Child and adolescent obesity

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Abstract
Childhood obesity has reached epidemic proportions worldwide. With adult obesity-related co-morbidities now appearing in obese children, there has been a big push to educate the population and establish effective weight-losing initiatives. However, the limited success of non-operative methods has led to the introduction of bariatric surgery in the under 18-year olds. Laparoscopic Roux-en-Y gastric bypass is the most commonly performed operation, followed by the adjustable gastric band and sleeve gastrectomy. This review seeks to present the current position of bariatric surgery in the treatment of obese adolescents, and reviews the available evidence on selection and outcome, as well as the inherent uncertainties, particularly within the UK.

Keywords adolescent and child obesity; bariatric surgery; medical consequences; non-operative methods; psychological effects

Introduction

The prevalence of childhood obesity in the United Kingdom (UK) has more than tripled since the 1980s. The Health Survey estimates for England in 2011 suggested that around three in ten boys and girls aged 2–15 were classed as either overweight or obese (31% and 28% respectively). The dramatic rise in the prevalence of childhood obesity has been accompanied by an increased risk of developing serious co-morbidities at an early age. Such co-morbidities include type II diabetes mellitus, hypertension, hyperlipidemia, sleep apnea and cholelithiasis, as well as significant psychosocial consequences and the increased likelihood of becoming obese adults.

Bariatric surgery

The extension of bariatric surgery to adolescents was based on the failure of non-surgical treatments in children and adolescents and also the expansion of the evidence base from adult bariatric surgery showing its efficacy and relative safety. However, uptake has been remarkably slow when compared to the exponential increase in adult bariatric surgery over the last decade. In the UK in 2007/2008 only 36 procedures were performed on patients within the 15–19 age range (out of a total of 2994 cases overall). There is little reason to believe the numbers have increased further and a January 2011 survey by the authors identified no established dedicated pediatric or adolescent bariatric unit in the UK. Some adult bariatric surgery centers however had formed collaborations with specialist pediatric and adolescent physicians and had performed a handful of procedures on adolescents within the framework of specific tailored pathways and specialist MDTs. In comparison, between 2000 and 2003, the rate of surgical weight loss procedures in adolescents in the United States tripled to an estimated 771 procedures nationwide. In a survey of bariatric surgeons in the United States in 2005, 75% indicated they were planning to perform an adolescent procedure in the upcoming year, and 42% were in the process of developing a multidisciplinary adolescent weight loss surgery program in their community. Although numbers are rising, weight loss surgery for adolescents remains a small percentage of overall annual weight loss surgery procedures in the United States (0.7%), with the majority of these cases (90%) being gastric bypass.

The reasons for the slow uptake are several-fold. Not least is the perception of bariatric surgery for this age group amongst UK healthcare professionals. The authors conducted a survey exploring the perspectives of medical professionals in the United Kingdom regarding adolescent bariatric surgery. Careful thought was put into identifying and defining certain criteria the healthcare professionals felt should be met before an adolescent undergoes bariatric surgery. Most participants believed that surgery should only be offered to patients more than or equal to 16 years of age and 17% of bariatric surgeons marked no minimum age limit. A BMI of 40 and above, or a minimum BMI of 35 in the presence of obesity-related diseases were selected as cut offs by most, and this is in keeping with the NICE guidelines.

In this survey, more controversy was noted regarding monitored weight management programs as only half of the respondents deemed it a necessary pre-requisite to surgery. Most respondents felt that weight loss targets should not be set, as it was felt that the adolescent's motivation and demonstrable eagerness in their attempt to lose weight were more important than any actual amount of weight lost. It is accepted that in adult bariatric surgery the patient's motivation and determination are key factors in enhancing the likelihood of successful weight loss post-bariatric surgery.

The pre-requisite that was believed to be most essential was parental psychological counseling and involvement in their child's journey through weight-losing treatment.

Surprisingly, over 80% of the respondents, which included bariatric surgeons, pediatricians, dietitians, specialist nurses and general practitioners considered bariatric surgery in adolescents to be acceptable practice. Despite this highly favorable view, only 4 out of 45 physicians surveyed (9%) had ever referred an obese adolescent for a surgical assessment. Possible reasons may include the lack of available bariatric services locally, not considering surgery as a possible treatment option, patients' refusal to be referred and lack of motivation, or the physicians'

Abbreviations: AGB, adjustable gastric band; BMI, body mass index; BOLD, bariatrics outcomes longitudinal database; CT, computer tomography; DXA, dual-energy X-ray absorptiometry; LSG, laparoscopic sleeve gastrectomy; MDT, multidisciplinary team; MRI, magnetic-resonance imaging; NHS, National Health Service; NICE, National Institute for Clinical Excellence; RYGB, Roux-en-Y gastric bypass; SCT, social cognitive theory; SD, standard deviation; SIGN, Scottish Intercollegiate Guidelines Network; SLT, social learning theory; UK, United Kingdom; WHO, World Health Organization.

