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Gastric Bypass with Long Pouch and Transit Bipartition for Endoscopic Access to the Remaining Stomach

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Abstract

Introduction: obesity has a complex and multifactorial etiology, difficult treatment and increasing incidence rates in recent decades. The treatment involves clinical and pharmacological approaches and, in case of lack of results, surgical interventions. Roux-en-Y gastric bypass (RYGB) is one of these surgical interventions in which the stomach is divided, creating a small pouch, and the remaining portion of the stomach become excluded and left without endoscopic access. **Objective:** to evaluate the results of modified RYGB with long pouch and endoscopic access to the remaining stomach. **Materials and Methods:** prospective clinical trial with sample selected among patients seen at the Alberto Rassi General State Hospital of Goiânia (HGG) and indicated for bariatric and metabolic surgery confirmed by the medical and multidisciplinary team. The study was conducted from January 2020 to August 2021. Clinical history and laboratory test results of the selected patients were collected through consultations with the medical and multidisciplinary team. **Results:** twelve participants were included in the study. Of these, 11 (91.7%) were women and the mean age was 46.3 years. The weight before surgery was 112.17 kg (92.00 - 150.00) and the Body Mass Index (BMI) was 44.89 (35.06 - 74.39). After 18 months of surgery, the mean weight was 80.77 kg (±11.92) and the mean BMI was 29.46 (±11.00), showing a significant reduction in both ($p = 0.003$ and $p = 0.002$, respectively). All patients underwent endoscopic evaluation of the pouch, remaining stomach and duodenum at 12 months postoperatively. The mean percentage of lost excess weight loss was 68.21%. **Conclusion:** We conclude that the proposed changes in RYGB (GBLP + GIB – Roux-en-Y gastric bypass with long pouch and ga-

strointestinal bipartition) did not compromise weight loss or control of type 2 diabetes and other comorbidities and proved to be a safe and effective alternative without gastroduodenal exclusion, enabling a better postoperative follow-up.

Keywords

Obesity, Bariatric Surgery, Metabolic Surgery, Roux-En-Y Gastric Bypass

1. Introduction

In the scenario of coping with Chronic Non-Communicable Diseases (CNCDs), obesity has gained increasing prominence due to its complex and multifactorial causes, difficult treatment, and considerable growth in recent decades [1] [2]. Characterized by excess weight related mainly to the accumulation of fat in subcutaneous and visceral regions, obesity has emerges from a complex mechanism of interaction between individual genetic variability, endocrine and neuroendocrine changes, and environmental factors marked by excessive consumption of high-calorie foods and decreased physical activity levels [3] [4].

The treatment of comorbidities associated with excess weight and the reduction of the individual's functionality entail substantial economic implications with direct, indirect and intangible costs for the Unified Health System and other social spheres. In Brazil, annual expenditures with these diseases are estimated to be R$ 3.6 billion, with the highest values directed to cardiovascular diseases (67%) and cancer (15%) [5].

Treatment of overweight involves clinical and pharmacological approaches and, in the case of failure of these approaches, surgical interventions. The latter are characterized by the limitation of the gastric and/or absorptive capacity of the intestine and are popularly known as gastroplasty or bariatric surgeries. They perform a therapeutic option whose goal is to minimize the health problems arising from this clinical condition [4] [6].

The results of bariatric surgery go far beyond considerable and sustained weight loss. For severely obese (class III) patients undergoing surgery, a total reversal rate of type II diabetes has been observed in 76.8% of cases. Obstructive apnea is usually resolved in up to 85.7% of cases; systemic arterial hypertension tends to improve in 78.5% of cases; and the hyperlipidemic condition can be corrected in 88%, with a reduction in serum triglyceride and cholesterol levels. The most important consequence of this outcome is the reduction of overall mortality by up to 35%, morbidity and risk of death related to cardiovascular diseases [7] [8] [9]. In this sense, bariatric surgery improves or eliminates comorbid conditions of obese patients, being more effective than non-surgical procedures [10] [11].

Despite the many benefits of bariatric surgery, some studies have suggested that the individual remains vulnerable to complications and unfavorable out-

comes associated with the anatomical and physiological changes resulting from this procedure. Among these complications are gallstones, stenosis of the gastroenteroanastomosis, digestive fistulas, intra-abdominal bleeding, occlusion, hernias, and nutritional disorders such as vitamin, iron and folic acid deficiency [12] [13] [14] [15].

