v. 2, n. 71, 2022

International Journal of Health Science

METABOLIC SURGERY INDICATED FOR TREATING PATIENTS WITH TYPE 2 DIABETES

Francielly Hungria de Paula Alves Fontoura
Resident Doctor in General Surgery at the Hospital Universitário de Vassouras (HUV)
Vassouras, Rio de Janeiro, Brazil
http://lattes.cnpq.br/7744278693175534

Hercules da Costa Ribeiro Junior
Resident Doctor of General Surgery at the Hospital Universitário de Vassouras
Vassouras, Rio de Janeiro, Brazil
http://lattes.cnpq.br/8219353150932700

Paulo Armando Marques Luna
Resident Doctor of Plastic Surgery at the Hospital da Santa Casa de Misericórdia de Barretos
Barretos, Sao Paulo, Brazil
http://lattes.cnpq.br/3403498012470845

Lucas do Nascimento Freire
Resident Doctor at the Medical Clinic at the Hospital Universitário de Vassouras (HUV)
Vassouras, Rio de Janeiro, Brazil
http://lattes.cnpq.br/3870344853129443

Fabiane Roberto Leite
Student of the Medicine course at the Universidade de Vassouras (UV)
Vassouras, Rio de Janeiro, Brazil
http://lattes.cnpq.br/6303147243673779

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).

Patrick de Abreu Cunha Lopes
Student of the Medicine course at the Universidade de Vassouras and Scientific Initiation Student at PIBIC at the Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ). SUSEME Academic Internship at Miguel Couto Hospital.
Rio de janeiro Brazil
http://lattes.cnpq.br/9719714143799267

Aline Trovão Queiroz
Professor and Preceptor of the Medical Residency in General Surgery at the Hospital Universitário de Vassouras (HUV). General Surgery, Endosurgical Clinic, Specialist in Bariatric Surgery and Videolaparoscopy.
Vassouras, Rio de Janeiro, Brazil.
http://lattes.cnpq.br/8895921080117128

Lucineide Martins de Oliveira Maia
Professor and Preceptor of the Medical Residency in General Surgery at the Hospital Universitário de Vassouras (HUV). General Surgery, Endosurgical Clinic, Specialist in Bariatric Surgery and Videolaparoscopy.
Vassouras, Rio de Janeiro, Brazil.
http://lattes.cnpq.br/6587742990857108

Abstract: Introduction: Metabolic improvement results not only from weight loss and reduced insulin resistance, but also from changes in digestive hormones (especially incretins) that help improve insulin secretion. This paradigm shift, evolving from bariatric surgery to metabolic surgery, opens new perspectives. **Materials and Methods:** The present work was bibliographic research, with the main objective of describing the nursing record in auditing. A survey was carried out in the Google Scholar and SciELO and Lilacs databases. Observing publications in Portuguese, Spanish and English. **Results:** This article will consider the development of innovative surgical techniques aimed at endocrine-metabolic improvement rather than weight loss, the surgical treatment of type 2 diabetic patients with body mass index. **Discussion**: Numerous randomized clinical trials, although mostly short/medium term, demonstrate that metabolic surgery achieves excellent glycemic control. **Final considerations:** Although additional studies are needed to demonstrate long-term benefits, there is sufficient clinical and mechanistic evidence to support the inclusion of metabolic surgery among anti-diabetes interventions for people with T2DM and obesity.
Keywords: Metabolic surgery; metabolism; general surgery; diabetes mellitus.

INTRODUCTION

The modern world is faced with a true "epidemic" of obesity and type 2 diabetes (DM2), two pathologies that progress together in an environment where excessive caloric intake and insufficient energy expenditure coexist. A significant number of severely obese patients (body mass index or BMI > 35 kg/m) develop T2DM 2. The management of an obese patient with T2DM is complex and the Doctor is often faced with failure. Indeed, hygienic-dietary measures,

although essential, are rarely respected on a lasting basis and pharmacological means are limited. On the one hand, their action is hampered by the progressive depletion of B cells and, therefore, an inevitable drop in insulin-secreting function, on the other hand, many used antidiabetic drugs (sulfonamides, thiazolidinediones, insulin) are exposed to weight gain along with possible improvement in glycemic control [1].