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unwillingness to actually refer an adolescent. Iqbal et al. reported that reluctance to refer was most commonly due to the unknown long-term metabolic effects of weight loss surgery in such a young population. However, there is growing evidence that early surgical intervention can lead to the resolution of obesity-associated co-morbidities, as well as improving the psychosocial and educational consequences of morbid obesity. Therefore it seems that the potential disadvantages of long-term metabolic side effects from bariatric surgery are outweighed by the disappearance of the obesity-related co-morbidities. Broadly speaking, there seem to be three important areas that elicit concern when considering bariatric surgery in adolescents:

- Psychological readiness and support
- Limited data on short- and long-term outcomes in adolescents
- Service provision and the role of the MDT

Psychological readiness and support

Referring to our survey, a prevailing concern about this patient population's psychiatric needs and uncertainties about the type of support they would need if contemplating surgery became apparent. It was universally felt that all adolescent patients have the need for psychological input and that involving the parents in the psychological counseling process would be essential and in fact even beneficial to the family as a whole.

In adults the psychological support has traditionally been concentrated on the pre-operative phase. Psychiatrists and psychologists have been involved in the selection of patients for surgery and their expert pre-operative assessments used to try to identify those thought to be at too high a psychological risk for surgery. The assessments also search for pre-operative pointers to the patient's own coping mechanisms — both for when the surgery is successful but also for situations when complications may occur or weight loss and co-morbidity resolution is less than expected. The pre-operative screening also involves the identification of eating disorders and treating these where possible pre-operatively with interventions such as cognitive behavioral therapy. More recently, an increasingly significant component of psychological input for adults undergoing bariatric surgery has been focused on patient education and learning.

The multidisciplinary team (MDT) standardized pathway and routine psychological assessment is the model in many adult services. Initially routine psychological assessments were performed on all patients and this also provided reassurance to funding bodies and referrers. There is a growing realization that the psychological support (a limited resource) needs to be focused at least as much in the post-operative phase as this is likely to help achieve better results. The pre-operative assessments selectively performed may allow diversion of psychological resources to the post-operative phase.

In adolescents the needs are clearly very different and the models used in adult service cannot simply be replicated, but some lessons can be drawn. In adults, less successful surgery was associated with the patients feeling unprepared for the changes required after surgery, reporting being unsupported in the time following surgery and a sense that, psychological issues relating to dietary control, self-esteem, coping and emotional eating remain neglected. Hargreaves et al.'s study on 452 adolescents aged 12—15 years found that self-esteem, confidence and personal responsibility for health (most of which are generally low in obese adolescents) were associated with better general health and health-promoting behaviors including healthy eating and more physical exercise. The paper also highlighted the role of family, peers, school and local community as important influencing factors for these outcomes especially with regards to smoking, drug use and healthy weight. There is therefore a definite need for psychological assessment in all adolescents pre-operatively, and also essential that there is peri-operative and post-operative access to trained adolescent psychologists both for the patient and the family. At present there is not sufficient evidence, nor is it intuitively feasible to bypass this step in the pre-operative preparation. However, once properly resourced, the adolescent patient's psychological preparedness is not an insurmountable barrier to surgery and by carefully focusing specialized psychological resources to educational and behavioral therapies both pre- and post-operatively a successful outcome should be achievable. Further, the patients themselves are maturing whilst on the pathway and have much greater ability to re-learn new and lasting behaviors, as opposed to adults who have 'practiced' their bad habits over years and years.

Limited outcomes data

We have limited data, especially long-term data, on outcomes in children and adolescents undergoing bariatric surgery. Part of the problem is the actual age range used in 'adolescent' studies and whether an 18-year old should be considered a child or an adult. In a report by Inge et al. dramatic improvement is demonstrated in the 11 patients undergoing gastric bypass in terms of reversal of type 2 diabetes mellitus and improvements in cardiovascular risk factors. However, the median age of the surgical cohort was 18 years with an age range of 14—21 years. Yitzhak et al., included a younger population in his study with a mean age of 16 years at operation and age range from 9 to 18 years. Clinical improvements with complete resolution of diabetes mellitus, sleep apnea and asthma were noted in a cohort of 60 adolescents who underwent gastric banding. There were no mortalities in this group, but eight patients (13%) required re-intervention for band slippage.

