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REVIEW

Bariatric surgery and diabetes: Current challenges and perspectives

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Abstract

Diabetes mellitus (DM) and obesity have become public issues of global concern. Bariatric surgery for the treatment of obesity combined with type 2 DM has been shown to be a safe and effective approach; however, there are limited studies that have systematically addressed the challenges of surgical treatment of obesity combined with DM. In this review, we summarize and answer the most pressing questions in the field of surgical treatment of obesity-associated DM. I believe that our insights will be of great help to clinicians in their daily practice.

Key Words: Bariatric surgery; Diabetes mellitus; Obesity; Metabolic surgery; Challenge

Core Tip: Obesity and diabetes are now public problems that threaten the health of people worldwide. Although bariatric surgery for the treatment of obesity associated with type 2 diabetes mellitus has been shown to be a safe and effective approach, its challenges have not been described systematically and comprehensively. This review is at the forefront of presenting and answering the challenges faced in the field of surgical management of obesity-associated diabetes mellitus today. It provides an up-to-date insight into the daily practice of clinicians.

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INTRODUCTION

Obesity and diabetes mellitus (DM) are now public health problems that threaten the health of people around the world. Obesity is associated with increased morbidity and mortality from various diseases. Historically, DM has long been recognized as a permanent disease that is difficult to cure. In recent years, with the rapid development of metabolic surgery, bariatric surgery has become an effective way to treat obesity and type 2 DM (T2DM)[1]. However, the surgical treatment of obesity and diabetes also faces significant challenges: For example, is bariatric surgery indicated for patients with type 1 DM (T1DM)? Is it suitable for people over 70 or for children under 16? Is it appropriate for people of normal weight or non-diabetics? How is new-onset diabetes managed after bariatric surgery? Here, our review will address these poignant questions and lead to more comprehensive studies in the future. We conducted a comprehensive search of PubMed, MEDLINE, CNKI, Wanfang, Embase, Google Scholar, Scopus, Wiley, Cochrane, and ScienceDirect online databases, as well as the medRxiv and bioRxiv gray literature, using the keywords "bariatric surgery", "diabetes", "obesity", and "metabolic surgery" either individually or in combination, and a final update of the latest cutting-edge researches in bariatric surgery was performed using Reference Citation Analysis (https://www.referencecitation-analysis.com).

Bariatric surgery for the treatment of obesity combined with DM not only results in significant and long-lasting weight loss[2], but also significantly reduces morbidity and mortality from a wide range of obesity-associated diseases, including T2DM[3], cardiovascular disease[4], obstructive sleep apnea[5], non-alcoholic fatty liver disease[6], and osteoarthritis[7]. Bariatric surgery has become an illuminating scientific model that has evolved from the treatment of obesity, to the treatment of T2DM, and further to the treatment of a range of metabolic syndromes centered on obesity and its accompanying metabolic disorders (including endocrine[1], cardiovascular[4], respiratory[5], and reproductive disorders [8]). More surprisingly, bariatric surgery has been reported to improve proteinuria, with a profound effect on chronic kidney disease[9]. The clinical use of laparoscopic bariatric surgery has grown exponentially over the past two decades, and different types of bariatric surgery may have different outcomes. Table 1 lists the major surgical types of bariatric surgery available today, their respective weight loss potential, advantages and disadvantages, and complications.

CHALLENGE ONE, FROM AGE: < 18 OR > 65 YEARS OLD

Childhood obesity is now a truly global health problem[10]. Data suggest that childhood obesity is strongly associated with the development of certain comorbidities, including cardiovascular disease[11,12], endocrine/metabolic disorders [13], respiratory disease[14], and musculoskeletal problems[15]. In addition, obese children often develop psychosocial problems such as mood disorders, anxiety, prejudice, and low self-esteem[16]. A study by Shah *et al*[17] suggests that prepubertal bariatric surgery is safe and effective and may not require age criteria. A review summarizing recent data on long-term outcomes following bariatric surgery in severely obese adolescents suggests that bariatric surgery has a beneficial impact on both weight loss and resolution of comorbidities in severely obese adolescents[18], which may help to remove barriers to the referral of adolescents for bariatric surgery[19]. With the increasing number of cases of metabolic surgery for the treatment of obesity in children and adolescents, the latest guideline, 2019 edition, recommends an age range of 2-18 years for surgery[20]. Even more encouraging is the fact that research has shown that bariatric surgery for severely obese adolescents is cost-effective[21]. Although it is more expensive than not having the surgery, it significantly improves quality of life, and overall costs, including medical care and medication, decrease after surgery. In other words, bariatric surgery increases short- to medium-term healthcare costs but can save money in the long term[22, 23]. Of course, some researchers have said that although bariatric surgery in adolescents can result in sustainable weight loss and reverse many of the complications associated with severe obesity, its safety and long-term effectiveness remain unclear, and therefore large, long-term prospective studies are still needed to determine the role of surgical treatment in childhood obesity[24].

Historically, bariatric surgery has been performed in patients < 65 years old because of the balance of risks (surgical safety, survival time, and availability of lifestyle changes) and benefits of surgery in older patients due to reduced cardiorespiratory fitness and frequent comorbidity with other underlying diseases. As quality of life improves and longevity increases, the need for bariatric surgery in older patients > 65 years is increasing, and studies have shown that bariatric surgery is safe and effective in older patients > 65[25,26] and even > 70 years[27-29] and that older patients appear to have better cardiovascular risk improvement[30]. In addition, elderly patients who undergo bariatric surgery also experience improvements in other areas, including physical and mental functioning, work capacity, self-confidence, sexual activity, and health-related quality of life[31]. Therefore, age per se should not prevent older patients from receiving optimal bariatric surgery for obesity and related complications.

Table 1 Types of bariatric surgery, their respective weight loss potential, advantages, disadvantages and complications

Procedure	Target weight loss	Advantages	Disadvantages	Complications
Laparoscopic adjustable gastric banding	20%-25%	No anatomic alteration, removable, adjustable	Erosion, slip, and prolapse	Gastric ptosis, outlet obstruction, erosion of the gastric wall by gastric banding
Sleeve gastrectomy	25%-30%	Easy to perform, no anastomosis, reproducible, few long-term complications	Leaks difficult to manage, 20%-30% risk of GERD	Bleeding of the cutting edge, leakage and stenosis
Roux-en-Y gastric bypass	30%-35%	Effective for GERD, can be used as second stage after sleeve gastrectomy	Internal hernias possible, long-term micronutrient deficiencies	Anastomotic leakage, bleeding, incisional infection, anastomotic stenosis and malnutrition
Biliopancreatic diversion with duodenal switch	35%-45%	Long-lasting weight loss, especially effective in patients with very high BMI	GERD, potential for hernias, technically challenging	Diarrhoea, nutrient deficiency
Single anastomosisduodeno-ileal bypass with sleeve gastrectomy	35%-45%	Single anastomosis with strong metabolic effect and low rate of early complic-ations	Nutritional and micronutrient deficiencies possible, duodenal dissection	GERD, bile reflux
Intragastric balloon	10%-12%	Endoscopic or swallowed, good safety profile	Temporary (6 months) therapy, early removal rate of 10%-19%	Abdominal pain, nausea and vomiting
One-anastomosisgastric bypass	35%-40%	Simpler to perform, strong metabolic effects, no mesenteric defects	Potential for bile reflux, long biliopan-creatic limb	Malnutrition, diarrhea
Transpyloric bulb	14%	Outpatient endoscopic procedures with long implantation times	Gastric mucosal erosion	Gastric ulcer
Aspiration therapy	12%-14%	Endoscopy, treatment is completely reversible	Tube-related problems/complications, 26% early removal	Abdominal pain, gastrostomy site infection
Vagal nerve blocking therapy	8%-9%	No anatomic changes, low complication rate	Explant required for conversion to another procedure	Pain at neuroregulatory site, indigestion, nausea
Gastric electric stimulation	20%-30%	No anatomical changes, minimal surgical trauma, high surgical safety	Difficulty in determining electrode implantation position and electrical stimulation parameters	Perforation, electrode dislodgement, electrode failure
Left gastric artery embolization	3%-14%	No anatomical changes, minimal surgical trauma	Difficulty in selecting embolic materials and target vessels	Ulcer, abdominal pain, and vomiting

GERD: Gastroesophageal reflux disease; BMI: Body mass index.

CHALLENGE TWO, FROM SPECIAL POPULATIONS

T1DM

Bariatric surgery can significantly improve glycaemic control and even alleviate diabetes in people with T2DM, so can it also benefit people with T1DM?

The International Federation for the Surgery of Obesity and Metabolic Disorders stated in 2016 that bariatric surgery not only treats obesity-related diseases but also improves insulin resistance and reduces insulin requirements, so obese T1DM can be used as a therapeutic indication for bariatric surgery[32]. Studies have shown that bariatric surgery leads to significant improvements in weight and cardiometabolic variables and modest improvements in blood glucose with few reported adverse events in cohorts of patients with obesity and T1DM[33]. The study by Vilarrasa *et al*[34] described the long-term outcomes of bariatric surgery in a cohort of patients with T1DM: Bariatric surgery provided some benefits in terms of weight loss, insulin requirements, obesity comorbidities and diabetic complications in patients with T1DM, but the long-term impact on glycaemic control was likely to be small. The study by Landau *et al*[35] demonstrated the same point; in people with obesity and T1DM, weight loss after bariatric surgery was successful without significant improvement in glycaemic control. A meta-analysis involving 9 studies with a total of 78 patients showed that glycated hemoglobin (HbA1c), insulin dose, and body mass index (BMI) improved after surgery, although the improvement in HbA1c did not reach statistical significance (P = 0.40)[36]. It is worth noting that the postoperative risks of diabetic ketoacidosis and severe hypoglycemic episodes should also be considered when performing bariatric surgery in the T1DM population[35].