In addition, most of these obese patients with T2DM accumulate many other risk factors or comorbidities, which usually requires the prescription of many specific drugs, for example, to treat high blood pressure, dyslipidemia, etc. This polypharmacy can lead to increased costs, lack of adherence or the occurrence of drug interactions, or even adverse events.

Surgery for obesity, known as bariatric surgery, has been shown to be effective in causing significant and sustained weight loss, as demonstrated in a recent meta-analysis by the *Cochrane Collaboration*. Recommendations for obesity surgery have been published recently and their practical consequences have already been analyzed in the review. This surgery is better tolerated as it is performed with a laparoscopic approach rather than laparotomy. The significant weight loss that follows favorably influences several pathologies and risk factors directly related to excess fat mass [2].

In metabolic surgery, the same process occurs as in bariatric surgery. The difference between the two is that metabolic surgery aims to control the disease. On the other hand, the aim of bariatric surgery is to reduce weight, with the aim of controlling diseases like diabetes and hypertension in the background. The Federal Council of Medicine (CFM) has standardized that metabolic surgery for patients with type 2 diabetes will be performed primarily through Roux-en-Y reconstruction surgery (RYGB). Sleeve gastrectomy (GV) can be selected only if RYGB is contraindicated or unfavorable. No other surgical technique can be used to treat these patients [3].

In Brazil, metabolic surgery has been used as an "unconventional" procedure for more than a decade, as it was originally only for obese patients with a body mass index (BMI) greater than 35. However, since 2017, the Federal Council of Medicine has expanded its indications for people with lower obesity rates (BMI greater than 30), paving the way for more people who cannot control the disease and seek to reduce the risk of complications. Two recently published randomized controlled studies point to effective bariatric surgery both in experimental groups and in humans. The first analyzed that there is no correlation between initial BMI and the success rate of long-term weight loss and surgical treatment. [4].

For T2DM patients with a BMI between 30 and 35 without adequate clinical control, after complete treatment, metabolic surgery may be an option. The second article pointed out that the treatment of gastrointestinal morbid obesity shows a great improvement in T2DM, which is not directly related to weight loss. Studies have shown that the rearrangement of the anatomical structure of the gastrointestinal tract is the main means of surgical control of diabetes. All bariatric surgery will improve T2DM, but this improvement occurs through different physiological mechanisms [5].

The two studies provide concordant results and show that weight loss and the reduction in the level of glycated hemoglobin (HbA1c) are markedly more pronounced in the surgical groups than in the medical group. The diabetes remission rate, considered the primary endpoint in these two studies, is also significantly higher with surgical treatment compared with medical therapy. The purpose of this article is to reflect on metabolic surgery in patients with Type 2 Diabetes.

Interestingly, the improvement in glycemic control with these different operations was not predicted either by the initial BMI or by the weight loss obtained, which argues for the contribution of endocrine-metabolic factors independent of the evolution of body weight. In recent years, the understanding of the mechanisms that explain the improvement of glycemic control has progressed remarkably, with an increasing role attributed to digestive hormones (especially the incretin system) and no longer simply to the decrease in insulin resistance linked to weight loss stricto sensu. From purely bariatric surgery, the evolution is therefore taking place towards the so-called metabolic surgery. This paradigm shift opens the way for the development of new surgical techniques, to offer surgery to T2DM patients with a BMI <35 kg/m^2 or even to consider surgery in certain type 1 diabetic patients, given the obesity that limits their medical care.[6]

METHODOLOGY

To deepen the knowledge on the subject, we opted for an Integrative Literature (RIL), a systematic literature review, which is based on the lived experience of the authors, configuring itself as a quantitative, exploratory and descriptive research. It is noteworthy that this type of research is the most suitable for this study, which evidenced aspects related to metabolic surgery in patients with type 2 diabetes.

This research will be carried out with articles published in Portuguese, Spanish and English, in full, available and published within a period of five years. After identification, the title will be read. As exclusion criteria: works in several databases; articles that did not correspond to the research topic and literature review searches

The analysis process helps researchers to better define their object of study and select the theories, procedures and methods to be used. By reviewing the literature before designing the project, the researcher is able to define more precisely the objective of his study, selecting the relevant literature for his research.

