Laparoscopic Surgical Treatment of Gastric Cancer – Standardization of a Completely Intracorporeal Lymphadenectomy and Reconstruction Technique

Tratamento Cirúrgico do Câncer Gástrico por Videocirurgia – Padronização Técnica da Linfadenectomia e Reconstrução Totalmente Intra-Corpórea

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ABSTRACT

INTRODUCTION: Laparoscopic gastrectomy is a relatively new techique, first reported in 1992. This is mainly due to the challenges of lymphadenectomy and reconstruction, especially in advanced stage gastric cancer. **METHODS:** We present our experience with laparoscopic subtotal gastrectomy (37 cases) and total gastrectomy (115 cases) for oncological purposes performed by our group at the Barretos Cancer Hospital since 2009. We describe the technical details of the D2 lymphadenectomy, as well as the proper technique of reconstruction after total gastrectomy, using completely intracorporeal "reverse anvil". Most patients presented with advanced stage disease. **CONCLUSION:** One of the major challenges of laparoscopic gastrectomy is the reconstruction. The "reverse anvil" technique described by Lacerda and Torres facilitates reconstruction after total gastrectomy. It is safe, inexpensive, reproducible and can be performed rapidly, even in the advanced stage cases,. It constitutes an important contribution to addressing the challenge of reconstruction after total gastrectomy.

Key words: Gastric Cancer. Surgery. Laparoscopy. Braz. J. Video-Sur, 2013, v. 6, n. 3: 103-109

_ Accepted after revision: july, 29, 2013.

INTRODUCTION

The official history of laparoscopic gastric resection began in Singapore in 1992, when Goh et al., performed the first totally intra-abdominal laparoscopic distal gastrectomy with Billroth II reconstruction, in an elderly patient with a chronic gastric ulcer.¹ In 1993, in Belgium, Azagra et al., performed the first minimally invasive total gastrectomy for gastric cancer treatment and, in 1999, reported their experience with thirteen patients. They concluded that laparoscopy for the treatment of gastric cancer was feasible, oncologically safe, and should be used for patients with early lesions, reserving combined (video-assisted) surgery for more advanced lesions.^{2, 3}

In 2006, these same authors participated in a multicenter study, which analyzed 130 patients with

gastric adenocarcinoma, with a mean follow-up of 49 months, concluding that laparoscopic gastrectomy with any type of lymphadenectomy and even as a palliative method is a safe procedure, with acceptable morbidity and mortality rates in patients with advanced gastric cancer. They concluded that these patients typically present in poor clinical conditions, and that laparoscopy for localized disease is equivalent to laparotomy in terms of oncological results, but with the well established benefits of laparoscopy.⁴ In 2007, Kitano et al., published a multicenter study in Japan of early stage gastric cancer which demonstrated that laparoscopic surgery is associated with shorter hospital stays, less postoperative pain, better esthetic outcomes, and disease-free survival at 5 years comparable to open surgery for stages I and II.⁵

Lacerda et al.

An Italian study comparing video-assisted gastrectomy with open surgery also found no difference in survival. The average number of lymph nodes resected was higher, the surgical time was shorter, and morbidity was less with the video-assisted technique.⁶

Seventeen years after the first laparoscopic resection for gastric cancer, the Japanese Society of Gastric Cancer included laparoscopic surgery for stage 1A and 1B tumors in their 2010 treatment guidelines, taking care to emphasize the parsimony with which this method should be indicated for the treatment of this type of tumor.⁷⁻⁹

In 2010, Kodera et al. published a metaanalysis that tried to address existing controversies. They concluded that laparoscopic surgery with D2 lymphadenectomy is feasible, safe, adheres to the oncologic principles, and should be performed in centers with considerable case volume by surgeons with appropriate training and sufficient experience to perform the procedure.⁸ The meta-analysis found no significant differences in morbidity and mortality and oncologic safety in the studies – randomized or not – of early stage gastric cancer.^{5,8} Experience in the West is limited due to the small number of gastric cancer cases detected early; for this reason there are few studies reporting the use of laparoscopic surgery in advanced gastric cancer.¹⁰⁻¹²

METHODS

We present a case series obtained by a retrospective review of the medical records of patients treated by our service, and the standardization of the D2 lymphadenectomy with reconstruction in laparoscopic subtotal and total gastrectomy first described by Torres & Lacerda.

