Review Article

An evaluation of the bariatric surgical patient

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Obesity continues to be one of the most common prevalent chronic diseases worldwide with recent data stating that it has now reached global pandemic proportions making it a major public health problem. In 2008 the World Health Organisation (WHO) stated that worldwide around 1.4 billion adults were overweight (body mass index [BMI] 25.0-29.9 kg/m^2) and a further 500 million were obese (BMI ≥30 kg/m^2). Of note, the prevalence of obesity has tripled in Europe over the last 30 years with around 50% of the population in the majority of European countries being overweight or obese.[1-4] Locally, the situation is also alarming with data from the European Health Interview Survey (EHIS) in 2011 stating that Malta had the highest rate of obese males in Europe (24.7%) and when it comes to females, Maltese women were the second most obese after British women (21.1% and 23.9% respectively).[5] Even more worrisome is the fact that Malta also tops the charts for the highest prevalence of overweight and obesity in school-aged children thus accentuating the fact that urgent action needs to be taken in order to tackle effectively this world-wide epidemic.[6] Unfortunately obesity is strongly linked to several co-morbid conditions such as type 2 diabetes, hypertension, cardiovascular disease, dyslipidaemia, obstructive sleep apnoea, non-alcoholic steatohepatitis, osteoarthrosis, as well as some cancers (including breast, ovary, prostate, endometrium and colon) and psychiatric illnesses and thus it stands to reason that an increase in prevalence of obesity has also led to an increase in prevalence of these co-morbidities resulting in an impaired overall quality of life and decreased life expectancy in these subjects.[7-10]

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In view of the heavy burden obesity is posing on health-care systems worldwide, several medical and surgical societies have put forward guidelines on how one should best manage such patients.[11-16] Unfortunately, the non-surgical options available for the treatment of obesity (including dietary modification enhanced physical activity, behavioural modification and drug treatment) do not lead to sustained weight loss over the long-term. On the other hand, bariatric surgery is proving to be the only evidence-based method for inducing weight loss as well as resolving or improving major obesity-associated co-morbidites.[7-11,16] The Swedish Obese Subjects Study, (a prospective nonrandomized study involving at total of 4047 obese subjects) found that at 2- and 10- year follow-up both recovery and incidence rates of diabetes, hypertriglyceridemia and hyperuricemia were more favourable in the surgically treated group then in the control (medically treated) group. Moreover, at 10 year follow-up the surgically treated subjects exhibited greater weight loss, increased physical activity and lower energy intake then controls.[12,17] This same study also looked at overall mortality 10 years after bariatric surgery and demonstrated a hazard ratio of 0.71.[5,18] Furthermore, a recent paper from this ongoing study looked at the effects of bariatric surgery on cardiovascular events and found that over a median follow-up of 14.7 years surgically treated subjects had a reduced number of cardiovascular deaths and a decreased incidence of cardiovascular events (including myocardial infarction or stroke).[5, 19]

Thus, it is not surprising therefore, that the total number of bariatric surgery procedures performed worldwide is increasing, with nearly 350 thousand procedures performed globally in 2008.[20-22] Bariatric procedures have been traditionally classified according to their physiologic mechanism of action namely: restrictive (adjustable gastric band, sleeve gastrectomy and vertical banded gastroplasty) malabsorptive (biliopancreatic diversion and duodenal switch) and those that have both a restrictive and malabsorptive component (Roux-en-Y gastric bypass). Although bariatric surgery can be performed using both the open or laparoscopic approach, the latter modality is proving to be more popular with over 90% of bariatric surgeries being performed laparoscopically in 2008.[21-23] Of note, the procedure leading to greatest excess weight loss is the biliopancreatic diversion/duodenal switch (diversionary procedures) and the least is for banding procedures (purely restrictive).[9-10, 20]

