

# EARLY OUTCOMES OF THE FIRST BRAZILIAN EXPERIENCE IN TOTALLY ROBOTIC BARIATRIC SURGERY

*Resultados iniciais da primeira série de casos brasileira de cirurgia bariátrica totalmente robótica*

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**ABSTRACT - Background:** Currently, bariatric surgery is the most effective therapy for morbid obesity, and the laparoscopic approach is considered gold-standard for Roux-en-Y gastric bypass. Totally robotic Roux-en-Y gastric bypass has been proposed as a major evolution in minimally invasive bariatric surgery and its use is becoming more widespread. **Aim:** To provide an early report of the first Brazilian case-series of totally robotic gastric bypass and perioperative short-term outcomes. **Methods:** All consecutive patients who underwent totally robotic gastric bypass at two recognized centers of bariatric surgery were included. Patient demographic data, body mass index, operative times, hospital stay, complications and mortality in the 30 postoperative days were recorded. The surgeons received the same training program before the clinical procedures and all the surgeries were performed under the supervision of an experienced robotic surgeon. **Results:** The surgeries were performed by five surgeons and included 68 patients (52 women - 76.5%), with a mean age of 40.5 years (range 18 to 59) and mean BMI of 41.3 (35.2 – 59.2). Total mean operative time was 158 minutes (range 90 to 230) and mean overall hospital stay was 48 h. Postoperative surgical complication rate (30 day) was 5.9%, with three minor and one major complication. There was no mortality, leak or stricture. **Conclusion:** Even with surgeons in early learning curves, the robotic approach within a well-structured training model was safe and reproducible for the surgical treatment of the morbid obesity.

**HEADINGS** - Bariatric surgery. Gastric bypass. Robotic. Laparoscopic.

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**DESCRITORES** - Cirurgia bariátrica.  
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**RESUMO - Racional:** Atualmente a cirurgia bariátrica é o tratamento mais eficaz para a obesidade mórbida. Embora ainda tenha algumas dificuldades, a abordagem laparoscópica tem-se tornando o padrão-ouro para o by-pass gástrico em Y-de-Roux. O uso da robótica representa grande evolução no campo da cirurgia bariátrica minimamente invasiva e seu uso tem sido cada vez mais difundido. **Objetivo:** Relatar a primeira experiência brasileira em cirurgia bariátrica totalmente robótica. **Métodos:** Foram avaliados todos os pacientes submetidos à cirurgia bariátrica totalmente robótica em dois centros de excelência em cirurgia bariátrica. Foram registrados a incidência demográfica, índice de massa corporal, tempos operatórios, duração da internação hospitalar, mortalidade e todas as complicações em até 30 dias. As equipes cirúrgicas receberam treinamento específico para aprendizagem da técnica robótica e todos os procedimentos foram feitos com supervisão. **Resultados:** O procedimento foi realizado por cinco equipes cirúrgicas em 68 pacientes (52 mulheres - 76,5%), com idade média de 40,5 anos e IMC médio de 41,3. O tempo médio operatório total foi de 158 minutos e a média de permanência hospitalar foi de 48 h. O percentual de complicações perioperatórias foi de 5,9%. Não houve mortalidade, fístulas ou estenoses. **Conclusão:** Mesmo com cirurgões em período inicial da curva de aprendizagem, o by-pass gástrico por abordagem totalmente robótica é opção técnica segura e reproduzível no tratamento cirúrgico da obesidade mórbida, desde que respeitado modelo de treinamento bem estruturado.

## INTRODUCTION

In the last few years, obesity has emerged as the most common non-infectious epidemic worldwide, with prevalence more than 30% in several countries. It is considered a multifactorial disease, with growing incidence and high morbidity and mortality rates, mainly due to obesity-related comorbidities that affect the quality and length

of life. It was estimated that at least 1.7 billion people are overweight<sup>10</sup>.

Changes in lifestyle are key therapeutic recommendations for the mild obesity, but for patients with more severe degrees of the disease bariatric surgery is the only long-term effective treatment for obtaining significant and lasting weight loss with resolution of comorbidities and reduction in overall mortality<sup>7,9,25</sup>.

Although related-problems to operative technique have declined markedly in the last years, some postoperative complications is still a concern both for surgeons as well as patients, especially in "super-obesity", resulting in constant search of new methods, equipment and techniques that could provide risk reduction, better results and faster recovery. As a consequence, in last years, there has been a stepwise, continuous changing from open towards laparoscopic approach in bariatric surgery.

