CAN ROBOTIC GASTRIC BYPASS BE CONSIDERED A VALID ALTERNATIVE TO LAPAROSCOPY? OUR EARLY EXPERIENCE

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ABSTRACT

BACKGROUND: Robotic bariatric surgery is an alternative to laparoscopy. It gives the surgeon an accurate three-dimensional view, allowing complex maneuvers while maintaining full control of the theater.
HYPOTESIS: We report our experience with this innovative surgery compared with laparoscopy during Roux-en-Y gastric bypass, to demonstrate its safety and feasibility. The aim of this study is to evaluate if there are any differences between the robotic and laparoscopic techniques.
MATERIALS AND METHODS: Our study retrospectively identified 33 consecutive obese patients who underwent either laparoscopic or robotic gastric bypass procedures over a 2-year period in our Department of Medical and Surgical Sciences, University of Foggia. Demographics, Operative Time, Conversion, length of stray and mortality data were collected and compared in the two groups of patient: 19 underwent laparoscopic procedure and 14 robotic.
RESULTS: We analyzed 33 patients underwent gastric bypass with a mean age of 42,58 years of which 23 were female; 14 treated with robotic approach and 19 with laparoscopic approach. The initial mean body mass index (BMI) was 45,73 kg/m^2 and weight 130,50 kg. The mean operative time was 224,75 min for Robotic Gastric Bypass (RGB) (including docking time) and 101,22 min for Laparoscopic Gastric Bypass (LGB) ($p<0,05$). The median length of stay was 4,1 days for RGB group and 3,9 day for LGB group ($p=0,89$). Only one conversion to laparoscopy in RGB group. We observed only 1 case of post-operative complication: 1 endoluminal bleeding in laparoscopic group underwent to medical treatment. No mortality was observed in either group.
CONCLUSION: Statistic analysis seems to favor robotic approach that had a less incidence of complication but longer operative time. In our experience laparoscopic approach remain a technique with a major haptic feedback than robotic approach and more confident for the surgeon.

Key words: Roux and Y gastric bypass; bariatric surgery; robotic bariatric surgery; da Vinci system.

INTRODUCTION

Obesity is a chronic, relapsing disease associated with numerous complications and significant morbidity, mortality, and healthcare burden. Bariatric surgery now plays an important role in the treatment of obesity in addition to non-invasive conservative treatments such as lifestyle changes, pharmacotherapy, and behavioral therapy [1,2]. In 1991, the National Institutes of Health Consensus Statement on Gastrointestinal Surgery for Severe Obesity stated that bariatric surgery is the most effective treatment for obesity because of its benefits in weight loss, glycemic control, and reduced mortality [3,4].

Many different surgical approaches are used to treat severely obese people, Roux-en-Y gastric bypass (RYGB) is the most common procedure in Europe [5,6], especially in the presence of gastroesophageal reflux or type 2 diabetes cases [7-9]. It is usually performed laparoscopically and the technique is well established. Laparoscopic Roux-en-Y gastric bypass (LRYGB) is significantly superior to open surgery [10,11], with a low complication rate but high technical requirements and a flat learning curve between 1006 and 500 cases [12,13].

The introduction of the da Vinci® Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, US) in 2000, however, has allowed some of the technical limitations of laparoscopic surgery to be overcome. One of the main advantages is that of enhanced dexterity (increased degrees of freedom of movement) in the instruments and filtering of tremor, which enables the surgeon to operate in a similar manner to open surgery, thus enabling fine microsurgery and microanastomosis to be performed [14,15]. Other advantages include a three-dimensional view of the operative field, which allows for better depth perception, the ability of the surgeon to control of the view of the operative field, and an ergonomically designed workstation where the surgeon assumes a comfortable sitting position [16,17].

In this study we report our experience with this innovative surgery compared with laparoscopy during Roux-en-Y gastric bypass, to demonstrate its safety and feasibility. The aim is to evaluate if any differences between the robotic and laparoscopic techniques subsist.

MATERIALS AND METHODS

Our study retrospectively identified 33 consecutive obese patients who underwent either laparoscopic or robotic gastric bypass procedures over a 2-year period (2020 – 2022) in our Department of Medical and Surgical Sciences, University of Foggia. Demographics, Operative Time, Conversion, length of stray and mortality data were collected and compared in the two groups of patient: 19 underwent laparoscopic procedure and 14 robotic.

The UIN for ClinicalTrial.gov Protocol Registration and Results System is: NCT05476159 for the Organization UFoggia (https://clinicaltrials.gov/ct2/show/ NCT05476159).

