ISSN 1948-9358 (online)

World Journal of *Diabetes*

World J Diabetes 2022 December 15; 13(12): 1001-1183

Published by Baishideng Publishing Group Inc

WJD

World Journal of
Diabetes

Contents

Monthly Volume 13 Number 12 December 15, 2022

World Journal of Diabetes

Monthly Volume 13 Number 12 December 15, 2022

Contents

ABOUT COVER

Editorial Board Member of *World Journal of Diabetes*, Joseph M Pappachan, Professor, MBBS, MD, MRCP, FRCP, Academic Editor, Consultant Endocrinologist, Senior Researcher, Department of Endocrinology & Metabolism, Lancashire Teaching Hospitals NHS Trust, Preston PR2 9HT & Manchester Metropolitan University, Manchester, M15 6BH, United Kingdom. drpappachan@yahoo.co.in

AIMS AND SCOPE

The primary aim of *World Journal of Diabetes* (*WJD*, *World J Diabetes*) is to provide scholars and readers from various fields of diabetes with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJD mainly publishes articles reporting research results and findings obtained in the field of diabetes and covering a wide range of topics including risk factors for diabetes, diabetes complications, experimental diabetes mellitus, type 1 diabetes mellitus, type 2 diabetes mellitus, gestational diabetes, diabetic angiopathies, diabetic cardiomyopathies, diabetic coma, diabetic ketoacidosis, diabetic nephropathies, diabetic neuropathies, Donohue syndrome, fetal macrosomia, and prediabetic state.

INDEXING/ABSTRACTING

The *WJD* is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Current Contents/Clinical Medicine, Journal Citation Reports/Science Edition, PubMed, PubMed Central, Reference Citation Analysis, China National Knowledge Infrastructure, China Science and Technology Journal Database, and Superstar Journals Database. The 2022 Edition of Journal Citation Reports® cites the 2021 impact factor (IF) for *WJD* as 4.560; IF without journal self cites: 4.450; 5-year IF: 5.370; Journal Citation Indicator: 0.62; Ranking: 62 among 146 journals in endocrinology and metabolism; and Quartile category: Q2.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Yu-Xi Chen*; **Production Department Director:** *Xu Guo*; **Editorial Office Director:** *Yun-Xiaojiao Wu*.

NAME OF JOURNAL
World Journal of Diabetes

ISSN
ISSN 1948-9358 (online)

LAUNCH DATE
June 15, 2010

FREQUENCY
Monthly

EDITORS-IN-CHIEF
Lu Cai, Md. Shahidul Islam, Jian-Bo Xiao, Michael Horowitz

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/1948-9358/editorialboard.htm

PUBLICATION DATE
December 15, 2022

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

World Journal of Diabetes

Submit a Manuscript: https://www.f6publishing.com

World J Diabetes 2022 December 15; 13(12): 1096-1105

DOI: 10.4239/wjd.v13.i12.1096

ISSN 1948-9358 (online)

MINIREVIEWS

Prehabilitation of overweight and obese patients with dysglycemia awaiting bariatric surgery: Predicting the success of obesity treatment

Maja Cigrovski Berkovic, Ines Bilic-Curcic, Anna Mrzljak, Silvija Canecki Varzic, Vjekoslav Cigrovski

Specialty type: Gastroenterology and hepatology

Provenance and peer review: Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B, B, B
Grade C (Good): 0
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Estabile P, Brazil; Obando A, Nicaragua; Salimi M, Iran

Received: July 21, 2022
Peer-review started: July 21, 2022
First decision: September 4, 2022
Revised: September 9, 2022
Accepted: November 2, 2022
Article in press: November 2, 2022
Published online: December 15, 2022

Maja Cigrovski Berkovic, Department of Endocrinology, Diabetes and Clinical Pharmacology, Clinical Hospital Dubrava, Zagreb 10000, Croatia

Maja Cigrovski Berkovic, Vjekoslav Cigrovski, Faculty of Kinesiology, University of Zagreb, Zagreb 10000, Croatia

Ines Bilic-Curcic, Silvija Canecki Varzic, Faculty of Medicine University of Osijek, Osijek 31000, Croatia

Ines Bilic-Curcic, Silvija Canecki Varzic, Department of Endocrinology and Diabetes, Clinical Hospital Centre Osijek, Osijek 31000, Croatia

Anna Mrzljak, Department of Gastroenterology and Hepatology, University Hospital Center Zagreb, Zagreb 10000, Croatia

Anna Mrzljak, School of Medicine, University of Zagreb, Zagreb 10000, Croatia

Corresponding author: Maja Cigrovski Berkovic, MD, PhD, Adjunct Associate Professor, Department of Endocrinology, Diabetes and Clinical Pharmacology, Clinical Hospital Dubrava, Gojaka Suska 6, Zagreb 10000, Croatia. maja.cigrovskiberkovic@gmail.com

Abstract

Bariatric surgery offers the best health results in overweight and obese patients but is not a risk and/or complication-free treatment. In cases with additional hyperglycemia, the burden of surgery can be even higher and alter both short-term and long-term outcomes. Although bariatric surgery offers glycemic improvements and in the case of early onset diabetes disease remission, weight loss results are lower than for obese patients without diabetes. Different multimodal programs, usually including interventions related to patients' performance, nutritional and psychological status as well as currently available pharmacotherapy before the surgery itself might considerably improve the immediate and late postoperative course. However, there are still no clear guidelines addressing the prehabilitation of obese patients with dysglycemia undergoing bariatric surgery and therefore no unique protocols to improve patients' health. In this minireview, we summarize the current knowledge on prehabilitation before bariatric surgery procedures in patients with obesity and dysglycemia.

Key Words: Bariatric surgery; Obesity; Dysgylcemia; Diabetes outcome; Prehabilitation

Core Tip: The prehabilitation of bariatric surgery patients is an insufficiently investigated area of research. Adequate perioperative preparation for patients awaiting bariatric surgery could present one of the main determinants of predicting the success of surgical treatment, especially in patients with associated dysglycemia. A combination of calorie restrictive diet, structured exercise program, psychological support, and anti-obesity pharmacotherapy should be implemented in the perioperative care of candidates for bariatric procedures. This multimodal approach has the most promising potential to promote 5% weight loss at least thus affecting chronic inflammation and insulin resistance, the main culprits of bariatric surgery resistance.

Citation: Cigrovski Berkovic M, Bilic-Curcic I, Mrzljak A, Canecki Varzic S, Cigrovski V. Prehabilitation of overweight and obese patients with dysglycemia awaiting bariatric surgery: Predicting the success of obesity treatment. *World J Diabetes* 2022; 13(12): 1096-1105
URL: https://www.wjgnet.com/1948-9358/full/v13/i12/1096.htm
DOI: https://dx.doi.org/10.4239/wjd.v13.i12.1096

INTRODUCTION

Obesity is a chronic debilitating disease with many health-related consequences. Nearly 39% of the worldwide adult population in 2019 met the criteria of being overweight and obese, and had multiple comorbidities[1,2]. In the case of additional derangements in glucose metabolism, such as glucose intolerance or diabetes whose incidence increases with increasing body mass index (BMI), patients have an even worse long-term prognosis, with accentuated cardiovascular risk, morbidity, and mortality[3].