Other challenging outcomes related to bariatric surgery are those associated with the excluded stomach, such as bile reflux, gastritis and/or gastric and duodenal ulcers, polyp emergence, and difficulty/impossibility of endoscopic access for investigation/therapy, among others [16] [17]. It has recently been proposed that the presence of the duodenal content of the excluded stomach may increase the predisposition to gastric cancer by generating a carcinogenic environment that may affect the genetic response when the organ is exposed to this content [17].

Furthermore, classical bariatric surgeries performed today rely on mechanical restriction, malabsorption, or both. Over time, scientific evidence has shown that mechanical restriction, malabsorption and excluded segments are not physiological. In an ideal procedure, the objective should be to create a smaller functional stomach and avoid excluding segments [18].

Studies indicate that upper digestive endoscopy is one of the main exams for gastroduodenal evaluation and one of the techniques for detecting neoplasms in the digestive system and other gastric pathologies, being considered, therefore, the gold standard in the diagnosis of gastric cancer [16] [19].

Considering that patients undergoing bariatric surgery of the Roux-en-Y gastric bypass (RYGB) type have the remaining stomach excluded and become vulnerable to the abovementioned conditions, adaptations in the surgical techniques are necessary to allow endoscopic access to the gastroduodenal region and, thus, the prevention, diagnosis and treatment of possible complications in the excluded stomach [19] [20].

Thus, the present study aimed to evaluate the RYGB surgery modified with a long pouch and endoscopic access to the remaining stomach (GBLP + GIB – Roux-en-Y gastric bypass with long pouch and gastrointestinal bipartition), as well as weight loss and control of comorbidities.

2. Material and Methods

A prospective clinical trial with a convenience sample was carried out at the Alberto Rassi General State Hospital of Goiânia (HGG). Patients on demand indicated for metabolic surgery by the medical and multidisciplinary team were selected to compose the sample. The study was conducted from January 2020 to August 2021. Twelve patients were selected at random and invited to participate in the study. They received full information about the planned procedures, risks and possible benefits. All who consented to participate in the study signed the informed consent form. Individuals of both sexes with a minimum age of 18 and a maximum of 70 years for a Body Mass Index (BMI) greater than or equal to 35

kg/m²; age from 30 to 70 years for a BMI greater than or equal to 30 and less than or equal to 34.9 kg/m², associated with type 2 diabetes mellitus (DM2); and who had no contraindications for the surgical procedure. The exclusion criteria were dropout before 12 months multidisciplinary preoperative follow-up; members of vulnerable groups; presence of uncompensated psychiatric disorders or cognitive deficits confirmed by a psychiatrist and/or psychologist; presence of alcohol or illicit drug abuse confirmed after evaluation by a psychiatrist and/or psychologist; presence of chronic diseases not related to obesity such as cancer, lung disease, nephropathy, heart disease, Parkinson's and Alzheimer's disease; and/or previous bariatric surgeries.

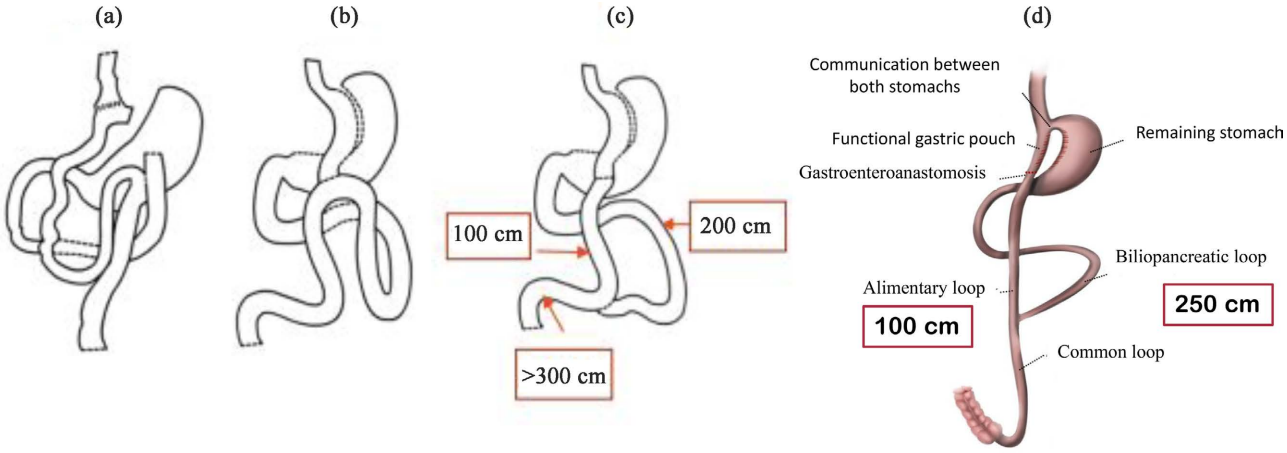
Clinical data were collected from the selected patients (age, weight, BMI, blood pressure, presented comorbidities, cardiovascular history, clinical treatments previously performed to control DM2, eating habits and physical activity) from their clinical records during multidisciplinary pre-operative consultations.