Inclusion criteria

Body mass index (BMI) ≥35-39 kg/m^2 with one obesity- associated co-morbidity or BMI≥40kg/m^2, age ≥ 18 years. Before surgery, patients underwent a standardized psychological and physical evaluation which includes blood chemistry tests, chest x-rays, electrocardiogram and cardiological examinations, nutritional evaluation, esophagogastroduodenoscopy, spirometry and psychiatric evaluation.

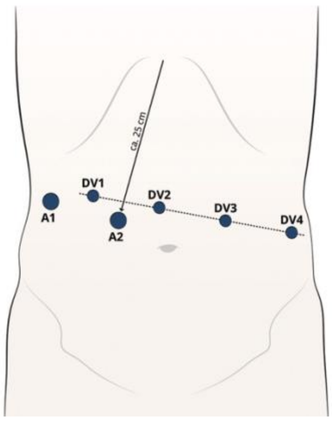
Exclusion criteria

We excluded from the study Re-do surgery procedures.

Surgical Technique

The pneumoperitoneum is established [15 mmHg] using a 12 mm First Entry trocar about 25 cm below the xyphoid (Assistant trocar 2) [A2] on the right paramedian. This is inserted while pulling the skin towards the sealing to increase the intra-abdominal space. Another 12 mm or 5 mm (depending on the retractor) trocar (Assistant trocar 1) [A1] is inserted at the right lateral flank. This is mainly used for liver retraction. From A1, a line is drawn across the upper abdomen at a 90° angle to the xyphoid-A2 line. All da Vinci (DV) ports are placed along this line. Port 1 (8 mm) [DV1] is placed 8 – 10 cm lateral to port A1. Port 2 (8 mm) [DV2] is placed 8 – 10 cm lateral to port 1. This will be the camera port. Port 3 (8 mm) [DV3] and port 4 (8 mm) are placed [DV4] 8 – 10 cm lateral to each other on the patient's left side (Figure 1).

Figure 1: Robotic trocar placement.



The liver paddle is first inserted through the A1 and the liver is retracted towards the right upper quadrant.

Starting from the ligament of Treitz, 120 cm of jejunum is measured aborally, the jejunum is dissected by the assistant through a linear stapler from A2, creating the biliary limb. Another 120 cm is counted (alimentary limb) and the jejunum is opened antimesenterally on both limb with Ultracision and a side-to-side jejunojejuno anastomosis is created using the 60 mm linear stapler. The enterotomy is closed using a single suture with Stratafix 3-0 in a seromuscular suture.
To preserve the left gastric artery, a retrogastric tunnel is formed starting 6 cm below the lesser curvature gastroesophageal junction. To ensure the correct size of the pouch, reducing the risk of stricture or dumping syndrome, a 40 mm bougie is inserted orally by the anesthesiologist. Using a linear stapler, the stomach pouch is formed with the bougie as a calibration.
At the lowest point, away from the minor curvature, the pouch is opened using Ultracision.
The stapler is inserted into the gastric pouch and the alimentary limb, and then the lateral gastrojejuno anastomosis is contoured after good positioning of both ends to create only a small enterostomy.
A 15 cm unidirectional Stratafix 2-0 suture is used to close the enterotomy for a continuous seromuscular suture. Arm 4 is used to optimize the position of the small bowel loop while arms 1 and 3 are used dynamically for suturing. Starting on each side of the enterostomy, two sutures are required to complete the anastomosis.
To test the gastrojejunostomy a methylene blue test is conducted. The systolic blood pressure is then raised above 130 mmHg to identify any signs of bleeding. Any bleeding is treated with either the bipolar forceps, with a clip application, or a suture.
A drainage is placed through the A1, all trocars are retrieved under view. The pneumoperitoneum is released though the A2 and the patient cart can be undocked.