In summary, bariatric surgery has brought new hope to the treatment of obese T1DM and, apart from its controversial effect on blood glucose, it has played a significant role in reducing BMI, improving obesity-related diseases, improving insulin sensitivity, and alleviating or even reversing diabetic complications. As a result of these positive results, more and more patients with T1DM are willing to undergo bariatric surgery.

Normal weight diabetics

More than 10 years ago, some animal studies have successively confirmed that bariatric surgery has certain effects on non-obese DM[37,38]. Bariatric surgery was performed in 69 patients with T2DM and a BMI of 21-29 kg/m^2, with a mean follow-up of 21.7 months, resulting in satisfactory glycaemic control in 95.7% of patients[39]. The study of Zhang *et al*[40] showed that Billroth II gastrojejunostomy for the treatment of non-obese patients with T2DM had similar short- and medium-term glycaemic control effects as Roux-en-Y gastric bypass (RYGB) surgery for the treatment of obese patients with T2DM. Malapan *et al*[41] included 29 non-obese (BMI < 27 kg/m^2) T2DM patients who underwent laparoscopic RYGB and showed a significant reduction in mean body weight, mean BMI, and mean waist circumference, as well as mean systolic and diastolic blood pressure over a one-year prospective follow-up; and other biochemical variables, including blood glucose, HbA1c, C-peptide, insulin, triglycerides, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and homeostatic model assessment insulin resistance were significantly improved. More surprisingly, ten patients with T2DM and a BMI < 24.0 kg/m^2 (mean BMI 23.8 kg/m^2 ± 1.2 kg/m^2) were reported to have undergone duodenojejunal bypass, with resolution of T2DM in one patient and significant reductions in fasting glucose, 2-hour postprandial glucose and HbA1c at all postoperative time points, without significant weight loss[42]. However, the sample sizes of these clinical trials are small, and further large, multicentre, prospective, randomized controlled trials are needed to confirm the role of bariatric surgery in mildly obese or normal-weight patients with T2DM.

Non-diabetics

For obese and diabetic patients, bariatric surgery can provide relief from both conditions. But can bariatric surgery benefit non-diabetic patients? Bariatric surgery has been shown to restore visual cortical plasticity in non-diabetic obese patients [43]. Luo *et al*[44] reported on the effects of bariatric surgery in diabetic and non-diabetic patients who were followed for five years, and final subgroup analyses showed a linear increase in the percentage of non-diabetic patients from the worst clinical outcome to successful weight loss, and even more unexpectedly, non-diabetics lost a higher percentage of excess weight than diabetics over all five years. In addition, the Michigan Bariatric Surgery Collaborative reported that patients without DM were more likely to achieve a post-operative BMI of less than 30 kg/m^2 within one year[45]. It is well known that the obese population is at an increased risk of microvascular complications, and the risk is even greater in patients with T2DM. Bashir *et al*[46] evaluated the effects of bariatric surgery on microvascular complications in diabetic and non-diabetic patients, and they concluded that obese patients with or without DM benefit from the improvement in microvascular complications with bariatric surgery.

Immunodeficient patients

Although the risks of obesity in people with human immunodeficiency virus (HIV) are unclear, the incidence of DM and cardiovascular disease is increased in HIV-infected people, whether they are obese or not[47]. Many of those treating obese HIV patients are concerned that weight loss is unsafe for these patients. Flancbaum *et al*[48] reported on the first cohort of HIV-infected patients to undergo bariatric surgery, including six morbidly obese patients with obesity-related comorbidities who had asymptomatic, stable HIV infection. In their study, none of the patients showed a clinically significant deterioration in CD4 count or immune status, or progression of acquired immunodeficiency syndrome, and all of the patients' comorbidities improved or resolved. Fazylov *et al*[49] reported two cases of morbidly obese, asymptomatic HIV-infected patients who underwent laparoscopic RYGB, both patients successfully lost weight and maintained their weight loss at the last follow-up. Yang *et al*[50] evaluated the efficacy and safety of bariatric surgery in three HIV-infected patients. In their three cases, bariatric surgery resulted in stable CD4 counts and undetectable viral loads. A growing body of data suggests that bariatric surgery can be safely performed in HIV-infected patients without progression to acquired immunodeficiency syndrome.

Cancer patients

Obesity is a major risk factor for cancer morbidity and mortality[51,52]. Whether the anatomical, physiological, and microbiome changes induced by bariatric surgery in the gastrointestinal tract result in an increased risk of cancer in this area remains an open question. Numerous studies have shown that bariatric surgery is beneficial in reducing morbidity and mortality from all cancers[53-55], particularly breast[56-58] and endometrial cancers[59,60]. In addition to the effects on cancer development, some studies have suggested that bariatric surgery improves cancer prognosis in severely obese patients[61,62]. However, esophagogastric cancers have been reported to be induced after bariatric surgery[63], but epidemiological studies have not shown a higher incidence of these cancers in patients undergoing bariatric surgery compared with the general population[64]. Equally distressing is the conflicting evidence regarding the risk of colorectal cancer after bariatric surgery, with several studies showing a reduced risk of colorectal cancer in patients who have undergone bariatric surgery[65,66], while Aravani *et al*[67] showed that bariatric surgery was not associated with an increased risk of colorectal cancer, and others even suggest that patients who have undergone bariatric surgery are at an increased risk of colorectal cancer[68,69]. There are still some unanswered questions about the possible effects of bariatric surgery on cancer risk in patients with obesity, and there is a need for prospective, randomized controlled, and longer studies in populations undergoing bariatric surgery.

In addition to the special populations mentioned above, it is also important to consider what to do when pregnancy and bariatric surgery conflict, with the best evidence to date coming from expert opinion[70,71] that either pregnancy should be postponed during the bariatric surgery phase or bariatric surgery should be postponed during pregnancy.

More high-quality randomized controlled trials are needed to explore the relationship between bariatric surgery and pregnancy in more detail.

CHALLENGE THREE, FROM RELAPSE, INCLUDES WEIGHT REGAIN AND NEW-ONSET DM

Postoperative recurrence rate

Although a large proportion of patients with T2DM who have undergone bariatric surgery initially experience remission, some patients later relapse. It is estimated that around half of patients regain 5% of their body weight within two years of bariatric surgery[72]. An observational study of 300 patients undergoing RYGB showed that 37% of patients regained ≥ 25% of their maximum weight loss after a mean follow-up of 7 years[73]. The incidence of weight regain ranges from 9% to 91%, depending on the definition used[74]. Similarly, patients are at risk of developing a new onset DM after bariatric surgery[75]. In an analysis of data from a non-randomized, prospective, controlled trial, Carlsson *et al*[76] found that the incidence of new-onset T2DM after bariatric surgery was 6.8 cases per 1000 patient-years during a 15-year follow-up period. In a single-center retrospective study, Nor Hanipah *et al*[77] investigated the incidence of new-onset DM over 17 years after bariatric surgery, and they found that the incidence of new-onset DM was 0.4%; weight regain was common among patients with new-onset DM (> 50%).

Prediction of postoperative recurrence

Many studies have tried to explore the best biological and clinical predictors of T2DM recurrence after surgery[78-81]. Unfortunately, it is still difficult to predict which patients will experience postoperative weight regain or new-onset DM. A prospective study of 175 patients with RYGB T2DM and a 5-year follow-up found that several baseline factors (duration of DM, number of DM medications, HbA1c) and status at 1 year (fasting blood glucose, number of DM medications, remission status, percentage total weight loss) predicted the rate of DM remission and recurrence at 5 years [82]. A growing number of studies have shown that shorter duration of T2DM, better preoperative glycaemic control, lower baseline HbA1c and waist circumference, and greater postoperative weight loss are associated with higher rates of T2DM remission and lower risk of recurrence[83-85]. In addition, it has been suggested that gender is also an important factor in T2DM recurrence, with men having a lower risk of T2DM recurrence[86,87].

Management of postoperative recurrence

Despite the risk of weight regain or a new onset of DM, surgery still has the potential to have beneficial metabolic effects in the long term. Therefore, a higher risk of recurrence should not be a reason for exclusion from surgery. Careful preoperative patient selection and preoperative optimization appear to be important. Patients with postoperative recurrence, either weight regain or diabetic recurrence, are usually re-operated. Previous studies have shown that early surgery reduces the risk of recurrence[85,86]. Therefore, patients with obesity and T2DM should prioritize metabolic surgery at an early stage. Of course, it seems equally important to optimize lifestyle changes in patients after bariatric surgery[88]. In addition, the use of anti-obesity medications may provide more options for patients and healthcare providers[89].

CHALLENGE FOUR, FROM THE OPTIMAL TIMING OF SURGERY

Exactly when surgery is most effective in diabetes remains controversial. Recent studies have confirmed that the chances of achieving complete remission are negatively correlated with the duration of DM[86]. The available evidence strongly supports that patients benefit more from bariatric surgery when it is performed in the pre-diabetic or early stages of DM, or even during periods of abnormal glucose tolerance. Reserving surgery for more advanced and complex stages of the disease appears to be less beneficial for the clinical course of DM[90]. Based on these findings, we should offer bariatric surgery to patients with T2DM at an early stage of their disease. This idea seems revolutionary in the treatment of obesity, and it is exactly the same idea that underlies early cancer screening - offering bariatric surgery as a last resort, after years of obesity and T2DM have wreaked havoc on the body, is like waiting until the cancer has metastasized throughout the body.