The operative technique used for these patients was the modified RYGB (GBLP + GIB – Roux-en-Y gastric bypass with long pouch and gastrointestinal bipartition), with long pouch and endoscopic access to the remaining stomach and duodenum. Initially, a median laparotomy was performed with measurement of the length of the entire small intestine. The small curvature of the stomach is approached and a functional gastric pouch is created (~18 cm long and ~150 ml) by a first horizontal fire, as described by Chaim. [21] The following firing is performed vertically with a 32 F Fouchet probe to calibrate the functional gastric pouch and maintain the gastro-gastric communication as explained by de Melo, [22] at approximately 1 to 1.5 cm from the angle of Hiss, allowing endoscopic access for exams and/or endoscopic procedures also in the remaining stomach.

The staple lines of the gastric pouch and the remaining stomach are reinforced with continuous 3-0 vicryl suture. Then, the gastrointestinal transit is reconstructed in "Roux-en-Y", leaving an alimentary loop of 100 cm and a biliopancreatic loop of 250 cm from the angle of Treitz. It is also possible to know the size of the common loop, since, as already mentioned, the entire small intestine is measured. After performing the antecolic gastroenteroanastomosis of approximately 30 mm with a stapler, a methylene blue test is performed, the closure of the gaps and the hemostasis, drainage of the abdominal cavity, and closure by planes are reviewed (**Figure 1**).

Visits were carried out with a medical and multidisciplinary team in the postoperative period, one week after hospital discharge, three months after surgery, and six months after surgery. In all visits, routine outpatient clinical evaluation, data collection and postoperative examinations were performed. The access to the remaining stomach and duodenum was endoscopically assessed nine months after surgery.

The decrease in body weight obtained after surgery was measured through absolute BMI values measured after the operative period. The percentage of BMI



Source: Adapted from Ribeiro, 2019 [23].

Figure 1. Comparison between techniques. (a) Roux-en-Y gastric bypass (RYGB); (b) one anastomosis gastric bypass (OAGB); (c) Roux-en-Y gastric bypass with long pouch; (d) GBLP + GIB (RYGB + long pouch and endoscopic access to the remaining stomach and duodenum).

lost was calculated and the excess weight loss (EWL) was classified according to the literature [24]:

% of lost BMI (EWL):

% of lost BMI (EWL) = (preoperative BMI − current BMI/preoperative BMI − 25) × 100

Data were analyzed using the SPSS statistical package version 24, with a significance level of 5% ($p < 0.05$). The characterization of clinical aspects was performed using descriptive statistics: absolute (n) and relative (%) frequency for categorical variables and median, mean, standard deviation, minimum and maximum for continuous variables. Multiple regression analyses were applied to assess the interrelationship of biochemical parameters with BMI and % of excess body weight loss. Continuous data were expressed as means and standard deviations. Categorical data were represented by absolute or relative frequencies (%). The Wilcoxon test was used for data comparisons.

The study was approved by the Ethics and Research Committee of the General Hospital of Goiânia with the Embodied Opinion CEPHGG n˚ 3,714,625 of November 20, 2019.

