Bariatric Surgery for Obese Adolescents – ‘Make Assurance Doubly Sure’

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Obesity among children and adolescents is becoming a significant health problem across the world. The emergence of a greater number of severely obese individuals in this age group, rarely encountered in previous decades, has led to an increased incidence of obesity related co-morbidities appearing at an earlier age. Such co-morbidities includes type 2 diabetes (T2DM), non-alcoholic fatty liver disease (NAFLD), sleep apnea, and other conditions previously considered ‘non-pediatric’ diseases. Standard interventions against obesity in children and adolescents that involve elements of nutritional guidance and increased physical activity are usually labor-intensive, rather expensive and not covered by health insurance in many countries, and unfortunately result in poor compliance as well as in limited success. Similarly, pharmacological treatment of obese adolescents (by agents approved for use in the adolescent age range) may result in a modest degree of weight loss; yet it is not clear whether this effect is sufficient to reverse significant metabolic derangements in obese youth [1].

Bariatric surgery procedures are gaining acceptance as an effective treatment for obesity in adults. The long-term effects of some of these procedures have been studied, and the results, particularly with regard to metabolic complications of obesity, are very promising, especially when compared to conservative lifestyle modification interventions [2]. The positive impact of bariatric surgery on glucose metabolism in patients with T2DM has received the greatest attention, and the postulated hormonal mechanisms of such effects have led to the concept of ‘metabolic surgery’ that aims not only to achieve weight reduction per se but also to positively alter the hormonal profile of the patient. Recently, there is increasing interest in the performance of bariatric procedures in younger obese patients, specifically in adolescents. Indeed, preliminary results of non-controlled studies on the impact of bariatric surgery in adolescents show promising outcomes [3]. One can

argue that the expected morbidity associated with severe obesity during adolescence, especially in cases where significant complications are already present, justifies the performance of bariatric surgery early, even if long-term outcome studies are not available yet and unforeseen future complications are potentially possible.

Several guidelines regarding patient selection for bariatric surgery in adolescence have been published and highlight criteria of eligibility [4, 5]. These obviously include severe obesity with presence of significant obesity-related co-morbidity and near complete physical maturity (defined by bone age). Additional criteria include failure of adequate response to a standard weight reduction program, while demonstrating compliance, motivation to participate adherence to nutritional recommendations, and commitment to a comprehensive medical and psychological evaluation before and mainly after surgery. An additional criterion includes the presence of a supporting family environment. While criteria such as anthropometric measures and presence of disease are straightforward, the criteria of compliance, adherence, presence of a supporting environment, and mental capacity to understand the implications of bariatric surgery are more difficult to define and quantify. As most caregivers know and as it has been demonstrated by the vast majority of interventional studies, compliance and adherence are not exactly the forte of this unique population of patients, and familial support is commonly not present. Despite the qualitative nature of these eligibility criteria and the lack of comparative long-term studies of ‘compliant versus non-compliant’ patients, one can reasonably assume that the initial degree of adherence and compliance is the key to the long-term success of the procedure. Thus, operating on obese adolescents who a priori have poor compliance should not be performed, unless an immediate life-threatening condition that may be reversed by the procedure is present (a condition rarely encountered).

Despite possessing physical dimensions comparable to adult surgical candidates, the physiology of adolescents as well as the psychological and mental problems of this age group are entirely different. Adolescence is characterized by specific nutritional requirements as well as by the need for attention to sexual maturation and bone accrual, issues that are addressed differently in adults. The presence of significant mental disorders (ranging from binge eating to depression) as well as major psychosocial issues typical of this age group are highly common among obese adolescents. Diagnosing such disorders and problems is crucial prior to surgery as not addressing these problems early on may negatively impact the postoperative success of the procedure as well as lead to exacerbation of existing mental problems. This implies that adolescent candidates for bariatric surgery need a pre- and postoperative evaluation and follow-up performed by medical teams with expertise specific to this age group. In other words, the obese adolescent is not a 'young adult' (as perceived by some), and the ancillary care to surgery should be performed by pediatric specialty teams.

