Best Practice & Research Clinical Gastroenterology 28 (2014) 159–173

Contents lists available at ScienceDirect

Best Practice & Research Clinical Gastroenterology

13

Laparoscopy for primary and secondary bariatric procedures

Matthias Lannoo, MD, PhD student [a,*], Bruno Dillemans, MD [b,1]

[a] Department of Abdominal Surgery, University Hospitals, Leuven, Belgium
[b] Department of Abdominal Surgery, AZ Sint Jan, Bruges, Belgium

Keywords:
Obesity
Bariatric surgery
Gastric bypass
Sleeve gastrectomy
Gastric banding
Gastroplasty
Surgical technique
Revisional
Complication

A B S T R A C T

Recently obesity has been defined as a disease and has turned bariatric surgery into a part of a chronic illness management. Obesity induces several comorbidities leading to cardiovascular disease and mortality. The effects of bariatric surgery on these comorbidities used to be classified as weight-loss induced. However bariatric surgery has recently been termed metabolic surgery because of the suspected direct, weight loss independent effect of bariatric procedures on the physiopathological mechanisms causing excess fat storage and insulin resistance. This review describes the standard procedures commonly performed and their specific outcomes on metabolic diseases in order to work towards more patient tailored treatment of obesity and to reduce side effects. Furthermore this review focuses on gaps in understanding the pathogenesis of obesity and its treatment with bariatric surgery. Surgery failures as well as new techniques are discussed and evaluated.

Introduction

At its 2013 Annual Meeting the American Medical Association (AMA) has finally conceded that 'obesity has to be classified as a disease'. It is a genetic disease whose phenotype is completely dependent on the presence of an easy accessible, abundant quantity of food. In some cases a second hit

* Corresponding author. Tel.: +32 16 34 42 65.
E-mail addresses: Matthias.lannoo@uzleuven.be (M. Lannoo), bruno.Dillemans@azsintjan.be (B. Dillemans).
[1] Tel.: +32 50 45 25 60.

1521-6918/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.bpg.2013.11.013

trigger in the form of a live event is necessary [1]. This trigger can already occur in foetal life with child obesity as a consequence [2]. Apart from a number of monogenetic syndromes, knowledge of the causal genetic defects is very limited due to the large number of genes simultaneously involved together with an even larger partition of epigenetic phenomena [3].

The most obvious characteristics of the phenotype are the overall presence of large fat deposits as a result of a hyperplasia and hypertrophy of fat cells storing a large quantity of free fatty acids. In many patients this condition results in the development of the 'metabolic syndrome' with hypertension, type 2 diabetes dyslipidemia, gastro-oesophageal reflux disease, steatohepatitis and, finally, end-stage cardiovascular disease and early death.

These fat deposits are specialized in self-preservation through neuronal and hormonal mechanisms altering food intake, food processing and usage of the energy delivered. Food intake is controlled by two complementary regulation systems, the homeostatic system adapting energy delivery to energy needs and the hedonic system controlling rewarding mechanisms related to food consumption. The homeostatic system modulates insulin sensitivity, beta cell function basal metabolism, heat production, food thermogenesis. Fasting can modulate the hedonic system [4].

These new insights in the pathogenesis of obesity as well as the development of the laparoscopic approach has been changing bariatric surgery in several ways:

- Nearly complete shift from open to laparoscopic approach.
- Increase in the more physiological procedures at the cost of the more mechanic restrictive procedures.
- The choice of type of procedure is less a matter of the patient or dependent on the surgeon's expertise but more for the multidisciplinary team, based on the comorbidities and psychosocial state of the individual patient.
- Surgery is no longer a stand alone procedure but a therapeutic module in a multidisciplinary chronic illness management model for the treatment of obesity.

Laparoscopy has rendered open bariatric surgery obsolete

As no other sub discipline in abdominal surgery, bariatric surgery worldwide has implemented laparoscopy on a vast scale. Currently bariatric surgery is by laparoscopy in more than 90% usage of cases. This is because of the added value for both the patient and the surgeon [5].

For the patient laparoscopy reduced operative time, postoperative pain and duration of immobility. These are all determining factors for pulmonary complications such as atelectasis, pneumonia and lung embolism. For the surgeon laparoscopy offers better exposure which facilitates the creation of an optimal gastric pouch, the placement of a band or sleeve resection. This is especially important in patients with extreme obesity [6]. Buchwald et al reported lower mortality in the laparoscopic approach, reduced incidence of wound complications and incisional hernias and conclude laparoscopy is the preferred approach [7].

Technique of most common procedures

Laparoscopic gastric banding

Currently given the lower rates of band erosion with the pars flaccida technique, in which the band is placed around the mesentery of the smaller curvature of the stomach, is uniquely implemented. A point just lateral of the angle of Hiss is identified and the peritoneum is opened and this will be the endpoint of the retrogastric dissection. This dissection starts through the pars flaccida component over the lowermost aspect of the right crus of the diaphragm where the peritoneum is opened. The dissection continues anterior of both crus to arrive on the greater curvature aspect of the stomach at the site of prior dissection at the angle of Hiss. The band, after is brought intra-abdominal through a 12 mm trocar, is grasped and drawn behind the stomach with the grasper at the end of the tubing and closed. The tubing is brought outside and the port-a-cath is fixed on the fascia in the left upper quadrant of the abdomen [8].

Laparoscopic Roux en Y gastric bypass (RYGB) (Fig. 1)

Various techniques of laparoscopic RYGB have been described. In general the procedure consists of partitioning the stomach with surgical stapling devices in order to create a small gastric pouch. The pouch is then connected with a loop of small bowel that has been transected below Treitz at a point where the maximal mesentery length is present. The small bowel limb is measured from the pouch anastomosis on to between one and two meter more distally and reconstructed in a Roux-en-Y fashion to restore continuity [9].

Some technical key-steps have been the subject of extensive discussion and are still performed variably worldwide. These debates focus on:

- Construction of the gastro-jejunostomy (hand sewn, linear or circular stapled).
- Length of the alimentary limb.
- Construction and closure of the jejuno-jejunostomy.
- Closure versus non-closure of the mesenteric defects.

Construction of the gastro-jejunostomy

A variety of surgical techniques have been developed to construct the gastrojejunostomy: the circular-stapled anastomosis, the linear-stapled anastomosis and the totally hand-sewn anastomosis.

In the circular technique the anastomosis is performed with a circular stapler with a diameter of 25 mm. The anvil of the circular stapler can be introduced either trans abdominally or trans orally.

In the linear stapled gastrojejunostomy, an enterotomy is made at the posterior side of the gastric pouch and one in the jejunum that has been pulled up. A 45 mm linear stapler is then introduced with the anvil in the stomach and the cartridge in the jejunum to perform the anastomosis. The common enterotomy is then closed with a resorbable suture.

The hand-sewn anastomosis is usually performed in a one-layer fashion with two resorbable running sutures.