Increased understanding of the multiple hormonal alterations which occur following different surgical approaches to obesity is providing new insight into the more plausible hormonal mechanisms responsible for the control of appetite and weight loss as well as improvement in glycemic control then the putative mechanical ones which inspired the different bariatric techniques.[24] Several studies have repeatedly confirmed that bariatric surgery is associated with better glycemic control then conventional (medical) therapy and that amelioration in carbohydrate metabolism frequently precedes weight loss and often occurs within days of the bariatric procedure. [25-28] It is now known that homeostatic alterations of certain gastrointestinal hormones - notably the incretin hormones glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypepide (GIP) are the main contributory factors towards the improvement in diabetes control following bariatric operations. The reason for this has been postulated to be the sustained increase in release of GLP-1 from the L-cells of the distal small intestine which occurs following procedures where nutrient flow bypasses the duodenum and proximal jejunum such as the Roux-en-Y gastric bypass. The incretin effects of GLP-1 include enhanced insulin release and islet cell mass and improved insulin sensitivity all of which promote normal plasma glucose, plasma insulin and glycated haemoglobin levels following surgery.[29] Furthermore, GLP-1 has also been implicated in the regulation of appetite such that it induces early satiety and thus reduces food intake. [29] Another important gut hormone implicated in appetite control is the orexigenic hormone ghrelin. Ghrelin is a peptide hormone which is secreted from the stomach and upper intestine in the pre-prandial phase and is suppressed rapidly following food ingestion. Studies have shown conflicting results with respect to plasma ghrelin levels following bariatric surgery with some stating there is a decreased, similar or even increased level 24 hours following gastric bypass surgery.[24] The reasons for such heterogeneity in these results remain yet to be elucidated, however, interestingly diabetic patients often exhibit reduced suppression of post-prandial ghrelin release which may delay the onset of satiety. Thus, the varied spectrum of altered baseline and postprandial gut hormone profile which occurs following certain bariatric procedures is currently under intense scrutiny with the aim being to search for novel medical or surgical treatment modalities for refractory morbid obesity.

Hence, in order to ensure the best possible surgical outcomes, the bariatric patient must be selected carefully and undergo a rigorous preoperative assessment to assess suitability for surgery. Currently the clinical guidelines endorsed by different societies (including British, Scottish, American and European guidelines) generally state that patients should be considered for bariatric surgery if they have a BMI ≥40 kg/m^2 or a BMI≥ 35 kg/m^2 with one or more obesity related co-morbidity which is expected to improve following surgically induced weight loss.[7-12] Recently there has also been some published data demonstrating the benefits of bariatric surgery in mild to moderate obese patients (BMI 30–34.9 kg/m^2) in terms of weight loss and cardiometabolic improvements. One randomised controlled study stated that subjects with mild to moderate obesity undergoing laparoscopic adjustable gastric banding had better outcomes with regards to weight loss and resolution of features of the metabolic syndrome then their non-surgically treated counterparts.[11, 31-33] This has led to the US Food and Drug Administration (FDA) to approve the use of laparoscopic banding in patients with mild to moderate obesity and an obesity-related co-morbidity.[11, 34] However, further well designed studies are needed with longer follow-up periods to further assess the long term risk/benefit ratio of surgery in this cohort of patients.[11]

Another area of interest is the age cut-off used by different bariatric programs. Although some authors state that advanced age (≥45 years) is associated with increased perioperative morbidity and mortality, in the Longitudinal Assessment of Bariatric Surgery (LABS) Consortium, age was not significantly associated with adverse outcomes.[30,35] Moreover in another study, elderly age (≥ 65) did not pose any limitations and led to sustained weight loss and improvement in quality of life with a negligible mortality rate and acceptable morbidity profile.[11, 13, 15, 36]

Prior to surgery, the potential candidate must have a comprehensive interdisciplinary assessment ideally involving a specialist bariatric physician and surgeon as well as a dietician, psychologist or psychiatrist and a social worker.[11-16] In the preoperative evaluation one should try to get a detailed medical, psychosocial and nutritional history.[11-12, 16, 21, 24] The medical history should include a weight history including previous attempts at weight loss and previous management strategies as well as a family history of obesity. One should also ask for any symptoms suggestive of co-morbidities such as a history of snoring or daytime somnolence for obstructive sleep apnoea or a history of shortness of breath or chest pain for cardiovascular disease and so forth. One should also consider asking for any symptoms that could suggest a secondary cause for obesity (such as symptoms relating to hypothyroidism, Cushing's syndrome or polycystic ovary syndrome [PCOS]) if indicated. Furthermore a nutritional history should be pursued including eating habits, the types of food eaten as well as triggers for eating and activity levels.[11] A detailed psychological evaluation is important as unidentified underlying psychiatric illnesses might interfere with giving informed consent and also might influence the type of bariatric surgery to be

performed.[21] It has been stated that patients with a strong-obsessive compulsive component would not be suitable for gastric banding as this procedure requires co-operation and self control on the part of the patient.[21] During this preoperative encounter, one is also able to assess the willingness and motivation of the patient and their potential to adhere to long term follow-up especially with regards to dietary recommendations and behavioural modifications that are required after surgery. [12, 16] At this point one can also evaluate the patients' expectations as well as the risks/benefits of surgery including discussion about the different procedures available and choice of surgical intervention, potential complications as well as perioperative mortality (table 1). The candidate should also be made aware of patient support groups and to enquire about support from family members. It is thought that patients who do not have long-term family support fare much worse than patients who have support from family members.[10, 16]

The physical examination should include weight and the BMI as well as a comprehensive systemic exam. One should look out for signs suggestive of a secondary cause of obesity such as features of Cushing's syndrome or hypothyroidism or signs suggestive of the presence of co-morbidities such as hypertension, cardiac failure, arthritis, evidence of diabetic retinopathy or neuropathy, acanthosis nigricans, eruptive xanthomata and so forth.