Even the accumulation of free fat mass in the legs, arm, and trunk area is reversely associated with diabetes as was demonstrated in a recent study[4]. Moreover, when weight reduction results (due to lifestyle interventions, pharmacotherapy, or metabolic surgery) are compared to obese patients with and without diabetes, later are always more humble, suggesting the necessity for a structured and multimodal approach[5].

Weight management aimed at weight reduction has favorable metabolic, and mental health benefits in obese patients. A healthy lifestyle, including physical activity, is one of the pillars of weight management, impacting overall cardiometabolic health and well-being[6]. In addition, newly available anti-obesity drugs can lead to potent weight loss results, but the most powerful strategy includes bariatric surgery. Different surgical approaches can be selected, some with malabsorptive effects and others, such as gastric sleeve-resection do not have malabsorptive effects.

Malabsorptive procedures lead to nutritional risks, which might also exist preoperatively, regardless of patients' BMI. Therefore, preoperative nutritional status assessment and cardiorespiratory fitness status might be important parameters in decision making, treatment planning, and psychiatric evaluation. The Enhanced Recovery after Bariatric Surgery protocol suggests that a higher preoperative fitness level leads to improved outcomes and fewer postoperative complications[7]. Unfortunately, current medical care does not routinely include a physical exercise component for bariatric surgery patients. Moreover, < 10% of bariatric surgery patients meet the current physical activity recommendations, although it has been shown that two weeks before surgery, 40% of obese patients would feel ready to start exercise[8].

In addition, prehabilitation might be the key to improving responsiveness to metabolic surgery, especially in patients with dysglycemia, one of the common comorbidities in overweight/obese patients that must be addressed preoperatively[9].

In this minireview, we will focus on multimodal prehabilitation of patients undergoing bariatric surgery and specifically look into data on patients with coexisting dysglycemia.

ROLE OF EXERCISE

Exercise is a cornerstone of a healthy lifestyle and disease prevention, and sedentarism, lack of exercise, or nonattainment of physical exercise goals have been strongly correlated with chronic non-communicable diseases such as obesity, metabolic syndrome, and type 2 diabetes mellitus (T2DM)[10,11]. The inclusion of physical exercise in multimodal preconditioning programs for patients undergoing different surgical procedures has been in the research scope of numerous investigations[12].

The role of exercise programs before and after bariatric surgery procedures might be important both from the aspect of reduction of perioperative and postoperative complications and as a means of retaining weight loss results achieved by surgery and acquisition of a healthy lifestyle[13,14]. Unfortunately, despite convincing beneficial outcomes reported from other surgical procedures, structured perioperative exercise programs are barely/rarely used perioperatively for bariatric procedures. According to the literature, physical exercise can contribute to approximately 4% excess weight loss, and when exercise is performed post-bariatric surgery, it results in an additional 3.6 kg weight loss[15]. The beneficial effects of exercise on anthropometric measures (weight loss, reduction of fat mass, and reduction of neck circumference) accompanied by improvement in physical performance (measured by the 6-min walk test) and quality of life are well documented[16,17]. There are, however, no clear recommendations on validated programs concerning starting the exercise before bariatric surgery, type of exercise, the intensity of exercises, duration of exercise sessions, or the comparison of different exercise types concerning short-term and long-term outcomes. Moreover, the literature is mainly focused on exercise performed post-bariatric surgery procedures and how it might help retain weight loss and cut cardiovascular risk compared to preoperative exercise programs[18,19].

A few studies that have assessed the value of preoperative exercise suggest benefits in fitness level and achievement of presurgery weight loss. Specifically, a 12-wk pre-bariatric surgery program including endurance and resistance exercises suggests improvements in fitness and quality of life-extending one year post-operatively[14,16,20]. In addition, studies using endurance and resistance training as a pre-bariatric surgery intervention reported improvements in weight and functional capacity, comorbidities, and quality of life[21,22].

Recently published data from a randomized controlled trial, although having major adherence issues, suggested the benefit of resistance exercises with elastic bands involving large muscle groups of the upper and lower extremities in the perioperative period of obese patients awaiting bariatric surgery together with respiratory prehabilitation[23].

Obese patients with dysglycemia (prediabetes or diabetes) are at higher risk of diabetes and obesity-related comorbidities[24].

In the study by Hickey *et al*[25] a seven-day 60-min daily exercise program led to a significant decrease in fasting plasma insulin level, suggesting improvements in tissue insulin sensitivity, which is particularly important for overweight/obese patients with dysglycemia. During 24 wk of low-intensity endurance training, in addition to anthropometric parameter measurements, Marcon *et al*[26] found substantial improvements in systolic and diastolic blood pressure, lipid and glucose levels, and patients' performance. A study by Woodlief *et al*[27] focusing on exercise dose after Roux-en-Y gastric bypass surgery showed that even a modest amount of structured exercise leads to improvements in insulin sensitivity but that higher volumes of exercise are needed for more profound health benefits.

On the other hand, Gilbertson *et al*[28] investigated the effects of aerobic exercise (30 min/d, 5 d/wk, at home, walking at the intensity of 65%-85% peak heart rate during 30 d) on metabolic and short-term postoperative outcomes of bariatric patients. They found a significant decrease in calorie intake, increase in VO_2peak, decrease in high sensitivity C-reactive protein (hsCRP), cytokeratin 18 and improvement in quality of life, decreased sugar intake, improved whole-body insulin sensitivity, and glucose levels together with a shorter hospital stay in patients who were in the exercise group[28]. Moreover, from the aspect of choosing a better exercise type, interval training might be superior to moderate-intensity continuous training in terms of reducing fat mass[29].

The main problem in objectively assessing the contribution of exercise programs on weight loss outcomes, besides the lack of randomized controlled trials, is the lack of structured exercise, poor patient adherence, and the self-reported measurement of exercise limiting interpretation of the results.

ROLE OF DIET

Restrictive calorie intake is widely advocated for obese patients undergoing metabolic surgery, and a weight loss of 5%-10% is generally mandatory before patients are considered as candidates for bariatric surgery, primarily as a means of assessing patient’s motivation and adherence to follow-up after the surgery[30].

Currently, different dietary interventions mainly investigated in a non-randomized and uncontrolled manner, such as a low-calorie diet (800/1200 kcal daily) or a very-low-calorie diet (600 kcal per day), were shown to reduce weight preoperatively (4.2% and 5.8%, respectively) with no difference in inducing a reduction in liver volume and having similar effects on surgical complications, length of hospital stay and biochemical parameters[31]. In addition, very low-calorie ketogenic diets have recently been investigated in the context of weight reduction in obese patients. Although concern is raised due to their ability to induce catabolism, enhance oxidative stress response, and through high protein intake, induce a negative metabolic response, data available from a few non-randomized studies suggest that the mentioned dietary regimen when used 30 d before bariatric surgery and in a sequential way with low calorie and a very low-calorie diet adds beneficial effects in terms of better weight reduction, waist circumference, visceral fat reduction, and improvement in glycemic and lipid profiles accompanied by a mean 30% reduction in liver volume[32-34].

It is still unclear whether overweight and obese patients benefit from short-term dietary weight loss interventions while changes in the level of circulating mediators of appetite such as leptin, ghrelin, and GIP might favor long-term weight regain[35]. Moreover, overweight/obese patients might also be at nutritive risk, which might escalate if restrictive diets are not controlled[36]. Numerous studies reported multiple micronutrient deficiencies in obese patients[37-39], while Schiavo *et al*[40] showed that preoperative micronutrient supplementation leads to the prevention of micronutrient deficit in the postoperative period. Therefore, current guidelines support the preoperative nutritional status screening of all patients awaiting bariatric surgery[41].