CHALLENGE FIVE: WHO BENEFITS MOST FROM BARIATRIC SURGERY?

Obesity has been shown to be a heterogeneous disease. Despite the effectiveness of bariatric surgery, there are large individual differences in surgical outcomes. If we can predict who will benefit most, we may be able to target bariatric surgery more accurately. Previous studies have identified several predisposing factors for benefit from bariatric surgery, including patient factors (*e.g.*, age, BMI, gender, history and duration of DM, family history, glycemic control, and comorbidities), surgical factors (*e.g.*, surgeon experience, type of surgery), and social factors (*e.g.*, socioeconomics, medical conditions, and social discrimination)[91,92]. It has been shown that over 10 years, the number of treatments required to prevent one additional death was 8.4 in diabetic patients compared with 29.8 in non-diabetic patients[93], so diabetic patients benefit more from bariatric surgery than non-diabetic patients in terms of both the relative and absolute risk of reducing morbidity and mortality.

Due to the high degree of patient heterogeneity, it is difficult to tailor surgical techniques to all patients, the decision to operate is empirical and there is no robust evidence-based approach, and predicting which patients will benefit most from bariatric surgery remains a challenge at present. There is evidence that there is less variation in outcomes when identical twins or first-degree relatives undergo bariatric surgery compared with unrelated individuals, but the variation in outcomes increases when bariatric surgery is performed on couples or people living together in the same environment [94-97]. This suggests that there may be biological factors that predict response to bariatric surgery. Studies have shown that a variety of omics technologies such as genomics, transcriptomics, proteomics, metabolomics, and lipidomics can provide a holistic molecular view of systems biology[98]. Unfortunately, currently available biomarkers cannot be used in clinical practice[99]. Prediction of the efficacy of bariatric surgery seems to improve when clinical variables are combined with genetic testing[100]. More research is needed to accurately predict who will benefit most from bariatric surgery.

CHALLENGE SIX, FROM REACTIVE HYPOGLYCEMIA

Reactive hypoglycemia, or post-bariatric surgery hypoglycemia (PBSH), was first described by Service *et al*[101] and most commonly occurs 1-3 years after RYGB[102], but has also been reported after sleeve gastrectomy[103]. Reactive hypoglycemia is a notoriously difficult-to-manage metabolic complication of bariatric surgery, the presentation of which can be non-specific and unrecognizable, and for which there are no clear diagnostic criteria or standardized tests, making it a challenging condition for both surgeons and endocrinologists.

Clinical features

PBSH typically presents with palpitations, sweating, weakness, and dizziness one to three hours after a meal, and some patients experience severe and potentially life-threatening symptoms of hypoglycemia, including seizures, coma, or loss of consciousness. Repeated hypoglycemic events lead to reduced quality of life for patients[104] and are associated with increased all-cause mortality[105], risk of dementia[106], and risk of motor vehicle accidents[107], and severe hypoglycemia increases morbidity and mortality in patients with T2DM[108].

Incidence

The true incidence of PBSH remains uncertain, with previous reports ranging from 0.1% to 50.0%[109-111]. However, as there are cases where hypoglycemia goes undiagnosed due to undetected hypoglycemia[103], it is clear that the true incidence is likely to be underestimated. The incidence of hypoglycemia based on continuous glucose monitoring data has been reported to be as high as 75% in postoperative RYGB patients[112].

Mechanisms

The pathogenesis of PBSH is controversial and involves rather complex mechanisms that can be divided into insulin-dependent and non-insulin-dependent mechanisms. Insulin-dependent mechanisms include excessive insulin secretion by pancreatic beta cells, decreased insulin clearance, and increased insulin sensitivity. Non-insulin-dependent mechanisms include functional and structural adaptations in the gut after bariatric surgery that affect gastric emptying rate, glucose absorption, glucagon-like peptide-1 (GLP-1) levels, bile acid levels, gut microbiota, and counter-regulatory mechanisms to prevent hypoglycemia[113-118].

Management

The management of PBSH is equally challenging and requires a multidisciplinary approach that includes dietary, pharmacological, and surgical interventions. The first line of treatment for PBSH is dietary modification, particularly restriction of carbohydrate intake and avoidance of simple carbohydrates[119,120]. If dietary changes do not adequately control the patient's symptoms, pharmacological treatment with GLP-1 agonists, acarbose, growth inhibitor analogues, and calcium channel blockers may be considered[121-123]. Avexitide and glucagon pumps are two newer therapeutic options that have recently been tested[124,125]. Recent studies have shown that the acute effects of exercise training on glycaemic homeostasis after bariatric surgery can be used as a non-pharmacological adjunctive therapy[126]. Surgery is the last option when all other treatments have failed [127,128].

Predictors

In a prospective controlled Swedish study of patients treated with bariatric surgery for up to 31 years, male gender, older age, and higher HbA1c levels were associated with hypoglycemia-related events[129]. Previous studies have found that preoperative HbA1c, lower BMI, and greater postoperative weight loss are predictors of PBSH[109,130]. A study by Nielsen *et al*[131] showed that younger age and lower postoperative BMI were strong predictors of PBSH, while a study by Belligoli *et al*[132] demonstrated that the incidence of hypoglycemia was higher in younger patients with lower fasting blood glucose levels and higher triglyceride levels before laparoscopic sleeve gastrectomy. It has also been shown that the longer the duration of surgery, the higher the risk of hypoglycemia[109,133].

Much remains to be learned about the causes, diagnosis, and treatment of PBSH, and it will be necessary in the future to reach a consensus on the definition and diagnostic criteria for PBSH and to adopt a more scientifically intelligent diagnostic paradigm for the long-term monitoring of bariatric surgery patients in order to detect and reduce the risk of PBSH promptly. In conclusion, despite the risk of serious adverse events from reactive hypoglycemia, it is not sufficient to be a contraindication to bariatric surgery.

Future prospects

As the prevalence of obesity continues to rise, medical technology improves, and health awareness increases, more and more people with DM will benefit from bariatric surgery. With further basic and clinical research, we believe that the challenges we face today will become clearer in the future. Looking ahead, if one day we discover the mechanism for treating diabetes surgically, looking back, bariatric surgery may be just one step in the treatment of diabetes; we even look forward to the day when a genetic means of curing diabetes in the truest sense of the word will be found, by increasing or eliminating a particular segment of a gene, or by increasing or suppressing the expression of a particular factor.

Limitations

This review also has some limitations. Firstly, most of the studies had a short follow-up period, and the advantages and disadvantages of bariatric surgery for specific populations require longer follow-ups to obtain more stable and reliable results. Secondly, we did not adequately discuss the effects of bariatric surgery on pregnancy and gender.

CONCLUSION

This review summarizes the types of procedures and their advantages and disadvantages for the surgical treatment of DM, highlights the serious challenges faced today, stands at the forefront of perspectives, systematically answers these poignant questions, and boldly envisions the future, providing invaluable insights into the field of surgical treatment of DM.

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FOOTNOTES

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REFERENCES

1 **Syn NL**, Cummings DE, Wang LZ, Lin DJ, Zhao JJ, Loh M, Koh ZJ, Chew CA, Loo YE, Tai BC, Kim G, So JB, Kaplan LM, Dixon JB, Shabbir A. Association of metabolic-bariatric surgery with long-term survival in adults with and without diabetes: a one-stage meta-analysis of matched cohort and prospective controlled studies with 174 772 participants. *Lancet* 2021; **397**: 1830-1841 [PMID: 33965067 DOI: 10.1016/S0140-6736(21)00591-2]

2 **Abu Dayyeh BK**, Bazerbachi F, Vargas EJ, Sharaiha RZ, Thompson CC, Thaemert BC, Teixeira AF, Chapman CG, Kumbhari V, Ujiki MB, Ahrens J, Day C; MERIT Study Group, Galvao Neto M, Zundel N, Wilson EB. Endoscopic sleeve gastroplasty for treatment of class 1 and 2 obesity (MERIT): a prospective, multicentre, randomised trial. *Lancet* 2022; **400**: 441-451 [PMID: 35908555 DOI: 10.1016/S0140-6736(22)01280-6]

3 **Wadden TA**, Kushner RF, Chao AM. Bariatric Surgery Produces Long-Term Benefits in Patients With Type 2 Diabetes: Evidence Supporting

