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Surgery for Obesity and Related Diseases ■ (2015) 00–00

SURGERY FOR OBESITY
AND RELATED DISEASES

Original article

Plateaued national utilization of adolescent bariatric surgery despite increasing prevalence of obesity-associated co-morbidities

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Received September 4, 2015; accepted September 16, 2015

Abstract

Background: The number of adolescent bariatric surgeries (ABS) performed from 2003 to 2009 has been stable despite reports of an increase in adolescent morbid obesity.

Objectives: We sought to determine the trend in national ABS volume and the changes in obesity-associated co-morbidities (OACM) from 2004 to 2011.

Setting: The Healthcare Cost and Utilization Project National Inpatient Sample database.

Methods: The National Inpatient Sample database was queried for adolescents undergoing Roux-en-Y gastric bypass, adjustable gastric banding, or sleeve gastrectomy from 2004 to 2011. Twelve OACM categories were created by ICD-9 code.

Results: From 2004 to 2011, an estimated 968 ABS cases per year were performed with no significant change in yearly volumes. There was a significant decrease in the annual volume of Roux-en-Y gastric bypasses (85.7%–54.4%, $P < .001$) with a significant increase in the number of adjustable gastric bandings (13.6%–18.9%, $P = .002$) and sleeve gastrectomies (.7%–26.7%, $P < .001$). The mean patient age was 18.0 ± 1.3 years, and 76% of patients were female. The average number of OACMs per adolescent increased significantly, from 1.44 ± 1.3 in 2004–2005 to 1.85 ± 1.5 in 2010–2011 ($P < .001$). There was a significant increase over time in the prevalence of preoperative obstructive sleep apnea (15.6%–26.8%, $P < .001$), hypertension (16.6%–24.2%, $P = .006$), hyperlipidemia (10.2%–15.4%, $P = .021$), and fatty liver disease (5.2%–10.5%, $P = .004$).

Conclusions: There was a significant increase in OACMs for patients undergoing ABS. Despite the increase in OACMs, there has not been a concomitant increase in the number of ABS performed as of 2011. Given the increase in OACMs, these data support efforts to address barriers to adolescent bariatric surgical evaluation and treatment. (Surg Obes Relat Dis 2015;■:00–00.) © 2015 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords:

Adolescent bariatric surgery; Co-morbidities; Surgery utilization; Gastric bypass; Fatty liver disease

Severe obesity, defined as class II with a body mass index (BMI) equal to 120% of the 95th percentile and class III with a BMI equal to 140% of the 95th percentile, affects a staggering 8% of the adolescent population as of 2011–12

[1]. With severe obesity comes obesity-associated co-morbidities (OACMs) including hypertension, type 2 diabetes mellitus, obstructive sleep apnea, gastroesophageal reflux disease, depression, as well as many others [2]. In fact, data from the Teen Longitudinal Assessment of Bariatric Surgery (Teen-LABS) study have indicated that 51% of adolescents undergoing bariatric surgery have 4 or more major co-morbid conditions [2]. Not only are adolescents suffering from multiple co-morbid conditions but

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severe adolescent obesity also increases the risk of adult comorbid conditions. Inge et al. found that class II or III adolescent obesity independently increased the risk for venous edema, severe walking limitation, abnormal kidney function, polycystic ovary syndrome, asthma, diabetes, obstructive sleep apnea (OSA), and hypertension in adulthood [3].

Adolescents fare no better than adults when it comes to the success of medical weight loss, with reports of only marginal BMI reduction by 1 year (.55–1.7 kg/m²) [4,5]. Bariatric surgery is far superior in weight reduction and comorbidity treatment compared with medical weight loss [6]. With this, in appropriately selected adolescents, bariatric surgery is recommended as treatment for morbid obesity [7]. The selection criteria for adolescent bariatric surgery (ABS) is a BMI ≥ 35 kg/m² with major co-morbidities (type 2 diabetes mellitus, moderate to severe OSA, pseudotumor cerebri, or severe nonalcoholic steatohepatitis) or a BMI ≥ 40 kg/m² with other co-morbidities (hypertension, insulin resistance, glucose intolerance, substantially impaired quality of life or activities of daily living, dyslipidemia, or mild sleep apnea) [7,8].