A broad bibliographic review on the research topic helps to carry out with satisfaction, the task of delimiting the reading unit, that is, to define exactly what within the chosen topic we chose to research, it also helps the researcher to capture sources of ideas. for new investigations, orientation in relation to what is already known, the perception of themes and problems that are not well researched and to perceive the moment when the problem situation is clarified.

Exclusion selection criteria are: articles published before 2015, articles unavailable in full, with the theme of chronic infectious diseases, articles published in more than one database, articles that did not focus on metabolic surgery and bibliographic reviews. As exclusion criteria, articles were not found in the following databases: Latin American and Caribbean Literature on Health Sciences (LILACS), Scientific Electronic Library Online (SciELO) and National Library of Medicine of the United States (PUBMED).

RESULTS

The study included 15 articles that met the inclusion criteria previously established, the distribution in the selected database is as follows:

Of the 15 articles on the subject in question, the articles selected from 2015 to 2020; one article in 2015 (6.66%); two in 2016 (13.33%); four in 2017 (26.66%); an article published in 2018 (6.66%); one article in 2019 (6.66%); four in 2020 (26.66%).

The methodology used in the elaboration of this work, it was found that: nine articles are Randomized Controlled Clinical Trials (60%);

AUTHOR	YEAR	TITLE	RESULTS
Cazzo et al	2018	Comparison of C-reactive protein, GLP-1 and GLP-2 levels between diabetic, morbidly obese and healthy controls: an exploratory study.	The GLP-2 levels of the NDO and T2D groups were significantly lower than those of the C group during the entire time evaluated. The area under the GLP-2 curve of the NDO and T2D groups was significantly smaller than that of the C group (P = 0.05 and P = 0.01, respectively).
Metabolic Surgery for Type 2 Diabetes: Changing the Landscape of Diabetes Care	2016	Metabolic Surgery for Type 2 Diabetes: Changing the Landscape of Diabetes Care.	Before we can fully assess the role of metabolic surgery in becoming a viable and readily available option in our treatment algorithm and expand the appropriate candidate pool, we need to fully understand efficacy, complications, long-term clinical outcomes, and costs. In particular, it will be important to clarify the financial implications for patients, providers and insurers (in the private and government sectors) and to recognize that these barriers can be very difficult to overcome in resource-poor areas of the world. While we have excellent short- to mid-term (up to 5 years) Level 1 evidence regarding the impact of metabolic surgery compared to medical/lifestyle interventions for glycemic control and weight loss, there is a paucity of data on outcomes of long-term RCTs related to microvascular and macrovascular complications.
Coelho et al.	2018	Diabetes remission rate at different BMI grades after roux-en-y gastric bypass.	There were no significant differences in the remission of hypertension, dyslipidemia and surgical morbidity, while weight was better controlled in the GI group.
Cohen et al.	2015	Bariatric and metabolic surgery and microvascular complications of type 2 diabetes mellitus.	Effective actions to prevent and control these diseases depend on timely access to accurate and reliable information, to inform where resources must be designed to optimize outcomes, and to observe and assess the impact of actions taken.
Courcoulas AP, King WC, Belle SH, Berk P., Flum DR, Garcia L, et al.	2018	Seven-Year Weight Trajectories and Health Outcomes in the Longitudinal Assessment of Bariatric Surgery (LABS)	Most participants followed trajectories in which 3- to 7-year weight regain was small relative to 3-year weight loss, but patterns were variable. Compared with baseline, the prevalence of dyslipidemia was lower 7 years after both procedures; The prevalence of diabetes and hypertension was lower after RYGB alone.
Delgado-Floody, P., Caamaño-Navarrete, F., Jerez-Mayorga, D., Martínez-Salazar, C., García-Pinillos, F., & Latorre-Román, P.	2017	Adaptations to physical exercise in the lipid profile and cardiovascular health of the morbidly obese.	Weight, BMI and WC showed significant changes ($p < 0.05$) in both groups, with better results in the adherent group. In the adherent group, cardiorespiratory capacity ($p = 0.001$) also increased, while diastolic pressure ($p = 0.011$), baseline blood glucose ($p = 0.021$) and triglycerides significantly decreased ($p < 0.001$). The non-adherent group showed no significant changes in these variables ($p \geq 0.05$).
Fuchs, T., Loureiro, M., Both, GH, Skraba, H. Helena, & Costa-Casagrande, TA	(2017).	The role of sleeve gastrectomy and the management of type 2 diabetes.	From May 8, 2013 to October 7, 2017, the eligibility of 658 patients was analyzed, of which 167 patients were randomly assigned to the early parenteral nutrition group and 168 patients were assigned to the late parenteral nutrition group. At 30 days, 46 complications (27.5%) occurred in the early group and 68 complications (40.5%) occurred in the late group [the difference between the two groups in the confidence interval was 95% -12.9 (- 22.7-2.8), P = 0.013]. Regarding secondary results, there was no difference between the two groups. Conclusion: Among cancer patients undergoing selective gastrointestinal surgery, the early parenteral nutrition strategy is better than the late parenteral nutrition strategy in preventing postoperative complications.