Its Expanded Use and Coverage. *JAMA* 2024; **331**: 643-645 [PMID: 38411656 DOI: 10.1001/jama.2023.28141]
4 **Harris E**. Weight Loss Surgery Managed Blood Pressure for People With Obesity. *JAMA* 2024; **331**: 725-726 [PMID: 38353978 DOI: 10.1001/jama.2024.0355]
5 **Hart S**, Tobias L. A dramatic response to sleeve gastrectomy in a patient with severe obstructive sleep apnea. *Sleep* 2023; **46** Suppl 1: A440 [DOI: 10.1093/sleep/zsad077.0999]
6 **Verrastro O**, Panunzi S, Castagneto-Gissey L, De Gaetano A, Lembo E, Capristo E, Guidone C, Angelini G, Pennestrì F, Sessa L, Vecchio FM, Riccardi L, Zocco MA, Boskoski I, Casella-Mariolo JR, Marini P, Pompili M, Casella G, Fiori E, Rubino F, Bornstein SR, Raffaelli M, Mingrone G. Bariatric-metabolic surgery versus lifestyle intervention plus best medical care in non-alcoholic steatohepatitis (BRAVES): a multicentre, open-label, randomised trial. *Lancet* 2023; **401**: 1786-1797 [PMID: 37088093 DOI: 10.1016/S0140-6736(23)00634-7]
7 **Lohmander LS**, Peltonen M, Andersson-Assarsson JC, Maglio C, Sjöholm K, Taube M, Jacobson P, Svensson PA, Carlsson LMS, Ahlin S. Bariatric surgery, osteoarthritis and arthroplasty of the hip and knee in Swedish Obese Subjects - up to 31 years follow-up of a controlled intervention study. *Osteoarthritis Cartilage* 2023; **31**: 636-646 [PMID: 36754250 DOI: 10.1016/j.joca.2022.11.015]
8 **Samarasinghe SNS**, Leca B, Alabdulkader S, Dimitriadis GK, Davasgaium A, Thadani P, Parry K, Luli M, O'Donnell K, Johnson B, Abbara A, Seyfried F, Morman R, Ahmed AR, Hakky S, Tsironis C, Purkayastha S, le Roux CW, Franks S, Menon V, Randeva H, Miras AD. Bariatric surgery for spontaneous ovulation in women living with polycystic ovary syndrome: the BAMBINI multicentre, open-label, randomised controlled trial. *Lancet* 2024; **403**: 2489-2503 [PMID: 38782004 DOI: 10.1016/S0140-6736(24)00538-5]
9 **Kukla A**, Kudva YC, Navratil P, Sahi SS, Benzo RP, Fipps DC, Erickson AE, Majorowicz RR, Clark MM, Schinstock CA, Shah P, Shah M, Diwan TS. Management of Patients With Kidney Disease Undergoing Bariatric Surgery: A Multidisciplinary Approach. *Mayo Clin Proc* 2024; **99**: 445-458 [PMID: 38432750 DOI: 10.1016/j.mayocp.2023.11.008]
10 **Hannon TS**, Arslanian SA. Obesity in Adolescents. *N Engl J Med* 2023; **389**: 251-261 [PMID: 37467499 DOI: 10.1056/NEJMcp2102062]
11 **Baker JL**, Olsen LW, Sørensen TI. Childhood body-mass index and the risk of coronary heart disease in adulthood. *N Engl J Med* 2007; **357**: 2329-2337 [PMID: 18057335 DOI: 10.1056/NEJMoa072515]
12 **Twig G**, Yaniv G, Levine H, Leiba A, Goldberger N, Derazne E, Ben-Ami Shor D, Tzur D, Afek A, Shamiss A, Haklai Z, Kark JD. Body-Mass Index in 2.3 Million Adolescents and Cardiovascular Death in Adulthood. *N Engl J Med* 2016; **374**: 2430-2440 [PMID: 27074389 DOI: 10.1056/NEJMoa1503840]
13 **Bjerregaard LG**, Jensen BW, Ängquist L, Osler M, Sørensen TIA, Baker JL. Change in Overweight from Childhood to Early Adulthood and Risk of Type 2 Diabetes. *N Engl J Med* 2018; **378**: 1302-1312 [PMID: 29617589 DOI: 10.1056/NEJMoa1713231]
14 **Manuel SS**, Luis GM. Nutrition, Obesity and Asthma Inception in Children. The Role of Lung Function. *Nutrients* 2021; **13** [PMID: 34836093 DOI: 10.3390/nu13113837]
15 **Paulis WD**, Silva S, Koes BW, van Middelkoop M. Overweight and obesity are associated with musculoskeletal complaints as early as childhood: a systematic review. *Obes Rev* 2014; **15**: 52-67 [PMID: 23941399 DOI: 10.1111/obr.12067]
16 **Puhl RM**, Lessard LM. Weight Stigma in Youth: Prevalence, Consequences, and Considerations for Clinical Practice. *Curr Obes Rep* 2020; **9**: 402-411 [PMID: 33079337 DOI: 10.1007/s13679-020-00408-8]
17 **Shah A**, Liang NE, Bruzoni M, Pratt JSA, Zitsman J, Nadler EP. Outcomes after metabolic and bariatric surgery in preteens versus teens using the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program database and center-specific data. *Obesity (Silver Spring)* 2024; **32**: 150-155 [PMID: 37800184 DOI: 10.1002/oby.23908]
18 **Ahn SM**. Current Issues in Bariatric Surgery for Adolescents with Severe Obesity: Durability, Complications, and Timing of Intervention. *J Obes Metab Syndr* 2020; **29**: 4-11 [PMID: 32183507 DOI: 10.7570/jomes19073]
19 **Jaklevic MC**. The Push for Earlier Bariatric Surgery for Adolescents With Severe Obesity. *JAMA* 2021; **325**: 2241-2242 [PMID: 34014255 DOI: 10.1001/jama.2021.7912]
20 **Wang CC**, Zhang P, Yang JG, Dong ZY. Guidelines for the Surgical Treatment of Obesity in Children and Adolescents in China (2019 Edition). *Zhonghua Feipang Yu Daixiebing Dianzi Zazhi* 2019; **5**: 3-9 [DOI: 10.3877/cma.j.issn.2095-9605.2019.01.001]
21 **Panca M**, Viner RM, White B, Pandya T, Melo H, Adamo M, Batterham R, Christie D, Kinra S, Morris S. Cost-effectiveness of bariatric surgery in adolescents with severe obesity in the UK. *Clin Obes* 2018; **8**: 105-113 [PMID: 29224241 DOI: 10.1111/cob.12232]
22 **Xia Q**, Campbell JA, Ahmad H, Si L, de Graaff B, Palmer AJ. Bariatric surgery is a cost-saving treatment for obesity-A comprehensive meta-analysis and updated systematic review of health economic evaluations of bariatric surgery. *Obes Rev* 2020; **21**: e12932 [PMID: 31733033 DOI: 10.1111/obr.12932]
23 **McGlone ER**, Carey I, Veličković V, Chana P, Mahawar K, Batterham RL, Hopkins J, Walton P, Kinsman R, Byrne J, Somers S, Kerrigan D, Menon V, Borg C, Ahmed A, Sgromo B, Cheruvu C, Bano G, Leonard C, Thom H, le Roux CW, Reddy M, Welbourn R, Small P, Khan OA. Bariatric surgery for patients with type 2 diabetes mellitus requiring insulin: Clinical outcome and cost-effectiveness analyses. *PLoS Med* 2020; **17**: e1003228 [PMID: 33285553 DOI: 10.1371/journal.pmed.1003228]
24 **Herouvi D**, Soldatou A, Paschou SA, Kalpia C, Karanasios S, Karavanaki K. Bariatric surgery in the management of childhood and adolescence obesity. *Endocrine* 2023; **79**: 411-419 [PMID: 36194346 DOI: 10.1007/s12020-022-03210-9]
25 **Vinan-Vega M**, Diaz Vico T, Elli EF. Bariatric Surgery in the Elderly Patient: Safety and Short-time Outcome. A Case Match Analysis. *Obes Surg* 2019; **29**: 1007-1011 [PMID: 30536201 DOI: 10.1007/s11695-018-03633-2]
26 **Lainas P**, Dammaro C, Gaillard M, Donatelli G, Tranchart H, Dagher I. Safety and short-term outcomes of laparoscopic sleeve gastrectomy for patients over 65 years old with severe obesity. *Surg Obes Relat Dis* 2018; **14**: 952-959 [PMID: 29703506 DOI: 10.1016/j.soard.2018.03.002]
27 **Smith ME**, Bacal D, Bonham AJ, Varban OA, Carlin AM, Ghaferi AA, Finks JF. Perioperative and 1-year outcomes of bariatric surgery in septuagenarians: implications for patient selection. *Surg Obes Relat Dis* 2019; **15**: 1805-1811 [PMID: 31530451 DOI: 10.1016/j.soard.2019.08.002]
28 **Al-Kurd A**, Grinbaum R, Mordechay-Heyn T, Asli S, Abubeih A, Mizrahi I, Mazeh H, Beglaibter N. Outcomes of Sleeve Gastrectomy in Septuagenarians. *Obes Surg* 2018; **28**: 3895-3901 [PMID: 30032420 DOI: 10.1007/s11695-018-3418-2]
29 **Hammond JB**, Webb CJ, Pulivarthi VSKK, Pearson DG, Harold KL, Madura JA 2nd. Is There an Upper Age Limit for Bariatric Surgery? Laparoscopic Gastric Bypass Outcomes in Septuagenarians. *Obes Surg* 2020; **30**: 2482-2486 [PMID: 32152838 DOI: 10.1007/s11695-020-04532-1]
30 **Pereira PR**, Guimarães M, Morais T, Pereira SS, Nora M, Monteiro MP. Diabetic and Elder Patients Experience Superior Cardiovascular Benefits After Gastric Bypass Induced Weight Loss. *Front Endocrinol (Lausanne)* 2018; **9**: 718 [PMID: 30546346 DOI: 10.3389/fendo.2018.00718]

31 **Miller ME**, Kral JG. Surgery for obesity in older women. *Menopause Int* 2008; **14**: 155-162 [PMID: 19037064 DOI: 10.1258/mi.2008.008028]

32 **De Luca M**, Angrisani L, Himpens J, Busetto L, Scopinaro N, Weiner R, Sartori A, Stier C, Lakdawala M, Bhasker AG, Buchwald H, Dixon J, Chiappetta S, Kolberg HC, Frühbeck G, Sarwer DB, Suter M, Soricelli E, Blüher M, Vilallonga R, Sharma A, Shikora S. Indications for Surgery for Obesity and Weight-Related Diseases: Position Statements from the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO). *Obes Surg* 2016; **26**: 1659-1696 [PMID: 27412673 DOI: 10.1007/s11695-016-2271-4]