3. Results

Twelve participants took part in the pilot study. Of these, 11 (91.7%) were women and the mean age was 46.3 years. The mean weight and BMI before surgery were 112.17 kg (92.00 - 150.00) and 44.89 kg/m^2 (35.06 - 74.39) (**Table 1**). During the operation, the size of the small intestine of each patient was measured and the size of the gastric bypass loop and the size of the alimentary loop were recorded (**Table 2**). There were no complications or mortality among patients during surgery or during follow-up.

One year after the surgery, the mean weight was 91.95 kg (±23.52) (**Graph 1**)

and the mean BMI was 33.38 kg/m^2 (±13.73) (Graph 2) and at 18 months after the surgery, the mean weight was 80.77 kg (±11.92) (Graph 3) and the mean BMI of 29.46 kg/m^2 (±11.00) (Graph 4), showing a significant reduction in relation to preoperative values (p = 0.003 and p = 0.002, respectively). The mean percentage EWL was 68.21% (Table 1).

Table 1. Descriptive data of the general sample.

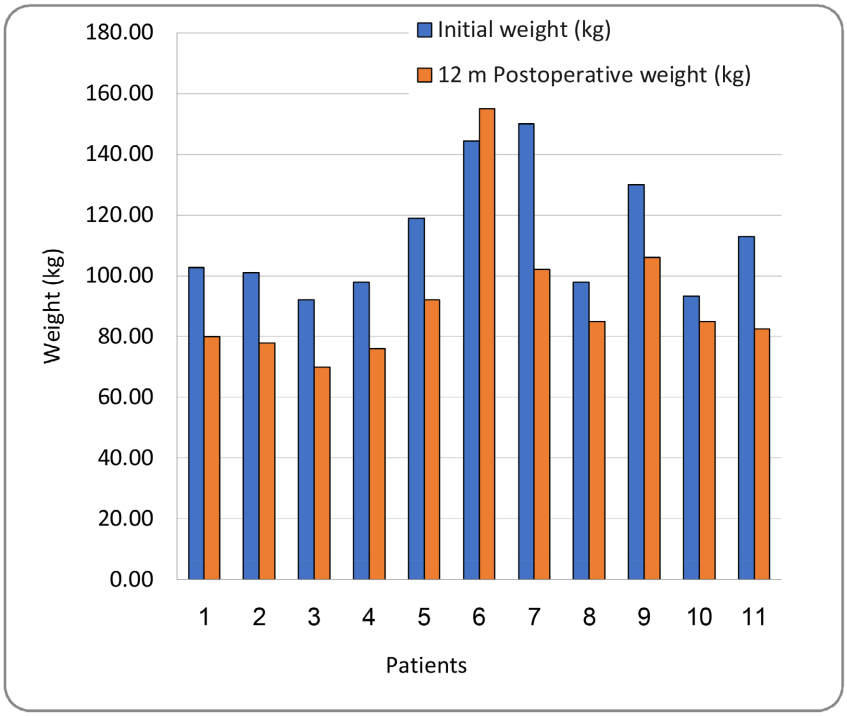
	N	Minimum	Maximum	Mean	Standard deviation
Height (cm)	12	1.42	1.68	1.59	0.07
Initial weight (kg)	12	92.00	150.00	112.17	19.69
Preoperative BMI (kg/m^2)	12	35.06	74.39	44.89	10.82
Postoperative weight (kg) 12 months	11	70.00	155.00	91.95	23.52
Postoperative BMI (kg/m^2) 12 months	12	0.00	56.25	33.38	13.73
Postoperative weight (kg) 18 months	11	64.00	106.00	80.77	11.92
Postoperative BMI (kg/m^2) 18 months	12	0.00	44.63	29.46	11.00
EWL (%)	11	35.93	102.22	68.21	17.83

Table 2. Bowel measurements of operated patients: total bowel, alimentary loop and gastric bypass (BP) loop.