A meta-analysis including 6060 patients showed significant weight reduction achieved through preoperative dietary restriction led to significant weight loss and 27% shorter duration of hospital stay, but with no difference regarding perioperative morbidity and mortality[42]. Stefura *et al*[43] prospectively collected data from 909 bariatric patients treated by ERAS principles and depicted predictors of success in losing > 5% of initial weight as positive (diabetes mellitus, obstructive sleep apnea, and previous surgery) or negative (steatohepatitis, respiratory disorders). Although there was no influence of preoperative weight loss on perioperative morbidity or mortality, patients who lost > 5% in the perioperative period had better weight loss results post-surgery[43].

The efficacy of calorie restriction (very-low-calorie diet and more recently very low-calorie ketogenic diet) in weight loss potential is an interesting bridging therapy before bariatric surgery but is still under debate due to the lack of large randomized studies addressing the issues around the effect on postoperative complications.

ROLE OF PHARMACOTHERAPY IN PREHABILITATION

A certain number of individuals are resistant to the weight loss effects of bariatric surgery due to multiple reasons such as the level of chronic inflammation, presence of T2DM, age, gender, and ethnicity[44].

Chronic inflammation and increased circulating levels of pro-inflammatory cytokines such as interleukin-6 and tumor necrosis factor-α caused by white visceral adipose tissue could be one of the main reasons for bariatric surgery resistance independent of all other factors[45]. In responsive individuals, bariatric surgery reduces pro-inflammatory cytokines promoted by weight loss and attenuates insulin resistance[46-48]. Therefore, reducing pre-operative inflammation could improve response to bariatric surgery[49].

To date, several studies have demonstrated that severe dysglycemia, duration of diabetes, and anti-hyperglycemic therapy at the time of surgical procedure are the key factors in predicting response to bariatric surgery[50-54]. Whether hyperglycemia or insulin resistance are the main culprits in bariatric surgery resistance remains to be seen but improving glycemic regulation and insulin sensitivity could be the most important pre-operative pharmacological targets to improve responsiveness to bariatric surgery.

In addition, unchangeable factors, including aging, female sex[55,56], and Hispanic and African American races[57], are associated with higher rates of bariatric surgery failure. Therefore, influencing modifiable risk factors seems to be the most reasonable approach to improve the success of bariatric procedures.

Although lifestyle modifications such as physical activity and diet play a major role in the prehabilitation of bariatric patients, adherence to lifestyle changes remains an elusive and poorly attainable goal [42]. Implementing pharmacological options that reduce insulin resistance and chronic inflammation by lowering body weight preoperatively in patients with or without diabetes has great potential to improve the response to bariatric surgery.

There are several weight loss agents available on the market. One of the most frequently used is liraglutide, a long-acting glucagon-like peptide 1 receptor agonist (GLP 1 RA) approved for the treatment of T2DM and obesity due to its mechanism of action based on delayed gastric emptying, central reduction of appetite, and stimulation of glucose-dependent insulin secretion[58,59]. The efficacy and safety of liraglutide 3 mg daily were assessed in the phase III clinical trial program SCALE, demonstrating greater improvement compared to placebo with regard to HbA1c, blood pressure, lipid reduction, and health-related quality of life in overweight people and obese patients[58-61]. However, most research seems to focus on the role of liraglutide in post-operative management, preventing weight regain, and promoting further weight loss. At the same time, data on perioperative administration are scarce. The effectiveness of liraglutide in the prehabilitation of bariatric patients was demonstrated for the first time in a retrospective cohort analysis by Wood *et al*[62] in which therapy with GLP-1 receptor agonists in combination with other anti-diabetic medication prior to bariatric surgery led to higher T2DM remission rates, short- and long-term, compared to therapy with other anti-diabetic medications alone[62,63]. Recently, a case series also demonstrated the potential benefit of short-term therapy with liraglutide prior to bariatric surgery[64]; however, data from randomized clinical trials (RCTs) are lacking.

Presently, there are several retrospective studies demonstrating the efficacy of liraglutide therapy in patients that underwent bariatric surgery with inadequate weight loss or weight regain[65,66], including one RCT investigating liraglutide effects compared to placebo on total weight loss and excess body weight loss added early after laparoscopic sleeve gastrectomy in obese individuals[63]. Liraglutide significantly improved the resolution of dysglycemia and weight loss effects of the surgical procedure compared to placebo.

Another promising agent from the same class is semaglutide, a long-acting GLP 1RA with proven effects on diabetes management and weight loss and recently approved by the FDA for both indications.

Semaglutide has improved pharmacokinetic properties compared to liraglutide, enabling once-weekly administration and greater efficacy[67]. In a phase III clinical trial assessing the efficacy and safety of semaglutide 2.4 mg in obesity treatment, greater reductions in body weight were observed after 68 wk with once-weekly semaglutide 2.4 mg sc *vs* placebo (mean change from baseline -14.9% *vs* -2.4%; ETD -12.4%; 95%CI: -13.4 to -11.5; $P < 0.001$)[68-71]. Similar results were found in a 68-wk phase III study (STEP 3) comparing the effects of semaglutide 2.4 mg *vs* placebo in overweight or obese adults without diabetes. The mean body weight decreased 16% with semaglutide, compared to 5.7% with placebo ($P = 0.0001$)[70]. No data are available on semaglutide in the prehabilitation of bariatric patients.

Tirzepatide belongs to an emerging new class of drugs called twincretins, dual receptor agonists of the glucose-dependent insulinotropic polypeptide (GIP) and GLP-1[72]. In the phase III clinical trial program SURPASS, designed to assess the efficacy and safety of tirzepatide 5, 10, and 15 mg as a treatment to improve glycemic control in patients with T2DM, tirzepatide demonstrated impressive results in terms of glycemic regulation and weight management[73,74]. In SURPASS-2, a higher dose of tirzepatide (15 mg) had more pronounced weight loss effects compared to semaglutide 1 mg (13.1% *vs* 6.7%) as well as better anti-hyperglycemic effects (2.3% *vs* 1.86%)[74].

Older anti-obesity medications such as orlistat, phentermine/topiramate, and naltrexone/bupropion have low efficacy and cause a drop in body weight up to 3%-7% compared to placebo with unfavorable safety profiles[75]. Liraglutide also induces similar weight loss but with a more acceptable safety profile. Consequently, the efficacy of semaglutide 2.4 mg and tirzepatide 15 mg in terms of weight loss effects is extremely significant, highlighted by the fact that approximately 75% of patients treated with semaglutide 2.4 mg or tirzepatide 15 mg experience 10% to 15% body weight loss accompanied by well-known side-effects such as nausea, vomiting, diarrhea and obstipation[76].

Therefore, these new agents could represent a new era in optimizing the medical care of bariatric surgery patients with the potential to significantly influence surgery outcomes. Further prospective randomized trials are necessary to determine the significance of these new classes of anti-obesity medications in the prehabilitation of bariatric surgery patients.