Laboratory investigations should be carried out as for any other major abdominal surgery, however, further tests should be directed according to the findings on history taking and physical examination. Thus one should screen the patient for the presence of co-morbidities including diabetes (fasting plasma glucose or $HBA1_C$), hyperlipidemia or non-alcoholic steatohepatitis (liver function tests and clotting studies). Hormonal evaluation should be carried out if one suspects a secondary (endocrine) cause for obesity (such as thyroid function tests, 24-hour urine free cortisol or androgens if suspecting PCOS). Nutrient screening including iron studies as well as folate, vitamin B_{12} and vitamin D levels should be obtained especially if the patient will undergo malabsorptive procedures.[11, 16] Baseline cardiopulmonary testing including a chest x-ray and an electrocardiogram should be undertaken with further investigations carried out as prompted by the history and physical exam.[11]

The most recent guidelines (issued by the American Association of Clinical Endocrinologists [ACCE], The Obesity Society [TOS] and the American Society for Metabolic and Bariatric Surgery [ASMBS]) go further to discuss the elements which will lead to 'medical clearance' for bariatric surgery. In it they discuss certain issues which could influence the outcome of surgery in the bariatric patient.[11]

Pre-operative weight loss has been debated over the past few years. Some studies have shown that 5% excess body weight loss is associated with beneficial short term outcomes including shorter operative times, reduced hospital stay and higher post-operative weight loss.[7, 11 37]

However one French study did not find any relationship between pre and postoperative weight loss, 48 months after surgery.[38] Some studies have also described that preoperative weight loss leads to a reduction in liver size as well as intrahepatic fat and abdominal wall depth facilitating operative technique. However, there is no conclusive evidence with regards to preoperative weight loss on long-term outcomes. On the other hand it has been thought that preoperative weight loss will help with improving and optimizing glycemic control preoperatively as well as promote patient compliance and better chance of diabetes remission in the postoperative period.[7, 11]

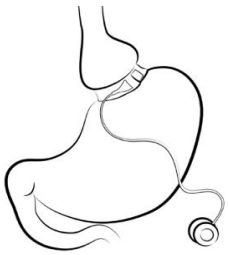
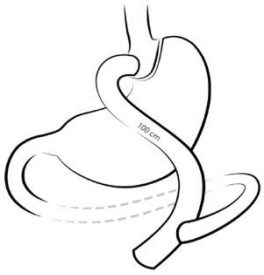
Another important aspect in patient preparation prior to surgery is evaluation of obstructive sleep apnoea (OSA). A significant number of patients may have undiagnosed sleep apnea, however a good medical history and physical examination should alert the clinician to screen for OSA with polysomnography studies and if positive further tests such as spirometry and echocardiography should be undertaken. Preoperative treatment entails using continuous positive airway pressure and postoperatively, the majority of patients experience resolution or improvement in their symptoms.[7, 10-11]

There have also been some studies regarding preoperative evaluation of the gastrointestinal tract. Some centres advocate routine screening with preoperative upper gastrointestinal (UGI) endoscopy in such patients.[7, 39] The rationale for this stems from the fact that following gastric bypass, evaluating of the UGI tract may be problematic. One study stated that significant pathological findings of the UGI tract were found in nearly 80% of patients but only 20% had reported symptoms.[40] In another study by UGI tract screening resulted in low yield for anatomical findings with UGI tract symptoms also not correlating with the endoscopic findings.[39] Preoperative *Helicobacter pylori* screening is also controversial with some authors reporting lower incidences of postoperative marginal ulcers and others saying such ulcers were related to surgical technique and not due to *H. pylori* exposure.[7, 11] Further randomised controlled studies are needed in this area, however endoscopic screening should be considered in high risk patients as it might alter surgical strategy.[11, 40]

Table 1: *Overview of the current bariatric procedures performed including a comparison of efficacy, complication and mortality rates.*

Adapted from L. Vu et al. Best Practice & Research Clinical Endocrinology & Metabolism, 2013; 27: 239-246.

[a] Weight loss is expressed in terms of excess body weight (EBW). EBW = current weight – expected body weight based on height and gender. Percentage excess weight loss (EWL) is calculated as (weight loss/excess weight) x100.