In a systematic review by Aikenhead and colleagues 34 studies on bariatric surgery effectiveness in 831 children or adolescents were included spanning 36 years. The mean age overall from these studies was 15.6 years with most studies including patients within an age range of 14—17 years. Papers published from the USA tended to have 17 years as the upper age limit. However, there were patients as young as 8 years, and 10 out of the 34 studies included adolescents up to the age of 19 years. So the definitions between units and between countries and continents differ. The problem therefore has been twofold — to what extent outcome data from adults is truly representative and second, the paucity of mid to long-term outcome data in genuine adolescents.

Service provision

The MDT is regarded as an essential component of any adult bariatric service and this seems all the more so in the case of adolescent surgery. The MDT ensures quality assurance to the referrers, patients and funding bodies. It is also a safe and secure forum where clinicians can consider and revise decisions on

these often complex patients. This seems all the more important when considering the adolescent patients, and the decision making may require multiple meetings over months or years: A recent study by Woolford et al. highlighted the fragile instability of adolescents' decisions regarding bariatric surgery. Most of the 21 patients (mean age of 15 years) who initially wanted bariatric surgery changed their minds following a 6 month organized weight loss program. Given this uncertainty, the opinions of a number of members of the multidisciplinary team who are familiar with the patient and the parents will be valuable and are more likely to reflect the patients' true intentions in order to establish the most appropriate treatment plan. More practical and logistical issues also need to be considered when setting up a bariatric unit including spacing and equipment. Ordinary clinic rooms or operating theatres are not suitable for the bariatric patient who will require larger chairs and beds, larger blood pressure cuffs, larger scales in outpatients, larger operating table and robust transfer methods and hoists, to mention a few. Obese adolescents will also have similar requirements at least with regards to their physical size. However, it may not be appropriate for adolescents to be seen and nursed alongside adults in the adult outpatient clinic and on the specialist adult bariatric ward.

On the adolescent wards the critical mass of bariatric experience may be missing, whilst on the adult specialist bariatric ward, where there is a concentration of the essential bariatric nursing expertise, the specialist expertise required for children and adolescents may be lacking. This becomes even more important when a bariatric surgical complication occurs as, due to the body habitus and large abdomens, the common abdominal signs are less easy to assess and interpret. Early identification of a leak is essential and early re-laparoscopy the default for a patient in pain or persistently tachycardic post-operatively. The signs and manifestations of post-operative problems that would allow early detection and re-intervention may be less apparent to those not used to nursing bariatric patients.

In adult surgery it has been shown that high volume units have better outcomes. Part of this at least is due to the early re-intervention for complications. A trained specialist team with optimal resources is therefore essential to ensure that patients receive the best possible care and that any complications are recognized and dealt with effectively. The ideal is to have flexibility in resource allocation and distribution of specialist staff.

Selection for surgery – who, when and what?

Who? Most studies measure the success of surgery according to the absence of post-operative complications and the excess weight loss achieved. Psychological predictors of surgical success include pre-operative demonstration of dietary adherence and adaptation of new eating behaviors; whilst unrealistic patient expectations lead to worse outcomes. Meticulous patient selection and preparation and good post-operative care are vital for successful weight loss surgery.

Starting with the selection criteria for surgery, whilst NICE guidelines use BMI categories, the Scottish Intercollegiate Guidelines Network (SIGN) select patients based on BMI percentile. The validity of using BMI as part of the selection criteria in children and adolescents is debatable since during these early years BMI in a healthy normally growing child is not a static measurement; in fact it is expected to varies greatly between birth and adulthood. Further, BMI is not sensitive to the variability in adiposity, i.e. the proportion of fat mass to lean body mass, nor does it convey any information about changes in body composition during treatment. Magnetic-resonance imaging (MRI) and computed tomography (CT) provide accurate data on adipose tissue composition, however, are unsuitable modalities for routine clinical follow-up especially in children. Dual-energy X-ray absorptiometry (DXA) has also been evaluated as a potential technique to assess body composition in obese children. Unfortunately results have shown limitations to the accuracy of DXA with differential bias, as fat mass was significantly over-estimated whilst lean mass was under-estimated. Also, a significant number (14%) of individuals could not even be scanned due to their large size. Studies comparing the use of different measures of obesity including BMI, waist circumference and international cut offs are limited and with small numbers of subjects.