The initial surgical steps of subtotal and total gastrectomy are similar, following the same technical standards of the conventional laparotomy procedure. The patient is placed in the lithotomy position with legs extended and separated, and properly supported in appropriate leggings. The surgeon is positioned between the patient's legs with the assistants for the camera and surgical assistance to the left of the surgeon. The laparoscopic set (including the monitor, when there is only one) is positioned at the head, to the right of the operating table. The positions of the six ports are identical for the two procedures: A. 11 mm trocar in the umbilicus (10 mm optic at 30

degrees); B and C: 12 mm trocars in the right and left flanks, at the mid-clavicular lines (used by the surgeon); D and E: 12 mm trocars in the right and left costal margins at the mid-clavicular lines (also for the surgeon's work); and E: 5 mm trocar in the midline sub-xiphoid (for the retractor) figure 1.

After inspection of the abdominal cavity, the procedure and staging begin with omentectomy at the level of the middle third of the transverse colon in the direction of the splenic flexure up to the beginning of the short vessels near the lower pole of the spleen, leaving the stomach to be prepared to be sectioned, in the case of the subtotal gastrectomy, at this point. Returning to the transverse colon, we complete the omentectomy until the release of the hepatic flexure, following the branch of the middle colic artery toward the right gastroepiploic vein and artery, isolating and separately ligating them with double ligature using LT 300 clips. At this time, lymph node dissection of chains 6, 14v, and 15 is completed (Figure 2).

The next surgical step consists of exposing the liver (left lobe and hilum) with a 5 or 10 mm retractor inserted through the sub-xiphoid port. The hepatogastric ligament is sectioned and lymph node chains 5 and 12A are dissected with a harmonic scalpel (Figure 3).

In this same presentation, the dissection and ligation of the pyloric vessels is performed, leaving the duodenum prepared for subsequent stapling. Lymph node dissection of the common hepatic, anterior aspect, left gastric, and celiac trunk arteries (chains 8A, 8P, 7 and 9) is completed, proceeding along the superior aspect of the pancreas to lymph node chain 11P, leaving the proximal segment of splenic artery denuded (Figure 4). The common hepatic artery is dissected and mended with thick surgical suture or cardiac tape to facilitate the presentation and dissection of the posterior ganglia (8P), taking care not to damage the vein.

The left gastric artery and vein are both ligated at their origins with LT400 or LT300 clips and/or a **Hem-O-Lok**. The presentation is maintained – without sectioning the duodenum – to facilitate the dissection of the right branch of the right pillar of the diaphragm. From this point, the peri-esophageal tissue around the distal esophagus is released, without isolating the esophagus in the case of subtotal gastrectomy. Lymph node dissection of chain 1 (Figure 5), leaves the surface of the gastric wall and cardia stripped and ready for the subsequent "stapling".



Figure 1 – *Trocar arrangement for subtotal or total gastrectomy. Four 12 mm ports are used for the staplers, 11 mm port for the liver retractor, and 5 mm umbilical port for the optic.*



Figure 2 - Lymphadenectomy of lymph node chain 14v (along the superior mesenteric vein) and chain 15 (along the middle colic vein).

The duodenum is transected with a 60 mm laparoscopic stapler using blue loads. Reinforcement is not necessary as three lines of staples make this suture secure. The resection of the stomach is completed, from the greater curvature, near the inferior pole of the spleen toward the contra-lateral cardia, using two 60 mm laparoscopic stapler blue loads, taking care not to staple the esophagus. After complete resection of the stomach, the reconstruction of the 4/ 5 subtotal gastrectomy is carried out; it may be a Billroth II (gastrojejunostomy anastomosis with blue load and intra-corporeal suturing of the "gap" using continuous 3-0 polypropylene sutures) or a "Roux-en Y".

In the case of total gastrectomy, the initial steps are the same as for the subtotal gastrectomy



Figure 3 - Lymphadenectomy of the hepatic hilum (chains 8a, 12a, 12b and 12d). The common hepatic artery and the portal vein are shown.



Figure 4 - Lymphadenectomy of the chains along the common hepatic artery (8a and 8p). The hepatic artery, dissected and mended, and the pancreas without its capsule (bursectomy) are shown.