Laparoscopic bariatric procedures are minimally invasive, providing minimal surgical trauma, low morbidity and faster patient recovery, therefore being currently the best surgical technique, due to its inherent advantages<sup>18,15,2,21,24,23</sup>. However, laparoscopic approach is not entirely satisfactory for surgical team once limits the view in two dimensions ("2D"), is poorly ergonomic, especially in super-obese patients, and the instruments still needs better adjustment to fine dexterity and intuitive surgeon movements. Besides, laparoscopic technology determines a long learning curve to the surgeon and his team, around 50 to 100 cases<sup>5</sup>.

Since robotic surgery has emerged, with its higher image quality ("high-definition 3D") and more ergonomic instruments - fully flexible and better adapted to the precision of surgical movements -, brought forward the possibility to overcome some limitations associated with conventional laparoscopic surgical procedures.

Although there is some questioning on the use of robotics in bariatric surgery, especially about the true benefit for the patients, early reports using the robot-assisted or totally robotic bariatric surgery has shown similar or even lower complication rates than conventional laparoscopic approach, with report of leaks being rare<sup>12,4,19,11</sup>.

The institutions that perform bariatric surgery via robot in Brazil is still small since it demands large investment in equipment, structure adaptation and adequate training for the surgical team. The first Brazilian report in robotic bariatric surgery is a series of cases with the "hybrid" technique (robot-assisted)<sup>1</sup>. To date, there is no Brazilian published report on totally robotic bariatric surgery.

The objective of this study is to report the first Brazilian experience in totally robotic bariatric surgery.

This is a retrospective review of prospectively collected data from initial casuistic on totally robotic bariatric surgery performed in two Brazilian institutions specialized in minimally invasive bariatric surgery ("Nove de Julho" Hospital, São Paulo, and "Samaritano" Hospital, Rio de Janeiro)

Until July 2013, were included all morbid obese patients submitted to bariatric surgery by means of robotic technology (da Vinci Si Surgical System®, Intuitive Surgical Inc., Sunnyvale, CA, USA). All procedures were performed within a supervised training program, in an agreement with The Global Robotic Institute (Florida Hospital Celebration Health), a traditionally recognized center for robotic bariatric surgery in USA.

Patient characteristics included age, gender and preoperative body mass index (BMI). Were also analyzed the total operative time (time elapsed from the beginning of the pneumoperitoneum to the final skin suture), docking time (placement of robotic trocars, approximation and coupling of robot's arms to trocars and placement of robotic graspers), console time (time during which the surgeon uses the console to perform the operation), length of hospital stay, intra operative events, conversion rate to open or conventional laparoscopy, mortality and early postoperative complications (up to 30 days).

#### Totally robotic Roux-en-Y gastric bypass (TR-RYGB) - surgical technique

The access to the peritoneal cavity was achieved by six trocars: two disposable 12 mm (Endopath Xcel® Bladeless, Ethicon Endo-Surgery, Inc.), one long for the 30° robotic lens and the other to use the auxiliary trocar; one 5 mm permanent trocar for the liver retractor; and the other three 8 mm robotic trocars for the robot's arms (Figure 1).

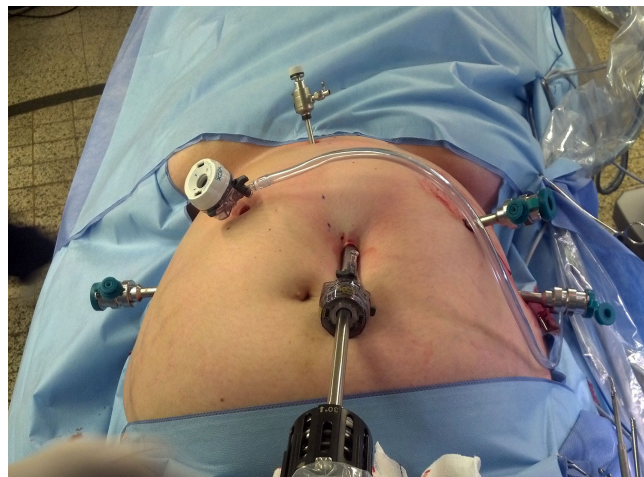


FIGURE 1 – Illustrative picture of the of trocars position

As specialized robotic material, two Cadere forceps, one ultrasonic scissor and one needle holder were utilized. With the trocars in place, the robot (da Vinci Si Surgical System®, Intuitive Surgical Inc.) was approximated and the robotic arms connected to the trocars (docking) (Figure 2).



FIGURE 2 – Coupling of robotic arms to the trocars (docking)

The operation started with the opening of the phrenoesophageal membrane next to the esophagogastric angle and resection of the fat pad of the esophagogastric transition to expose and visualize the left crus of the gastric hiatus. The gastric lesser curvature was opened at the level of the third and fourth vessels with ultrasonic scissors and the dissection was performed towards the esophagogastric transition in order to access the gastric retro cavity. A rectangular gastric pouch was created by linear stapler blue load (Echelon Endopath Flex Staplers, Ethicon Endo-Surgery, Inc.). The stapling was sequential, towards the esophagogastric transition, calibrated by a 32 Fouchet catheter, until completely gastric septation.