Most published epidemiology studies in the UK define obesity as BMI more than or equal to 95th centile of the 1990 reference chart for age and sex, ensuring high specificity and moderate sensitivity. SIGN guidelines also use BMI centiles. However, they state that for clinical use a BMI more than or equal to 98th centile defines an obese child whilst severe obesity includes children with BMI more than or equal to 99.6th centile. The selection criteria for surgery is therefore much more stringent. SIGN recommends that in most obese children (more than 98th centile) weight maintenance is an acceptable goal and that surgery can be considered for post-pubertal adolescents with very severe to extreme obesity (BMI more than 3.5 SD above the mean on 1990 UK charts, i.e. BMI more than or equal to 99.6th centile) and severe co-morbidities. This would exclude the majority of obese adolescents and we know from the current evidence from outside the UK that even those with less extreme, but nevertheless severe obesity, gain benefits from obesity surgery. There are many reasons for maintaining a conservative and highly selective approach to offering bariatric surgery to adolescents. There is the fear of interfering with normal growth and the uncertainty of long-term effects post-bariatric surgery. Motivation, compliance and regular follow-up are key components to the management of the bariatric patient, all of which, may be much harder in a child or adolescent especially if already affected by a behavioral disorder. Furthermore, approximately 30% of obese children will stabilize and become lean adults.

However, given that 70% of obese children go on to become obese adults, one should also ask whether it is best to intervene early when the patient has not been affected by almost inevitable obesity-related co-morbidities that carry with them psychological distress, poorer quality of life and increased cost to the NHS.

When? the NICE guidelines for adolescent bariatric surgery state that surgery should only be considered when physiological maturity has been achieved. This occurs at different ages for different individuals, making age a non-ideal selection criterion. Given the extensive physiological changes that take place during early years of life special consideration has to be made as to whether skeletal and sexual maturity has been achieved, e.g. by using the Tanner stage (Figure 4). Obese adolescents tend to be more mature and taller for their age. Some would argue that adolescents with an increased BMI are physiologically similar to

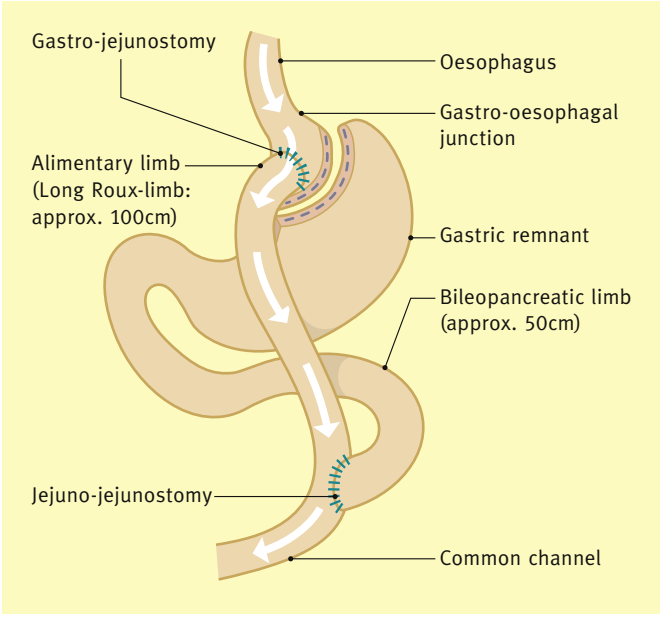

Figure 1 Roux-en-Y gastric bypass.

young adults of similar BMI. One could then extrapolate much of the evidence base and knowledge to these adolescents from what we know about adult bariatric surgery. Furthermore, the surgical technique, surgical approach, technical difficulties to overcome are all similar for these adolescents who are of similar size to obese adults. The tailored bariatric operating theatre and specialist surgical and laparoscopic equipment would be the same.

As already mentioned, approximately 70% of obese children become obese adults especially if parents are also obese. The medical and psychological consequences of obesity have also been described. This raises the question whether it is best to intervene with bariatric surgery before psychological and physical problems arise, as well as social isolation and educational compromise.