Many questions remain unanswered in regard to bariatric surgery in adolescence, e.g. what procedure to perform, how to define a 'failure' of a lifestyle modification program prior to surgery, or how to assess the mental capacity of the adolescent surgical candidate to understand and accept the implications of such procedures. Moreover, noncontrolled studies in adults make the evaluation of safety and potential future complications difficult [6], and significant early complications have been documented in adolescents [7]. Careful patient selection using the published criteria should lead to limiting bariatric interventions to only those selected few adolescents with the worst degree of obesity and accompanying morbidity who may benefit most from such procedures and who also possess the personal and environmental factors that support the long-term effects of surgery. Despite the recent popularity of bariatric surgery in adults, only a limited number of adolescents actually meet the above mentioned criteria, and those should be the ones to be operated. Thus, one must 'make assurance doubly sure' (Macbeth) before selecting the right adolescent patient and the appropriate medical center for performing bariatric procedures.

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On the Contents of This Issue

In this issue of *OBESEITY FACTS*, our main focus is on the youngest generation; a total of 5 studies focus on children, adolescents and young adults.

Muckelbauer et al. (Germany) [1] investigated the effect of the installment of water fountains in schools on obesity incidence over a 10-month period; the respective randomized controlled study represents an add-on to the original study published in *Pediatrics* [2]. Water fountains were installed in 17 schools in which second and third graders received a water bottle and their teachers promoted drinking water. The pupils of the 15 control schools in a second city received no intervention. Intervention and control schools were all in neighborhoods of low socioeconomic background. At follow-up, obesity incidence was significantly lower in the pupils of the intervention schools (3.8 vs. 6.0%). In contrast, remission rates did not differ significantly. We would like to point out that in contrast to other countries (e.g. USA) most schools in Germany do not have school fountains. The study of Muckelbauer et al. [1] suggests that school authorities should consider the installment of water fountains; as shown by the investigators, children accepted drinking water throughout the study period.

In Germany several pediatric hospitals specialize in the inpatient treatment of obesity, mostly paid for by different national health insurances. Over 4,500 obese children and adolescents are treated annually for 3–6 weeks. Typically, weight loss is at around 1 kg/week. Currently, systematic evaluations of the medium and long-term outcome of such children are scarce and based on small samples only; most of these results have not been encouraging. It has been suggested that such negative results are based on the fact that the children do not subsequently receive outpatient treatment. One of the major German health insurances funded a combined inpatient (6 weeks) and outpatient (10.5 months) treatment program. The study of Adams et al. (Germany) [3] was based on a total observation period of 6 months which included the 6 weeks of inpatient treatment and the initial 4.5 months of outpatient treatment. The investigators aimed to assess weight loss according to this regimen; results were compared with children on the waiting list. BMI-SDS of the 162 children in the intervention group was reduced by 0.36 ± 0.34 (mean BMI decrease -2.1 kg/m^2) in the intervention group, whereas no significant change of BMI-SDS was observed in the control group (0.04 ± 0.17 ; mean BMI increase: $+0.27 \text{ kg/m}^2$). In addition to the positive effect on BMI, the intervention group also showed improvements in various psychological variables and reported fitness. The authors delineate methodological shortcomings of their study; unfortunately, the costs of the intervention were not disclosed. Assuming daily costs of EUR 150.– for

inpatient treatment and another EUR 1,500.– for the outpatient program, the total costs per child can be assumed to be in the range of EUR 7,800.–. Obviously, the cost effectiveness of such interventions needs to be addressed in future studies as well as the longer-term outcome.