For gastrojejunal anastomosis in a Roux-en-Y technique, a longitudinal opening was done in the greater omentum with the ultrasonic scissors. The

proximal jejunum was grasped at about 100 cm from the ligament of Treitz (biliopancreatic limb) and brought out to the posterior face of the gastric pouch via the antecolic route. The gastrojejunostomy was performed by using the same stapler with blue cartridge, but narrower (15 to 20 mm), to provide a more restrictive anastomosis. By surgeon's choice, this gastrojejunostomy was also done by two-layered hand sewn absorbable running sutures (n=18).

The jejunal limb was sectioned nearby the gastrojejunal anastomoses, delimitating the alimentary limb between 80 to 100 cm and a side-to-side jejunojejunostomy was created with linear stapler white load (Echelon Endopath Flex Staplers, Ethicon Endo-Surgery, Inc.). Also according to the surgeon's preference, this anastomosis was done without the stapler, with one-layered hand sewn absorbable running suture (n=18).

The holes created for the positioning of the stapler were closed with one-layered absorbable running suture and the newly created mesenteric defects, especially "Petersen's defect", were closed by a nonabsorbable running suture.

Once the anastomoses were completed, the leak test was done introducing saline with methylene blue through Fouchet catheter. The peritoneal cavity was not routinely drained. The aponeurosis hole in the trocar camera site was closed with absorbable suture.

## RESULTS

Since the first surgery in December 2012, 70 patients were submitted to totally robotic bariatric surgery in both centers by five surgical teams until July 2013. Two patients underwent sleeve gastrectomy and were excluded. The remaining (n=68) was undergone a TR-RYGB and constituted the study sample.

Of these 68 patients, two were submitted to TR-RYGB as revisional surgery, the first of adjustable gastric band and the second of sleeve gastrectomy, both due to weight regain.

Fifty-two patients were women (76.5%) and age ranged from 18 to 59 years (mean  $40.5 \pm 9.5$ ). Mean BMI was  $41.3 \pm 4.3$  (35.2 – 59.2) at the operation time. Most patients were admitted for 24 to 48 hours, except for four patients who needed a longer hospitalization stay (three for 72 hours and one for 120 hours). Total operative time was  $158 \pm 36.6$  min and varied from 90 to 230 min. Mean docking time was  $8 \pm 7.3$  min and ranged from 3 to 60 min, and the mean console time was  $135 \pm 34.9$  min, ranging from 70 to 210 min.

Complications were seen in four patients (5.9%). One required reoperation six hours after the robotic

procedure, performed by conventional laparoscopy, to control bleeding at the surgical mesenteric defect, what led to the only patient admitted to intensive care unit for clinical control. Two patients had lung complications (atelectasis), one of them needed readmission in a medical ward to treat associated pulmonary infection. The last one had melena in the 7<sup>th</sup> postoperative day, what was controlled clinically with no hospitalization. There were no leaks in the sutures or staple lines. Drainage of peritoneal cavity was done just in eight cases (11.7%). There was no mortality in this series.

## DISCUSSION

The concept of robotic surgery appeared in the 90's with the main objective of rendering possible distant procedures in battle fields, launching the principles of "telesurgery". Since its military applicability did not develop as initially expected, robotic surgery technology was modified towards the development of equipment which could align the excellent quality of high definition 3-D image, the intuitive movements of the open surgery and the precision, refinement and minimally invasive aspects of laparoscopic surgery. This combination seems to be very useful and beneficial in advanced and complex gastrointestinal surgeries, such as bariatric surgery<sup>14,29</sup>.

The first reports on the use of robotic technology in surgery encompassed the hybrid technique ("robot-assisted") where the robot was used in only part in the conventional laparoscopy, mainly in the anastomoses. The first robotic bariatric surgery took place in 1998, with the placement of a robot-assisted adjustable gastric band<sup>8</sup>. In 2003, in a series of 211 cases of robot-assisted surgeries, the authors reported seven RYGB, those been the first reports of this type of bariatric surgery with the help of robotics<sup>28</sup>. In Brazil, the first report was published in 2012 about a case-series initiated in 2008, with 27 bariatric procedures, 16 of those having undergone RYGB, all of them with hybrid technique ("robot-assisted")<sup>1</sup>.

In many instances, the hybrid technique in bariatric surgery represented a preliminary step toward performing a totally robotic bariatric surgery. Nevertheless, from the dissemination of the use of robotics in bariatric surgery, better standardizing, technical evolution in instruments and equipment, several surgeons worldwide began to perform the entire procedure robotically, increasing the number of cases operated by this technique.