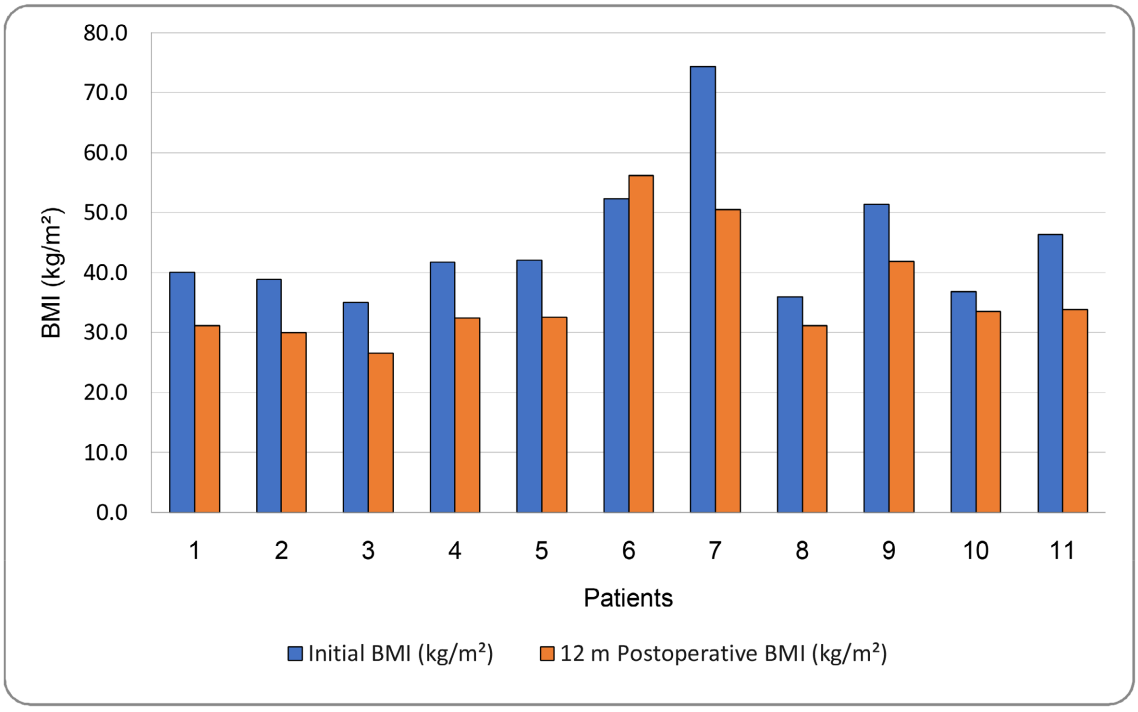
Patients	Total bowel (cm)	Alimentary loop (cm)	BP (cm)	Common loop
1	1150	100	250	800
2	1200	100	250	850
3	1030	100	250	680
4	1180	100	250	830
5	1000	100	250	650
6	1130	100	250	780
7	1080	100	250	730
8	1280	100	250	930
9	1000	100	250	650
10	1310	100	250	960
11	1080	100	250	730
12	1000	100	250	650
13	1030	100	250	680
Mean	1113	100	250	763

Before surgery, 11 (91.7%) patients were diabetic and 1 (8.3%) was pre-diabetic. After surgery, the number of diabetic individuals dropped to 3 (25.0%) and 8 (66.7%) had remission of the disease, but without statistical significance (p =

