

Laparoscopic liver resection. Personal experience with 107 cases

Hepatectomia videolaparoscópica. Experiência pessoal com 107 casos

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A B S T R A C T

Objective: To analyze our experience after 107 laparoscopic hepatectomies and discuss the technical evolution of laparoscopic hepatectomy in the last five years. **Methods:** Between April 2007 and April 2012 we performed 107 laparoscopic hepatectomies in 105 patients. The mean age was 53.9 years (17 to 85). Fifty-three patients were male. All interventions were performed by the authors. **Results:** from the total of 107 operations, there was need for conversion to open technique in three cases (2.8%). Sixteen patients (14.9%) had complications. Two patients died, a mortality of 1.87%. One death was due to massive myocardial infarction, unrelated to the procedure, which was uneventful and showed no conversion or bleeding. The other death was due to failure of the stapler. Twenty patients (18.7%) required blood transfusion. The most frequent type of hepatectomy was bisegmentectomy of segments 2-3, (33 cases), followed by right hepatectomy (22 cases). Seventy-two procedures (67.3%) were performed by the technique of Glissonian access. **Conclusion:** The dissemination of results is of utmost importance. The technical difficulties, complications and even death, inherent in this complex type of surgery, need to be clearly disclosed. This procedure should be performed in a specialized center with knowledgeable staff. The technique of laparoscopic Glissonian access, described by our staff, facilitates the realization of anatomical hepatectomies.

Key words: Liver. Techniques. General surgery. Laparoscopy. Hepatectomy.

INTRODUCTION

The development and improvement of new instrumental techniques enabled the performance of laparoscopic liver resections¹⁻³ in the early 1990s. From the 2000s, there was an exponential growth in the number of hepatectomies by this method, reflecting the growing number of publications⁴⁻⁸.

The first laparoscopic hepatectomy in Brazil, a bisegmentectomy of segments 2-3, was performed by Kalil et al.³ in 1997. In 2007, our team performed the first major laparoscopic hepatectomy, a right hepatectomy⁹. After these pioneering cases, there was a spread of our technique in our country¹⁰⁻¹².

The advantages of laparoscopy over open technique include smaller incisions, reduced postoperative pain, shorter recovery time, lower immune and metabolic response, shorter hospital stay, as well as lower morbidity^{7,8,13}.

Today laparoscopic hepatectomy is a reality in Brazil and is now part of the surgical armamentarium in the treatment of liver diseases. Currently major and / or complex hepatic resections, such as right hepatectomy⁹,

right trisegmentectomy¹⁴, left hepatectomy¹⁵, mesohepatectomy¹⁶ and even two-time hepatectomy¹⁷ are routinely performed by laparoscopy in Brazil in specialized centers by skilled teams^{3,9,14-18}.

The objective of this study was to analyze our experience with more than a hundred cases and discuss the technical evolution of laparoscopic hepatectomy in the past five years, highlighting our contribution to the development of the laparoscopic Glissonian access technique.

METHODS

All patients who underwent laparoscopy liver resection between April 2007 and April 2012 were retrospectively analyzed from prospectively collected database.

During this period, 107 laparoscopic hepatectomies were performed in 105 patients. Mean age was 53.9 ± 15.8 years (17 to 85). Fifty-two patients were female and 53 male. Tables 1 and 2 show the types of laparoscopic hepatectomy performed and indications. Of

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the total of 107 resections, 29 were performed outside our service.

RESULTS

Conversion to laparotomy was required in three cases (2.8%) due to bleeding (1 case), embolism (1 case) and instrumental failure (1 case).

Sixteen patients had complications, a rate of 14.9% morbidity. Major complications were ascites and transient hepatic failure, occurring in cirrhotic patients. One patient with liver metastases, previous chemotherapy, undergoing a right trisegmentectomy without prior portal embolization, presented with prolonged hepatic insufficiency, with gradual improvement and was discharged after 15 days of hospitalization. Two patients had biliary fistula after hepatic resection. One patient was reoperated by laparoscopy for suspected bleeding (sudden drop in hematocrit), but no bleeding focus was found, and evolved to stabilization of the hemoglobin levels after transfusion. Two patients died after surgery, a mortality of 1.87%. These two patients were operated on another service; one death was due to myocardial infarction, unrelated to that laparoscopic hepatectomy, which was uneventful. The other patient died during hepatectomy, due to failure of the stapler that resulted in bleeding, conversion and need for massive transfusion; death occurred on the third day after surgery.