Strictures at the gastro-jejunostomy, leading to vomiting, dysphagia, nausea, solid food intolerance, or even severe dehydration, are a well-known complication following RYGB. Generally hyperemesis is

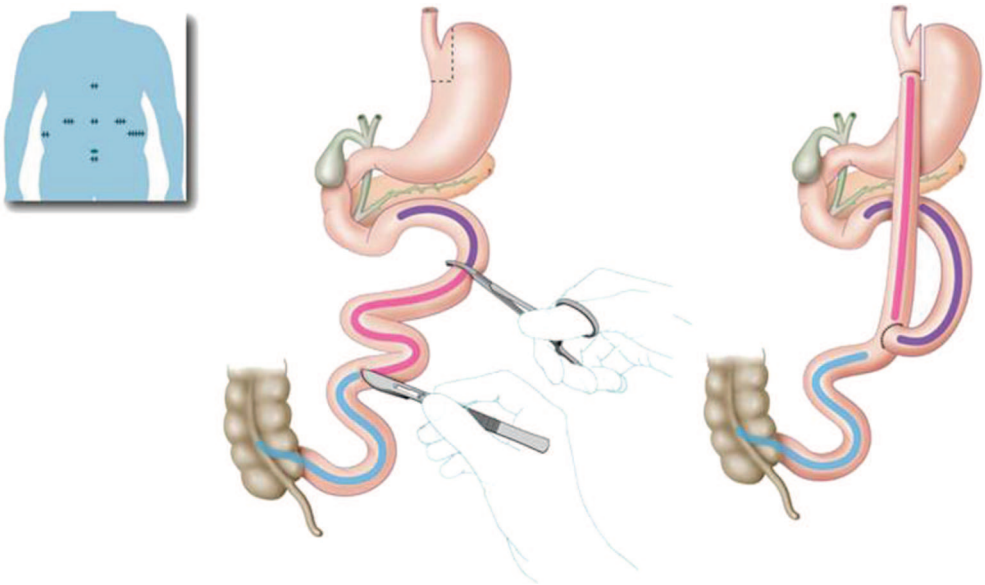

Fig. 1. Gastric bypass.

not observed in patients with an RYGB, in contrast to the patients with an AGB. Different stricture rates have been described for the three techniques but most in the circular technique [10].

The alimentary limb is pulled over the transverse colon (antecolic). The results of this study of 754 patients have shown that the use of the retrocolic technique is a risk factor for internal herniation after LRYGB through the mesenterial breach of the transverse colon along with the alimentary limb [11].

Length of the alimentary limb

RYGB performed with at least a 150 cm Roux limb results in significantly greater weight loss than shorter (<100 cm) Roux limb procedures in super-obese patients (BMI ≥50 kg/m^2). Conversely, longer Roux limb procedures do not provide greater weight loss in less obese (BMI <50 kg/m^2) patients. Modest elongation of the Roux limb in the range of 150–200 cm does not result in more frequent nutritional seuelae compared with shorter Roux limb procedures. Conversely, RYGBs, in which the Roux or the biliopancreatic limb is very long, with anastomosis to the mid or distal ileum (very, very long), usually results in more metabolic problems than RYGBs in which the Roux limb measures up to 150 cm and the biliopancreatic limb is short [12].

Construction and closure of the jejuno-jejunostomy

Many surgeons utilize a single stapling technique and subsequently close the enterotomy with a running suture. Others utilize a double or even a triple stapling technique to anastomose and close the small bowel [13].

Closure versus non-closure of the mesenteric defects

There are three sites where an internal hernia after RYGB may occur:

1. Through the transverse mesocolon defect (only in the retrocolic technique)
2. Through the entero-enterostomy mesenteric defect;
3. Through the space between the mesentery of the Roux limb and transverse mesocolon (Petersen's space).

The increased incidence of internal hernia after LRYGB has been primarily attributed to the reduced formation of postoperative adhesions following laparoscopy. Even though accurate closure of all mesenteric defects does not avoid this complication, closure is recommended because it resulted in a reduced incidence of internal hernias in several studies [14].

Sleeve gastrectomy (Fig. 2)

Sleeve gastrectomy (SG) involves a longitudinal resection of the greater curvature of the stomach starting halfway between the pylorus and a point, at the end of the nerve of Latarjet, up to the angle of His [15]. This longitudinal gastrectomy 'sleeves' the stomach to reduce it to a narrow tube and eliminates the gastric fundus, the dilating part of the stomach. A naso-gastric tube (bougie) is used to avoid stenosis of the gastroplasty. Dissection at the angle of His is critical to avoid stapling on oesophageal tissue because a leak will occur. There now seems some agreement over the use of a 32–36 Fr tube, which should be positioned along the smaller curvature. It looks more attractive to resect only a small piece of the antrum to balance between the regulation of gastric emptying and to diminish the risk of narrowing the sleeve at the incisura angularis and minimizing the chance on weight regain in the long term through dilatation of the antrum [16].

Air insufflation and/or methylene blue instillation has been proposed to control staple line integrity during the surgery. A gastrografin swallow in the early postoperative phase is highly advisable.

What operation for which patient?

The guidelines of the NIH of 1991 are still valid [17]. In order to benefit from a bariatric procedure, patients selected should be morbidly obese with a BMI of at least 35 kg/m^2 in the presence of obesity

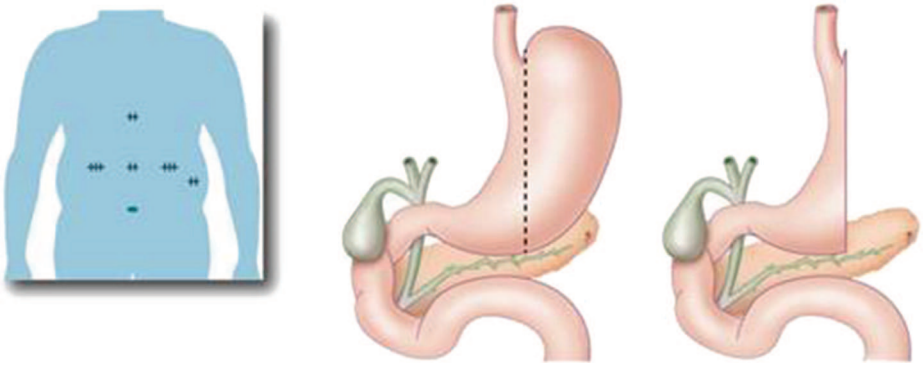

Fig. 2. Sleeve gastrectomy.

related comorbidities and 40 kg/m^2 if not. The last decade has witnessed a reduction in morbidity and mortality thanks to the introduction of laparoscopy, an increasing number certified high-volume centers and improved surgical and anaesthesiology techniques. Recently some have suggested a lowering of the indicated BMI threshold certainly for patients with type 2 diabetes, who benefit the most. Some scientific data already support this suggestion but at the moment the available data do not suffice to change guidelines for general practice [18].