ROLE OF PSYCHOLOGICAL SUPPORT

Numerous studies have demonstrated a link between obesity and psychological disorders in patients awaiting bariatric surgery, the most common being anxiety, depression and binge eating disorders (BED)[77-79]. However, the effect of psychological status perioperatively on the success of bariatric surgery remains to be clarified due to large heterogeneity within the same psychiatric diagnosis influencing eating patterns. For instance, in a recently published study, better weight loss was associated with depression and BED diagnosis[80] as opposed to other findings linking higher levels of psychopathology with the diminished success of weight reduction[81,82]. Moreover, the results of the latest meta-analysis including published studies on psychological interventions in patients undergoing bariatric surgery were ambiguous regarding the usefulness of psychological support on bariatric surgery outcomes[83]. Therefore, further research on this topic is needed to assess if the benefit of psychological therapy really exists.

FUTURE IMPLICATIONS

Without a doubt, lifestyle modifications based on implementing structured exercise programs and nutritional plans offer great benefits in the prehabilitation of patients awaiting bariatric surgery, especially those with associated dysglycemia. The ultimate goal is achieving a minimum 5% weight loss and improving cardiorespiratory fitness and increasing basal rate consequently promoting further postoperative weight loss and bariatric surgery responsiveness as well as reducing postoperative complications and mortality. However, clear recommendations regarding the most efficient exercise protocols and calorie-restrictive diets are lacking and further prospective studies are needed to establish effective and safe protocols to upgrade peri and postoperative care as well as the short- and long-term outcomes of surgery. One should not forget the influence of patient characteristics, psychological profile, social conditions, and behavioral responses to the operation, which also have a great impact on surgery success requiring the development of protocols for psychological support. Furthermore, current

Table 1 Proposed recommendations for the perioperative care of all bariatric surgery patients, especially those with associated dysglycemia

Prehabilitation- treatment modality	Potential advantages and clinical rationale
Exercise	
Resistance and endurance training	Short- and long-term improvements in weight and functional capacity, comorbidities, quality of life, improvements in tissue insulin sensitivity
Aerobic training	Short-term decrease in calorie intake, improvement in quality of life, improved whole-body insulin sensitivity, decrease in glucose levels, shorter hospital stay
Nutritional interventions	
Low and very low calorie and ketogenic diet	Better weight reduction, visceral fat reduction, improvement in glycemic and lipid profiles, mean 30% reduction in liver volume
Pharmacotherapy	
GLP 1 receptor agonists	Higher T2DM remission rates, better body weight reduction, improvement in glycemic and lipid profiles
Psychological support	
Preoperative counseling and education	Reduced anxiety, depression, and fear, positive influence on eating disorders

GLP 1: Glucagon-like peptide 1; T2DM: Type 2 diabetes mellitus.

anti-obesity pharmacotherapy such as GLP-1 RA and in the future twincretins offers a significant opportunity to improve the peri and post-operative care of bariatric patients, acting in synergy with exercise and calorie-restrictive diets. Moreover, the degree of obesity and age influence the choice of treatment strategy or protocol in perioperative care. However, there are significant shortcomings as most of the research to date has been focused on the postoperative care of bariatric surgery patients, while research on perioperative care has been somewhat neglected.

CONCLUSION

We have attempted to summarize current knowledge and propose recommendations for perioperative care of all bariatric surgery patients, but with special emphasis on those with disturbances of glucose metabolism (Table 1). Future studies should focus on the development of perioperative treatment protocols consisting of the most optimal combination of lifestyle changes and pharmacotherapy thus optimizing response to bariatric surgery, ultimately improving both short -and long-term outcomes by reducing the incidence of T2DM and cardiovascular disease.

FOOTNOTES

Author contributions: Cigrovski Berkovic M conceived and wrote the original draft; Bilic-Curic I, Canecki Vrazic S, Mrzljak A and Cigrovski V were involved in data collection and analysis and writing the manuscript; all authors approved the final version of the manuscript.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Country/Territory of origin: Croatia

ORCID number: Maja Cigrovski Berkovic 0000-0003-0750-9785; Ines Bilic-Curcic 0000-0002-8861-5987; Anna Mrzljak 0000-0001-6270-2305; Silvija Canecki Varzic 0000-0001-9535-7915; Vjekoslav Cigrovski 0000-0003-4519-4235.

S-Editor: Gong ZM
L-Editor: Webster JR

P-Editor: Gong ZM

REFERENCES

1 **NCD Risk Factor Collaboration (NCD-RisC)**. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet* 2017; **390**: 2627-2642 [PMID: 29029897 DOI: 10.1016/S0140-6736(17)32129-3]

2 **Seidell JC**, Halberstadt J. The global burden of obesity and the challenges of prevention. *Ann Nutr Metab* 2015; **66** Suppl 2: 7-12 [PMID: 26045323 DOI: 10.1159/000375143]

3 **Boye KS**, Lage MJ, Terrell K. Healthcare outcomes for patients with type 2 diabetes with and without comorbid obesity. *J Diabetes Complications* 2020; **34**: 107730 [PMID: 32943301 DOI: 10.1016/j.jdiacomp.2020.107730]

4 **Nematollahi MA**, Askarinejad A, Asadollahi A, Salimi M, Moghadami M, Sasannia S, Bazrafshan M, Farjam M, Homayounfar R, Pezeshki B, Amini M, Roshanzamir M, Alizadehsani R, Drissi HB, Sheikh MSI. Association and Predictive Capability of Body Composition and Diabetes Mellitus Using Artificial Intelligence: A cohort study. *Research Square* [DOI: 10.21203/rs.3.rs-1675052/v1]

5 **Courcoulas AP**, Belle SH, Neiberg RH, Pierson SK, Eagleton JK, Kalarchian MA, DeLany JP, Lang W, Jakicic JM. Three-Year Outcomes of Bariatric Surgery *vs* Lifestyle Intervention for Type 2 Diabetes Mellitus Treatment: A Randomized Clinical Trial. *JAMA Surg* 2015; **150**: 931-940 [PMID: 26132586 DOI: 10.1001/jamasurg.2015.1534]

6 **Shiroma EJ**, Lee IM. Physical activity and cardiovascular health: lessons learned from epidemiological studies across age, gender, and race/ethnicity. *Circulation* 2010; **122**: 743-752 [PMID: 20713909 DOI: 10.1161/CIRCULATIONAHA.109.914721]

7 **Pouwels S**, Sanches EE, Cagiltay E, Severin R, Philips SA. Perioperative Exercise Therapy in Bariatric Surgery: Improving Patient Outcomes. *Diabetes Metab Syndr Obes* 2020; **13**: 1813-1823 [PMID: 32547143 DOI: 10.2147/DMSO.S215157]

8 **Bond DS**, Jakicic JM, Unick JL, Vithiananthan S, Pohl D, Roye GD, Ryder BA, Sax HC, Wing RR. Pre- to postoperative physical activity changes in bariatric surgery patients: self report vs. objective measures. *Obesity (Silver Spring)* 2010; **18**: 2395-2397 [PMID: 20379143 DOI: 10.1038/oby.2010.88]

9 **Topal B**, Smelt HJM, Van Helden EV, Celik A, Verseveld M, Smeenk F, Pouwels S. Utility of preoperative exercise therapy in reducing postoperative morbidity after surgery; a clinical overview of current evidence. *Expert Rev Cardiovasc Ther* 2019; **17**: 395-412 [PMID: 31179756 DOI: 10.1080/14779072.2019.1625771]