The estimated blood loss, as well as operative time and length of hospitalization, varied according to the type of resection. Twenty patients (18.7%) required transfusion (1-6 units) during or after hepatectomy. Most patients requiring transfusion had undergone major hepatectomies.

The most common type of hepatectomy was bisegmentectomy of segments 2-3, followed by right hepatectomy (Table 1) and the main indication was hepatic metastasis (Table 2). Seventy-two operations (67.3%) were performed by the Glissonian access technique, previously described^{11,12}. The remaining 35 (32.7%) were performed by dissection of the hepatic hilum or were non-anatomic dissections (Table 3). In ten cases, the hemi-Pringle technique¹⁹ was used to perform non-anatomic resections. In four cases, we decided to use the technique of intermittent Pringle, after preconditioning (ten minutes by clamping the hepatic hilum followed by ten minutes of release of hepatic perfusion). In two cases we used the aid of the hand and in the other two we used the hybrid technique. One patient with hilar cholangiocarcinoma underwent a left hepatectomy with totally laparoscopic lymphadenectomy, but the intrahepatic hepatic-jejunal anastomosis was performed by a hybrid method due to the location and caliber of the biliary tree that did not permit a safe anastomosis. Of the total of 107 operations, except for conversions (3 cases) and hybrid operations (2 cases) or with the aid of the hand (2 cases), 100 were performed completely laparoscopically (93.5%).

In four cases of liver metastasis, hepatectomy was concurrently performed with laparoscopic colorectal surgery, two being right hepatectomies and one bisegmentectomy of segments 5-8, associated with rectosigmoidectomy for low rectal tumor and diverting ileostomy. In one case there were concomitant right hepatectomy and right colectomy, with ileal-transverse anastomosis.

Three patients with hepatic metastases from neuroendocrine tumors underwent resection of the primary tumor during surgery, two being enterectomies and a body-tail pancreatectomy. In all these

Table 1- Distribution of patients according to type of hepatic resection performed.

Type of Hepatic Resection	Procedures	%
Bisegmentectomy 2-3	33	30.8
Right Hepatectomy	22	20.6
Bisegmentectomy 6-7	8	7.5
Left Hepatectomy	4	3.7
Bisegmentectomy 7-8	3	2.8
Mesohepatectomy	3	2.8
Right Trisegmentectomy	2	1.9
Bisegmentectomy 4-5	2	1.9
Bisegmentectomy 5-8	1	0.9
Bilateral Resections	2	1.9
Monosegmentectomies	7	6.5
Non-anatomical	20	18.7
Total	107*	100.0

* Two patients were operated on twice.

Table 2- Distribution of patients according to indication of hepatic resection.

Baseline condition	Number of patients	%
Metastasis	45	42.9
Hepatocelular Carcinoma	25	23.8
Hepatic Adenoma	12	11.4
Intra-hepatic Lithiasis	6	5.7
Cholangiocarcinoma	4	3.8
Angiomyolipoma	4	3.8
Hemangioma	4	3.8
Focal Nodular Hyperplasia	3	2.9
Hepatic Artery Aneurism	1	0.95
Biliary Cistadenoma	1	0.95
Total	105*	100.0

* Two patients were operated on twice, for the same reason.

procedures, the associated operation was also performed laparoscopically.

Other procedures performed at the same time of laparoscopic hepatectomy (resection of segment 4 and right hepatectomy, respectively) were a laparoscopic right nephrectomy and thoracoscopic pulmonary metastatic excision (performed by other teams).

In 33 operations (30.8%) the type of hepatectomy was major, ie there was resection of three or more segments in the same operation. Although highly complex and with large raw area, bisegmentectomies (segments 6-7, 7-8 and 5-8) were considered minor hepatectomies (Table 4).

The annual number of laparoscopic resections performed during the study period is shown in figure 1.

DISCUSSION

The development of the technique of laparoscopic liver resection requires technical training in advanced laparoscopic surgery and liver surgery^{7,8,13,20,21}. The lack of such knowledge can lead to mistakes, which, when dealing specifically with laparoscopic liver resection, may result in intraoperative bleeding with risk of severe complications and mortality.