As already mentioned, an increasing number of multidisciplinary teams aim at a patient-tailored approach to treat obesity. A complete work-up of the morbidly obese patients' medical-, psychological- and socioeconomic status in combination with the current knowledge of mechanisms and outcomes of the different surgical procedures will improve healthcare for these patients.

Young patients without comorbidities

For young patients without comorbidities, achieving profound weight loss, which has to be maintained for almost half a century to prevent metabolic syndrome, is the main therapeutic goal. In this population, bariatric surgery is also indicated. However it is unacceptable to induce pathological conditions on the long term in consequence of a bariatric procedure.

In the past, when LAGB was more popular, it was tempting to perform this procedure in young patients because of the reversibility and the low surgical mortality [19]. However, adult obesity is getting worse with age so that reversibility is a non-issue in the context of surgery for a chronic disease with a high risk of life-threatening complications [20].

Although the mortality rate of LAGB is only 0.1%, which is the lowest of all bariatric procedures, it is still too high if durability of the procedure is not sufficiently guaranteed. Most studies of LAGB have indeed reported long-term results that are not acceptable. Two of the most cited reports, Buchwald's systematic review and the SOS study, claim superiority for RYGB and BPD concerning weight loss both on the short and long term and for the lowest surgical re-intervention rate. The Cochrane review of 2009 identified the RCT between LAGB and RYGB of Angrisani and colleagues as minimally biased and they reported recently the ten-year results of this group of patients. EWL% was higher for RYGB with 76.2% versus 46.2% for the LAGB at a cost of a higher early complication rate 8.3% versus 0% and potentially lethal late complication rate of 4.7% [21]. Patients with LAGB have a high risk of developing GERD and motility disorders of the oesophagus, which may require removal of the LAGB and a revisional procedure [22]. Therefore RYGB seems to be the procedure of choice. Nevertheless young patients especially merit a critical evaluation of the side effects after RYGB that are more likely to appear over time, such as GERD, cancer, osteoporosis and dumping.

GERD

Generally it now becomes clear that it is important to investigate the patient with preoperative GERD symptoms on the presence of a hiatal hernia (HH). If present it is strongly advised to perform

RYGB. If this procedure is chosen, the acid reflux is completely resolved. Opposite to LAGB and SG were approximately one third of the patients will experience an increase of their symptoms. In case of the presence of low grades of oesophagitis SG can be carried out under PPI protection for at least one year.

Osteoporosis

Another obviously important issue in young patients is the impact of bariatric surgery on bone density. Bone mass is built up until the age of 26 in women. All procedures in bariatric surgery cause an initial bone loss requiring postoperative compensation with vitamin D and Calcium. Knowing that calcium absorption mainly happens (in the duodenum) some have been advocating a mandatory preoperative evaluation and avoidance of duodenum bypassing in case of preexisting deficiencies.

Stomach and esophageal cancer

Cancer of the stomach has been a concern in patients with RYGB for a number of years. However, although in recent years millions of people have had an RYGB, only a few cases of stomach cancer have been described [23]. There is no doubt that an upper GI endoscopy with biopsy for *Helicobacter pylori* (HP) is mandatory in the preoperative work up for bariatric surgery. At least in case of RYGB, HP should be eradicated before initiating the procedure. On upper GI endoscopy it is important to look for Barrett's disease, which is frequent in morbidly obese patients. If Barrett's is present, a biopsy is necessary to assess if dysplasia is present. If this is the case, bariatric surgery should be postponed until endoscopic treatment has been confirmed to be successful. SG is not indicated when the upper GI endoscopy reveal a high grade oesophagitis with or without Barrett, because SG requires resection of the fundus, necessary for the reconstruction after an esophagectomy [24].

Dumping and hypoglycemia

Dumping may occur after surgery to the stomach more particularly after ingestion of mainly simple carbohydrates. To a lesser extent it may also occur after fatty food and low calorie food with a beverage, or with a beverage less than half an hour after the meal. Early dumping occurs immediately after a meal and symptoms are dizziness, nausea, diarrhoea, abdominal cramping pain and angina-like pain. Late dumping occurs two hours after a meal causing hypoglycemia with neuroglycopenia symptoms. These symptoms are induced by osmotic large-fluid shift to the small intestine with consequent vasomotor reactions and by an excessive incretin response with disproportional insulin secretion, respectively. Dumping can be avoided if the patient adheres to a sugar-free and fat-free diet. Moreover, a very regular eating pattern and avoidance of alcohol are mandatory to avoid hypoglycemic events [25]. Especially binge drinking can cause a lethal combination of late dumping hypoglycemia and an alcohol-blocked glucagon response to hypoglycemia. In general a more chaotic and more intense lifestyle is the privilege of the younger and is less compatible with the gastric bypass.

Overall, Overall, SG is becoming the procedure of choice as it seems metabolic more active than AGB and has a better adverse events profile, regarding dumping frequency and vitamin deficiencies. Later on in life it allows a retailoring when weight regain appears and patient-specific situation has changed towards RYGB or BPD-DS.

Patients with obesity-related comorbidities

Hypertension

Hypertension, as one of the important determinants of the metabolic syndrome, is more frequent in obese patients, with a strong negative impact on cardiovascular mortality [26]. Buchwald et al reported a 60% resolution rate of hypertension two years postoperatively, with a significant superiority of RYGB over LAGB [27]. Even in the Swedish Obese Subjects (SOS) study a long-term (ten years) difference was observed in the frequency of hypertension in operated obese patients versus obese controls, notwithstanding the long-term increase in hypertension prevalence irrespective of weight changes [28]. However, in the latter study most patients underwent a restrictive operation, vertical banded gastroplasty.

Some authors also evaluated the effect of RYGB on hypertension as early as one week post-operatively and already noticed a reduction in BP, Some authors also evaluated the effect of RYGB on

hypertension as early as one week postoperatively and already noticed a reduction in BP, suggesting specific weight loss independent hormonal mechanism of RYGB [29]. Finally, patients with complete resolution have a shorter duration of disease as compared to patients without resolution (53 versus 95 months, respectively, $p = 0.01$) [30].

The correlation between weight loss and improvement of hypertension explains the fairly positive results after AGB, described by Brancantisano et al prospectively in 838 consecutive morbidly obese patients with a median follow-up of 13 months (range 6–36 months). Resolution and/or improvement of hypertension have been noted in 67% of the patients [31].

Nevertheless, it should be noted that we have to keep in mind the long-term results of AGB described by Himpens et al are not in favour of being a durable therapy for morbid obesity [32]. In general the side-effects of BPD are a contraindication to treat stand-alone hypertension, given the better-proven effect of RYGB on this comorbidity.

Obstructive sleep apnoea

Obesity is one of the key risk factors for sleep apnoea. In severe obesity (BMI >40 kg/m^2), the prevalence of sleep apnoea was estimated to vary between 40 and 90%, and the severity of sleep apnoea was generally greater than that found in leaner clinical populations. [33].