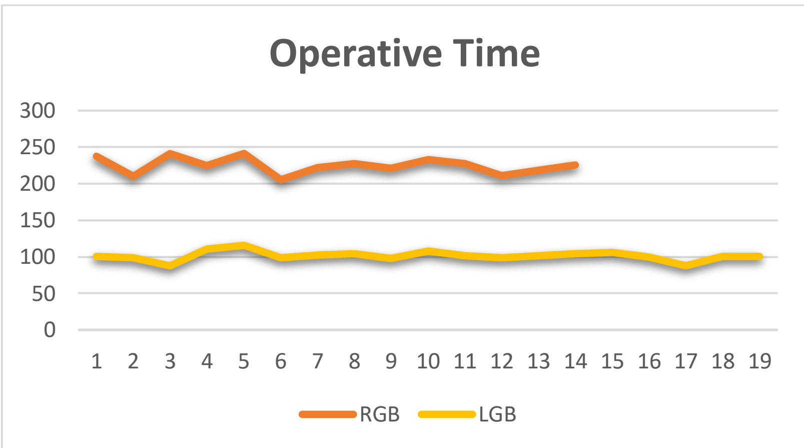
RESULTS

We analyzed 33 patients underwent gastric bypass with a mean age of 42,58 years of which 23 were female; 14 treated with robotic approach and 19 with laparoscopic approach. The initial mean weight was 130,50 kg and the initial mean body mass index (BMI) was 45,73 kg/m^2, 43,68 kg/m^2 for robotic group and 45,53 kg/m^2 for laparoscopic group.
The mean operative time was 224,75 min for Robotic Gastric Bypass (RGB) (including docking time) and 101,22 min for Laparoscopic Gastric Bypass (LGB) ($p<0,05$) which is statistically significant (Table 1) (Graphic 1).

Table 1: Operative time for Robotic and Laparoscopic groups

Operative Time RGB	Operative Time LGB
237,45	100,56
210,4	98,76
241,23	87,6
224,3	110,5
241,31	115,7
205,34	99,11
221,78	102,67
227,81	103,8
221,12	97,6
233,12	107,5
227,4	101,1
210,9	98,6
218,5	101,2
225,8	104,26
	106,1
	99,5
	88,1
	100,22
	100,3

Graphic 1: Operative Time for Robotic and Laparoscopic groups



The surgical technique is the same which provides for the creation of a gastric pouch, Biliopancreatic limb and jejunojejunal anastomosis, Alimentary limb and Gastrojejunal anastomosis (Figure 2-3).

Figure 2: Robotic gastrojejuno anastomosis

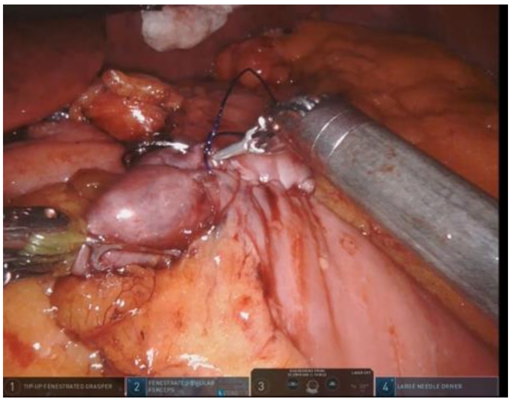
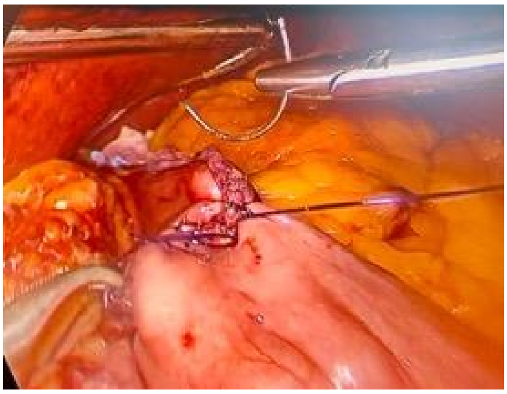
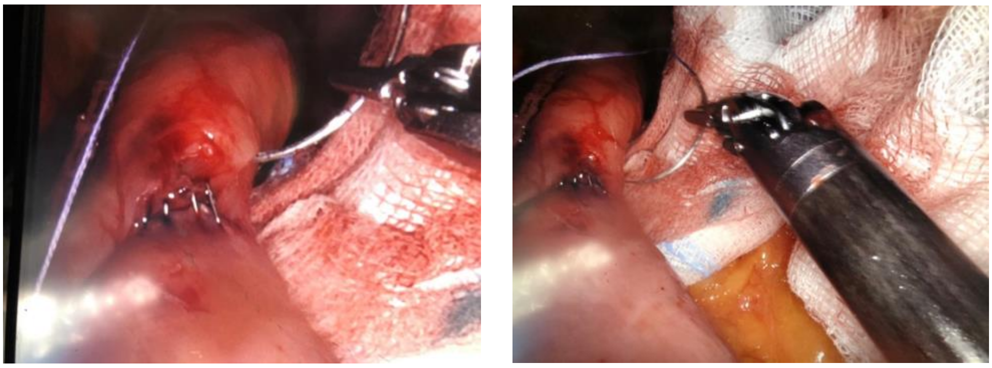


Figure 3: Laparoscopic gastrojejuno anastomosis



The median length of stay was 4,1 days for RGB group and 3,9 day for LGB group (p=0,89).
Patients were discharged on the third post-operative day after oral contrast gastro-intestinal tract radiography.
Only one conversion to laparoscopy in robotic group because we observed a positive intraoperative methylene blue test. The surgeon preferred to reinforce the gastro-jejunal anastomosis with laparoscopic sutures due to the lack of haptic feedback with robotic procedure. We observed only 1 case of post-operative complication: 1 endoluminal bleeding in laparoscopic group underwent to medical treatment. No mortality was observed in either group (Figure 4-5).