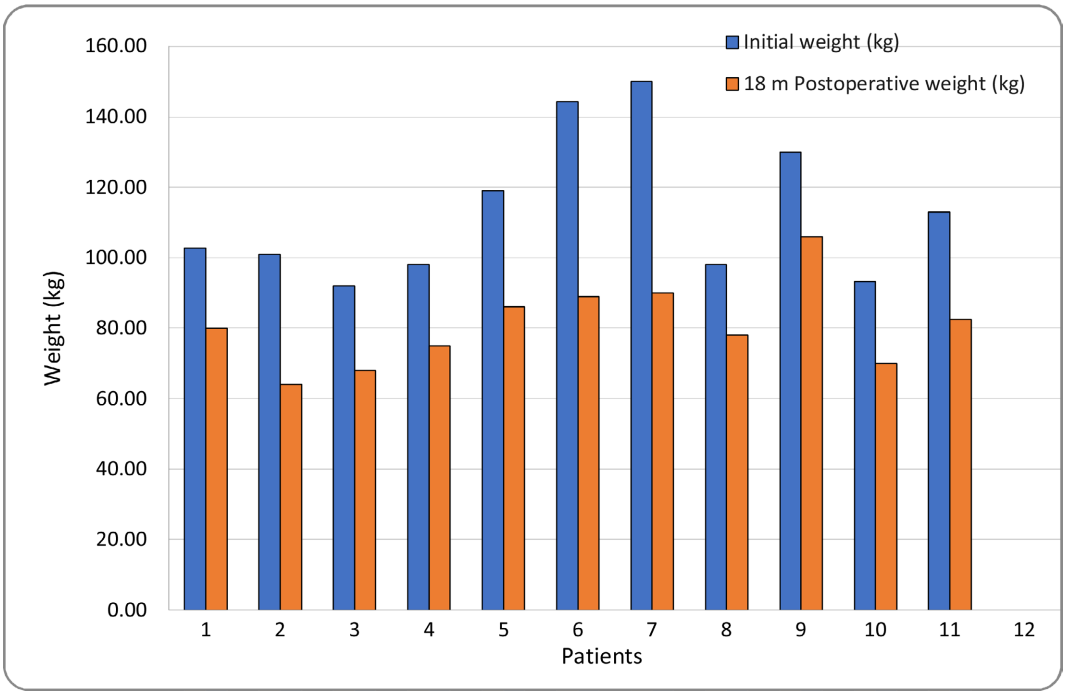
0.76); one (8.3%) patient was lost to follow-up. Regarding blood glucose, glycated hemoglobin (HBA1c) and estimated mean glycemia, we found decreasing trends, especially for glycated hemoglobin (p = 0.06) and estimated mean glycemia (p = 0.058), as shown in Table 3. The non-exclusion of segments of the



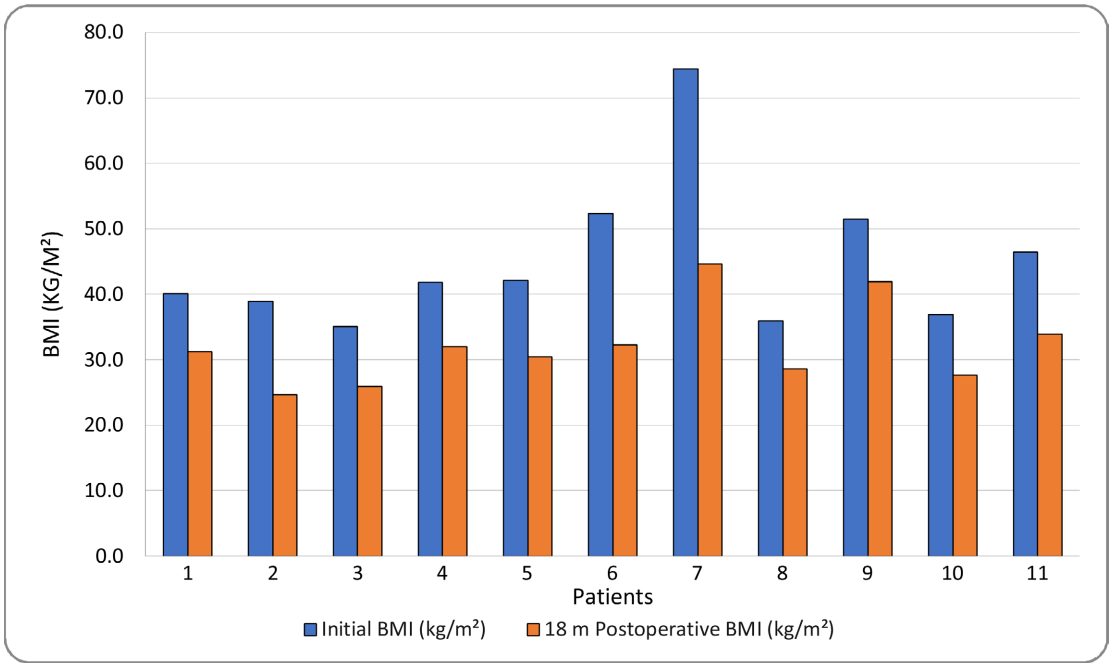
Graph 1. Weight of patients before and 12 months after surgery.



Graph 2. BMI of patients before and 12 months after surgery.



Graph 3. Weight of patients before and 18 months after surgery.



Graph 4. BMI of patients before and 18 months after surgery.

Table 3. Assessment of the glycemic profile.