Junges VM, Cavalheiro JM, Fam EF, Closs VE, Moraes JF, Gottlieb MG	2017	Impact of Roux-en-Y gastric bypass (RYGB) surgery on metabolic syndrome components and associated drug use in obese patients.	Significant differences were found in weight, body mass index and waist circumference after 60 days postoperatively. The components for the diagnosis of metabolic syndrome (hypertension P = 0.001; hyperglycemia P < 0.001; hypertriglyceridemia P = 0.006) were reduced after 60 postoperative days, with the exception of HDL-c (P = 0.083). There was a significant reduction in the use of antihypertensive (P<0.001), hypoglycemic (P=0.013), lipid-lowering (P<0.001) and anti-obesity (P=0.010) medications and an increase in the use of gastroprotective medications, vitamins and minerals (P <0.001) after 60 days postoperatively.
Marques, PC	2018	Randomized comparative study between early and late parenteral nutrition in cancer patients undergoing elective gastrointestinal surgery: a clinical, randomized, controlled trial	From May 8, 2013 to October 7, 2017, the eligibility of 658 patients was analyzed, of which 167 patients were randomly assigned to the early parenteral nutrition group and 168 patients were assigned to the late parenteral nutrition group. At 30 days, 46 complications (27.5%) occurred in the early group and 68 complications (40.5%) occurred in the late group [the difference between the two groups in the confidence interval was 95% -12.9 (- 22.7-2.8), P = 0.013]. Regarding secondary results, there was no difference between the two groups. Conclusion: Among cancer patients undergoing selective gastrointestinal surgery, the early parenteral nutrition strategy is better than the late parenteral nutrition strategy in preventing postoperative complications.
Pajecki et al.	2020	Real-world evidence of health outcomes and medication use 24 months after bariatric surgery in the public healthcare system in Brazil: a retrospective, single-center study. Clinics.	During surgery, the mean age of the patients was 43.42 years (standard deviation [SD], 10.9 years), and the mean BMI was 46.7 kg/m2 (SD, 6.7 kg/m2). At 24 months, significant declines were observed in weight (mean, -37.6 kg), BMI (mean, -14.3 kg/m2); presence of T2D, hypertension and apnea (-29.6%, -50.6% and -20.9%, respectively); and number of patients using medication (-66.67% for diabetes, -41.86% for hypertension and -55.26% for dyslipidemia). The average cost of drugs (total costs for all drugs) decreased by 450% in 12-24 months postoperatively compared to 12 months preoperatively.
Ramada Faria, GF, Nunes Santos, JM, & Simonson, DC	2017	Quality of life after gastric sleeve and gastric bypass for morbid obesity.	Improved results were reported just after 3 months and SF-36 scores were improved in all domains over the medium to long term. It remains to be seen whether the improvement in QoL is related to weight loss and which factors are associated with improved patient perception. There is great heterogeneity in the reporting of PRO measurements after bariatric surgery, but the data are consistent with a significant improvement after both surgeries.
Rasera I Jr, Luque A, Junqueira SM Jr, Brasil NC, Andrade PC.	2020	Intestinal expression of toll-like receptor gene changes early after gastric bypass surgery and association with type 2 diabetes remission.	In the evaluation period, the number of bariatric surgeries increased by 339%. 94% of patients used gastric bypass, 2.4% of patients used cuff surgery and 3.6% of patients used other techniques. Between 2017 and 2018, the rate of use of laparoscopic technology was 4.7%. The number of operations carried out in different regions of the country varies.