Nasal continuous positive airway pressure (CPAP) is the primary form of treatment for OSA. Excessive daytime sleepiness is reversed, and the cardiopulmonary sequelae are eliminated with nasal CPAP [34].

Patients with symptoms of OSA should undergo polysomnography. Patients with severe OSA should be treated with a CPAP mask six weeks prior to surgery. Postoperative CPAP/BiPAP should be omitted in laparoscopic RYGB patients with known OSA, provided they are observed in a monitored setting and their pulmonary status is optimized by aggressive incentive spirometry and early ambulation [35].

Weight loss is a highly effective strategy for treating OSA. In consequence according to the meta-analysis of 22,094 patients who underwent bariatric surgery, Buchwald et al clearly demonstrated dramatic improvement in the vast majority of patients after surgery, with reductions in AHI of 33.9 episodes/hour and OSA resolution in 85.7% of patients [27]. Varela et al compared the Epworth Sleepiness Scale (ESS) scores and the number of patients requiring the use of CPAP therapy preoperatively and at three-month intervals in 56 morbidly obese patients with documented sleep apnoea by polysomnography that have been scheduled to undergo RYGB. The mean ESS score decreased significant and maintained below the threshold level of seven, considered as normal, for the entire 12 months of follow-up and. Only 14% of patients still required CPAP at three months postoperatively and none required CPAP at nine months [36].

In contrast, the results of OSA resolution after gastric banding are far less positive. Only Dixon et al reported a 100% improvement after one year in patients with an AGB, but this was only based on an unvalidated clinical assessment [37]. In a meta-analysis of all studies reporting on AGB and sleep apnoea the mean resolution or improvement rate is not higher than two thirds of the patients in comparison with gastric bypass of more than 75%. Recently a new meta-analysis has studied the effect of bariatric surgery on OSA and found that sleeve gastrectomy together with BPD has a better effect (more than 87%) than RYGB and gastric banding [38].

Dyslipidemia

Dyslipidemia results in an increased risk of cardiovascular disease.

The meta-analysis of Buchwald confirmed that effective weight loss obtained by bariatric surgery in morbidly obese subjects leads to an improvement of hyperlipidaemia in more than 70% of patients [27]. In the SOS study, bariatric surgery induced improvement of hypertriglyceridaemia and low HDL cholesterol levels, but not of hypercholesterolaemia, in comparison with conventional therapy [39].

The largest RYGB series with the longest FU, shows a decreased prevalence of hypercholesterolaemia, hypertriglyceridaemia and low HDL from 41.6% to 15.2%, from 45.2% to 4.4% and from 65.8% to 28.9%, respectively [40].

It can be stated the procedures that bypass a part of the small intestine have a superior impact on dyslipidaemias. Ten years after RYGB, subjects in the SOS study have greater improvements in

triglycerides (28.0% versus 18.0% decrease), total cholesterol (12.6% versus 5.0% decrease), and HDL levels (47.5% versus 20.4% increase) than those who had AGB [39].

In a larger series of 709 patients who had undergone AGB, 34% presented with elevated triglyceride levels. By 12 months after surgery, only 9% had elevated levels. Eighteen percent presented with low HDL-cholesterol levels and by 12 months only 5% had low levels [41].

Without any doubt BPD is superior to treat dyslipidemias. Scopinaro had remarkable results on 312 obese patients with type 2 diabetes who had undergone BPD. The percentage of hypertriglyceridaemic patients showed a progressive decrease, reaching 1% at five and ten years. In all subjects the serum total cholesterol level was in the normal range at the second year and at all subsequent follow-up times. All subjects were free of medication and on totally free diet. The normalization of serum total cholesterol at long term following BPD is accompanied by a rise of HDL cholesterol [42].

Given the side-effects of BPD and the availability of lipid lowering medication, RYGB is the preferred procedure in patients with dyslipidaemia.

Type 2 diabetes

Already in the early 1990s Walter Pories stated that type 2 diabetes in the morbidly obese patient is a surgical disease [43]. To date, there is growing evidence that surgery can effectively drive type 2 diabetes into remission and results in a clear survival benefit [44, 45]. This surgically induced diabetes resolution is not only the result of weight loss or caloric restriction but also of certain direct mechanisms on the physiopathology of deficient glucose metabolism.

In the Buchwald meta-analysis, complete resolution of diabetes occurred in 76.8% and resolved or improved in 86% of the patients after bariatric surgery. Complete resolution of diabetes was demonstrated in 83.7% of the patients after RYGB and in 98.9% of the patients after BPD. This effect is maintained over the long-term and is independent of weight loss [27]. The same author conducted a comprehensive review of all studies published in the literature containing data on weight loss and type 2 diabetes-related outcomes for patients treated with any form of bariatric surgery. Diabetic patients had an overall 78.1% resolution of their clinical manifestations of diabetes, and diabetes was improved or resolved in 86.6%. Diabetes resolution was greatest for patients undergoing BPD/DS (95.1% resolved), followed by RYGB (80.3%), gastroplasty (79.7%), and then laparoscopic AGB (56.7%). The proportion of patients with diabetes resolution or improvement was fairly constant at time points less than two years and two years or more [46]. One study suggested that insulin sensitivity improved in proportion to weight loss with the use of predominantly restrictive procedures but was completely reversed by predominantly malabsorptive approaches long before normalization of body weight [47].

Recently two randomised studies compared the effect on type 2 diabetes of RYGB vs SG vs medical therapy and RYGB vs BPD, respectively. Overall the conclusion is supremacy of every surgical procedure over medical therapy in achieving a normal % HbA1c with lesser medication and no significant difference between the different procedures [48,49].

Proposed mechanisms of action are multiple these days. Certain is that there is more than only weight loss and caloric restriction. The most accepted mechanism is that of the enhanced incretin secretion postprandially. Glucagon-like peptide-1 (GLP-1) is secreted by the L-cells, which are primarily located in the distal ileum and colon. It is the most important incretin hormone involved. In response to a mixed meal it induces satiety and insulin secretion. Since after RYGB and BPD/DS the L-cells are stimulated earlier, GLP-1 production and consequent insulin secretion could be enhanced [50]. A long time duodenal exclusion has been supposed to be necessary for this effect. Recently according to the comparable effect of sleeve gastrectomy on gut hormones and similar clinical effect on type 2 diabetes this procedures gains popularity [51]. It is becoming increasingly apparent that incretins are not the only important mechanism and many others are under investigation: microbiome alteration, intestinal gluconeogenis and glucoseconsumption lipid and bile acid metabolism changes, adipokines and likely others [52,53].