	Preoperative (mean and SD)	Postoperative (mean and SD)	p
Glucose	105.2 ± 30.6	92.2 ± 15.6	0.21
HBA1c	6.2 ± 1.2	5.2 ± 0.6	0.06
Mean blood glucose	138.50 ± 37.7	101.0 ± 20.4	0.058

digestive system did not affect the control of obesity and type 2 diabetes in the present study so far, achieving the expected results for this type of surgery and still allowing the endoscopic study of the entire stomach and duodenum.

Ten (83.33%) patients underwent endoscopy nine months after surgery. In all of them (100%), it was possible to endoscopically access the remaining stomach and duodenum, as shown in Figure 2 and Figure 3. The endoscopist evaluated the patients during the examination following the protocol and the patients who were indicated for histopathological evaluation had a sample of tissue collected. Nine patients (90%) had an indication for biopsy; the majority (n = 7; 77.7%) had biopsy specimens obtained from the antrum, one individual from the gastric

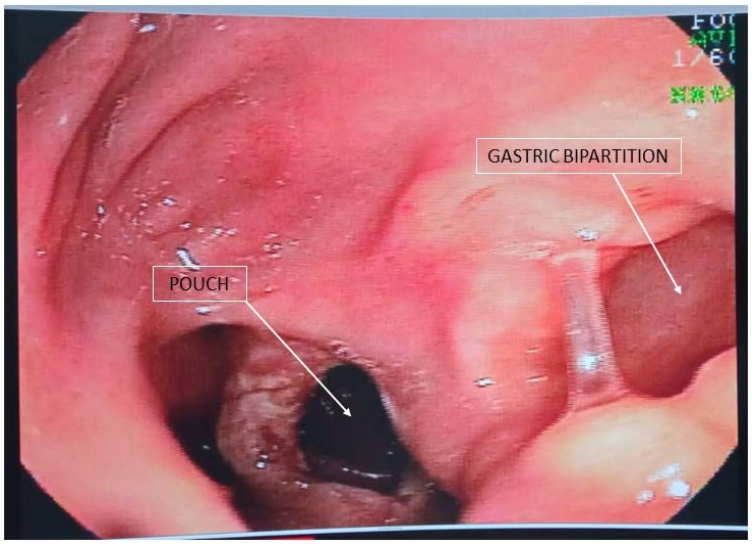


Figure 2. Upper digestive endoscopy nine months after modified Roux-en-Y gastric bypass with long pouch and endoscopic access to the remaining stomach, showing the gastric pouch and gastric bipartition.

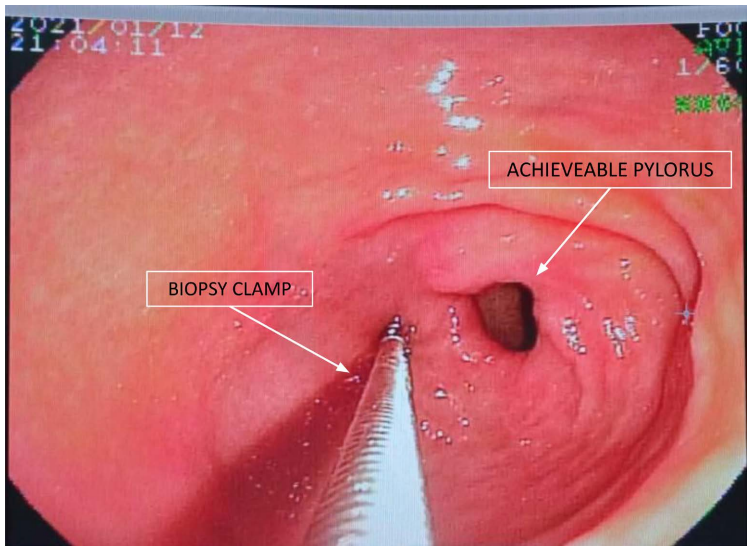


Figure 3. Upper digestive endoscopy of gastric biopsy performed nine months after surgery.

body (11.1%) and one from the gastric stump (11.1%). Eight (88.8%) patients were diagnosed with mild non-granulomatous gastritis and only one (11.1%) had moderate chronic gastritis associated with *H. pylori*.