The present study is the first Brazilian report of the bariatric surgery where the entire procedure was carried out robotically. The procedures had the cooperation of the Global Robotics Institute,

a specialized center in bariatric surgery from the Florida Hospital Celebration Health, Orlando, USA.

Within the time frame of about seven months, the 68 cases reported were operated by five adept laparoscopic bariatric surgeons who were participating in a training program in robotic surgery formerly in USA, based on robotic theory, practice in simulator ("Mimic") and use of the animal models. Later on and under the supervision and guidance of the institution enabling, the bariatric surgeries were initiated in two Brazilian centers. To date, each surgeon performed no more than 20 procedures, what really represents the learning curve<sup>23,20</sup>.

The robotic platform used was the Da Vinci system (Da Vinci Surgical System, Intuitive Surgical International, Sunnyvale, California, USA), a master-slave system whereby the surgeon sits at the console (master) and performs the procedure by manipulating controller joysticks that translate the movement into tissue manipulation through the surgical cart (slave) that is docked to the patient. This system is currently the most employed in hospitals all over the world and it is available in just few hospitals in Brazil, all of them in Rio-São Paulo axis.

The weight loss has not been evaluated due to the short follow-up, although it seems to be similar to the laparoscopic cases. Total operative time, length of hospital admission and rate of early complications were within the expected parameters, and at least equivalent to conventional laparoscopic bariatric surgery routinely performed in those same hospitals.

These good results may have been due to the large experience in conventional laparoscopic bariatric surgery by the surgical teams. The tutorial assistance of the adept surgeon with almost 1.000 robotic bariatric operations, who followed all cases and offered continuous guidance to the Brazilian surgeons, might have contributed as well. The results presented in this initial series validate the format of the training adopted, since the number of complications was totally acceptable.

Studies comparing the robotic versus conventional laparoscopic approach to bariatric surgery, although with a short follow-up, show that they at least are equivalents. However, in parameters such as total operative time, robotic surgery seems to be advantageous<sup>22,17,4,6</sup>. In robotic surgical technique, this time can be divided in three different steps: 1) total operative time, from the start of the abdomen insufflation to the skin suture; 2) docking time, concerning preparation and coupling of the robot to the trocars; and 3) console time, which is the time the surgeon actually stays performing the distant surgical procedure. Although a longer operative time would be expected in the first cases by adoption of a new method, our operative time

were very similar than others<sup>3,20</sup>. This may have been due to large experience in laparoscopic bariatric surgery of the Brazilian surgeons enrolled. The orientation and supervision by a surgeon with large training in robotic technique may be contributed as well.

Another likely advantage of the robotic technique is the anastomosis, especially the gastrojejunal anastomosis. Many surgeons have a preference for performing it by a "hand sewn" suture, besides being easier and more ergonomic, may be associated to lower stricture rate<sup>16</sup>. The surgeons in this study concurred that the surgical times spent on sutures were easier than by conventional laparoscopy.

The concern with the costs of robotic surgery still has an important role in the adoption and dissemination of the technology. However, the possible reduction in treatment of the complications such as stenosis, as well as not use some cartridges for the anastomoses, are factors which may also contribute to the cost reduction in robotic bariatric surgery<sup>13</sup>. The costs are still high, if it is included equipment acquisition and maintenance. In these cases, were used a minimal of graspers and robotic equipment – Cadiere graspers, one needle holder and one ultrasonic scissors - in an attempt to achieve a lower total cost.

In well-trained hands, with more experience, as well as more technical skills by the teams practicing robotic bariatric surgery, some challenges in the surgical treatment of morbid obesity have been approached by this technique, such as revisional surgery<sup>27,26</sup>. In this series, there were two cases of revisional surgery related to weight regain (one adjustable gastric band to TR-RYGB and another from vertical gastrectomy to TR-RYGB). Both had good outcome and did not present complications, what contributed to ratify the feasibility of totally robotic bariatric surgery in situations considered technically challenging.

For the surgeon, especially in adverse situations like longer and technically more difficult procedures, robotic approach may increase surgical precision and provide more comfort, since it is more ergonomic, has broader and more intuitive movements and may provide a tremor filtration and keep the robot's arms always stable. However, except for some advantages such as a shorter operative time and lower complication rate, robotic surgery still needs a better definition of its true benefit for the patient.

In the future, the decrease in costs as well as the increase in surgical experience with a longer follow-up, may define the true role of the use of robotics in bariatric surgery.

## CONCLUSION

Even with surgeons in their initial period of the learning curve, the totally robotic gastric bypass is a safe and reproducible technical option in the surgical treatment of morbid obesity, since a well-structured training model is respected.

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