Given that weight loss and caloric restriction are not considered to be the only causal mechanism, the question arises if obese patients (BMI$<$35 kg/m^2) with poorly controlled type 2 diabetes, despite maximal medical care, should not be taken into account for surgery. Even the International Diabetes Federation suggests bariatric surgery as an option in this population. It also becomes apparent that the

longer diabetes is present before surgery the smaller the chances of a complete remission of the disease. Therefore, some advocates propose surgery at an early stage. However, this extension of indications to include these patients for surgery remains under discussion and should not be taken as common practice [18].

Patients with specific not obesity related comorbidities

We here list all patients with specific comorbidity with the author's preferable procedure. Often SG is proposed because, if obesity-related comorbidities worsen, a revisional procedure can still be considered.

- Crohn's disease: SG in order to preserve small bowel.
- Transplant patients: SG to maximize drug absorption.
- Patients with type 1 diabetes: SG in order to minimize unpredictable malabsorption and consequently inadequate insulin doses.
- End stage renal insufficiency and dialysis patients: SG to facilitate peritoneal dialysis and in anticipation of a transplantation.
- Grade C &D oesophagitis: RYGB to prevent worsening
- Alcoholism and serious mental illness: SG for the lower rates of deficiencies and dumping and hypoglycemia with neuroglycopenia [54].
- ASA 4- patient due to uncontrollable cardiovascular and pulmonary disease
- BMI >60 kg/m^2

Elderly (+55 y) with or without comorbidities

In this group of patients it is difficult to diminish the loss of years-of-life. The main focus here is improving quality of life. It should be noted that the mortality is at least double that of the younger population. In consequence, less invasive operations have long been proposed for these patients such as laparoscopic gastric banding. However, since it has been shown that results in this population are much better after an RYGB, AGB is not indicated anymore [55].

With more and more evidence of SG having similar effects as RYGB, and because it results in less severe vitamin deficiencies, it is increasingly implemented in the care for the morbidly obese elderly [56].

New procedures

Banded gastric bypass

The technique starts with a standard gastric bypass but at the end of the procedure an additional banding is added 1 cm above the gastroenterostomy. Banding of this anastomosis is a proposed answer to the problem of some poor long-term gastric bypass results. Reports have claimed that up to 20% of the patients have insufficient weight loss or regain too much weight, with or without relapse of comorbidities. The main mechanisms would be dilatation of the anastomosis and the proximal alimentary limb allowing patients to increase meal size too much. A rigid silicone band with a fixed diameter of mostly 6.5 cm as well as a classic adjustable gastric band has been used. In their series, with a sufficient number of patients and a long FU, Bessler et al have described the percentage of EWL after banding of the GE anastomosis of a gastric bypass can reach up to a mean of 30% [57].

Banded gastric bypass is thus gaining ground in clinical practice, with upfront banding of the GE anastomosis being performed in all patients to prevent dilation of the GE anastomosis and subsequent weight regain. However, in the authors' opinion too this evolution is premature.

- First it still needs to be confirmed that the anti-diabetic effect of the gastric bypass construction is not neutralized due to the reduced speed at which food is delivered to the proximal intestine.

- After banded gastric bypass adverse effects such as band erosion and dysphagia have been reported. The health benefit for the whole population of patients who underwent banded gastric bypass still needs to be investigated, They are all exposed to these adverse effects and the percentage of them who really need it to prevent weight regain may be as low as 20%. May be for the patients who benefit from a band and a bypass, only gastric banding could be sufficient, avoiding the adverse effects from the gastric bypass. Patient selection will be important.

Given the high complication rate known from the AGB series, banded gastric bypass should not yet be included in the standard armamentarium of the bariatric surgeon.

Gastric plication

This technique consists of devascularisation of the greater curvature of the stomach and a double layer of sutures to invert the whole fundus and corpus of the stomach. Probably this wrapping of the stomach prevents food from contact with the fundus of the stomach, thus inhibiting normal ghrelin level pattern. On the other hand, faster gastric emptying is possibly obtained with a sleeve and RYGB-like effect.

The only advantage of plication over sleeve gastrectomy is the lack of cost of stapling material. Complications can be severe, for example gastric necrosis and subsequent leakage or dysphagia. The results reported to date are far from convincing [58].

The Mini gastric bypass/loop bypass

The Mini gastric bypass has already been performed for 15 years. The technique is not expected to gain importance because its so-called advantages are not so convincing. The only anastomosis made is a side-to-end gastrojejunostomy. This is claimed to be easy and safe but it is the most difficult anastomosis of a classic RYGB. When leakage occurs, a large amount of bile from the two meters-length afferent limb is spilled in the abdomen causing the most severe peritonitis. The stapler line of the pouch is longer than in RYGB and more prone to leakage.

A biliary limb of two meters length causing lipases to be inactive before they mix with food can induce malabsorption and diarrhoea. Finally analogous with the Bilroth II gastrectomy, there is some concern that stomach stump adenocarcinoma can develop after decades. Moreover it is impossible to eradicate HP lifelong.

Hence we cannot advise this procedure to be used in daily practice [59].

Patient with a failed bariatric operation

Two types of failures can be distinguished in bariatric surgery: technical failures versus functional ones. The latter can be divided in loss of therapeutic effect or the development of unacceptable side effect(s). Often the two types of failure co-occur. On the one hand technical failure causing weight regain. On the other hand the presence of important side effects can be so prominent that the patient becomes dysfunctional in daily life. Surgical intervention may then be necessary. These cases clearly demonstrate we have to keep in mind that obesity is a chronic disease. The surgical procedure should thus not only focus on the resolution of the side-effects but also on the prevention of weight regain postoperatively. In what follows, a non-exhaustive list of failures in bariatric surgery and their possible solution will be discussed.

Patient with a Mason gastroplasty

Mason gastroplasty has no longer been performed in the last decade because it is an open restrictive procedure. The gastric banding has become the preferred restrictive operation, thanks to its reversible character and its adjustability of the outlet diameter.

Nevertheless, an increasing number of patients with a Mason/Mclean gastroplasty experiencing a technical failure as dysphagia due to stenosis of the outlet or stapler line dehiscence. In case of a stenosis, the best repair option is a revisional gastric bypass instead of a pouchogastrostomy to avoid massive GERD and weight regain. In case of stapler line dehiscence without evidence for GERD and weight regain and absence of important comorbidities, a wait-and-see policy is preferable. So, a technically or functionally failed Mason gastroplasty can be safely converted into a RYGB [60].

When performing the pouch of the revisional gastric bypass it is important to resect the outlet ring and the old stapler lines. Old stapler lines should never be crossed with the new one. Anyway leakage rate and other comorbidities will always be higher in this population and an expertise in bariatric surgery is essential and laparoscopic approach will be feasible in this setting [60,61].

Patient with a gastric banding

Pure technical failure failures are leakage or infection of the band or port system. In case of an optimal result without any side-effect at the level of the oesophagus, band or port replacement is the best option. This option is also acceptable for band slippage without band erosion and for when a perigastrique technique was used. Band replacement can be carried out in a second procedure with a pars flaccida technique.