10 **Warburton DE**, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. *CMAJ* 2006; **174**: 801-809 [PMID: 16534088 DOI: 10.1503/cmaj.051351]

11 **World Health Organization**. NCDs global action plan on physical activity 2018-2030: more active people for a healthier world; 2019. [Accessed July 18, 2022] Available from: https://www.who.int/ncds/prevention/physical-activity/global-action-plan-2018-2030/en/

12 **Pouwels S**, Hageman D, Gommans LN, Willigendael EM, Nienhuijs SW, Scheltinga MR, Teijink JA. Preoperative exercise therapy in surgical care: a scoping review. *J Clin Anesth* 2016; **33**: 476-490 [PMID: 27555213 DOI: 10.1016/j.jclinane.2016.06.032]

13 **Bond DS**, Vithiananthan S, Thomas JG, Trautvetter J, Unick JL, Jakicic JM, Pohl D, Ryder BA, Roye GD, Sax HC, Wing RR. Bari-Active: a randomized controlled trial of a preoperative intervention to increase physical activity in bariatric surgery patients. *Surg Obes Relat Dis* 2015; **11**: 169-177 [PMID: 25304832 DOI: 10.1016/j.soard.2014.07.010]

14 **Baillot A**, Vallée CA, Mampuya WM, Dionne IJ, Comeau E, Méziat-Burdin A, Langlois MF. Effects of a Pre-surgery Supervised Exercise Training 1 Year After Bariatric Surgery: a Randomized Controlled Study. *Obes Surg* 2018; **28**: 955-962 [PMID: 28963710 DOI: 10.1007/s11695-017-2943-8]

15 **Egberts K**, Brown WA, Brennan L, O'Brien PE. Does exercise improve weight loss after bariatric surgery? *Obes Surg* 2012; **22**: 335-341 [PMID: 22038571 DOI: 10.1007/s11695-011-0544-5]

16 **Baillot A**, Mampuya WM, Comeau E, Méziat-Burdin A, Langlois MF. Feasibility and impacts of supervised exercise training in subjects with obesity awaiting bariatric surgery: a pilot study. *Obes Surg* 2013; **23**: 882-891 [PMID: 23430477 DOI: 10.1007/s11695-013-0875-5]

17 **Sellberg F**, Possmark S, Willmer M, Tynelius P, Persson M, Berglind D. Meeting physical activity recommendations is associated with health-related quality of life in women before and after Roux-en-Y gastric bypass surgery. *Qual Life Res* 2019; **28**: 1497-1507 [PMID: 30721385 DOI: 10.1007/s11136-019-02120-0]

18 **Shah M**, Snell PG, Rao S, Adams-Huet B, Quittner C, Livingston EH, Garg A. High-volume exercise program in obese bariatric surgery patients: a randomized, controlled trial. *Obesity (Silver Spring)* 2011; **19**: 1826-1834 [PMID: 21681226 DOI: 10.1038/oby.2011.172]

19 **Castello-Simões V**, Polaquini Simões R, Beltrame T, Bassi D, Maria Catai A, Arena R, Azambuja NC Jr, do Nascimento Ortega J, Borghi-Silva A. Effects of aerobic exercise training on variability and heart rate kinetic during submaximal exercise after gastric bypass surgery--a randomized controlled trial. *Disabil Rehabil* 2013; **35**: 334-342 [PMID: 22725971 DOI: 10.3109/09638288.2012.694575]

20 **Baillot A**, Mampuya WM, Dionne IJ, Comeau E, Méziat-Burdin A, Langlois MF. Impacts of Supervised Exercise Training in Addition to Interdisciplinary Lifestyle Management in Subjects Awaiting Bariatric Surgery: a Randomized Controlled Study. *Obes Surg* 2016; **26**: 2602-2610 [PMID: 27038045 DOI: 10.1007/s11695-016-2153-9]

21 **Marcon ER**, Baglioni S, Bittencourt L, Lopes CL, Neumann CR, Trindade MR. What Is the Best Treatment before Bariatric Surgery? *Obes Surg* 2017; **27**: 763-773 [PMID: 27620342 DOI: 10.1007/s11695-016-2365-z]

22 **Marc-Hernández A**, Ruiz-Tovar J, Aracil A, Guillén S, Moya-Ramón M. Impact of Exercise on Body Composition and Cardiometabolic Risk Factors in Patients Awaiting Bariatric Surgery. *Obes Surg* 2019; **29**: 3891-3900 [PMID: 31313237 DOI: 10.1007/s11695-019-04088-9]

23 **García-Delgado Y**, López-Madrazo-Hernández MJ, Alvarado-Martel D, Miranda-Calderín G, Ugarte-Lopetegui A, González-Medina RA, Hernández-Lázaro A, Zamora G, Pérez-Martín N, Sánchez-Hernández RM, Ibarra-González A, Bengoa-Dolón M, Mendoza-Vega CT, Appelvik-González SM, Caballero-Díaz Y, Hernández-Hernández JR, Wägner AM. Prehabilitation for Bariatric Surgery: A Randomized, Controlled Trial Protocol and Pilot Study. *Nutrients* 2021; **13** [PMID: 34578781 DOI: 10.3390/nu13092903]

24 **Boye KS**, Lage MJ, Thieu V, Shinde S, Dhamija S, Bae JP. Obesity and glycemic control among people with type 2 diabetes in the United States: A retrospective cohort study using insurance claims data. *J Diabetes Complications* 2021; **35**: 107975 [PMID: 34176723 DOI: 10.1016/j.jdiacomp.2021.107975]

25 **Hickey MS**, Gavigan KE, McGammon MR. Effects of 7 days of exercise training on insulin action in morbidly obese men. *Clin Exerc Physiol* 1999; **1**: 24-28

26 **Marcon ER**, Gus I, Neumann CR. [Impact of a minimum program of supervised exercises in the cardiometabolic risk in patients with morbid obesity]. *Arq Bras Endocrinol Metabol* 2011; **55**: 331-338 [PMID: 21881816 DOI: 10.1590/s0004-27302011000500006]

27 **Woodlief TL**, Carnero EA, Standley RA, Distefano G, Anthony SJ, Dubis GS, Jakicic JM, Houmard JA, Coen PM, Goodpaster BH. Dose response of exercise training following roux-en-Y gastric bypass surgery: A randomized trial. *Obesity (Silver Spring)* 2015; **23**: 2454-2461 [PMID: 26537198 DOI: 10.1002/oby.21332]

28 **Gilbertson NM**, Eichner NZM, Khurshid M, Rexrode EA, Kranz S, Weltman A, Hallowell PT, Malin SK. Impact of Pre-operative Aerobic Exercise on Cardiometabolic Health and Quality of Life in Patients Undergoing Bariatric Surgery. *Front Physiol* 2020; **11**: 1018 [PMID: 32982777 DOI: 10.3389/fphys.2020.01018]

29 **Viana RB**, Naves JPA, Coswig VS, de Lira CAB, Steele J, Fisher JP, Gentil P. Is interval training the magic bullet for fat loss? *Br J Sports Med* 2019; **53**: 655-664 [PMID: 30765340 DOI: 10.1136/bjsports-2018-099928]