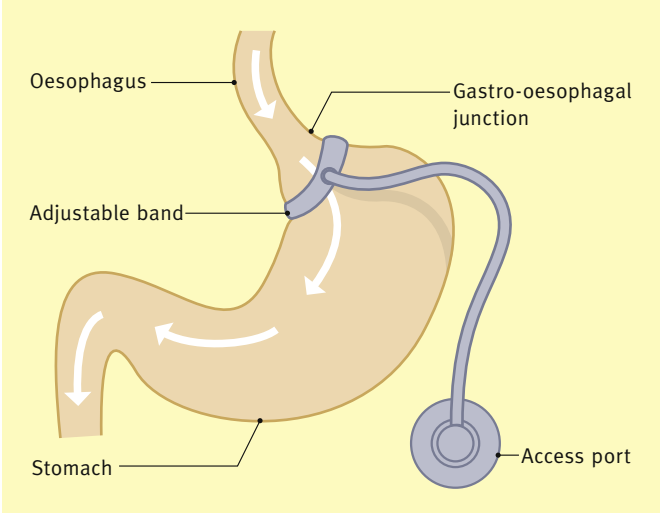

Figure 2 Adjustable gastric band.

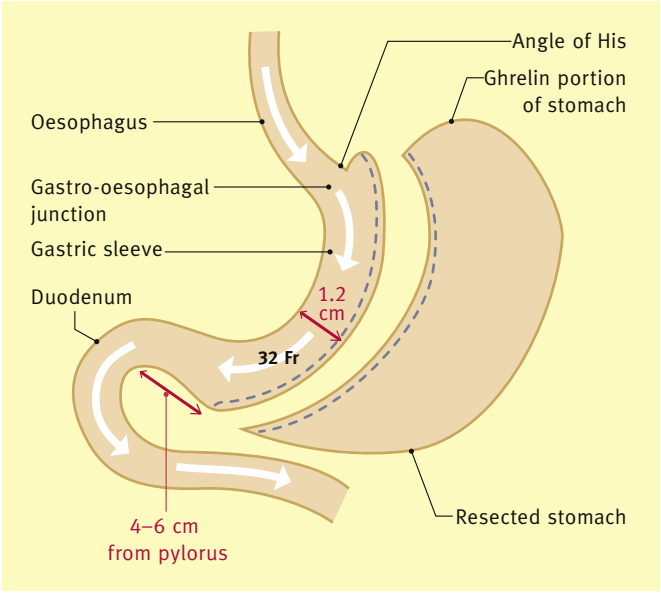

Figure 3 Sleeve gastrectomy.

Before undergoing surgery the guidelines recommend other pre-requisites including a trial of a weight management program. There is ongoing debate as to how long such a program should continue before the patient has proved whether they can lose weight, as well as how much weight should be lost prior to being considered for surgery. Emphasis on the adolescent's motivation and determination to reach a healthy weight rather than setting an actual weight target may be more realistic given the difficulties in losing weight by conservative methods.

There is unlikely to be a clear answer to all the above that will apply to all patients. Every case should be considered individually taking into account physical maturity stages as well as medical co-morbidities, psychological readiness, parental involvement and patient choice.

The risks: the risk-benefit ratio is less clear-cut in children compared to adults. For example, the total mortality rate of a morbidly obese adult is said to be 0.28% at 30 days and 0.35% at 2 years which is most often secondary to end-stage disease such as ischemic heart disease or cirrhosis. Obese children have not developed end-stage diseases yet and so quantifying risk is more difficult. To date, no mortalities have been reported in the published series of adolescents who have undergone bariatric surgery.

What? the most commonly performed bariatric procedure in adolescents is the Roux-en-Y gastric bypass (RYGB), with the laparoscopic approach as the current gold standard of care. The procedure consists in the creation of a 30 ml pouch from the proximal stomach by completely separating the lower part of the stomach. Two anastomoses are then formed to ensure intestinal continuity – an alimentary limb formed by joining a loop of jejunum to the gastric pouch, and a second biliary limb formed via a jejunojejunostomy which allows the bile and pancreatic juices to enter the main circuit (Figure 1). Patients should expect to lose approximately 60–85% of excess body weight with dramatic improvements and even complete resolution of co-