33 **Mohammed N**, Buckley A, Elsheikh M, Allum M, Suliman S, Al Hadad M, le Roux CW, Lessan N, Suliman M. Bariatric surgery in the treatment of patients with obesity and type 1 diabetes: A retrospective study of clinical data. *Diabetes Obes Metab* 2021; **23**: 1562-1570 [PMID: 33687753 DOI: 10.1111/dom.14369]

34 **Vilarrasa N**, Rubio MA, Miñambres I, Flores L, Caixàs A, Ciudin A, Bueno M, García-Luna PP, Ballesteros-Pomar MD, Ruiz-Adana M, Lecube A. Long-Term Outcomes in Patients with Morbid Obesity and Type 1 Diabetes Undergoing Bariatric Surgery. *Obes Surg* 2017; **27**: 856-863 [PMID: 27709487 DOI: 10.1007/s11695-016-2390-y]

35 **Landau Z**, Kowen-Sandbank G, Jakubowicz D, Raziel A, Sakran N, Zaslavsky-Paltiel I, Lerner-Geva L, Pinhas-Hamiel O. Bariatric surgery in patients with type 1 diabetes: special considerations are warranted. *Ther Adv Endocrinol Metab* 2019; **10**: 2042018818822207 [PMID: 30728940 DOI: 10.1177/2042018818822207]

36 **Hussain A**. The effect of metabolic surgery on type 1 diabetes: meta-analysis. *Arch Endocrinol Metab* 2018; **62**: 172-178 [PMID: 29641734 DOI: 10.20945/2359-3997000000021]

37 **Rubino F**, Marescaux J. Effect of duodenal-jejunal exclusion in a non-obese animal model of type 2 diabetes: a new perspective for an old disease. *Ann Surg* 2004; **239**: 1-11 [PMID: 14685093 DOI: 10.1097/01.sla.0000102989.54824.fc]

38 **Pacheco D**, de Luis DA, Romero A, González Sagrado M, Conde R, Izaola O, Aller R, Delgado A. The effects of duodenal-jejunal exclusion on hormonal regulation of glucose metabolism in Goto-Kakizaki rats. *Am J Surg* 2007; **194**: 221-224 [PMID: 17618808 DOI: 10.1016/j.amjsurg.2006.11.015]

39 **DePaula AL**, Macedo AL, Mota BR, Schraibman V. Laparoscopic ileal interposition associated to a diverted sleeve gastrectomy is an effective operation for the treatment of type 2 diabetes mellitus patients with BMI 21-29. *Surg Endosc* 2009; **23**: 1313-1320 [PMID: 18830750 DOI: 10.1007/s00464-008-0156-x]

40 **Zhang X**, Cheng Z, Xiao Z, Du X, Du J, Li Y, Long Y, Yu H, Zhang X, Tian H. Comparison of Short- and Mid-term Efficacy and the Mechanisms of Gastric Bypass Surgeries on Managing Obese and Nonobese Type 2 Diabetes Mellitus: A Prospective Study. *Arch Med Res* 2015; **46**: 303-309 [PMID: 26087171 DOI: 10.1016/j.arcmed.2015.06.003]

41 **Malapan K**, Goel R, Tai CM, Kao YH, Chang PC, Huang CK. Laparoscopic Roux-en-Y gastric bypass for nonobese type II diabetes mellitus in Asian patients. *Surg Obes Relat Dis* 2014; **10**: 834-840 [PMID: 24857051 DOI: 10.1016/j.soard.2014.01.018]

42 **Jiang F**, Zhu H, Zheng X, Tu J, Zhang W, Xie X. Duodenal-jejunal bypass for the treatment of type 2 diabetes in Chinese patients with an average body mass index<24 kg/m2. *Surg Obes Relat Dis* 2014; **10**: 641-646 [PMID: 24238729 DOI: 10.1016/j.soard.2013.09.001]

43 **Daniele G**, Lunghi C, Dardano A, Binda P, Ceccarini G, Santini F, Giusti L, Ciccarone A, Bellini R, Moretto C, Morrone MC, Del Prato S. Bariatric surgery restores visual cortical plasticity in nondiabetic subjects with obesity. *Int J Obes (Lond)* 2021; **45**: 1821-1829 [PMID: 34002040 DOI: 10.1038/s41366-021-00851-0]

44 **Luo Y**, Haddad RA, Ontan MS, Eldin AWJ, Abu-Rumaileh M, Yosef M, Khalatbari S, Varban O, Kraftson A, Esfandiari NH, Oral EA. Impact of diabetes on weight loss outcomes after bariatric surgery: Experience from 5-year follow-up of Michigan Bariatric Surgery Cohort. *Clin Endocrinol (Oxf)* 2023; **99**: 285-295 [PMID: 37041100 DOI: 10.1111/cen.14922]

45 **Varban OA**, Cassidy RB, Bonham A, Carlin AM, Ghaferi A, Finks JF; Michigan Bariatric Surgery Collaborative. Factors Associated With Achieving a Body Mass Index of Less Than 30 After Bariatric Surgery. *JAMA Surg* 2017; **152**: 1058-1064 [PMID: 28746723 DOI: 10.1001/jamasurg.2017.2348]

46 **Bashir B**, Iqbal Z, Adam S, Ferdousi M, Chick W, Hussein HA, Syed AA, Le Roux CW, Cohen RV, Malik RA, Soran H. Microvascular complications of obesity and diabetes-Role of bariatric surgery. *Obes Rev* 2023; **24**: e13602 [PMID: 37515402 DOI: 10.1111/obr.13602]

47 **Noubissi EC**, Katte JC, Sobngwi E. Diabetes and HIV. *Curr Diab Rep* 2018; **18**: 125 [PMID: 30294763 DOI: 10.1007/s11892-018-1076-3]

48 **Flancbaum L**, Drake V, Colarusso T, Belsley S. Initial experience with bariatric surgery in asymptomatic human immunodeficiency virus-infected patients. *Surg Obes Relat Dis* 2005; **1**: 73-76 [PMID: 16925217 DOI: 10.1016/j.soard.2005.02.004]

49 **Fazylov R**, Soto E, Merola S. Laparoscopic gastric bypass surgery in human immunodeficiency virus-infected patients. *Surg Obes Relat Dis* 2007; **3**: 637-639 [PMID: 17936082 DOI: 10.1016/j.soard.2007.08.012]

50 **Yang W**, Zalin A, Nelson M, Bonanomi G, Smellie J, Shotliff K, Efthimiou E, Greener V. Bariatric surgery in individuals with human immunodeficiency virus and type 2 diabetes: a case series. *J Med Case Rep* 2019; **13**: 146 [PMID: 31072397 DOI: 10.1186/s13256-019-2078-8]

51 **Renehan AG**, Tyson M, Egger M, Heller RF, Zwahlen M. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. *Lancet* 2008; **371**: 569-578 [PMID: 18280327 DOI: 10.1016/S0140-6736(08)60269-X]

52 **Lauby-Secretan B**, Scoccianti C, Loomis D, Grosse Y, Bianchini F, Straif K; International Agency for Research on Cancer Handbook Working Group. Body Fatness and Cancer--Viewpoint of the IARC Working Group. *N Engl J Med* 2016; **375**: 794-798 [PMID: 27557308 DOI: 10.1056/NEJMsr1606602]

53 **Zhang K**, Luo Y, Dai H, Deng Z. Effects of Bariatric Surgery on Cancer Risk: Evidence from Meta-analysis. *Obes Surg* 2020; **30**: 1265-1272 [PMID: 31865552 DOI: 10.1007/s11695-019-04368-4]

54 **Arterburn DE**, Telem DA, Kushner RF, Courcoulas AP. Benefits and Risks of Bariatric Surgery in Adults: A Review. *JAMA* 2020; **324**: 879-887 [PMID: 32870301 DOI: 10.1001/jama.2020.12567]

55 **Schauer DP**, Feigelson HS, Koebnick C, Caan B, Weinmann S, Leonard AC, Powers JD, Yenumula PR, Arterburn DE. Bariatric Surgery and the Risk of Cancer in a Large Multisite Cohort. *Ann Surg* 2019; **269**: 95-101 [PMID: 28938270 DOI: 10.1097/SLA.0000000000002525]

56 **Feigelson HS**, Caan B, Weinmann S, Leonard AC, Powers JD, Yenumula PR, Arterburn DE, Koebnick C, Altaye M, Schauer DP. Bariatric Surgery is Associated With Reduced Risk of Breast Cancer in Both Premenopausal and Postmenopausal Women. *Ann Surg* 2020; **272**: 1053-1059 [PMID: 30998538 DOI: 10.1097/SLA.0000000000003331]

57 **Anveden Å**, Taube M, Peltonen M, Jacobson P, Andersson-Assarsson JC, Sjöholm K, Svensson PA, Carlsson LMS. Long-term incidence of female-specific cancer after bariatric surgery or usual care in the Swedish Obese Subjects Study. *Gynecol Oncol* 2017; **145**: 224-229 [PMID: 28259424 DOI: 10.1016/j.ygyno.2017.02.036]

58 **Winder AA**, Kularatna M, MacCormick AD. Does Bariatric Surgery Affect the Incidence of Breast Cancer Development? A Systematic

Review. *Obes Surg* 2017; **27**: 3014-3020 [PMID: 28840450 DOI: 10.1007/s11695-017-2901-5]

59 **Winder AA**, Kularatna M, MacCormick AD. Does Bariatric Surgery Affect the Incidence of Endometrial Cancer Development? A Systematic Review. *Obes Surg* 2018; **28**: 1433-1440 [PMID: 29512036 DOI: 10.1007/s11695-018-3151-x]