With this in mind, the authors initiated a training program in mid-sized animals (dogs and pigs), deeming possible the use and development of various instruments. This program resulted in the description of a useful experimental model²², because the experience of situations, such as poor positioning of trocars and intraoperative bleeding, caused the authors to gain experience in this complex type of procedure.

The application in humans began gradually, with segmental resections of the liver with the use of the hemi-Pringle technical¹⁹. The initial results in humans, the continuous technical improvement and the continuous exchange of information with surgeons from other centers

Table 3 - Hepatectomies performed according to technique applied.

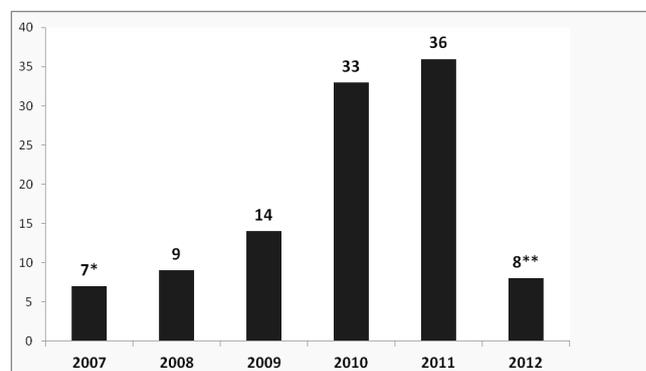
Control technique	Procedures	%
Glissonian Access	72	67.3
No Glissonian Access	35	32.7
Total	107*	100.0

* Two patients were operated on twice.

Table 4 - Type of hepatectomy performed according to the number segments removed. Major resection was considered the removal of three or more liver segments, adjacent or not.

Type of Hepatic Resection	Procedures	%
Major (> 3 segments)	33	30.8
Minor (up to 2 segments)	74	69.2
Total	107*	100.0

* Two patients were operated on twice.

**Figure 1 -** Distribution of laparoscopic hepatectomies according to year of performance.

* - from April 2007

** - till April 2012

made authors able to perform major liver resections successfully.

After the initial success of the first cases of right hepatectomy^{9,10,23}, the authors have organized various courses of training and teaching of laparoscopic surgery in midsize animals after technical capacitation and development of experimental models. Performing operations in other hospitals was important for seeding the technique throughout Brazil, and enabled a rapid increase in our series. The disclosure of our experience in several congresses and medical events in recent years, as well as access to our edited videos available on websites for public access and educational, helped spread the art in Brazil. Today laparoscopic hepatectomy is a reality in our midst.

Our experience with the Glissonian access technique via laparotomy, employed since 2001 in more than 400 cases, prompted us to also use this technique in laparoscopic surgery^{11,12}. Indeed, knowledge of anatomical points, useful for the location of segmental pedicles, and experience with laparotomy procedures, facilitated this task and we quickly abandoned the technique of dissection of the hepatic hilum in patients without anatomic alteration. The only exception was in one case of Klatskin tumor, where the dissection of the hilum was mandatory.

A new strategy of hepatic parenchymal section²⁴ during right hepatectomy resulted in reduced bleeding and operative time. The section of the posterior part of the liver before inserting the stapler for parenchymal transection reduces bleeding from the accessory hepatic veins draining directly to the retro-hepatic vena cava.

Another important change in the art, introduced in recent cases, was the reduction in the number and size of the trocars²⁴. Initially we used five trocars for a right hepatectomy, three being 12mm. Currently, we use only one 12mm trocar to introduce the stapler, a 10mm for the optics and other two 5mm. The introduction of flexible staplers allowed this change. Previously, for each angle of parenchymal section, a trocar 12mm was necessary. Another change was the systematic removal of the surgical specimen through a suprapubic incision, replacing the use of previous incisions or extended ports. The reason for this change was the minor pain with Pfannenstiel incision²⁵.