30 **National Clinical Guideline Centre (UK)**. Obesity: Identification, Assessment and Management of Overweight and Obesity in Children, Young People and Adults: Partial Update of CG43. London: National Institute for Health and Care Excellence (NICE); 2014 [PMID: 25535639]

31 **Gils Contreras A**, Bonada Sanjaume A, Montero Jaime M, Rabassa Soler A, Sabench Preferrer F, Molina López A, Becerra Tomás N, Del Castillo Déjardin D, Salas-Salvadó J. Effects of Two Preoperatory Weight Loss Diets on Hepatic Volume, Metabolic Parameters, and Surgical Complications in Morbid Obese Bariatric Surgery Candidates: a Randomized Clinical Trial. *Obes Surg* 2018; **28**: 3756-3768 [PMID: 30109669 DOI: 10.1007/s11695-018-3413-7]

32 **Leonetti F**, Campanile FC, Coccia F, Capoccia D, Alessandroni L, Puzziello A, Coluzzi I, Silecchia G. Very low-carbohydrate ketogenic diet before bariatric surgery: prospective evaluation of a sequential diet. *Obes Surg* 2015; **25**: 64-71 [PMID: 25005809 DOI: 10.1007/s11695-014-1348-1]

33 **Pilone V**, Tramontano S, Renzulli M, Romano M, Cobellis L, Berselli T, Schiavo L. Metabolic effects, safety, and acceptability of very low-calorie ketogenic dietetic scheme on candidates for bariatric surgery. *Surg Obes Relat Dis* 2018; **14**: 1013-1019 [PMID: 29785940 DOI: 10.1016/j.soard.2018.03.018]

34 **Albanese A**, Prevedello L, Markovich M, Busetto L, Vettor R, Foletto M. Pre-operative Very Low Calorie Ketogenic Diet (VLCKD) vs. Very Low Calorie Diet (VLCD): Surgical Impact. *Obes Surg* 2019; **29**: 292-296 [PMID: 30251088 DOI: 10.1007/s11695-018-3523-2]

35 **Sumithran P**, Prendergast LA, Delbridge E, Purcell K, Shulkes A, Kriketos A, Proietto J. Long-term persistence of hormonal adaptations to weight loss. *N Engl J Med* 2011; **365**: 1597-1604 [PMID: 22029981 DOI: 10.1056/NEJMoa1105816]

36 **Bettini S**, Belligoli A, Fabris R, Busetto L. Diet approach before and after bariatric surgery. *Rev Endocr Metab Disord* 2020; **21**: 297-306 [PMID: 32734395 DOI: 10.1007/s11154-020-09571-8]

37 **Aasheim ET**, Hofsø D, Hjelmesaeth J, Birkeland KI, Bøhmer T. Vitamin status in morbidly obese patients: a cross-sectional study. *Am J Clin Nutr* 2008; **87**: 362-369 [PMID: 18258626 DOI: 10.1093/ajcn/87.2.362]

38 **Peterson LA**, Cheskin LJ, Furtado M, Papas K, Schweitzer MA, Magnuson TH, Steele KE. Malnutrition in Bariatric Surgery Candidates: Multiple Micronutrient Deficiencies Prior to Surgery. *Obes Surg* 2016; **26**: 833-838 [PMID: 26297429 DOI: 10.1007/s11695-015-1844-y]

39 **Aigner E**, Feldman A, Datz C. Obesity as an emerging risk factor for iron deficiency. *Nutrients* 2014; **6**: 3587-3600 [PMID: 25215659 DOI: 10.3390/nu6093587]

40 **Schiavo L**, Pilone V, Rossetti G, Romano M, Pieretti G, Schneck AS, Iannelli A. Correcting micronutrient deficiencies before sleeve gastrectomy may be useful in preventing early postoperative micronutrient deficiencies. *Int J Vitam Nutr Res* 2019; **89**: 22-28 [PMID: 30694119 DOI: 10.1024/0300-9831/a000532]

41 **Mechanick JI**, Youdim A, Jones DB, Garvey WT, Hurley DL, McMahon MM, Heinberg LJ, Kushner R, Adams TD, Shikora S, Dixon JB, Brethauer S; American Association of Clinical Endocrinologists; Obesity Society; American Society for Metabolic & Bariatric Surgery. Clinical practice guidelines for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient--2013 update: cosponsored by American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery. *Obesity (Silver Spring)* 2013; **21** Suppl 1: S1-27 [PMID: 23529939 DOI: 10.1002/oby.20461]

42 **Roman M**, Monaghan A, Serraino GF, Miller D, Pathak S, Lai F, Zaccardi F, Ghanchi A, Khunti K, Davies MJ, Murphy GJ. Meta-analysis of the influence of lifestyle changes for preoperative weight loss on surgical outcomes. *Br J Surg* 2019; **106**: 181-189 [PMID: 30328098 DOI: 10.1002/bjs.11001]

43 **Stefura T**, Droś J, Kacprzyk A, Wierdak M, Proczko-Stepaniak M, Szymański M, Pisarska M, Małczak P, Rubinkiewicz M, Wysocki M, Rzepa A, Pędziwiatr M, Budzyński A, Major P. Influence of Preoperative Weight Loss on Outcomes of Bariatric Surgery for Patients Under the Enhanced Recovery After Surgery Protocol. *Obes Surg* 2019; **29**: 1134-1141 [PMID: 30632072 DOI: 10.1007/s11695-018-03660-z]

44 **Gilbertson NM**, Paisley AS, Kranz S, Weltman A, Kirby JL, Hallowell PT, Malin SK. Bariatric Surgery Resistance: Using Preoperative Lifestyle Medicine and/or Pharmacology for Metabolic Responsiveness. *Obes Surg* 2017; **27**: 3281-3291 [PMID: 29058238 DOI: 10.1007/s11695-017-2966-1]

45 **Bastard JP**, Maachi M, Lagathu C, Kim MJ, Caron M, Vidal H, Capeau J, Feve B. Recent advances in the relationship

between obesity, inflammation, and insulin resistance. *Eur Cytokine Netw* 2006; **17**: 4-12 [PMID: 16613757]

46 **Madsen EL**, Rissanen A, Bruun JM, Skogstrand K, Tonstad S, Hougaard DM, Richelsen B. Weight loss larger than 10% is needed for general improvement of levels of circulating adiponectin and markers of inflammation in obese subjects: a 3-year weight loss study. *Eur J Endocrinol* 2008; **158**: 179-187 [PMID: 18230824 DOI: 10.1530/EJE-07-0721]

47 **Heneghan HM**, Huang H, Kashyap SR, Gornik HL, McCullough AJ, Schauer PR, Brethauer SA, Kirwan JP, Kasumov T. Reduced cardiovascular risk after bariatric surgery is linked to plasma ceramides, apolipoprotein-B100, and ApoB100/A1 ratio. *Surg Obes Relat Dis* 2013; **9**: 100-107 [PMID: 22264909 DOI: 10.1016/j.soard.2011.11.018]

48 **Malin SK**, Bena J, Abood B, Pothier CE, Bhatt DL, Nissen S, Brethauer SA, Schauer PR, Kirwan JP, Kashyap SR. Attenuated improvements in adiponectin and fat loss characterize type 2 diabetes non-remission status after bariatric surgery. *Diabetes Obes Metab* 2014; **16**: 1230-1238 [PMID: 25132119 DOI: 10.1111/dom.12376]