Figure 5 – Complete lymphadenectomy (chains 1, 2, 3, 4SA, 4SB, 4d, 5, 6, 7, 8a, 8p, 9, 10, 11p, 11d, 12a, 12c, 14v, and 15). The main hepatic artery is identified with thread and the splenic artery in the background of the photo is raised with forceps.

described above. The esophagus is isolated with dissection of the esophagogastric junction and the abdominal esophagus is anchored with "cardiac tape" or using a flexible retractor (endoflex). An ultrasonic scalpel or LigaSure Atlas can be used to section the small vessels, combined with ligation using LT400 clips during the lymph node dissection of chains 2 and 11D and the completion of the gastrectomy (Figure 5).

The reconstruction starts with the preparation of the intra-abdominal esophagus, with a transverse section near the esophagogastric transition (EGT) leaving 60% of it. We prepared the "anvil" with an 8 cm 14 gauge Levine catheter with a 10 cm needled 3-0 prolene suture, so that the graded probes (Figure 6) facilitate the passage through the esophageal wall when traction is applied, without penetrating the esophagus and placing the anvil snugly within the esophageal wall.

The anvil is introduced in reverse (Figure 7), i.e., after transverse section of 60% of the distal esophagus close to the gastric cardia. We identify the esophageal lumen, introduce the anvil into the lumen, and soon after, we pass the needle 1 cm from the edge of the sectioned esophagus, previously positioned on the anvil prepared with the catheters.

We section the esophageal "stump" with a 60 mm laparoscopic linear stapler blue load (Figure 8), then pull the Prolene suture with gentle traction, previously transfixed in the distal esophagus in order to position the anvil in the distal esophagus, and promptly cut the sutures that secure the catheter in the anvil of the stapler (Figures 9 A, B and C).

We section the jejunum, 20 cm to 30 cm from the angle of Traitz. After widening the left flank trocar incision we introduce the circular stapler. The jejunum (feeding loop – the distal stump sectioned 20 cm to 30 cm from the angle of Treitz) is opened near the staple line, so that a size 25 stapler head can be inserted through this opening in the jejunum ("crook" jejunum). We connect the anvil – already positioned in the esophagus – and perform the stapling (Figure 10). We use a 60 mm blue load to close the "stump of the crook" and a 45 mm blue load for the enteroenteroanastomosis and close the "gap" with continuous sutures of 3-0 PDS in two planes.

We test the anastomosis with methylene blue, pass a nasogastric feeding tube, and place a silicone abdominal drain. We expand the left flank trocar incision to 5 cm and protect the wall (with a wound protector) so that the surgical specimen can be withdrawn (Figure 11).

The entire procedure - including the resection and the reconstruction and all anastomoses - is performed intracorporeally. One of the biggest challenges of laparoscopic total gastrectomy is the reconstruction, because there is no technique that is



Figure 6 – Anvil of a number 25 circular stapler, with 3 cm No. 14 and 8 catheters connected and fixed with 3-0 Prolene sutures to the anvil and between them. Observe that at the beveled tip of the number 8 catheter, a 5 cm needled Prolene 3-0 suture is attached, so that it can be transfixed to the distal esophagus.



Figure 7 - Presentation with the introduction of the anvil in reverse (caudal to cranial), previously prepared with the catheters, with a needled suture at the tip.



Figure 8 - Section and closure of the esophageal stump with a 60 mm linear stapler blue load, taking care not to cut the exisitng suture.

really effective, reproducible, inexpensive, and that can be perfomed quickly. The "reverse anvil" technique used by the authors (Lacerda and Torres), however, permits a reconstruction with these attributes post total gastrectomy with good esthetic results (Figure 12).







Figure 9 - In Figure A, the suture being pulled with the emergence of the thinner catheter. In Figure B, the second catheter fully exposed, showing the tip of the anvil. In Figure C, the anvil is well positioned in the esophagus.



Figure 11 - Surgical specimen (D2 total gastrectomy).



Figure 12 - Final result of a patient who underwent D2 total gastrectomy, with the six ports. The left flank port incision is widened to permit passage of the circular stapler used to establish the esophagojejunal anastomosis and to enable removal of the surgical specimen. A silicone drain is positioned in the left costal margin port close to the esophagojejunal anastomosis.