60 **Lim PW**, Stucky CH, Wasif N, Etzioni DA, Harold KL, Madura JA 2nd, Ven Fong Z. Bariatric Surgery and Longitudinal Cancer Risk: A Review. *JAMA Surg* 2024; **159**: 331-338 [PMID: 38294801 DOI: 10.1001/jamasurg.2023.5809]

61 **Bruno DS**, Berger NA. Impact of bariatric surgery on cancer risk reduction. *Ann Transl Med* 2020; **8**: S13 [PMID: 32309417 DOI: 10.21037/atm.2019.09.26]

62 **Hussan H**, Stanich PP, Gray DM 2nd, Krishna SG, Porter K, Conwell DL, Clinton SK. Prior Bariatric Surgery Is Linked to Improved Colorectal Cancer Surgery Outcomes and Costs: A Propensity-Matched Analysis. *Obes Surg* 2017; **27**: 1047-1055 [PMID: 27770262 DOI: 10.1007/s11695-016-2421-8]

63 **Orlando G**, Pilone V, Vitiello A, Gervasi R, Lerose MA, Silecchia G, Puzziello A. Gastric cancer following bariatric surgery: a review. *Surg Laparosc Endosc Percutan Tech* 2014; **24**: 400-405 [PMID: 25238176 DOI: 10.1097/SLE.0000000000000050]

64 **Musella M**, Berardi G, Bocchetti A, Green R, Cantoni V, Velotti N, Di Lauro K, Manzolillo D, Vitiello A, Milone M, De Palma GD. Esophagogastric Neoplasms Following Bariatric Surgery: an Updated Systematic Review. *Obes Surg* 2019; **29**: 2660-2669 [PMID: 31129886 DOI: 10.1007/s11695-019-03951-z]

65 **Almazeedi S**, El-Abd R, Al-Khamis A, Albatineh AN, Al-Sabah S. Role of bariatric surgery in reducing the risk of colorectal cancer: a meta-analysis. *Br J Surg* 2020; **107**: 348-354 [PMID: 31976551 DOI: 10.1002/bjs.11494]

66 **Bailly L**, Fabre R, Pradier C, Iannelli A. Colorectal Cancer Risk Following Bariatric Surgery in a Nationwide Study of French Individuals With Obesity. *JAMA Surg* 2020; **155**: 395-402 [PMID: 32159744 DOI: 10.1001/jamasurg.2020.0089]

67 **Aravani A**, Downing A, Thomas JD, Lagergren J, Morris EJA, Hull MA. Obesity surgery and risk of colorectal and other obesity-related cancers: An English population-based cohort study. *Cancer Epidemiol* 2018; **53**: 99-104 [PMID: 29414638 DOI: 10.1016/j.canep.2018.01.002]

68 **Hussan H**, Patel A, Akinyeye S, Porter K, Ahnen D, Lieberman D. Bariatric Surgery Is Associated with a Recent Temporal Increase in Colorectal Cancer Resections, Most Pronounced in Adults Below 50 Years of Age. *Obes Surg* 2020; **30**: 4867-4876 [PMID: 32789550 DOI: 10.1007/s11695-020-04902-9]

69 **Derogar M**, Hull MA, Kant P, Östlund M, Lu Y, Lagergren J. Increased risk of colorectal cancer after obesity surgery. *Ann Surg* 2013; **258**: 983-988 [PMID: 23470581 DOI: 10.1097/SLA.0b013e318288463a]

70 **Bhasker AG**, Prasad A, Raj PP, Wadhawan R, Khaitan M, Agarwal AJ, Tantia O, Baig S, Palaniappan R, Shivram HV, Shah S, Soni V, Bhandari M, Shivahare R, Dhorepatil S, Chowbey P, Narwaria M, Shah S, Khullar R. OSSI (Obesity and Metabolic Surgery Society of India) Guidelines for Patient and Procedure Selection for Bariatric and Metabolic Surgery. *Obes Surg* 2020; **30**: 2362-2368 [PMID: 32125645 DOI: 10.1007/s11695-020-04497-1]

71 **Di Lorenzo N**, Antoniou SA, Batterham RL, Busetto L, Godoroja D, Iossa A, Carrano FM, Agresta F, Alarçon I, Azran C, Bouvy N, Balaguè Ponz C, Buza M, Copaescu C, De Luca M, Dicker D, Di Vincenzo A, Felsenreich DM, Francis NK, Fried M, Gonzalo Prats B, Goitein D, Halford JCG, Herlesova J, Kalogridaki M, Ket H, Morales-Conde S, Piatto G, Prager G, Pruijssers S, Pucci A, Rayman S, Romano E, Sanchez-Cordero S, Vilallonga R, Silecchia G. Clinical practice guidelines of the European Association for Endoscopic Surgery (EAES) on bariatric surgery: update 2020 endorsed by IFSO-EC, EASO and ESPCOP. *Surg Endosc* 2020; **34**: 2332-2358 [PMID: 32328827 DOI: 10.1007/s00464-020-07555-y]

72 **Busetto L**, Dicker D, Azran C, Batterham RL, Farpour-Lambert N, Fried M, Hjelmesæth J, Kinzl J, Leitner DR, Makaronidis JM, Schindler K, Toplak H, Yumuk V. Practical Recommendations of the Obesity Management Task Force of the European Association for the Study of Obesity for the Post-Bariatric Surgery Medical Management. *Obes Facts* 2017; **10**: 597-632 [PMID: 29207379 DOI: 10.1159/000481825]

73 **Cooper TC**, Simmons EB, Webb K, Burns JL, Kushner RF. Trends in Weight Regain Following Roux-en-Y Gastric Bypass (RYGB) Bariatric Surgery. *Obes Surg* 2015; **25**: 1474-1481 [PMID: 25595383 DOI: 10.1007/s11695-014-1560-z]

74 **Lauti M**, Lemanu D, Zeng ISL, Su'a B, Hill AG, MacCormick AD. Definition determines weight regain outcomes after sleeve gastrectomy. *Surg Obes Relat Dis* 2017; **13**: 1123-1129 [PMID: 28438493 DOI: 10.1016/j.soard.2017.02.029]

75 **Aminian A**, Vidal J, Salminen P, Still CD, Nor Hanipah Z, Sharma G, Tu C, Wood GC, Ibarzabal A, Jimenez A, Brethauer SA, Schauer PR, Mahawar K. Late Relapse of Diabetes After Bariatric Surgery: Not Rare, but Not a Failure. *Diabetes Care* 2020; **43**: 534-540 [PMID: 31974105 DOI: 10.2337/dc19-1057]

76 **Carlsson LM**, Peltonen M, Ahlin S, Anveden Å, Bouchard C, Carlsson B, Jacobson P, Lönroth H, Maglio C, Näslund I, Pirazzi C, Romeo S, Sjöholm K, Sjöström E, Wedel H, Svensson PA, Sjöström L. Bariatric surgery and prevention of type 2 diabetes in Swedish obese subjects. *N Engl J Med* 2012; **367**: 695-704 [PMID: 22913680 DOI: 10.1056/NEJMoa1112082]

77 **Nor Hanipah Z**, Punchai S, Brethauer SA, Schauer PR, Aminian A. Development of De Novo Diabetes in Long-Term Follow-up After Bariatric Surgery. *Obes Surg* 2018; **28**: 2247-2251 [PMID: 29524184 DOI: 10.1007/s11695-018-3194-z]

78 **Debédat J**, Sokolovska N, Coupaye M, Panunzi S, Chakaroun R, Genser L, de Turenne G, Bouillot JL, Poitou C, Oppert JM, Blüher M, Stumvoll M, Mingrone G, Ledoux S, Zucker JD, Clément K, Aron-Wisnewsky J. Long-term Relapse of Type 2 Diabetes After Roux-en-Y Gastric Bypass: Prediction and Clinical Relevance. *Diabetes Care* 2018; **41**: 2086-2095 [PMID: 30082327 DOI: 10.2337/dc18-0567]

79 **Sjöholm K**, Svensson PA, Taube M, Jacobson P, Andersson-Assarsson JC, Carlsson LMS, Peltonen M. Evaluation of Prediction Models for Type 2 Diabetes Relapse After Post-bariatric Surgery Remission: a Post hoc Analysis of 15-Year Follow-up Data from the Swedish Obese Subjects (SOS) Study. *Obes Surg* 2020; **30**: 3955-3960 [PMID: 32535782 DOI: 10.1007/s11695-020-04763-2]

80 **Kwon Y**, Kwon JW, Kim D, Ha J, Park SH, Hwang J, Heo Y, Park S. Predictors of Remission and Relapse of Diabetes after Conventional Gastrectomy for Gastric Cancer: Nationwide Population-Based Cohort Study. *J Am Coll Surg* 2021; **232**: 973-981.e2 [PMID: 33831541 DOI: 10.1016/j.jamcollsurg.2021.03.019]

81 **Ciudin A**, Fidilio E, Ortiz A, Pich S, Salas E, Mesa J, Hernández C, Simó-Servat O, Lecube A, Simó R. Genetic Testing to Predict Weight Loss and Diabetes Remission and Long-Term Sustainability after Bariatric Surgery: A Pilot Study. *J Clin Med* 2019; **8** [PMID: 31277226 DOI: 10.3390/jcm8070964]

82 **Shukla AP**, He D, Saunders KH, Andrew C, Aronne LJ. Current concepts in management of weight regain following bariatric surgery. *Expert Rev Endocrinol Metab* 2018; **13**: 67-76 [PMID: 30058859 DOI: 10.1080/17446651.2018.1447922]

83 **Koliaki C**, Liatis S, le Roux CW, Kokkinos A. The role of bariatric surgery to treat diabetes: current challenges and perspectives. *BMC Endocr Disord* 2017; **17**: 50 [PMID: 28797248 DOI: 10.1186/s12902-017-0202-6]