Emptying the band can treat functional failures due to GERD and pseudo achalasia. Nevertheless, at some point, weight regain will occur and necessitate conversion to RYGB. Therefore a one-step procedure is preferred.

Weight regain or (re-) appearance of comorbidities is often due to the intake of high caloric soft food, termed the 'sweet eating syndrome'. This is the most frequent complication of LAGB and requires a revisional one-step gastric bypass.

Only in case of massive pouch dilatation is prior removal of the AGB necessary and a revisional RYGB after 6 weeks [62].

Although technically more demanding, RYGB after an AGB will not have a higher mortality, leakage rate or a longer hospital stay. Results of RYGB after AGB are similar to primary RYGB if attention is paid to the construction of a narrow pouch.

Conversion to GS should be avoided because of higher chance on leakage. Moreover it is relatively contraindicated in the case of sweet eating syndrome, GERD, pseudoachalasia [63].

Patient with a SG

Patients with a BMI above 55-60 should always have a SG first and a revisional BPD-DS or RYGB after a significant weight loss. Some patients have sufficient weight loss and resolution of comorbidities after this procedure and a wait and see policy is advised. The choice for BPD-DS or RYGB as a secondary procedure after SG depends on the patient's acceptance of side effects such as odorous and frequent stools and on the doctor's expectations as to compliance to follow-up schemes, intake of supplements and a low fat, low sugar and high protein diet.

Patients with a lower BMI that underwent an SG as a primary and definite procedure can experience weight regain or recurrence or worsening of comorbidities. BPD-DS will be the most effective solution. However, the above-mentioned reflections should be made and most often a RYGB is performed.

Patients with too much restriction after SG and underweight or therapy resistant GERD should undergo a revisional RYGB [62].

Patients with a BPD

The most frequently presented complication after BPD is nutritional deficiencies. The most common are fat-soluble vitamins (A, D, E, K) and proteins due to extreme fat mal-absorption. Some patients present were repulsed by the frequent odorous stool evacuations. Lengthening of common limb is the procedure to solve this problem with one entero–entero anastomosis. The alimentary limb is transected at the conjunction with the biliary limb and anastomosed side-to-side at a point two meters retrograde on the biliary limb. This is the preferred procedure if the patient is underweight [64]. In case

of weight regain or insufficient weight loss it will be necessary to reduce the stomach volume to the size of a typical RYGB pouch or a primary SG after BPD-DS with a width sleeve. Only reducing the stomach volume to treat weight regain after BPD is not advised due to the deficiencies that certainly will occur in the long term.

All these procedures are laparoscopic feasible although attention should be paid to the correct identification of the different limbs with the correct orientation and sufficient closure of the defects in the mesenteries.

Patient with a gastric bypass

Laparoscopic approaches to treat weight regain or insufficient weight loss after RYGB are banding of the gastro enteral anastomosis and shortening of the common limb. Resizing of the gastric pouch has also been mentioned but is only indicated in case the initial pouch creation was not adequate [65].

Laporoscopic distalization of the bypass used to be achieved by resecting the alimentary limb flush to the anastomosis with the biliary limb and re-anastomosed 150–180 proximal to the ileocaecal valve. However, this is no longer an option due to the important deficiencies induced postoperatively. These do not outweigh the effect on weight [62].

Although it is still not so clear if stoma size matters after an RYGB, some patients regain weight and attribute this to larger meal sizes. If this is the case, an AGB 1 cm proximal of the gastrojejunal anastomosis seems to have good results with up to 47% EWL at 5 years [66].

Reversal of the RYGB into normal anatomy is only indicated if invalidating hypoglycemic episodes occur, refractory to diet measures and pharmacotherapy.

Follow-up after bariatric surgery

Follow-up after bariatric surgery should anticipate imminent weight regain, undiagnosed relapse of comorbidities, and long term complications. If these problems occur, follow-up requires a multidisciplinary approach. A standard lifelong yearly routine visit with a specialized doctor and/or paramedic is mandatory for every patient. Any increase in weight should be detected and patients should be encouraged to adhere to diet and exercises. Patients with the metabolic syndrome preoperatively should be monitored regularly for dyslipidemia, hyperglycemia, hypertension and liver steatosis. Weight regain will re-induce disturbances in these metabolisms [67]. Deficiencies in iron stores, fat-soluble vitamins, cobalamin, parathyroid hormone, thyroid function should be monitored at least once a year.

On every visit caregivers should ask for upper abdominal pain episodes to detect internal herniation or marginal ulcer in RYGB patients. Symptoms of GERD in SG and AGB patients have to be detected so that upper I endoscopy can be carried out. Patients with preoperative Barrett present need a 1–2 yearly endoscopic follow-up.

Bariatric surgery changes obesity from a chronic disease into a chronic treatment. Both need chronic illness management, a daring task given the high prevalence of this disease.

Conclusions and future

Obesity is a disease or a symptom of a disease that results from multifactorial and multigenetic dysfunction of one or more neurohormonal physiological processes that drive eating behaviour, calorie management and energy expenditure. Moreover there is an influence of the microenvironment such as the host's microbiome as well as from the macro environment such as the food availability and the socioeconomic context. The developed surgical procedures are restoring these dysfunctions, at least in the morbidly obese patients, with an 85% success rate albeit at a certain cost of short and long-term complications.

More research is mandatory to help the remaining 15% of morbidly obese patients and the mildly obese with a serious metabolic syndrome. Invasiveness of surgical procedures needs to be further reduced. If treatment can be minimized, more patients can be treated, including those with lower BMI. Patients can also be treated earlier in the course of the disease.

Research points

- Unravelling the mechanisms of the disease obesity, its metabolic disorders, bariatric and metabolic surgery
- Matching the right procedures (present and expected) for the right patient at the right time and inducing a knowledge-based minimal invasive and pharmacological research products
- Defining ideal chronic-illness model for the post-bariatric patient

Practice points

- Preoperative work-up of patients eligible for surgery should be multidisciplinary and should fully assess comorbidities and nutritional status.
- Momentarily RYGB can be considered as the procedure of choice. However, final decision of the possible procedures should be specifically tailored for each patient. Sleeve gastrectomy can be an
- Alternative. If willingness of the patient to strictly adhere intensive follow AGB and BPD-DS can be proposed. The surgeon has to be trained and skilled in the complete armamentarium of bariatric procedures.
- Life-long multidisciplinary follow-up by experienced caregivers should be organized in specialized centers in order to detect complications and relapse of disease at an early stage.

Conflict of interest stated

None.