RESULTS



Figure 10 - Esophagojejunal anastomosis.

Since 2009, a single team at the Barretos Cancer Hospital has performed laparoscopic gastrectomies for the treatment of gastric cancer, regardless of stage, principally advanced cases and for palliation (Graph 1).

However, due to the difficulty of reconstruction, and because there is no standard technique for reconstruction, we developed a method of intracorporeal esophagojejunal anastomosis that does not require a mini-laparotomy and that is absolutely safe for the patient. Our series of gastrectomies for the treatment of gastric cancer included 152 procedures: 37 subtotal gastrectomies and 115 total gastrectomies. The first five were video-assisted; the rest were completely laparoscopic. The surgeon must know how to perform conventional surgery.

Laparoscopic D2 lymphadenectomy – sometimes facilitated by image magnification – follow all the steps of conventional surgery (laparotomy) respects oncologic principles, and is perfectly feasible. On average 26 lymph nodes were dissected in a subtotal gastrectomy, and 34 in a total gastrectomy. Lymph node chains 14v and 10 were dissected when indicated, not in all cases; the same applies to bursectomy.

Operative time varied from 3 to 4 hours. The esthetic results was quite favorable. Enteral feeding started on the first postoperative day and an oral liquid diet is instituted on the second postoperative day. Patients experienced less pain, require fewer analgesics (Graph 2), and ambulated sooner in the immediate postoperative period. This significantly reduced the hospital stay, with discharge (without complications), on average, on the seventh day. The quickest discharge was on the third day.

Blood loss was minimal, and the need for observation in the ICU, indicated for patients who are elderly or who have comorbidities, was infrequent. Patients returned to their normal activities quickly and, when indicated, adjuvant treatment (chemotherapy and/or radiotherapy) could be initiated promptly. The morbidity and mortality was not higher than that observed in conventional surgery in our service, respecting all oncologic principles.

DISCUSSION

Totally laparoscopic surgery is superior to video-assisted. It is safer and has better esthetic results. Conversion, when necessary, should not be made by small incisions, trying to justify the laparoscopic procedure. Laparoscopic gastric surgery, as with the laparoscopic surgery of any organ, is a completely safe procedure. It should be performed by professionals trained in open surgery, with ample experience in both techniques (open and laparoscopic). The team consisting of a circulating nurse,



Graph 1 - The large majority of patients in this series (85%) correspond to clinical stages (EC) advanced stages (III and IV).



Graph 2 - Comparison of the pain – measured as the number of episodes in the first 24 hours – experienced by the patients who underwent conventional open versus laparoscopic total gastrectomy.

instrumentation nurse, and two surgeons should be should be trained and attuned, so that the roles of the surgeon and the assistant can be swapped, depending on who has the best angle and visual field at particular moments of the surgery. They should have suitable materials, from the instruments to the laparoscopic equipment, and especially, the certainty that they are doing the best for our patients.

RESUMO

INTRODUÇÃO: Gastrectomia laparoscópica é uma técnica relativamente nova, descrita pela primeira vez em 1992. Isso ocorre principalmente devido à linfadenectomia e à reconstrução, em particular nos casos de câncer gástrico avançado. **MÉTODO:** Apresentamos nossa experiência com gastrectomia subtotal laparoscópica (37 casos) e gastrectomia total (115 casos) para casos oncológicos realizados por nosso grupo no Hospital de Câncer de Barretos desde 2009. Descrevemos os detalhes técnicos da linfadenectomia D2, assim como a técnica apropriada da reconstrução após a gastrectomia total, utilizando a ogiva reversa completamente intra-corpórea. A maioria dos pacientes apresentava doença em estádios avançados. **CONCLUSÃO:** Um dos maiores desafios da gastrectomia laparoscópica é a reconstrução. A técnica da ogiva reversa descrita por Lacerda e Torres facilita a reconstrução após a gastrectomia total. É segura, de custo acessível, reprodutível e pode ser realizada rapidamente, mesmo na doença em estádios avançados. Constitui importante contribuição no desafio da reconstrução após a gastrectomia total.

Palavras chave: Cancer Gástrico. Cirurgia. Laparoscopia.

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