Sala et al.	2014	Intestinal expression of toll-like receptor gene changes early after gastric bypass surgery and association with type 2 diabetes remission.	Patients experienced significant weight loss (P<0.001) and altered gut TLR gene expression 3 months after surgery. The main effects were a reduction in jejunal TLR4 expression in patients with complete and partial T2Dr (P < 0.05). There was a postoperative decrease in jejunal TLR7 expression in patients with complete T2Dr that correlated inversely with high-density lipoprotein cholesterol and positively with triglyceride concentrations, but not with weight loss.
Saleh F, Doumouras AG, Gmora S, Anvari M, Hong D.	2016	Results from the Ontario Bariatric Network: a cohort study.	A total of 5007 procedures (91.7% Roux-en-Y gastric bypass, 8.3% sleeve gastrectomy) were performed during the 3-year study period, with an overall complication rate of 11.7% (range of 95% confidence [CI] 10.8% - 12.6%). The leakage rate was 0.84% (95% CI 0.61% -1.13%), the reoperation rate was 4.6% (95% CI 4.0% -5.2%) and the mortality was 0.16% (95% CI 0.07% -0.31%). Male sex, chronic kidney disease and osteoarthritis were identified as risk factors for general complications (p value < 0.05). The median ORs between centers of excellence, calculated for general complications and reoperation rate, were 1.76 and 1.49, respectively.
Serafim, MP, Santo, MA, Gadducci, AV, Scabim, VM, Cecconello, I., & de Cleva, R.	2019	Very low-calorie diet in candidates for bariatric surgery: change in body composition during rapid weight loss.	Patients consumed the diet for 8 days. They showed a 5% weight loss (no significant difference between groups), which represented an 85% reduction in body fat. All changes in body circumference were statistically significant. There was greater weight loss and greater reduction in body fat in men, but the elderly had a significantly greater percentage of weight loss and greater reductions in body fat and fat-free mass. Greater reductions in body fat and fat-free mass were also observed in superobese patients. The changes in the diabetic participants did not differ significantly from those in the non-diabetic participants.

Table 1- Exposure of selected studies related to author, year, title and results.

two are longitudinal studies (13.33%); two are cross-sectional pilot studies and two are studies with Cohort methodology (13.33%).

Several techniques have been proposed in bariatric surgery in the last three decades, favoring or variably combining procedures of restriction or digestive malabsorption. A meta-analysis compared the effects of these different approaches on weight change. Compared with standard medical care, mean decreases in BMI one year after surgery were as follows: jejunoileal bypass: -11.4 kg/m ^{2}; mini gastric bypass: -11.3 kg / m ^{2}; biliopancreatic diversion: -11.2 kg / m ^{2}; sleeve gastrectomy (sleeve): -10.1 kg/m ^{2}; gastric bypass with Roux-en-Y loop: -9 kg / m ^{2}; horizontal gastroplasty: -5 kg / m ^{2}; vertical gastroplasty: -6.4 kg / m ^{2}; gastric band with adjustable ring: -2.4 kg / m ^{2}. In general, weight losses are greater with bypass procedures with malabsorption, intermediate with mixed bypass/restriction approaches, and lower with purely restrictive techniques [7]

The effect of surgery is not limited to its weight loss action. It is, among other things, favorable to metabolic control as a whole and glycemic control in particular, demonstrated in studies in 1995 [8]. Since then, numerous scientific publications have confirmed these facts and favored the abandonment of bariatric surgery terminology. This paradigm shift was endorsed in 2015 at the *Second Diabetes Surgery Summit* (DSS II), an international consensus conference where a college of international experts discussed with practitioners presenting the

first recommendations integrating metabolic surgery into the management of type 2 diabetes[9].