Figure 4-5: Positive intraoperative methylene blue test on the gastrojejunal anastomosis



DISCUSSION

Since its introduction nearly 20 years ago, robotic surgery has been successfully used in critical colorectal, gastric, pancreatic, urological and transplant procedures where anastomoses are a critical part of the procedure. Anastomoses are often time-sensitive, especially in transplantation, where minimizing warm ischemia of the organ is critical to graft function and outcome [18-20]. In most comparisons, the robotic approach appeared to provide similar results to the laparoscopic and open approaches in terms of anastomotic leaks or strictures. In particular, when comparing robotically performed anastomoses with laparoscopically performed anastomoses, no significant differences were found in post-RYGB leakage.

Robotic surgery gained popularity providing solutions to the challenges posed by laparoscopy, including ergonomics, a high-definition 3-dimensional camera, tremor filtration, a third surgeon arm and wristed instruments [21].

In the bariatric surgical field, for example, these features translate into the ability to perform a better traction of a normally thick abdominal wall, relieving the surgeon's physical efforts to overcome the counterproductive forces, as well as a highly stable camera and better manipulation of the surgical structures [22].

In agreement with the literature data, our study did not show significant differences in length of stay, reoperations and mortality [23,24].

Mean operative time was significantly shortened (101,22 minutes) in the laparoscopic group, due to the time consuming set-up and docking phase featuring the robotic approach.

Only 1 case of conversion from robotic to laparoscopic approach, probably due to a greater haptic feedback guaranteed by laparoscopy.

Compared to endoscopic or laparoscopic techniques, robotic surgical systems suffer from a complete loss of tactile feedback to the user [25]. Consequently, surgeons rely on visual cues and their expertise in order to perform the accurate motor movements required for operations [26,27]. The absence of tactile feedback leads to prolonged procedural times and a greater risk of surgical error [28].

Only 1 complication in the laparoscopic group likely explained by the better accuracy and precision of the intracorporeal suture during the robotic approach in comparison with the traditional laparoscopic approach.

Our results were in line with the ones presented in 2012 by Wilson et al. at the Annual Meeting of the American Society for Metabolic & Bariatric Surgery in San Diego [29]. In this trial the authors enrolled 1,695 patients undergoing robotic-assisted RYGB surgery; the post-operative complications were 17 bowel obstructions, 5 wound infections and 18 cases of bleeding. The hospital readmissions rate was 4.8% and re-intervention rate was 2.7%. Leak and anastomotic stricture rates were very low: 0.3% and 0.2% respectively. No death was reported. "This report of the largest series of robotic-assisted bypasses from three high-volume centers reveals very low complication rates in the first 30 days. It reveals zero 30-day mortality, an exceptionally low leak rate, and provides strong evidence that Robot-Assisted GB has extremely safe and reproducible outcomes".

Kim et al. concluded that the use of the robot is associated with a shorter learning curve especially in performing delicate and precise maneuvers such as fine dissections and sutures. Indeed it is widely recognized that robotic bariatric surgery, especially RGB, has a steeper learning curve than the laparoscopic approach and 20 cases may be sufficient to pass the basic learning phase [30,31].

CONCLUSION

Our statistical analysis seems to favor robotic approach in term of a less incidence of complication but the major disadvantage of the robotic bariatric surgery still remains the long operative time.

In our experience laparoscopic approach continues to be a technique with a major haptic feedback than robotic approach and more confident for the surgeon. RGB was found to be comparable to LGB in terms of safety and efficacy, but larger and longer studies are needed for a better comparative evaluation.

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DECLARATIONS

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All research methods were carried out in accordance with relevant guidelines and regulations.
Written informed consent was obtained from all individual participants included in the study.

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Authors' contributions:

GIOVANNA PAVONE and ANTONIO AMBROSI performed the study conception and design.
MARIO PACILLI and ALBERTO GERUNDO analysed and interpreted the data.
ANDREA QUAZZICO contributed to acquisition of the data.
NICOLA TARTAGLIA revised the manuscript.

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