Females

Stage	Breasts	Pubic hair	Annual height velocity	Other
I	Elevation of nipple	Villus hair only	5.0 to 6.0 cm (2.0 to 2.4 in)	Adrenarche
II	Breast buds palpable, enlarged areola	Sparse, slightly pigmented	7.0 to 8.0 cm (2.8 to 3.2 in)	Clitoral enlargement; labia pigmentation
III	Mammary extends beyond edge of areola	Coarser, darker, curled	8.0 cm (3.2 in)	Acne, underarm hair
IV	Nipple mound stacked on areola mound	Adult type, but not beyond pubic area	‹ 7.0 cm (2.8 in)	First menstruation
V	Integral nipple mound	Adult type, spreading onto inner thigh	final height reached at age 16	Adult genitals

Males

Stage	External Genitalia	Pubic hair	Annual height velocity
I	Prepubertal	Villus hair only	5 – 6 cm (2.0 to 2.4 in)
II	Enlargement of scrotum and testes; scrotum skin reddens and changes in texture	Sparse growth of long, slightly pigmented hair at base of penis	5 – 6 cm (2.0 to 2.4 in)
III	Enlargement of penis (length at first); further growth of testes	Darker, coarser and more curled hair, spreading over junction of pubes	7.0 to 8.0 cm (2.8 to 3.2 in)
IV	Increased size of penis with growth in breadth and development of glans; testes and scrotum larger, scrotum skin darker	Adult type but covering smaller area than in adults	10 cm (3.9 in)
V	Adult genitalia	Adult type and quantity	Final height reached at age 17

Figure 4 Tanner stages of puberty.

morbidities. This has especially been demonstrated with regards to diabetes mellitus II with even better results than those seen in adults.

Further, there is evidence that pregnancy outcomes within the first year post RYGB are not associated with any complications in pregnancy or adverse fetal outcomes, which is particularly relevant when treating young girls in certain communities where there is a high prevalence of unplanned pregnancies at a young age. On the other hand, RYGB also has the greatest potential for complications due to the presence of two anastomoses that could potentially leak, the added risk of internal hernias and an overall estimated mortality rate of approximately 0.2–0.5% from large adult series. To date there have been no reported deaths amongst adolescent who have undergone gastric bypass, however, this may just reflect the smaller number of procedures performed on this age group compared to the greater number performed on adults. Further complications reported in gastric bypass include anastomotic marginal ulcer, bleeding, or rarely perforation and severe stenosis. Small bowel obstruction due to internal hernia represents a surgical emergency, also caused by trocar site hernia, intussusceptions, adhesions, strictures, kinking, or blood clots. Rapid weight loss after bariatric surgery can cause cholecystitis or choledocholithiasis. Such complications can be kept to a minimum or recognized early if they occur by treating patients in more experienced and specialized bariatric centers.

Patients will require lifelong follow-up and both vitamin and mineral supplementation. The reconfiguration of the gastrointestinal tract, motility, pH and enzymatic profile, together with reduced oral intake leads to an imbalance in reduced absorption of vitamins and minerals. Anemia is the most common consequence affecting up to 49% of patients undergoing anti-obesity operations. This is closely followed by deficiencies in iron, folate, vitamin B12 and vitamin D. Routine blood tests, as well as regular review by a specialist bariatric dietitian, are therefore essential components of post-operative management.

The Adjustable gastric band (AGB) also produces weight loss but to a lesser degree than RYGB and typically at a slower rate. This procedure involves the placement of a soft, flexible and adjustable balloon wrapped around the upper part of the stomach and connected via a tube to an easily accessible reservoir port system (Figure 2). An Australian randomized controlled trial led by O'Brien et al. showed excess weight loss of up to 79% and significant improvement in metabolic syndrome and quality of life on obese adolescents who underwent AGB insertion.

Furthermore, these good results may as much be a reflection of an intensive and regular follow-up program with multiple clinic attendances for counseling and band adjustment (10 a year) Furthermore, 33% of participants required revision surgery of some form. Suter et al. described experience with over 300 patients and over 33% experienced serious late complications including erosion (9.5%) and slippage or dilatation (6.3%), highlighting that AGB is not fully safe proof.

Laparoscopic sleeve gastrectomy (LSG) is a newer technique adopted by bariatric surgeons and involves the permanent removal of approximately two thirds of the stomach leaving a 'tube' or 'sleeve' shaped stomach (Figure 3).

Weight loss following LSG is achieved by both restriction and hormonal modulation. The reduction in stomach size restricts distention and increases the patient's sensation of fullness, leading to smaller meal portions. Secondly, growing evidence suggests a reduction in the hunger drive of patients undergoing sleeve gastrectomy. This may be related to reduced serum levels of ghrelin, a hormone produced mainly by P/D1 cells lining the fundus of the human stomach which stimulates hunger.