In the case of treating diabetes, it is scientifically questionable. In fact, a 2015 meta-analysis showed that preoperative BMI is not predictive of surgical success in terms of diabetes remission. It remains the same whether the BMI is lower or higher than 35 kg / m 2 [5], as well as the improvement in glycated hemoglobin (HbA1c) is independent of BMI. The only criterion that showed an inverse relationship with improvement in HbA1c is waist circumference. This counter-intuitive result could be explained by the existence of a selection bias, with the operated diabetics being less obese, but with higher preoperative HbA1c values.

DISCUSSION

In diabetic patients, in addition to the effect on weight loss, it is important to analyze the effects on blood sugar. Initially, the improvement in metabolic control was attributed to weight loss and the significant decrease in insulin resistance associated with it. It appears, however, that specific endocrine-metabolic effects can be expected from digestive surgery, in particular by various actions on the secretion of gastrointestinal hormones that not only help to increase satiety (or reduce appetite), but also to improve glycemic homeostasis.[10]

In general, endocrine-metabolic improvement can be achieved by surgical techniques that exclude the duodenum (foregut hypothesis) and/or that accelerate the arrival of food in the distal part of the small intestine (small intestine hypothesis). Regarding the first category, the hypothesis is that excluding the duodenum from contact with food prevents the release of substances not yet identified, but which contribute to postprandial hyperglycemia and, therefore, worsen diabetes. Gastric *bypass with Roux-en-Y loop assembly* typically falls into this category of operation; this is also the case with duodenal-jejunal bypass or the technique called duodenal witch, but not sleeve gastrectomy or adjustable ring cerclage. Regarding the second category, the hypothesis is that the faster arrival of food to the ileum stimulates the production of glucagon-like peptide-1 (GLP-1) by L cells. Roux-en-Y or biliopancreatic bypass, but sleeve gastrectomy can also increase this effect, known as incretin [7].

Whatever technique is used, metabolic improvement is even more difficult to achieve after surgery, as the known duration of T2DM is long, the preoperative HbA1c level is high, and initial antidiabetic treatment is required (insulin therapy)., all of which are correlated with functional depletion of islet B cells in the pancreas. Metabolic surgery, therefore, must be offered at a time when there is still a residual functional insulin-secreting capacity, which could be reactivated by digestive changes induced by surgical procedures [1].

Advances in knowledge of the endocrine physiology of the digestive tract have led to the development of innovative surgical techniques. Some are thought to aim to exclude the proximal bowel (duodenum), in line with the foregut hypothesis. An innovative alternative is the endoscopic placement of a proximal intestinal endoluminal prosthesis that mimics the effects of a "duodenal-jejunal *bypass*", avoiding the contact of food with the duodenal mucosa [11]. Metabolic surgery is a method of surgical intervention that aims to restore the metabolic processes of the human body. Metabolic surgery plays an important role in the treatment of diabetes. Metabolic surgery must focus on functional limitation. The only way to do this is to activate ileum-induced appetizing neuropeptide hormones early in the feeding process. If the satiety signals from the limbs are too weak or too

late, it can happen that the person eats a lot until metabolic satiety occurs. After obesity, hypertension, hyperlipidemia, hypercaloric fat and diabetes are controlled by the secretion of hormones secreted by L cells, because diets will pass directly into the small intestine after bypassing diets, the passage of nutrients is surgically inhibited and the release of various hormones is avoided [1].

The data available with these new techniques are still very limited, in terms of the number of active centers, number of patients already treated, follow-up time and analysis of the benefit/risk balance. Under these conditions, it is still not possible to correctly evaluate them in comparison with other surgical approaches used for many years in the context of bariatric surgery, let alone recommend them now in clinical practice [12].

In contrast, surgical treatments for obesity (bariatric and metabolic surgery) often lead to T2DM remission with prolonged, often lifelong, normalization of blood glucose and glycated hemoglobin (HbAlc) levels with discontinuation of drug treatment. In the literature, there are reports, although sporadic, but quite regular, of cases of T2DM remission after gastric resection (Bill-Roth-II) for peptic ulcers in non-obese patients.

The meta-analysis performed by Cohen et al (2015). showed that often lifelong normalization of blood glucose and glycated hemoglobin (HbAlc) levels with drug treatment interruption. In this case, the efficiency and speed of glycemic control depend on the type of surgical intervention [4].