Type of bariatric surgical procedure	Adjustable Gastric Banding	Roux-en-Y Gastric Bypass	Sleeve Gastrectomy	Biliopancreatic Diversion and duodenal switch
Procedure	An inflatable silicon band is placed in the proximal portion of the stomach to create a pouch which can be adjusted to allow tailoring of the stoma outlet leading to decreased meal capacity and rate of emptying of pouch. 	The stomach is reduced to a gastric pouch of around 30mL in size which is then anastomosed to the distal jejunum via a *roux limb* of around 100cm. The remaining distal end of stomach and proximal small intestine are drained via a *bilipancreatic limb*. These 2 limbs eventually anastomose further down in the small intestine to create the roux-en-Y. 	Around 75% of the stomach is resected along the greater curvature with the open edges attached together using surgical staples. This creates a narrow gastric tube along the lesser curve limiting intake and also removing most of the ghrelin-producing cells of the gastric mucosa. 	The gastric reservoir is reduced by excising 75% of the stomach creating a gastric sleeve. The small intestine is then divided in two places – at the duodenum and ileum such that the proximal end of ileum is connected to proximal part of duodenum thus bypassing a significant amount of small bowel and the remaining distal end of duodenum is reconnected in the ileum. 
Effect on weight	Excess weight loss[a] at 5 years ranges between 45.4% - 48%. [8,10,21,23]	Excess weight loss[a] ranges between 60 – 70% 5 years after procedure. [8,10,21,23]	Excess weight loss[a] at 1-3 years post surgery is comparable to gastric bypass surgery and ranges between 55-66%.[10,21,23]	This procedure is associated with 70.1% excess weight loss [a] – the most effective operation at inducing weight loss.[10,23]
Effect on type 2 diabetes	Resolution of type 2 diabetes occurs in approximately 56% of patients 2 years after procedure.[9-10,21,23]	Diabetes remission occurs in around 80% of patients 2 years following surgery.[9-10,21,23]	Diabetes remission occurs in around 66% of patients.[21,23]	Diabetes resolution is highest with this procedure with remission rates of around 95% at 2 years.[10,23]
Complication and mortality rates	This procedure is considered to be the safest with literature data stating an operative mortality rate of between 0.05 to 0.1%. However, mechanical complications can arise at a rate of 11.6% including outlet obstruction, band slippage or band erosion requiring reoperation. [10,21,23]	Earliest complications include anastomotic or staple line leak (incidence rate 0.4 to 5.2%). Other complications include marginal ulcers, bowel obstruction, internal hernia dumping syndrome and roux limb ischemia. Late complications include nutrient deficiencies (vitamin B12, folate, iron). Operative mortality is low with reported rates up to 0.5%.[9-10,21,23,]	Early complications include bleeding and ischemia followed by postoperative gastroesophageal reflux. Nutritional deficiencies (including vitamin D, calcium and iron) occur with variable rates. Operative mortality is reported as being 0.33 ±1.6%. [21,23]	This procedure is associated with the highest rate of both early (operative) and long term complications such as anastomotic leaks and micronutrient deficiencies (including calcium and vitamin D deficiency) respectively. This procedure is also linked with the highest rate of perioperative mortality at a rate of 1.1%.[9-10,23]

As stated previously a thorough psychosocial–behavioural evaluation should be carried out especially if the patient has a previous history of psychiatric illness or substance abuse/ dependence. The European guidelines and several other authors state that uncontrolled psychiatric disorders as well as drug dependencies are specific contraindications for bariatric surgery as this may interfere with the consent process and may also impair the patients' adherence to post-operative follow up.[7, 9-10, 16, 21] The Scottish guidelines on the other hand state that such disorders should not be considered as absolute contraindications.[13] Thus, constant psychological support should be available both preoperatively as well as in the postoperative phase for such patients.

Another important issue is monitoring for micronutrient and vitamin deficiencies. The majority of obese patients are known to be deficient in vitamin D [7, 41] as well as vitamin A [42] and some other micronutrients such as ferritin and iron (more so in women).[7, 42] Appropriate preoperative measurements especially if the patient will undergo extensive malabsorptive procedures are prudent and micronutrient or multivitamin supplementation should be provided where necessary.[7, 11,13]

Finally, the choice of surgical procedure must be made jointly by the patient and the bariatric surgeon, taking into account all the above factors as well as the experience of the surgeon and the facilities and equipment available. [7, 11-12, 16]

As one can see bariatric surgery in the carefully selected obese patient, remains superior to any other nonsurgical forms of treatment for weight loss and improvement in surrogate markers of metabolic disease. However, further properly designed randomised controlled studies are needed to assess long-term benefits and durability of such outcomes.

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