49 **Hirsch FF**, Pareja JC, Geloneze SR, Chaim E, Cazzo E, Geloneze B. Comparison of metabolic effects of surgical-induced massive weight loss in patients with long-term remission versus non-remission of type 2 diabetes. *Obes Surg* 2012; **22**: 910-917 [PMID: 22246393 DOI: 10.1007/s11695-012-0589-0]

50 **Torquati A**, Lutfi R, Abumrad N, Richards WO. Is Roux-en-Y gastric bypass surgery the most effective treatment for type 2 diabetes mellitus in morbidly obese patients? *J Gastrointest Surg* 2005; **9**: 1112-6; discussion 1117 [PMID: 16269382 DOI: 10.1016/j.gassur.2005.07.016]

51 **Hall TC**, Pellen MG, Sedman PC, Jain PK. Preoperative factors predicting remission of type 2 diabetes mellitus after Roux-en-Y gastric bypass surgery for obesity. *Obes Surg* 2010; **20**: 1245-1250 [PMID: 20524158 DOI: 10.1007/s11695-010-0198-8]

52 **Wang GF**, Yan YX, Xu N, Yin D, Hui Y, Zhang JP, Han GJ, Ma N, Wu Y, Xu JZ, Yang T Predictive factors of type 2 diabetes mellitus remission following bariatric surgery: a meta-analysis. Obes Surg 2015; 25: 199-208 [PMID: 25103403 DOI: 10.1007/s11695-014-1391-y]

53 **Mehaffey JH**, Mullen MG, Mehaffey RL, Turrentine FE, Malin SK, Kirby JL, Schirmer B, Hallowell PT. Type 2 diabetes remission following gastric bypass: does diarem stand the test of time? *Surg Endosc* 2017; **31**: 538-542 [PMID: 27177952 DOI: 10.1007/s00464-016-4964-0]

54 **Khanna V**, Malin SK, Bena J, Abood B, Pothier CE, Bhatt DL, Nissen S, Watanabe R, Brethauer SA, Schauer PR, Kirwan JP, Kashyap SR. Adults with long-duration type 2 diabetes have blunted glycemic and β-cell function improvements after bariatric surgery. *Obesity (Silver Spring)* 2015; **23**: 523-526 [PMID: 25651277 DOI: 10.1002/oby.21021]

55 **Ma Y**, Pagoto SL, Olendzki BC, Hafner AR, Perugini RA, Mason R, Kelly JJ. Predictors of weight status following laparoscopic gastric bypass. *Obes Surg* 2006; **16**: 1227-1231 [PMID: 16989709 DOI: 10.1381/096089206778392284]

56 **Ding EL**, Song Y, Malik VS, Liu S. Sex differences of endogenous sex hormones and risk of type 2 diabetes: a systematic review and meta-analysis. *JAMA* 2006; **295**: 1288-1299 [PMID: 16537739 DOI: 10.1001/jama.295.11.1288]

57 **Anderson WA**, Greene GW, Forse RA, Apovian CM, Istfan NW. Weight loss and health outcomes in African Americans and whites after gastric bypass surgery. *Obesity (Silver Spring)* 2007; **15**: 1455-1463 [PMID: 17557983 DOI: 10.1038/oby.2007.174]

58 **Davies MJ**, Bergenstal R, Bode B, Kushner RF, Lewin A, Skjøth TV, Andreasen AH, Jensen CB, DeFronzo RA; NN8022-1922 Study Group. Efficacy of Liraglutide for Weight Loss Among Patients With Type 2 Diabetes: The SCALE Diabetes Randomized Clinical Trial. *JAMA* 2015; **314**: 687-699 [PMID: 26284720 DOI: 10.1001/jama.2015.9676]

59 **Wadden TA**, Hollander P, Klein S, Niswender K, Woo V, Hale PM, Aronne L; NN8022-1923 Investigators. Weight maintenance and additional weight loss with liraglutide after low-calorie-diet-induced weight loss: the SCALE Maintenance randomized study. *Int J Obes (Lond)* 2013; **37**: 1443-1451 [PMID: 23812094 DOI: 10.1038/ijo.2013.120]

60 **Pi-Sunyer X**, Astrup A, Fujioka K, Greenway F, Halpern A, Krempf M, Lau DC, le Roux CW, Violante Ortiz R, Jensen CB, Wilding JP; SCALE Obesity and Prediabetes NN8022-1839 Study Group. A Randomized, Controlled Trial of 3.0 mg of Liraglutide in Weight Management. *N Engl J Med* 2015; **373**: 11-22 [PMID: 26132939 DOI: 10.1056/NEJMoa1411892]

61 **le Roux CW**, Astrup A, Fujioka K, Greenway F, Lau DCW, Van Gaal L, Ortiz RV, Wilding JPH, Skjøth TV, Manning LS, Pi-Sunyer X; SCALE Obesity Prediabetes NN8022-1839 Study Group. 3 years of liraglutide versus placebo for type 2 diabetes risk reduction and weight management in individuals with prediabetes: a randomised, double-blind trial. *Lancet* 2017; **389**: 1399-1409 [PMID: 28237263 DOI: 10.1016/S0140-6736(17)30069-7]

62 **Wood GC**, Gerhard GS, Benotti P, Petrick AT, Gabrielsen JD, Strodel WE, Ibele A, Rolston DD, Still CD, Argyropoulos G. Preoperative use of incretins is associated with increased diabetes remission after RYGB surgery among patients taking insulin: a retrospective cohort analysis. *Ann Surg* 2015; **261**: 125-128 [PMID: 24646545 DOI: 10.1097/SLA.0000000000000588]

63 **Thakur U**, Bhansali A, Gupta R, Rastogi A. Liraglutide Augments Weight Loss After Laparoscopic Sleeve Gastrectomy: a Randomised, Double-Blind, Placebo-Control Study. *Obes Surg* 2021; **31**: 84-92 [PMID: 32656729 DOI: 10.1007/s11695-020-04850-4]

64 **Ta D**, Dang JT, Sharma AM, Karmali S, Modi R. Use of Liraglutide in a Tertiary Bariatric Clinic: A Case Series. *J Obes Chronic Dis* 2019; **3**: 36-39 [DOI: 10.17756/jocd.2019-027]

65 **Rye P**, Modi R, Cawsey S, Sharma AM. Efficacy of High-Dose Liraglutide as an Adjunct for Weight Loss in Patients with Prior Bariatric Surgery. *Obes Surg* 2018; **28**: 3553-3558 [PMID: 30022424 DOI: 10.1007/s11695-018-3393-7]

66 **Muratori F**, Vignati F, Di Sacco G, Gavazzi L, Pellegrino D, Del Prete M. Efficacy of liraglutide 3.0 mg treatment on weight loss in patients with weight regain after bariatric surgery. *Eat Weight Disord* 2022 [PMID: 35763245 DOI: 10.1007/s40519-022-01403-9]

67 **O'Neil PM**, Birkenfeld AL, McGowan B, Mosenzon O, Pedersen SD, Wharton S, Carson CG, Jepsen CH, Kabisch M, Wilding JPH. Efficacy and safety of semaglutide compared with liraglutide and placebo for weight loss in patients with obesity: a randomised, double-blind, placebo and active controlled, dose-ranging, phase 2 trial. *Lancet* 2018; **392**: 637-649 [PMID: 30122305 DOI: 10.1016/S0140-6736(18)31773-2]