Combined gastric bypass surgery and biliopancreatic bypass graft or their laparoscopic analogues in morbidly obese patients are the most effective interventions for T2DM. Therefore, although the control of diabetes after restrictive gastric interventions may be associated only with weight loss, the rapid and stable improvement in the course of T2DM after coronary artery bypass graft surgery has not yet been sufficiently explained. A significant decrease in caloric intake does not lead to as significant compensation for DM2 as occurred after combined operations in the same patients [5]. There are experimental studies that confirm the data that diabetes control after coronary artery bypass graft surgery is not just a consequence of reduced caloric intake from food and body weight [13].

Remission during T2DM after combined operations can also be explained by the development of intestinal malabsorption, which results in a decrease in glucose and fat absorption. As a result, the circulation of free fatty acids decreases with a corresponding improvement in insulin sensitivity. However, if intestinal malabsorption is obvious and reaches 100% after BPS, then malabsorption after standard LHD is less significant [14].

It becomes obvious that characteristic anatomical changes in the gastrointestinal tract can alter the dynamics of intestinal hormone secretion, especially in response to food stimulation. In support of this view, characteristic anatomical changes of the gastrointestinal tract can alter the dynamics of intestinal hormone secretion, especially in response to food stimulation. In support of this view, characteristic anatomical changes of the gastrointestinal tract can alter the dynamics of intestinal hormone secretion, especially in response to food stimulation.

FINAL CONSIDERATIONS

The favorable results gradually shifted the purely bariatric view of this surgery (goal: weight loss) to a more metabolic view (goal: diabetes remission). Therefore, it is becoming legitimate today to question the merits of offering an intervention for T2DM patients with grade 1 obesity (BMI 30-35 kg/m2) or even simply overweight, when their diabetes is unbalanced despite satisfactory dietary and

therapeutic compliance. However, the benefit/risk ratio of this surgery in these patients remains to be determined, in the absence of randomized trials conducted.

The position of the *International Diabetes Federation* (IDF) is based primarily on the analysis of data from observational studies that illustrate the effectiveness of surgical treatment of obesity in glycemic control and remission of T2DM. The IDF recognizes metabolic surgery as a therapeutic option in T2DM patients with a BMI between 30 and 35 kg/m2, as long as their diabetes remains unbalanced (HbA1c > 7.5%) despite optimal medical treatment, especially if there are associated comorbidities. to obesity.

REFERENCES

1. Serafim, M. P., Santo, M. A., Gadducci, A. V., Scabim, V. M., Cecconello, I., & Cleva, R. (2019). Very low-calorie diet in candidates for bariatric surgery: change in body composition during rapid weight loss. Clinics (Sao Paulo, Brazil), 74, e560. https://doi.org/10.6061/clinics/2019/e560.

2. Fuchs, T., Loureiro, M., Ambos, G. H., Skraba, H. Helena, & costa-Casagrande, T. A. (2017). O papel da gastrectomia da manga e a gestão do diabetes tipo 2. ABCD. Arquivos Brasileiros de Cirurgia Digestiva (São Paulo), 30 (4), 283-286. https://doi.org/10.1590/0102-6720201700040013.

3. Pajecki, D., Kawamoto, F., Dantas, A., Andrade, P. C., Brasil, N. C., Junqueira, S. M., Oliveira, F., Ribeiro, R. A., & Santo, M. A. (2020). Real-world evidence of health outcomes and medication use 24 months after bariatric surgery in the public healthcare system in Brazil: a retrospective, single-center study. Clinics (Sao Paulo, Brazil), 75, e1588. https://doi.org/10.6061/clinics/2020/e1588.

4. Cohen, R., Pechy, F., Petry, T., Correa, J. L., Caravatto, P. P.,& Tzanno-Martins, C. (2015). Cirurgia bariátrica e metabólica e complicações microvasculares do diabetes mellitus tipo 2 (DM2). Braz. J. Nephrol., 37(3), 399-409.

5. Coelho, D., Godoy, E.P, Marreiros, I.L.V.Fernando da, Oliveira, A. M. G de, Campos, J.M, Caldas-Neto, S.S & Freitas, M. P. C. (2018). Diabetes remission rate in different bmi grades following roux-en-y gastric bypass. abcd. Arquivos Brasileiros de Cirurgia Digestiva (São Paulo), 31(1), e1343. EpubMarch 01, 2018.https://doi.org/10.1590/0102-672020180001e1343.

