American Society for Metabolic and Bariatric Surgery
HCUP	= Healthcare Cost and Utilization Project
NIS	= Nationwide Inpatient Sample

METHODS

Discharge data from the NIS between 2003 and 2008 were obtained from the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality. The NIS is the largest all-payer inpatient care database in the United States containing data from almost 8 million hospital stays in about 1,000 hospitals. This sample represents approximately 20% of US community hospitals. The NIS includes public hospitals and academic medical centers. We obtained information from the NIS database concerning the total annual number of bariatric operations; the proportion of Roux-en-Y gastric bypass, gastric banding, and gastroplasty; the proportion of laparoscopic cases; patient characteristics (age, sex, and race); comorbidities; postoperative length of stay; and in-hospital mortality. Approval for the use of the HCUP patient data was obtained from the Institutional Review Board of the University of California Irvine Medical Center and the HCUP.

Using the HCUP database, we analyzed all discharge abstract data for patients who underwent bariatric surgery during the time period from January 1, 2003 through December 31, 2008. All hospitalizations during which a bariatric procedure was performed for the treatment of morbid obesity were identified using appropriate diagnosis and procedure codes as specified by the ICD-9-CM. The principal ICD-9 diagnosis codes for obesity and morbid obesity were 278.0, 278.01, 278.00, 278.8, and 278.1, which included a subcategory of obesity and a subclassification of morbid obesity. The principal ICD-9 procedure codes for open Roux-en-Y gastric bypass were 44.31 and 44.39, which included a subcategory of gastroenterostomy without gastrectomy and a subclassification of high gastric bypass. The principal ICD-9 procedure code for laparoscopic Roux-en-Y gastric bypass was 44.38, which included a subcategory of gastroenterostomy without gastrectomy and a subclassification of laparoscopic gastroenterostomy. The principal ICD-9 procedure code for laparoscopic adjustable gastric banding was 44.95. The principal ICD-9 procedure code for gastroplasty was 44.69.

We calculated the population-based rates of bariatric surgery per 100,000 adults for each year using the number of bariatric surgical procedures obtained from the NIS database and US Census data as the numerator. For the de-

nominator, we used the adult population (age older than 17 years) estimates from the US Census. To estimate the number of surgeons performing bariatric surgery, we obtained data from the American Society for Metabolic and Bariatric Surgery (ASMBS) of the number of regular members during the years 2003 through 2008. A "regular member" was defined as a general surgeon practicing bariatric surgery who was a Diplomat of the American Board of Surgery, a Fellow of the American College of Surgeons, or a Fellow of the Royal College of Surgeons.

RESULTS**Rates of bariatric surgery**

From 2003 through 2008, a total of 671,959 patients underwent bariatric surgery for the treatment of morbid obesity. The number of bariatric operations increased from 121,771 procedures in 2003 to 135,985 procedures in 2004, and eventually plateaued at 124,838 procedures in 2008 (Table 1). In 2003, the type of bariatric procedure most commonly performed was Roux-en-Y gastric bypass (99%). The proportion of Roux-en-Y gastric bypass decreased to 69% by 2008, and the proportion of laparoscopic adjustable gastric banding increased to 29%. The annual rate of bariatric surgery increased from 57.9 procedures per 100,000 adults in 2003, to 63.9 procedures in 2004, and decreased to 54.2 procedures in 2008 (Table 1). Figure 1 depicts the rapid penetrance of the laparoscopic approach in bariatric surgery. The proportion of laparoscopic bariatric operations increased from 20.1% in 2003 to 90.2% in 2008.

Patient characteristics and outcomes

Between 2003 and 2008, the median age of patients who underwent bariatric surgery ranged from 42 to 45 years, with 79.2% to 82.6% female. The proportion of Caucasians ranged from 71.3% to 78.2%. The prevalence of preoperative comorbidities is listed in Table 1. Compared with 1998–2002, patients who underwent bariatric surgery between 2003 and 2008 appear to have a higher prevalence of diabetes (14% to 21% vs 19% to 33%, respectively), hypertension (35% to 44% vs 44% to 56%, respectively), and dyslipidemia (5% to 7% vs 19% to 33%, respectively). Median length of stay was 2 to 3 days. In-hospital mortality decreased from 0.21% in 2003 to 0.10% in 2008.

Number of bariatric surgeons

The number of bariatric surgeons with membership in the ASMBS increased over time (Fig. 2). There were 931 members in 2003; 1,251 members in 2004; 1,510 members in 2005; 1,617 members in 2006; 1,707 members in 2007; and 1,819 members in 2008. This represents a 95% in-

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