



## Review Article

## Pediatric and adolescent obesity: Management, options for surgery, and outcomes

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## ABSTRACT

The past four decades have witnessed a marked rise in the number of children and adolescents with obesity. Severe obesity has also become increasingly prevalent. More young patients who have obesity are being referred for weight management and weight loss surgery, thus posing new challenges to both the medical personnel who care for them as well as the institutions in which that care is provided. This manuscript is generated from the material presented at the Education Day symposium entitled "Surgical Care of the Obese Child" held at the 42nd Annual Meeting of the American Pediatric Surgical Association in Palm Desert, CA, on May 22, 2011. Herein the presenters at the symposium update the material addressing evaluation of a young person for weight loss surgery (including the team approach to patient evaluation and institutional infrastructure and responsibilities). The procedures most frequently available to young patients with obesity are identified, and current outcomes, trends, and future direction are also discussed.

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## 1. Introduction

Obesity affects people of all ages in all countries. At present, approximately 1 in 5 children in the U.S. between the ages of 6 and 19 years is affected by obesity [1]; as many as 4–7% suffer from severe obesity (defined as body mass index (BMI)  $\geq 99$ th percentile for age). Severe obesity in childhood and adolescence often leads to severe obesity in adulthood [2].

Obesity affects both physical and emotional health [3]. As with other chronic diseases, untreated obesity increases the risk of developing numerous health complications (e.g., co-morbid conditions). Early intervention including weight loss surgery (WLS) may correct or avoid such obesity-related conditions as insulin resistance, type 2 diabetes mellitus, obstructive sleep apnea, and metabolic syndrome [4].

Not all primary care physicians, however, accept WLS as an acceptable therapy for adolescents with obesity [5]. The combination of surgical risk, nutritional challenge, and long term consequences makes some physicians reluctant to refer teenage patients for WLS. Those who question the applicability of WLS for obese younger patients cite recidivism and weight regain over time in numerous

adult studies to support their position that WLS should not be performed in adolescents. There are, however, no empiric data to support such an argument.

## 2. Weight loss programs and surgery

Similar to numerous reports in the adult population, lifestyle intervention (i.e., diet, exercise, and behavior modification) rarely results in significant and durable reduction in excess body weight in children and adolescents with severe obesity [6–8]. Bariatric surgery, however, has proven to be the most successful method by which individuals with severe obesity achieve significant weight loss. Surgical weight loss programs for adolescents incorporate numerous interested and committed team members from a variety of areas of expertise. Michalsky et al. have recommended that in addition to an experienced bariatric surgeon such WLS teams ideally should include pediatric specialists, a dietician, a mental health specialist, a coordinator, and an exercise specialist [9]. Adolescent-focused multidisciplinary teams should meet regularly to discuss surgical candidates as well as to review follow-up of patients who have undergone WLS. The team meeting provides a forum for members to exchange information which may not otherwise be readily available to all. Other individuals from other specialties (e.g., pediatric cardiology, nephrology, anesthesiology) may be invited to the meeting to share their expertise and help to optimize care during both the preoperative and postoperative periods.

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Institutional support is important to the development and success of WLS programs. This may be especially true for children's hospitals, which may not routinely carry materials appropriate for obese patients. Specific recommendations designed to optimize the care of the severely obese population include a number of logistical resources within the ambulatory and in-patient settings. Specific examples include the reception area, where patient seating must be capable of supporting individuals whose weight exceeds the limits of standard furniture. In addition, other routine clinic equipment including large blood pressure cuffs, examination tables and patient scales requires enhanced capacity to accommodate this population. Since standard wall-mounted toilets may not support an obese individual, floor-mounted or reinforced toilets are considered important for personal safety (since patients and family members alike can present with weight several multiples of average human weight) [10]. Additional equipment includes high weight capacity examination hospital beds, stretchers, patient gowns and patient assist devices (e.g., handrails throughout the clinic and inpatient spaces). Operating room (OR) tables also must have an increased weight capacity and lateral extensions to accommodate the extremely large patient. Additional considerations include special transport devices such as inflatable transfer mat and lift to help facilitate moving the patient from an OR table to a hospital bed. The OR needs to be equipped with long instruments which may be necessary to perform laparoscopic procedures in very large patients.

Additional considerations include high weight capacity diagnostic imaging equipment such as MRI scanners, CT scanners, and fluoroscopy to make possible necessary studies on severely obese adolescents [11]. Michalsky et al. have used cardiac MRI as an alternative to echocardiography to assess cardiac function in obese adolescents undergoing surgery, thus such imaging devices must be able to accommodate very obese patients [12]. Staff education is important to help hospital workers appreciate risks to patients and to themselves when dealing with someone who weighs much more than they are accustomed to treating, but also to sensitize them to the emotional and psychological issues that often accompany obesity [13].