4. Discussion

The studied patients lost 18% (20.22 kg) and 28% (31.4 kg) of weight in 12 and 18 months, respectively, which agrees with literature data [25] [26]. Excess weight loss gives an indication of the success of the procedure; losses of more than 50% are considered to indicate success [26]. The EWL was maintained around 64.3% one year after bariatric surgery, [27] [28] which is similar to the values found in this study, where the patients presented a mean EWL of 68.21% in 18 months, values even higher than those found in the literature, since in fact weight loss occurs in the first two years after surgery, remaining stable after this period [28].

There was remission of diabetes in the study patients. This was expected as it has been reported that diabetes remission can reach 76.8% after metabolic surgery [26] [27] [28] [29]. Postoperative glycated hemoglobin values one year after surgery are 5.8% on average in diabetic patients [26].

Even patients with a larger gastric chamber in the RYGB, with sizes greater than 100 ml, have shown EWL values similar to those of patients who had a gastric chamber of standard size created, and even less weight regain in 3 years [23] [30] [31].

Regarding the possibility of weight regain due to access to the remaining stomach, when compared to the modified Scopinaro operation with endoscopic access to the remaining stomach distal to the classic Scopinaro, no statistically significant difference in weight loss between the groups was found ($p = 0.027$) [22].

In the RYGB technique, the stomach is divided into a functional gastric pouch and a remaining stomach, which remains excluded. The latter can be the focus of postoperative complications, including bleeding, ulcer and cancer [17] [32] [33]. In the case of cancer, obesity is a risk [16].

One of the most feared complications among patients undergoing RYGB is the possibility of gastric cancer in the excluded stomach. The occurrence of reflux of duodenal content into the excluded portion of the stomach is one of the probable factors. From 40% to 70% of patients undergoing RYGB had a high content of microorganisms in the remaining portion of the stomach [34]. The reflux of bile content present in the duodenum is thought to be associated with a higher risk of gastritis, intestinal metaplasia and some rare types of cancer [17] [34].

Enterogastric bile reflux induces damage to the gastric mucosa, hypochloridia (which favors bacterial colonization), and the presence of secondary bile acid. Together, these events have proven to be carcinogenic factors. Cancer can develop from chronic atrophic gastritis and intestinal metaplasia, inducing adenoid cystic changes and abnormal cell kinetics [17].

Cases of gastric cancer resulting from bariatric procedures are reported in the literature, with diagnosis on average 8.6 years after bariatric surgery. Adenocarcinoma represented 83% of cases, being located in the excluded stomach in 83% and in the gastric pouch in 17% [35]. Lymph node involvement was reported in almost 60% of cases and metastases in 15%. The reported mortality rate was 48.1% [36].

The difficulty diagnosis of the carcinoma is a common feature of all cases. In the presence of symptoms by the patient, all the available tests, such as CT scans, endoscopies, colonoscopies, ultrasounds and radiographs, were performed and none was able to identify the carcinoma before very advanced stages. The diagnosis of cancer was only possible after very invasive interventions, such as laparotomy, as there was no other way of accessing the excluded stomach, where the possible carcinoma developed. The number of deaths was considerable among these patients, [20] [32] [37]-[42] which demonstrates the inefficiency of the tests available for the diagnosis of cancer in the excluded stomach and the consequences of late diagnosis.

Endoscopy is considered the gold standard diagnostic technique for neoplasms in the digestive system [16] [43]. As one of the goals of the present study, the endoscopic access to the excluded stomach occurred adequately, without intercurrences. The proposed technique thus provided a viable alternative to the endoscopic investigation of this area. Furthermore, the adaptation did not interfere in the weight loss of these patients, which occurred satisfactorily.

Thus, we emphasize that the non-exclusion of segments of the digestive system in bariatric/metabolic surgery can be a viable alternative for the clinical and endoscopic follow-up of these patients, allowing the early diagnosis and treatment of pathologies without interfering with the weight loss and control of comorbidities proposed by bariatric/metabolic surgery.

The number of participants, the loss to follow-up, and the follow-up time which did not allow the assessment of the long-term effects of the surgery, can be considered limitations of this study.

5. Conclusion

We conclude that the proposed changes in RYGB (GBLP + GIB) did not compromise weight loss or control of type 2 diabetes and other comorbidities and proved to be a safe and effective alternative without gastroduodenal exclusion, enabling a better postoperative follow-up.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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