References

[1] Xia Q, Grant SF. The genetics of human obesity. Ann New York Acad Sci 2013;1281:178–90.
[2] Shefer G, Marcus Y, Stern N. Is obesity a brain disease? Neurosci Biobehav Rev 2013;37(10 Pt 2):2489–503.
[3] Tchernof A, Despres JP. Pathophysiology of human visceral obesity: an update. Physiol Rev 2013;93(1):359–404.
[4] Berthoud HR, Shin AC, Zheng H. Obesity surgery and gut-brain communication. Physiol Behav 2011;105(1):106–19.
[5] Schauer PR, Ikramuddin S. Laparoscopic surgery for morbid obesity. Surg Clin North Am 2001;81(5):1145–79.
[6] Dillemans B, Van Cauwenberge S, Mulier JP. What an anaesthetist should know about bariatric surgery. Acta Anaesthesiol Belg 2009;60(3):177–80.
[7] Buchwald H, Estok R, Fahrbach K, Banel D, Sledge I. Trends in mortality in bariatric surgery: a systematic review and meta-analysis. Surgery 2007;142(4):621–32 [discussion 32–5].
[8] Fielding GA, Allen JW. A step-by-step guide to placement of the LAP-BAND adjustable gastric banding system. Am J Surg 2002;184(6B):26S–30S.
[9] Dillemans B, Sakran N, Van Cauwenberge S, Sablon T, Defoort B, Van Dessel E, et al. Standardization of the fully stapled laparoscopic Roux-en-Y gastric bypass for obesity reduces early immediate postoperative morbidity and mortality: a single center study on 2606 patients. Obes Surg 2009;19(10):1355–64.
[10] Gonzalez R, Lin E, Venkatesh KR, Bowers SP, Smith CD. Gastrojejunostomy during laparoscopic gastric bypass: analysis of 3 techniques. Arch Surg 2003;138(2):181–4.
[11] Escalona A, Devaud N, Perez G, Crovari F, Boza C, Viviani P, et al. Antecolic versus retrocolic alimentary limb in laparoscopic Roux-en-Y gastric bypass: a comparative study. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 2007;3(4):423–7.
[12] Brolin RE. Long limb Roux en Y gastric bypass revisited. Surg Clin North Am 2005;85(4):807–17 [vii].
[13] Lannoo M, Smet B, Miserez M, Penninckx F, D'Hoore A. Laparoscopic totally stapled entero-enterostomy: a safe and reproducible new technique. Obes Surg 2008;18(6):631–4.
[14] Iannelli A, Facchiano E, Gugenheim J. Internal hernia after laparoscopic Roux-en-Y gastric bypass for morbid obesity. Obes Surg 2006;16(10):1265–71.
[15] Iannelli A, Dainese R, Piche T, Facchiano E, Gugenheim J. Laparoscopic sleeve gastrectomy for morbid obesity. World J Gastroenterol WJG 2008;14(6):821–7.
[16] Deitel M, Crosby RD, Gagner M. The first international consensus summit for sleeve gastrectomy (SG), New York city, October 25–27, 2007. Obes Surg 2008;18(5):487–96.
[17] NIH conference. Gastrointestinal surgery for severe obesity. Consensus Development Conference Panel. Ann Intern Med 1991;115(12):956–61.

[18] Neff KJ, le Roux CW. Bariatric surgery: a best practice article. J Clin Pathol 2013;66(2):90–8.
[19] Nguyen NT, Nguyen B, Gebhart A, Hohmann S. Changes in the makeup of bariatric surgery: a national increase in use of laparoscopic sleeve gastrectomy. J Am Coll Surg 2013;216(2):252–7.
[20] Bray GA, Bellanger T. Epidemiology, trends, and morbidities of obesity and the metabolic syndrome. Endocrine 2006; 29(1):109–17.
[21] Colquitt JL, Picot J, Loveman E, Clegg AJ. Surgery for obesity. Cochrane Database Syst Rev 2009;2. CD003641.
[22] Snow JM, Severson PA. Complications of adjustable gastric banding. Surg Clin North Am 2011;91(6):1249–64 [ix].
[23] Menendez P, Padilla D, Villarejo P, Menendez JM, Lora D. Does bariatric surgery decrease gastric cancer risk? Hepato-gastroenterology 2012;59(114):409–12.
[24] Melstrom LG, Bentrem DJ, Salvino MJ, Blum MG, Talamonti MS, Printen KJ. Adenocarcinoma of the gastroesophageal junction after bariatric surgery. Am J Surg 2008;196(1):135–8.
[25] Goldfine AB, Mun EC, Devine E, Bernier R, Baz-Hecht M, Jones DB, et al. Patients with neuroglycopenia after gastric bypass surgery have exaggerated incretin and insulin secretory responses to a mixed meal. J Clin Endocrinol Metab 2007;92(12):4678–85.
[26] Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH. The disease burden associated with overweight and obesity. JAMA J Am Med Assoc 1999;282(16):1523–9.
[27] Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrbach K, et al. Bariatric surgery: a systematic review and meta-analysis. JAMA J Am Med Assoc 2004;292(14):1724–37.
[28] Hallersund P, Sjostrom L, Olbers T, Lonroth H, Jacobson P, Wallenius V, et al. Gastric bypass surgery is followed by lowered blood pressure and increased diuresis – long term results from the Swedish Obese Subjects (SOS) study. PloS one 2012; 7(11):e49696.
[29] Ahmed AR, Rickards G, Coniglio D, Xia Y, Johnson J, Boss T, et al. Laparoscopic Roux-en-Y gastric bypass and its early effect on blood pressure. Obes Surg 2009;19(7):845–9.
[30] Hinojosa MW, Varela JE, Smith BR, Che F, Nguyen NT. Resolution of systemic hypertension after laparoscopic gastric bypass. J Gastrointest Surg Off J Soc Surg Aliment Tract 2009;13(4):793–7.
[31] Brancatisano A, Wahlroos S, Brancatisano R. Improvement in comorbid illness after placement of the Swedish adjustable gastric band. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 2008;4(3 Suppl.):S39–46.
[32] Himpens J, Cadiere GB, Bazi M, Vouche M, Cadiere B, Dapri G. Long-term outcomes of laparoscopic adjustable gastric banding. Arch Surg 2011;146(7):802–7.
[33] Schwartz AR, Patil SP, Laffan AM, Polotsky V, Schneider H, Smith PL. Obesity and obstructive sleep apnea: pathogenic mechanisms and therapeutic approaches. Proc Am Thorac Soc 2008;5(2):185–92.
[34] Rapoport DM, Sorkin B, Garay SM, Goldring RM. Reversal of the "Pickwickian syndrome" by long-term use of nocturnal nasal-airway pressure. N Engl J Med 1982;307(15):931–3.
[35] Jensen C, Tejirian T, Lewis C, Yadegar J, Dutson E, Mehran A. Postoperative CPAP and BiPAP use can be safely omitted after laparoscopic Roux-en-Y gastric bypass. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 2008;4(4):512–4.
[36] Varela JE, Hinojosa MW, Nguyen NT. Resolution of obstructive sleep apnea after laparoscopic gastric bypass. Obes Surg 2007;17(10):1279–82.
[37] Dixon JB, Schachter LM, O'Brien PE. Sleep disturbance and obesity: changes following surgically induced weight loss. Arch Intern Med 2001;161(1):102–6.
[38] Sarkhosh K, Switzer NJ, El-Hadi M, Birch DW, Shi X, Karmali S. The impact of bariatric surgery on obstructive sleep apnea: a systematic review. Obes Surg 2013;23(3):414–23.
[39] Sjostrom L, Lindroos AK, Peltonen M, Torgerson J, Bouchard C, Carlsson B, et al. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. N Engl J Med 2004;351(26):2683–93.
[40] Diniz Mde F, Passos VM, Barreto SM, Linares DB, de Almeida SR, Rocha AL, et al. Different criteria for assessment of Roux-en-Y gastric bypass success: does only weight matter? Obes Surg 2009;19(10):1384–92.
[41] Dixon JB, O'Brien PE. Changes in comorbidities and improvements in quality of life after LAP-BAND placement. Am J Surg 2002;184(6B):51S–4S.
[42] Scopinaro N, Marinari GM, Camerini GB, Papadia FS, Adami GF. Specific effects of biliopancreatic diversion on the major components of metabolic syndrome: a long-term follow-up study. Diabetes Care 2005;28(10):2406–11.
[43] Pories WJ, MacDonald Jr KG, Flickinger EG, Dohm GL, Sinha MK, Barakat HA, et al. Is type II diabetes mellitus (NIDDM) a surgical disease? Ann Surg 1992;215(6):633–42 [discussion 43].
[44] Adams TD, Gress RE, Smith SC, Halverson RC, Simper SC, Rosamond WD, et al. Long-term mortality after gastric bypass surgery. N Engl J Med 2007;357(8):753–61.
[45] Muscelli E, Mingrone G, Camastra S, Manco M, Pereira JA, Pareja JC, et al. Differential effect of weight loss on insulin resistance in surgically treated obese patients. The American Journal of Medicine 2005;118(1):51–7.
[46] Sjostrom L, Narbro K, Sjostrom CD, Karason K, Larsson B, Wedel H, et al. Effects of bariatric surgery on mortality in Swedish obese subjects. N Engl J Med 2007;357(8):741–52.
[47] Buchwald H, Estok R, Fahrbach K, Banel D, Jensen MD, Pories WJ, et al. Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. Am J Med 2009;122(3):248–56. e5.
[48] Mingrone G, Panunzi S, De Gaetano A, Guidone C, Iaconelli A, Leccesi L, et al. Bariatric surgery versus conventional medical therapy for type 2 diabetes. N Engl J Med 2012;366(17):1577–85.
[49] Schauer PR, Kashyap SR, Wolski K, Brethauer SA, Kirwan JP, Pothier CE, et al. Bariatric surgery versus intensive medical therapy in obese patients with diabetes. N Engl J Med 2012;366(17):1567–76.
[50] Lindqvist A, Spegel P, Ekelund M, Mulder H, Groop L, Hedenbro J, et al. Effects of ingestion routes on hormonal and metabolic profiles in gastric-bypassed humans. J Clin Endocrinol Metab 2013;98(5):E856–61.
[51] Neff KJ, O'Shea D, le Roux CW. Glucagon like peptide-1 (GLP-1) dynamics following bariatric surgery: a Signpost to a new frontier. Curr Diabetes Rev 2013;9(2):93–101.
[52] Halperin F, Goldfine AB. Metabolic surgery for type 2 diabetes: efficacy and risks. Curr Opin Endocrinol Diabetes Obes 2013;20(2):98–105.
[53] Saeidi N, Meoli L, Nestoridi E, Gupta NK, Kvas S, Kucharczyk J, et al. Reprogramming of intestinal glucose metabolism and glycemic control in rats after gastric bypass. Science 2013;341(6144):406–10.