68 **Wilding JPH**, Batterham RL, Calanna S, Davies M, Van Gaal LF, Lingvay I, McGowan BM, Rosenstock J, Tran MTD, Wadden TA, Wharton S, Yokote K, Zeuthen N, Kushner RF; STEP 1 Study Group. Once-Weekly Semaglutide in Adults with Overweight or Obesity. *N Engl J Med* 2021; **384**: 989-1002 [PMID: 33567185 DOI: 10.1056/NEJMoa2032183]

69 **Davies M**, Færch L, Jeppesen OK, Pakseresht A, Pedersen SD, Perreault L, Rosenstock J, Shimomura I, Viljoen A, Wadden TA, Lingvay I; STEP 2 Study Group. Semaglutide 2·4 mg once a week in adults with overweight or obesity, and type 2 diabetes (STEP 2): a randomised, double-blind, double-dummy, placebo-controlled, phase 3 trial. *Lancet* 2021; **397**: 971-984 [PMID: 33667417 DOI: 10.1016/S0140-6736(21)00213-0]

70 **Wadden TA**, Bailey TS, Billings LK, Davies M, Frias JP, Koroleva A, Lingvay I, O'Neil PM, Rubino DM, Skovgaard D, Wallenstein SOR, Garvey WT; STEP 3 Investigators. Effect of Subcutaneous Semaglutide *vs* Placebo as an Adjunct to Intensive Behavioral Therapy on Body Weight in Adults With Overweight or Obesity: The STEP 3 Randomized Clinical Trial. *JAMA* 2021; **325**: 1403-1413 [PMID: 33625476 DOI: 10.1001/jama.2021.1831]

71 **Rubino D**, Abrahamsson N, Davies M, Hesse D, Greenway FL, Jensen C, Lingvay I, Mosenzon O, Rosenstock J, Rubio MA, Rudofsky G, Tadayon S, Wadden TA, Dicker D; STEP 4 Investigators. Effect of Continued Weekly Subcutaneous Semaglutide *vs* Placebo on Weight Loss Maintenance in Adults With Overweight or Obesity: The STEP 4 Randomized Clinical Trial. *JAMA* 2021; **325**: 1414-1425 [PMID: 33755728 DOI: 10.1001/jama.2021.3224]

72 **Coskun T**, Sloop KW, Loghin C, Alsina-Fernandez J, Urva S, Bokvist KB, Cui X, Briere DA, Cabrera O, Roell WC, Kuchibhotla U, Moyers JS, Benson CT, Gimeno RE, D'Alessio DA, Haupt A. LY3298176, a novel dual GIP and GLP-1 receptor agonist for the treatment of type 2 diabetes mellitus: From discovery to clinical proof of concept. *Mol Metab* 2018; **18**: 3-14 [PMID: 30473097 DOI: 10.1016/j.molmet.2018.09.009]

73 **Rosenstock J**, Wysham C, Frías JP, Kaneko S, Lee CJ, Fernández Landó L, Mao H, Cui X, Karanikas CA, Thieu VT. Efficacy and safety of a novel dual GIP and GLP-1 receptor agonist tirzepatide in patients with type 2 diabetes (SURPASS-1): a double-blind, randomised, phase 3 trial. *Lancet* 2021; **398**: 143-155 [PMID: 34186022 DOI: 10.1016/S0140-6736(21)01324-6]

74 **Frías JP**, Davies MJ, Rosenstock J, Pérez Manghi FC, Fernández Landó L, Bergman BK, Liu B, Cui X, Brown K; SURPASS-2 Investigators. Tirzepatide versus Semaglutide Once Weekly in Patients with Type 2 Diabetes. *N Engl J Med* 2021; **385**: 503-515 [PMID: 34170647 DOI: 10.1056/NEJMoa2107519]

75 **Kim BY**, Kang SM, Kang JH, Kim KK, Kim B, Kim SJ, Kim YH, Kim JH, Nam GE, Park JY, Son JW, Shin HJ, Oh TJ, Lee H, Jeon EJ, Chung S, Hong YH, Kim CH; Committee of Clinical Practice Guidelines, Korean Society for the Study of Obesity (KSSO). Current Long-Term Pharmacotherapies for the Management of Obesity. *J Obes Metab Syndr* 2020; **29**: 99-109 [PMID: 32378399 DOI: 10.7570/jomes20010]

76 **Jung HN**, Jung CH. The Upcoming Weekly Tides (Semaglutide vs. Tirzepatide) against Obesity: STEP or SURPASS? *J Obes Metab Syndr* 2022; **31**: 28-36 [PMID: 35314521 DOI: 10.7570/jomes22012]

77 **Kalarchian MA**, Marcus MD, Levine MD, Courcoulas AP, Pilkonis PA, Ringham RM, Soulakova JN, Weissfeld LA, Rofey DL. Psychiatric disorders among bariatric surgery candidates: relationship to obesity and functional health status. *Am J Psychiatry* 2007; **164**: 328-34; quiz 374 [PMID: 17267797 DOI: 10.1176/ajp.2007.164.2.328]

78 **Malik S**, Mitchell JE, Engel S, Crosby R, Wonderlich S. Psychopathology in bariatric surgery candidates: a review of studies using structured diagnostic interviews. *Compr Psychiatry* 2014; **55**: 248-259 [PMID: 24290079 DOI: 10.1016/j.comppsych.2013.08.021]

79 **Adami GF**, Gandolfo P, Bauer B, Scopinaro N. Binge eating in massively obese patients undergoing bariatric surgery. *Int J Eat Disord* 1995; **17**: 45-50 [PMID: 7894452 DOI: 10.1002/1098-108x(199501)17:1<45::aid-eat2260170106>3.0.co;2-s]

80 **Nielsen MS**, Christensen BJ, Schmidt JB, Tækker L, Holm L, Lunn S, Ritz C, Wewer Albrechtsen NJ, Holst JJ, Schnurr TM, Hansen T, le Roux CW, Lund TB, Floyd AK, Sjödin A. Predictors of weight loss after bariatric surgery-a cross-disciplinary approach combining physiological, social, and psychological measures. *Int J Obes (Lond)* 2020; **44**: 2291-2302 [PMID: 32327722 DOI: 10.1038/s41366-020-0576-9]

81 **Herpertz S**, Kielmann R, Wolf AM, Hebebrand J, Senf W. Do psychosocial variables predict weight loss or mental health after obesity surgery? *Obes Res* 2004; **12**: 1554-1569 [PMID: 15536219 DOI: 10.1038/oby.2004.195]

82 **Mitchell JE**, Lancaster KL, Burgard MA, Howell LM, Krahn DD, Crosby RD, Wonderlich SA, Gosnell BA. Long-term follow-up of patients' status after gastric bypass. *Obes Surg* 2001; **11**: 464-468 [PMID: 11501356 DOI: 10.1381/096089201321209341]

83 **Storman D**, Świerz MJ, Storman M, Jasińska KW, Jemioło P, Bała MM. Psychological Interventions and Bariatric Surgery among People with Clinically Severe Obesity-A Systematic Review with Bayesian Meta-Analysis. *Nutrients* 2022; **14** [PMID: 35458154 DOI: 10.3390/nu14081592]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com