Neovius et al. (Sweden) [4] addressed metabolic risk factors – triglycerides, HDL, f-insulin and blood pressure – in 300 17-year-old Swedish adolescents. Percent body fat was determined via densitometry based on air-displacement plethysmography measurements. Despite the use of this sophisticated method for determination of body composition, the diagnostic accuracy of percent body fat for detection of metabolic risk factors above specified cut-offs was not superior to that of BMI or waist circumference. In males, the three measures ranged from poor to fair in their diagnostic accuracy for high f-insulin and adverse HDL levels and from good to excellent in detecting hypertriglyceridemia, but no measure was found to be superior. In females, percent body fat proved superior to chance only in identifying adolescents with adverse levels of triglycerides; in this case, percent body fat was superior to the other two measures. All measures were weak in identifying individual risk factors. However, the use of a combined measure of metabolic risk revealed higher accuracy. Again, no measure proved superior in detecting the cluster of risk factors.

Using the alternative linear mixed model (LMM), Chivers et al. (Australia) [5] aimed to develop a simple model of BMI based on anthropometric assessments from birth on for separating the different International Obesity Taskforce (IOTF) cut-off categories of normal weight, overweight, or obese at 14 years. The study focused on both gender aspects and the adiposity rebound for each weight status group. Data sets of 1,403 individuals assessed at birth, and at ages 1, 2, 3, 6, 8, 10, and 14 years formed the basis of the study. The BMI trajectories followed a distinct pathway from birth to age 14 for individuals in different weight categories. The relevance of the timing of the adiposity rebound was confirmed. A simple model of BMI trajectory was proposed using LMM which shows that the life span from birth to 6 years is a key developmental period for adiposity.

Musher-Eizenman and Carels (USA) [6] aimed to assess how people rate male and female figures depicting different BMI categories ranging from low normal weight (18.5 kg/m^2) to extremely obese (40 kg/m^2) on dislike, personality, and functional limitations. The investigators point out that previous investigations pertaining to weight bias mostly relied on the participant's own characterization of 'fat' individuals; to avoid this subjective element, the authors presented figures depicting the currently accepted medical definitions of different degrees of overweight. The 308 participants (62% female; mean age 19.9 years)

were recruited from psychology classes. Relative to the low normal weight and overweight figures, weight bias was greater in the current study for obese and extremely obese figures. The highest levels of dislike, negative personality attributes, and perceived functional deficits were reported for the most obese figures regardless of gender. There was minimal evidence for weight bias against overweight figures which were judged as representing a normal body weight. Female participants judged obese female figures more positively than the corresponding male figures. Males rated the low normal weight, normal weight, and obese female figures more positively than corresponding male figures; only the most extremely obese female figures were disliked more than the male counterpart.

Riou et al. (Canada) [7] examined the relationships between fitness and components of the metabolic syndrome in 39 sedentary men aged 34 to 53 years. Fitness was assessed via VO_2max . Extensive phenotypical assessments were performed to determine different components of the metabolic syndrome, including measurements of muscle enzyme activities, capillary density, waist circumference, blood pressure and oral glucose tolerance test. The investigators concluded that the effects of fitness on components of the metabolic syndrome in sedentary men are explained by abdominal obesity and muscle phenotypes.

Bueter et al. (UK) [8] reviewed our current knowledge of the effects of bariatric surgery on the gut-brain axis and the respective effects on appetite and weight loss. They specifically contrasted effects induced via gastric banding or gastric bypass surgery. These two surgical approaches and their risks and side effects were explained; the effect of bypass surgery on weight loss exceeded that observed using restrictive procedures. Levels of glucagon-like peptide-1, peptide YY and gastric inhibitory peptide were all altered by bypass surgery and unaffected by banding procedures. Satiety effects could be reversed by blocking the

hormonal responses. The authors concluded that bariatric surgery may be used as a model to examine the physiological mechanisms of weight loss and to develop future surgical and nonsurgical weight loss treatments.

Stroh et al. (Germany) [9] present two case reports of patients who developed granulomatosis after the implantation of adjustable silicone gastric banding. In light of reported delayed-type hypersensitivity reactions to silicone implants, the authors recommend being aware of sarcoidosis as a potential short- and long-term complication after the implantation of silicon materials. They also suggest that silicone gastric banding represents a contraindication in patients with granulomatosis.

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