There is limited data on short-term outcomes in adolescents and currently none on long-term effects. However published data on mid-term results of large numbers of adults having sleeve gastrectomy appears promising. More recently, a group from Chile presented their experience and results of laparoscopic sleeve gastrectomy in obese adolescents. The study included 51 patients aged 15–19 years with a mean pre-operative BMI of 38.5 $\pm$ 3.7 kg/m^2. The percentage of excess weight loss at 6 months, 1 year and 2 years was 94.6%, 96.2%, and 92.9%, respectively. 76% of patients had pre-operative co-morbidities, all of which resolved or improved following surgery. These results appear better than those achieved in adults. The Moorehead–Ardelt Quality of Life questionnaire was also carried out and all reported very good or good quality after surgery (40% and 60%, respectively). No conversion to open surgery was necessary, however, one patient did require further endoscopic and laparoscopic treatment for a suture line leak. Staple-line leak is associated with significant morbidity, prolonged recovery and increased risk of mortality.

The Michigan Bariatric Surgery Collaborative reported on the largest LSG series in adults. This included 854 patients who underwent LSG between 2006 and 2009 across 25 hospitals and 62 surgeons and they reported a major complication rate of 2.2%. More recently, a systematic analysis of 4,888 patients from 29 studies was published by Aurora and colleagues. The mean leak rate was 2.4 % (range 0–7%) and 89% of cases demonstrate the leak to be found in the proximal third of the stomach. The leak rate was greater, 2.9%, in patients with a BMI greater than 50. Of note, 50% of leaks occurred more than 10 days post-operatively when the patient was at home. This highlights the importance of educating general practitioners on bariatric surgery as they may well be the first doctor to assess the unwell bariatric patient at home. Management of early leak should not be delayed. Suggested treatment options include operative or percutaneous drainage and endoscopic stenting in conjunction with gut rest and parenteral nutrition. However, sufficiently powered, prospective, randomized studies are needed to evaluate the optimal management of staple-line leaks.

Other well-recognized risks after sleeve gastrectomy are intra-abdominal bleeding and gastric structuring. Both outcomes had an incident rate of less than 1% in Aurora's review. Minor complications or consequences of the procedure include acid reflux requiring proton pump inhibitors, nausea and vomiting, and diarrhea, most of which settle with time.

It has also been noted that following weight loss surgery, patients lose weight rapidly at first, but weight appears to plateau after about 18–24 months. For procedures with a malabsorptive component a possible explanation is that the gastrointestinal tract adapts over time to its new anatomic change allowing better absorption of food. Another reason may be that the anastomosis dilates or the gastric pouch formed during gastric bypass and the gastric tube in sleeve gastrectomy stretch over time, which can then accommodate larger meals.

Comparison studies between RYGB and ABG in adolescents have been published. Messiah et al. analysed the prospective Bariatrics Outcomes Longitudinal Database (BOLD) to determine the weight loss and health related outcomes in adolescents. The BOLD data are collected from 423 surgeons at 360 facilities in the United States. A total of 890 participants were recruited at baseline, decreasing to 541 at 6 months and approximately a third at 12 months. A total of 45 readmissions occurred, with 29 re-operations amongst the gastric bypass and 8 of the adjustable gastric bands. Results showed that the overall 1-year mean weight loss for those who underwent gastric bypass surgery was more than twice that of those who underwent adjustable gastric band surgery (48.6 versus 20 kg, $p < 0.001$). The weight loss up to 12 months after surgery is approximately double in adolescents who underwent gastric bypass surgery versus those who underwent adjustable gastric band surgery. The authors concluded that bariatric surgery could safely and substantially reduce weight and related co-morbidities in morbidly obese adolescents for over a year.

Conclusion

There is now conclusive evidence that bariatric surgery is safe and gives good short-term and mid-term results in adolescents. Lack of awareness of its availability and efficacy amongst healthcare professionals probably accounts for the slow uptake of this treatment modality. That it should be offered within a formal and tightly structured adolescent multidisciplinary team is universally accepted in all surveys of healthcare professionals. The identification and configuration of these services requires more work and will lead to both increased awareness amongst referrers as well as equal and more equitable access for those patients who would benefit from this service. ◆

FURTHER READING

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