### 3. Operations

WLS is most commonly performed using laparoscopic techniques. At present the surgical interventions most readily available to severely obese adolescents includes Roux-en-Y gastric bypass (RYGB), vertical sleeve gastrectomy (VSG), and adjustable gastric banding (LAGB). At present, there are fifteen registered clinical trials evaluating WLS in adolescents [14]. Eight studies are registered to evaluate LAGB, two are evaluating RYGB, and six do not specify the procedures being studied or evaluate multiple procedures. To the best of our knowledge there are no endosurgical procedure clinical trials in progress that focus on adolescents.

RYGB has been the most common operation offered to adolescents for weight loss and treatment of specific metabolic derangements associated with obesity. This procedure was first reported as treatment for severe adolescent obesity in this journal by Soper et al. in 1975 [15]. Of the 25 studied patients (all 20 years of age or less) the average weight loss was 25% of their preop weight measured as long as 3 years after open surgery. Laparoscopic RYGB was reported by Stanford in four adolescents who lost an average of 87% of their excess body weight with follow-up of nearly 2 years [16]. Proponents of RYGB note that the operation offers both a reduced capacity stomach and diversion of ingested nutrients, thus engaging the satiety mechanisms early after meals to effectively limit intake by reducing hunger. Additionally, in those RYGB patients who ingest foods with concentrated simple sugars, rapid presentation of chyme into the jejunum invariably leads to "dumping syndrome" which results in

avoidance behaviors (at least in the early post-operative period). Complications of RYGB are infrequent but may be serious; these include internal hernia with bowel obstruction, anastomotic leak, bleeding, wound dehiscence, vitamin and iron deficiency (when poorly compliant with supplements) and rarely, metabolic consequences associated with malabsorption.

Following Dolan's report in 2003 [17], Holterman et al. reported the initial adolescent experience with LAGB in the U.S [18]. In four patients, weight loss ranged from 15% at 4 months to 57% at 30 months. Additional reports from their group [19], Nadler et al. [20], Reichert [21], and others [22–24] demonstrate successful short term and intermediate weight loss from LAGB. Compared to RYGB, operating time and hospital stay are much shorter, and early postoperative complications are less serious. Secondary operations for band displacement, port complications, and esophageal dilation with esophagitis are common in adults [25] and can be anticipated to occur with similar frequency in adolescents. Patients who have undergone LAGB tend to lose weight more slowly than those undergoing RYGB, and the overall weight loss is less as well [26]. The U.S. Food and Drug Administration (FDA) has not approved adjustable gastric band devices for use in patients under the age of 18 years, so band use in teenagers has been confined to patients who receive surgery as part of FDA-approved studies or whose surgeons perform the procedure off-label.

Till first reported using VSG as a "stand alone" weight loss procedure in four morbidly obese patients ranging in age from 8 to 17 years [27]. At 1 year postop the mean BMI dropped from 48.4 kg/m<sup>2</sup> to 37.2 kg/m<sup>2</sup>. Since that time, additional reports have been published confirming the safety and efficacy of VSG over periods of relatively short follow-up. Additional publications by Alqahtani [28], Nadler [29], and others [30] have confirmed successful weight loss and reversal of co-morbidities following VSG in children and adolescents.

Other weight loss procedures have had limited or no current application in pediatric and adolescent populations. Biliopancreatic diversion and duodenal switch have resulted in successful weight loss in patients with Prader-Willi syndrome and others with super obesity [28,29], but neither operation has been used in many patients. Laparoscopic gastric plication to reduce stomach volume has been reported in adults but has not been reported in patients younger than 18 years [30]. Intra-gastric balloon therapy reports have included a small percentage of children in the reported groups; the treatment is not presently approved for use in the United States. Gastric pacing and endoluminal stenting are techniques which have not been used other than incidentally in adolescents [31–34].

### 4. Outcomes

Evaluating the results of surgery for obesity requires monitoring quantity of weight loss, quality of weight loss, changes in co-morbid conditions, and duration of benefit. Recognizing the need for longitudinal outcomes the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) established the Longitudinal Assessment of Bariatric Surgery consortium (LABS) to evaluate risks, benefits, and health impact on adults undergoing WLS [35]. Teen-LABS [36], a multi-institutional prospective observational study designed to assess the safety and efficacy of WLS in patients 19 years or younger, was established in 2007 and has collected data on 242 patients who have undergone bariatric surgery, most commonly RYGB. In addition to reduction in excess body weight and associated changes in obesity-related comorbidities, Teen-LABS researchers will be able to analyze factors such as the relationship between distance to the surgical center and outcome, adherence to nutritional regimens, and participation in support groups. The group has recently reported favorable surgical safety profiles for RYGB, VSG, and LAGB in adolescents, with 30-day complication rates very similar to those seen in adults [37].

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