There was a 5-fold increase in adolescent bariatric surgery from 1997 and 2003; however, this still only represented .7% of nationally performed bariatric procedures in 2003 [9,10]. We have previously published reports that ABS is an exceptionally well tolerated procedure with a reduced 30-day in-hospital morbidity and readmission rate compared with adult bariatric patients [11]. The number of ABSs performed annually from 2003 to 2009 were stable despite numerous reports of the increase in adolescent morbid obesity [12]. We sought to determine the national trend in ABS volume given recent publications citing the detrimental impact of childhood obesity on adult comorbidities. In addition, we report for the first time the changes in specific OACMs over time for adolescents undergoing bariatric surgery.

Methods

The Healthcare Cost and Utilization Project National Inpatient Sample (NIS) database was queried from 2004 to 2011. Adolescents were defined as 10–19 years old. Adolescents were identified with an ICD-9 diagnosis code for obesity (278.0, 278.00, 278.01, 278.1, or 278.8) as well as having undergone 1 of following surgeries by ICD-9 code: Roux-en-Y gastric bypass (RYGB; 44.31, 44.38, 44.39), adjustable gastric banding (AGB; 44.95), or sleeve gastrectomy (43.82, 43.89). Patients were excluded if they included a diagnosis code for malignancy (including ICD-9 150–159) or a modifier for metastasis. The NIS case volumes were subcategorized by 2-year periods (2004–05, 2006–07, 2008–09, 2010–11) for trend analysis.

Demographic characteristics were collected, including patient age, sex, race, length of stay, mortality, and the

NIS calculated number of chronic conditions from 2008 to 2011 (chronic conditions were not reported before 2008). In addition, 12 OACM categories were created by ICD-9 code (Supplementary Table 1) and analyzed over time. The 12 included OACMs were developed from both the American Academy of Pediatrics table of OACMs and co-morbidities associated with morbid obesity according to Medicare guidelines and billing [13,14]. These 12 categories were hypertension, hyperlipidemia, cardiac (heart failure, cardiomegaly), gastroesophageal reflux disease (GERD, including a hiatal hernia), OSA, other respiratory (asthma, pulmonary hypertension, chronic pulmonary disease, respiratory failure), diabetes mellitus, polycystic ovary syndrome, other metabolic/endocrine (precocious puberty, Cushing's disease, pituitary and thyroid dysfunction), psychiatric (depression, anxiety, sleep disturbances), liver (nonalcoholic fatty liver disease [NAFLD] as well as nonalcoholic cirrhosis), and musculoskeletal disease (osteoarthritis, back pain, joint pain). The number of OACMs per patient was determined by unique patient identification, and the trend in number of OACMs per patient undergoing adolescent bariatric surgery was trended over time.

Fractional weights were calculated and applied from the NIS supplied discharge weights to retain proportionality of the original weighing scheme while preserving the actual sample size. National estimates were calculated from the supplied NIS sampling weights. Comparison of proportion of categorical variables used Pearson's χ^2 test as well as linear-by-linear association tests for identification of trends. Analysis of variance with post hoc pairwise comparisons was used for continuous variables. All statistics were calculated using IBM SPSS Statistics v. 22.0.0.0 (IBM Corp., Armonk, NY, USA) and used an α level of .05 for significance.

Results

From 2004–2011, national estimates from the NIS indicate an average of 968 cases were performed per year. As shown in Fig. 1, there was no statistically significant change in yearly case volumes over the 8-year study period, with 1030 cases estimated to be performed annually in 2004–2005, 804 cases/yr in 2006–2007, 1016 cases/yr in 2008–2009, and 1023 cases/yr in 2010–2011. There was a significant decrease in the number of RYGBs performed yearly (85.7% to 54.4%, $P < .001$) with a significant increase in the number of sleeve gastrectomies (.7% to 26.7%, $P < .001$) (Fig. 2). There was an overall significant increase in the percentage of GBs utilized over time however this number peaked at 28% in 2008–2009 with a decrease to 18.9% in 2010–2011.

Adolescent bariatric patient demographic characteristics from the NIS are shown in Table 1. The median patient age was 18 years old (range 12–19 yr), with a significant trend toward increasing patient age over time ($P < .001$); 76% of

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