84 **Moriconi D**, Manca ML, Anselmino M, Rebelos E, Bellini R, Taddei S, Ferrannini E, Nannipieri M. Predictors of type 2 diabetes relapse after Roux-en-Y Gastric Bypass: A ten-year follow-up study. *Diabetes Metab* 2022; **48**: 101282 [PMID: 34547450 DOI:

10.1016/j.diabet.2021.101282]

85 **Jans A**, Szabo E, Näslund I, Ottosson J, Näslund E, Stenberg E. Factors affecting relapse of type 2 diabetes after bariatric surgery in Sweden 2007-2015: a registry-based cohort study. *Surg Obes Relat Dis* 2022; **18**: 305-312 [PMID: 34974997 DOI: 10.1016/j.soard.2021.12.005]

86 **Jans A**, Näslund I, Ottosson J, Szabo E, Näslund E, Stenberg E. Duration of type 2 diabetes and remission rates after bariatric surgery in Sweden 2007-2015: A registry-based cohort study. *PLoS Med* 2019; **16**: e1002985 [PMID: 31747392 DOI: 10.1371/journal.pmed.1002985]

87 **Molarius A**, Lindén-Boström M, Granström F, Karlsson J. Obesity continues to increase in the majority of the population in mid-Sweden-a 12-year follow-up. *Eur J Public Health* 2016; **26**: 622-627 [PMID: 27074794 DOI: 10.1093/eurpub/ckw042]

88 **Nuijten MAH**, Tettero OM, Wolf RJ, Bakker EA, Eijsvogels TMH, Monpellier VM, Hazebroek EJ, Janssen IMC, Hopman MTE. Changes in Physical Activity in Relation to Body Composition, Fitness and Quality of Life after Primary Bariatric Surgery: a Two-Year Follow-Up Study. *Obes Surg* 2021; **31**: 1120-1128 [PMID: 33331984 DOI: 10.1007/s11695-020-05009-x]

89 **Lee PC**, Dixon JB, Sim PY, Lim CH. Treatment Options for Poor Responders to Bariatric Surgery. *Curr Obes Rep* 2020; **9**: 364-372 [PMID: 32447714 DOI: 10.1007/s13679-020-00381-2]

90 **Busetto L**. Timing of bariatric surgery in people with obesity and diabetes. *Ann Transl Med* 2015; **3**: 94 [PMID: 26015936 DOI: 10.3978/j.issn.2305-5839.2015.03.62]

91 **Moradi M**, Kabir A, Khalili D, Lakeh MM, Dodaran MS, Pazouki A, Kermansaravi M, Alibeigi P, Moazenzadeh H, Abdolhosseini MR, Eghbali F, Baradaran HR. Type 2 diabetes remission after Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG), and one anastomosis gastric bypass (OAGB): results of the longitudinal assessment of bariatric surgery study. *BMC Endocr Disord* 2022; **22**: 260 [PMID: 36289529 DOI: 10.1186/s12902-022-01171-8]

92 **Stenberg E**, Olbers T, Cao Y, Sundbom M, Jans A, Ottosson J, Naslund E, Näslund I. Factors determining chance of type 2 diabetes remission after Roux-en-Y gastric bypass surgery: a nationwide cohort study in 8057 Swedish patients. *BMJ Open Diabetes Res Care* 2021; **9** [PMID: 33990366 DOI: 10.1136/bmjdrc-2020-002033]

93 **Rebibo L**, Verhaeghe P, Cosse C, Dhahri A, Maréchal V, Regimbeau JM. Does longitudinal sleeve gastrectomy have a family "halo effect"? A case-matched study. *Surg Endosc* 2013; **27**: 1748-1753 [PMID: 23292552 DOI: 10.1007/s00464-012-2673-x]

94 **Mehta A**, Hutfless S, Blair AB, Karcher M, Nasatka S, Schweitzer M, Magnuson T, Nguyen HT. Outcomes of Partnered Individuals Undergoing Bariatric Surgery Together: A Single Institution Case Series. *Obes Surg* 2017; **27**: 2207-2210 [PMID: 28560527 DOI: 10.1007/s11695-017-2728-0]

95 **Hainer V**, Stunkard A, Kunesová M, Parízková J, Stich V, Allison DB. A twin study of weight loss and metabolic efficiency. *Int J Obes Relat Metab Disord* 2001; **25**: 533-537 [PMID: 11319658 DOI: 10.1038/sj.ijo.0801559]

96 **Boswell L**, Jiménez A, Ortega E, Pané A, Hollanda A, Moizé V, Andreu A, Ibarzabal A, Flores L, Vidal J. Genetic background influences weight-loss trajectories on the mid-term after bariatric surgery. *Int J Obes (Lond)* 2019; **43**: 1869-1874 [PMID: 30301966 DOI: 10.1038/s41366-018-0229-4]

97 **Hatoum IJ**, Greenawalt DM, Cotsapas C, Reitman ML, Daly MJ, Kaplan LM. Heritability of the weight loss response to gastric bypass surgery. *J Clin Endocrinol Metab* 2011; **96**: E1630-E1633 [PMID: 21832118 DOI: 10.1210/jc.2011-1130]

98 **Pinu FR**, Beale DJ, Paten AM, Kouremenos K, Swarup S, Schirra HJ, Wishart D. Systems Biology and Multi-Omics Integration: Viewpoints from the Metabolomics Research Community. *Metabolites* 2019; **9** [PMID: 31003499 DOI: 10.3390/metabo9040076]

99 **Bray MS**, Loos RJ, McCaffery JM, Ling C, Franks PW, Weinstock GM, Snyder MP, Vassy JL, Agurs-Collins T; Conference Working Group. NIH working group report-using genomic information to guide weight management: From universal to precision treatment. *Obesity (Silver Spring)* 2016; **24**: 14-22 [PMID: 26692578 DOI: 10.1002/oby.21381]

100 **Ciudin A**, Fidilio E, Gutiérrez-Carrasquilla L, Caixàs A, Vilarrasa N, Pellitero S, Simó-Servat A, Vilallonga R, Ruiz A, de la Fuente M, Luna A, Sánchez E, Rigla M, Hernández C, Salas E, Simó R, Lecube A. A Clinical-Genetic Score for Predicting Weight Loss after Bariatric Surgery: The OBEGEN Study. *J Pers Med* 2021; **11** [PMID: 34683180 DOI: 10.3390/jpm11101040]

101 **Service FJ**, Natt N, Thompson GB, Grant CS, van Heerden JA, Andrews JC, Lorenz E, Terzic A, Lloyd RV. Noninsulinoma pancreatogenous hypoglycemia: a novel syndrome of hyperinsulinemic hypoglycemia in adults independent of mutations in Kir6.2 and SUR1 genes. *J Clin Endocrinol Metab* 1999; **84**: 1582-1589 [PMID: 10323384 DOI: 10.1210/jcem.84.5.5645]

102 **Fischer LE**, Wolfe BM, Fino N, Elman MR, Flum DR, Mitchell JE, Pomp A, Pories WJ, Purnell JQ, Patti ME; LABS Investigators. Postbariatric hypoglycemia: symptom patterns and associated risk factors in the Longitudinal Assessment of Bariatric Surgery study. *Surg Obes Relat Dis* 2021; **17**: 1787-1798 [PMID: 34294589 DOI: 10.1016/j.soard.2021.04.021]

103 **Coffin J**, Haase A, Levy JA, Montagnier L, Oroszlan S, Teich N, Temin H, Toyoshima K, Varmus H, Vogt P. What to call the AIDS virus? *Nature* 1986; **321**: 10 [PMID: 3010128 DOI: 10.1210/jc.2018-00528]

104 **Davis RE**, Morrissey M, Peters JR, Wittrup-Jensen K, Kennedy-Martin T, Currie CJ. Impact of hypoglycaemia on quality of life and productivity in type 1 and type 2 diabetes. *Curr Med Res Opin* 2005; **21**: 1477-1483 [PMID: 16197667 DOI: 10.1185/030079905X61929]

105 **Action to Control Cardiovascular Risk in Diabetes Study Group**, Gerstein HC, Miller ME, Byington RP, Goff DC Jr, Bigger JT, Buse JB, Cushman WC, Genuth S, Ismail-Beigi F, Grimm RH Jr, Probstfield JL, Simons-Morton DG, Friedewald WT. Effects of intensive glucose lowering in type 2 diabetes. *N Engl J Med* 2008; **358**: 2545-2559 [PMID: 18539917 DOI: 10.1056/NEJMoa0802743]

106 **Whitmer RA**, Karter AJ, Yaffe K, Quesenberry CP Jr, Selby JV. Hypoglycemic episodes and risk of dementia in older patients with type 2 diabetes mellitus. *JAMA* 2009; **301**: 1565-1572 [PMID: 19366776 DOI: 10.1001/jama.2009.460]

107 **Redelmeier DA**, Kenshole AB, Ray JG. Motor vehicle crashes in diabetic patients with tight glycemic control: a population-based case control analysis. *PLoS Med* 2009; **6**: e1000192 [PMID: 19997624 DOI: 10.1371/journal.pmed.1000192]

108 **Zoungas S**, Patel A, Chalmers J, de Galan BE, Li Q, Billot L, Woodward M, Ninomiya T, Neal B, MacMahon S, Grobbee DE, Kengne AP, Marre M, Heller S; ADVANCE Collaborative Group. Severe hypoglycemia and risks of vascular events and death. *N Engl J Med* 2010; **363**: 1410-1418 [PMID: 20925543 DOI: 10.1056/NEJMoa1003795]