[54] Marsk R, Jonas E, Rasmussen F, Naslund E. Nationwide cohort study of post-gastric bypass hypoglycaemia including 5,040 patients undergoing surgery for obesity in 1986–2006 in Sweden. Diabetologia 2010;53(11):2307–11.
[55] Lynch J, Belgaumkar A. Bariatric surgery is effective and safe in patients over 55: a systematic review and meta-analysis. Obes Surg 2012;22(9):1507–16.
[56] Rosenthal RJ, International Sleeve Gastrectomy Expert P, Diaz AA, Arvidsson D, Baker RS, Basso N, et al. International Sleeve Gastrectomy Expert Panel Consensus Statement: best practice guidelines based on experience of >12,000 cases. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 2012;8(1):8–19.
[57] Vijgen GH, Schouten R, Bouvy ND, Greve JW. Salvage banding for failed Roux-en-Y gastric bypass. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 2012;8(6):803–8.
[58] Abdelbaki TN, Huang CK, Ramos A, Neto MG, Talebpour M, Saber AA. Gastric plication for morbid obesity: a systematic review. Obes Surg 2012;22(10):1633–9.
[59] Mahawar KK, Jennings N, Brown J, Gupta A, Balupuri S, Small PK. "Mini" gastric bypass: systematic review of a controversial procedure. Obes Surg 2013;23(11):1890–8.
[60] Vasas P, Dillemans B, Van Cauwenberge S, De Visschere M, Vercauteren C. Short- and long-term outcomes of vertical banded gastroplasty converted to Roux-en-Y gastric bypass. Obes Surg 2013;23(2):241–8.
[61] Cadiere GB, Himpens J, Bazi M, Cadiere B, Vouche M, Capelluto E, et al. Are laparoscopic gastric bypass after gastroplasty and primary laparoscopic gastric bypass similar in terms of results? Obes Surg 2011;21(6):692–8.
[62] Kellogg TA. Revisional bariatric surgery. Surg Clin North Am 2011;91(6):1353–71 [x].
[63] Elnahas A, Graybiel K, Farrokhyar F, Gmora S, Anvari M, Hong D. Revisional surgery after failed laparoscopic adjustable gastric banding: a systematic review. Surg Endosc 2013;27(3):740–5.
[64] Hamoui N, Chock B, Anthone GJ, Crookes PF. Revision of the duodenal switch: indications, technique, and outcomes. J Am Coll Surg 2007;204(4):603–8.
[65] Parikh M, Heacock L, Gagner M. Laparoscopic "gastrojejunal sleeve reduction" as a revision procedure for weight loss failure after roux-en-y gastric bypass. Obes Surg 2011;21(5):650–4.
[66] Bessler M, Daud A, DiGiorgi MF, Inabnet WB, Schrope B, Olivero-Rivera L, et al. Adjustable gastric banding as revisional bariatric procedure after failed gastric bypass–intermediate results. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 2010;6(1):31–5.
[67] DiGiorgi M, Rosen DJ, Choi JJ, Milone L, Schrope B, Olivero-Rivera L, et al. Re-emergence of diabetes after gastric bypass in patients with mid- to long-term follow-up. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 2010;6(3):249–53.