6. Delgado-Floody, P., Caamaño-Navarrete, F., Jerez-Mayorga, D., Martínez-Salazar, C., García-Pinillos, F., & Latorre-Román, P. (2017). Adaptaciones al ejercicio físico en el perfil lipídico y la salud cardiovascular de obesos mórbidos. *Gaceta medica de Mexico*, *153*(7), 781–786. https://doi.org/10.24875/GMM.17002894

7. Ramada F. G. F., Nunes Santos, J. M., & Simonson, D. C. (2017). Quality of life after gastric sleeve and gastric bypass for morbid obesity. Porto biomedical journal, 2(2), 40–46. https://doi.org/10.1016/j.pbj.2016.12.006

8. Sala, P., Torrinhas, R., Fonseca, D. C., Machado, N. M., Singer, J., Singer, P., Ravacci, G. R., Belarmino, G., Ferreira, B., Marques, M., Ishida, R. K., Guarda, I., de Moura, E., Sakai, P., Santo, M. A., Sunaga, D. Y., Heymsfield, S. B., Bezerra, D., Corrêa-Giannella, M. L., & Waitzberg, D. L. (2020). Intestinal expression of toll-like receptor gene changes early after gastric bypass surgery and association with type 2 diabetes remission. Nutrition (Burbank, Los Angeles County, Calif.), 79-80, 110885. Advance online publication. https://doi.org/10.1016/j.nut.2020.110885.

9. Junges V.M, Cavalheiro J.M, Fam E.F, Closs V.E, Moraes J.F, Gottlieb M.G (2017). Impacto da cirurgia de bypass gástrico em Y-de-Roux (RYGB) nos componentes da síndrome metabólica e no uso de drogas associadas em pacientes obesos. Arq Gastroenterol. ; 54 (2): 139-44. https://doi.org/10.1590/s0004-2803.201700000-11.

10. Courcoulas A.P, King W.C, Belle S.H, Berk P., Flum D.R, Garcia L, et al. Seven-Year Weight Trajectories and Health Outcomes in the Longitudinal Assessment of Bariatric Surgery (LABS) Study. JAMA Surg. 2018; 153 (5): 427-34. https://doi.org/10.1001/jamasurg.2017.5025.

11. Cefalu, W. T., Rubino, F., & Cummings, D. E. (2016). Metabolic Surgery for Type 2 Diabetes: Changing the Landscape of Diabetes Care. *Diabetes care*, *39*(6), 857–860. https://doi.org/10.2337/dc16-0686

12. Marques, P. C. (2018). Estudo randomizado comparativo entre nutrição parenteral precoce e tardia em pacientes com câncer submetidos à cirurgia gastrointestinal eletiva: estudo clínico, randomizado e controlado. Tese de Doutorado, Faculdade de Medicina, Universidade de São Paulo, São Paulo. doi:10.11606/T.5.2018.tde-02082018-120921. Recuperado em 2020-08-22, de www.teses.usp.br

13. Rasera I Jr, Luque A, Junqueira SM Jr, Brasil NC, Andrade PC. Eficácia e segurança da cirurgia bariátrica no sistema público de saúde no Brasil: evidências do mundo real em um centro de cirurgia de obesidade de alto volume. Obes Surg. 2017; 27 (2): 536-40. https://doi.org/10.1007/s11695-016-2439-y.

14. Cazzo, E., Pareja, J. C, Chaim, E. A, Coy, C. S. R & Magro, D. O. (2018). Comparação dos níveis de proteína c-reativa, glp-1 e glp-2 entre indivíduos com diabetes, obesidade mórbida e controles saudáveis: UM ESTUDO EXPLORATÓRIO. Arquivos de Gastroenterologia, 55 (1), 72-77. https://doi.org/10.1590/s0004-2803.201800000-14.

15. Saleh F, Doumouras AG, Gmora S, Anvari M, Hong D. Resultados da Ontario Bariatric Network: a cohort study. CMAJ Open. 2016; 4 (3): E383-E389. https://doi.org/10.9778/cmajo.20150112.