109 **Lee CJ**, Wood GC, Lazo M, Brown TT, Clark JM, Still C, Benotti P. Risk of post-gastric bypass surgery hypoglycemia in nondiabetic individuals: A single center experience. *Obesity (Silver Spring)* 2016; **24**: 1342-1348 [PMID: 27225597 DOI: 10.1002/oby.21479]

110 **Lupoli R**, Lembo E, Ciciola P, Schiavo L, Pilone V, Capaldo B. Continuous glucose monitoring in subjects undergoing bariatric surgery: Diurnal and nocturnal glycemic patterns. *Nutr Metab Cardiovasc Dis* 2020; **30**: 1954-1960 [PMID: 32807631 DOI: 10.1016/j.numecd.2020.06.029]

111 **Emous M**, van den Broek M, Wijma RB, de Heide LJM, van Dijk G, Laskewitz A, Totté E, Wolffenbuttel BHR, van Beek AP. Prevalence of hypoglycaemia in a random population after Roux-en-Y gastric bypass after a meal test. *Endocr Connect* 2019; **8**: 969-978 [PMID: 31234142 DOI: 10.1530/EC-19-0268]

112 **Kefurt R**, Langer FB, Schindler K, Shakeri-Leidenmühler S, Ludvik B, Prager G. Hypoglycemia after Roux-En-Y gastric bypass: detection rates of continuous glucose monitoring (CGM) versus mixed meal test. *Surg Obes Relat Dis* 2015; **11**: 564-569 [PMID: 25737101 DOI: 10.1016/j.soard.2014.11.003]

113 **Patti ME**, Goldfine AB. The rollercoaster of post-bariatric hypoglycaemia. *Lancet Diabetes Endocrinol* 2016; **4**: 94-96 [PMID: 26701701 DOI: 10.1016/S2213-8587(15)00460-X]

114 **Service GJ**, Thompson GB, Service FJ, Andrews JC, Collazo-Clavell ML, Lloyd RV. Hyperinsulinemic hypoglycemia with nesidioblastosis after gastric-bypass surgery. *N Engl J Med* 2005; **353**: 249-254 [PMID: 16034010 DOI: 10.1056/NEJMoa043690]

115 **Cavin JB**, Couvelard A, Lebtahi R, Ducroc R, Arapis K, Voitellier E, Cluzeaud F, Gillard L, Hourseau M, Mikail N, Ribeiro-Parenti L, Kapel N, Marmuse JP, Bado A, Le Gall M. Differences in Alimentary Glucose Absorption and Intestinal Disposal of Blood Glucose After Roux-en-Y Gastric Bypass vs Sleeve Gastrectomy. *Gastroenterology* 2016; **150**: 454-64.e9 [PMID: 26481855 DOI: 10.1053/j.gastro.2015.10.009]

116 **Abrahamsson N**, Börjesson JL, Sundbom M, Wiklund U, Karlsson FA, Eriksson JW. Gastric Bypass Reduces Symptoms and Hormonal Responses in Hypoglycemia. *Diabetes* 2016; **65**: 2667-2675 [PMID: 27313315 DOI: 10.2337/db16-0341]

117 **Cummings DE**, Weigle DS, Frayo RS, Breen PA, Ma MK, Dellinger EP, Purnell JQ. Plasma ghrelin levels after diet-induced weight loss or gastric bypass surgery. *N Engl J Med* 2002; **346**: 1623-1630 [PMID: 12023994 DOI: 10.1056/NEJMoa012908]

118 **Shah A**, Holter MM, Rimawi F, Mark V, Dutia R, McGinty J, Levin B, Laferrère B. Insulin Clearance After Oral and Intravenous Glucose Following Gastric Bypass and Gastric Banding Weight Loss. *Diabetes Care* 2019; **42**: 311-317 [PMID: 30523032 DOI: 10.2337/dc18-1036]

119 **Botros N**, Rijnaarts I, Brandts H, Bleumink G, Janssen I, de Boer H. Effect of carbohydrate restriction in patients with hyperinsulinemic hypoglycemia after Roux-en-Y gastric bypass. *Obes Surg* 2014; **24**: 1850-1855 [PMID: 24902654 DOI: 10.1007/s11695-014-1319-6]

120 **Kandel D**, Bojsen-Møller KN, Svane MS, Samkani A, Astrup A, Holst JJ, Madsbad S, Krarup T. Mechanisms of action of a carbohydrate-reduced, high-protein diet in reducing the risk of postprandial hypoglycemia after Roux-en-Y gastric bypass surgery. *Am J Clin Nutr* 2019; **110**: 296-304 [PMID: 30624666 DOI: 10.1093/ajcn/nqy310]

121 **Salehi M**, Gastaldelli A, D'Alessio DA. Blockade of glucagon-like peptide 1 receptor corrects postprandial hypoglycemia after gastric bypass. *Gastroenterology* 2014; **146**: 669-680.e2 [PMID: 24315990 DOI: 10.1053/j.gastro.2013.11.044]

122 **Øhrstrøm CC**, Worm D, Højager A, Andersen D, Holst JJ, Kielgast UL, Hansen DL. Postprandial hypoglycaemia after Roux-en-Y gastric bypass and the effects of acarbose, sitagliptin, verapamil, liraglutide and pasireotide. *Diabetes Obes Metab* 2019; **21**: 2142-2151 [PMID: 31144430 DOI: 10.1111/dom.13796]

123 **Quan Y**, Barszczyk A, Feng ZP, Sun HS. Current understanding of K ATP channels in neonatal diseases: focus on insulin secretion disorders. *Acta Pharmacol Sin* 2011; **32**: 765-780 [PMID: 21602835 DOI: 10.1038/aps.2011.57]

124 **Tan M**, Lamendola C, Luong R, McLaughlin T, Craig C. Safety, efficacy and pharmacokinetics of repeat subcutaneous dosing of avexitide (exendin 9-39) for treatment of post-bariatric hypoglycaemia. *Diabetes Obes Metab* 2020; **22**: 1406-1416 [PMID: 32250530 DOI: 10.1111/dom.14048]

125 **Mulla CM**, Zavitsanou S, Laguna Sanz AJ, Pober D, Richardson L, Walcott P, Arora I, Newswanger B, Cummins MJ, Prestrelski SJ, Doyle FJ, Dassau E, Patti ME. A Randomized, Placebo-Controlled Double-Blind Trial of a Closed-Loop Glucagon System for Postbariatric Hypoglycemia. *J Clin Endocrinol Metab* 2020; **105**: e1260-e1271 [PMID: 31714583 DOI: 10.1210/clinem/dgz197]

126 **Proulx É**, Auclair A, Piché ME, Harvey J, Pettigrew M, Biertho L, Marceau S, Poirier P. Safety of Blood Glucose Response Following Exercise Training After Bariatric Surgery. *Obes Surg* 2018; **28**: 3976-3983 [PMID: 30097897 DOI: 10.1007/s11695-018-3449-8]

127 **Davis DB**, Khoraki J, Ziemelis M, Sirinvaravong S, Han JY, Campos GM. Roux en Y gastric bypass hypoglycemia resolves with gastric feeding or reversal: Confirming a non-pancreatic etiology. *Mol Metab* 2018; **9**: 15-27 [PMID: 29449181 DOI: 10.1016/j.molmet.2017.12.011]

128 **Rao BB**, Click B, Eid G, Codario RA. Management of Refractory Noninsulinoma Pancreatogenous Hypoglycemia Syndrome with Gastric Bypass Reversal: A Case Report and Review of the Literature. *Case Rep Endocrinol* 2015; **2015**: 384526 [PMID: 26523235 DOI: 10.1155/2015/384526]

129 **Sjöholm K**, Jacobson P, Taube M, Svensson PA, Andersson Assarsson JC, Carlsson LMS, Peltonen M. Long-term incidence of hypoglycaemia-related events after bariatric surgery or usual care in the Swedish Obese Subjects study: A register-based analysis. *Diabetes Obes Metab* 2021; **23**: 1917-1925 [PMID: 33961331 DOI: 10.1111/dom.14420]

130 **Nannipieri M**, Belligoli A, Guarino D, Busetto L, Moriconi D, Fabris R, Mari A, Baldi S, Anselmino M, Foletto M, Vettor R, Ferrannini E. Risk Factors for Spontaneously Self-Reported Postprandial Hypoglycemia After Bariatric Surgery. *J Clin Endocrinol Metab* 2016; **101**: 3600-3607 [PMID: 27336358 DOI: 10.1210/jc.2016-1143]

131 **Nielsen JB**, Pedersen AM, Gribsholt SB, Svensson E, Richelsen B. Prevalence, severity, and predictors of symptoms of dumping and hypoglycemia after Roux-en-Y gastric bypass. *Surg Obes Relat Dis* 2016; **12**: 1562-1568 [PMID: 27425831 DOI: 10.1016/j.soard.2016.04.017]

132 **Belligoli A**, Sanna M, Serra R, Fabris R, Pra' CD, Conci S, Fioretto P, Prevedello L, Foletto M, Vettor R, Busetto L. Incidence and Predictors of Hypoglycemia 1 Year After Laparoscopic Sleeve Gastrectomy. *Obes Surg* 2017; **27**: 3179-3186 [PMID: 28547566 DOI: 10.1007/s11695-017-2742-2]

133 **Lupoli R**, Lembo E, Rainone C, Schiavo L, Iannelli A, Di Minno MND, Capaldo B. Rate of post-bariatric hypoglycemia using continuous glucose monitoring: A meta-analysis of literature studies. *Nutr Metab Cardiovasc Dis* 2022; **32**: 32-39 [PMID: 34802853 DOI: 10.1016/j.numecd.2021.08.047]