The use of laparoscopy results in clear benefits for the patient, such as less postoperative pain, preservation of the abdominal wall, shorter hospitalization, better cosmetic effect, less bleeding, earlier return to professional activities and others^{7,8,13,20,21,26}. With this in mind, we increased the indication for laparoscopy use. The use of the laparoscopic technique requires special instruments such as laparoscopic stapler with vascular load. This can result in increased procedure costs, but that may be offset by less blood loss, shorter hospital stay and earlier return to work. The cost analysis was not the object of this study. However, as occurred with the use of staplers in open surgery and in other laparoscopic surgery, the cost tends to fall with increasing number of cases. The type and amount of ma-

terial needed will vary greatly according to the type of surgery. A right hepatectomy needs more stapler loads, while a simple enucleation can be performed without any special material.

In patients for whom we anticipate a technical difficulty for the exclusive use of laparoscopy, we apply hybrid techniques with the use of an assisting hand or laparoscopic liver dissection followed by section through a small incision²⁷⁻²⁹.

The use of hand-assisted technique facilitates exposure of the liver parenchyma and section, especially in cirrhotic livers, and also gives the surgeon the tactile feel lost in laparoscopy²⁷. We believe that the systematic use of this technique is not required and, together with four other authors, the use it as a step prior to complete conversion to laparotomy or in cases of anticipated difficulties for carrying out an entirely laparoscopic technique.

The literature review shows an exponential growth in the number and indications of laparoscopic hepatectomy. In a review of all published cases of laparoscopic hepatectomy⁸, held in 2009, 2804 cases were found. In this study mortality was only 0.3% and morbidity 10.5%. Nevertheless, 45% of cases were wedge resections, and nearly half of cases in patients with benign tumors. Only 9% of the cases were right hepatectomies, ie there was case selection. When analyzing data from multicenter trials with only major resections³⁰, we find significantly greater morbidity and mortality; moreover, the conversion rate remained at 12.4%.

To the extent that this procedure was inserted in the therapeutic arsenal permanently and with no selection, findings tended to reflect the actual results of the method: lower morbidity, bleeding and mortality than open surgery. No mortality, present in the initial series, reflects selection of patients^{1,2,5}. Series with a large number of patients with benign lesions and minor resections show selection and should not be a parameter for comparison with open surgery. Randomized prospective studies have never been done, perhaps given the great diversity of liver procedures and the obvious preference of patients for minimally invasive surgery and, therefore, probably will not be carried out. Therefore, in the presence of impending hepatectomy, provided there are no contraindications to the method, laparoscopy must be the technique of choice.

Complex hepatic interventions, such as hepatectomy for Klatskin tumors and even the technique of "Associated Liver Partition and Portal vein ligation for Staged Hepatectomy" (ALPPS) (first case in the world) could be performed completely by laparoscopy³¹.

The criteria for performing a liver resection in this way include experience in hepato biliopancreatic surgery and advanced laparoscopy. But the indication of laparoscopy cannot and should not prevail over the surgical and oncological principles.

The dissemination of results after five years of use of laparoscopy in performing hepatic resections is of

utmost importance. The results, including technical difficulties, complications and even death, inherent of this complex type of surgery, need to be clearly disclosed.

The laparoscopic hepatectomy is a reality in Brazil, but there is still no method of teaching this procedure in major academic centers and universities. This procedure, therefore, should be performed in a specialized center by knowledgeable staff. The technique of laparoscopic

Glissonian access, described by our team, now used in major world centers, facilitates the realization of anatomic resections, which have a lower risk of complications and bleeding.

New techniques and instrumental improvements have continually been described and now, according to our experience, the proportion of patients amenable to laparoscopic liver resection is about 50% of cases.

R E S U M O

Objetivo: analisar nossa experiência após 107 hepatectomias videolaparoscópicas e discutir a evolução técnica da hepatectomia laparoscópica nos últimos cinco anos. **Métodos:** entre abril de 2007 e abril de 2012 foram realizadas 107 hepatectomias laparoscópicas em 105 pacientes. A média de idade foi 53,9 anos (17 a 85). Cinquenta e três pacientes eram do sexo masculino. Todas as intervenções foram realizadas pelos autores do trabalho. **Resultados:** do total de 107 operações, houve necessidade de conversão para a técnica aberta em três casos (2,8%). Dezesesseis pacientes (14,9%) apresentaram complicações. Dois pacientes foram a óbito, mortalidade de 1,87%. Um óbito foi decorrente de infarto miocárdio do miocárdio, sem relação com a hepatectomia laparoscópica, que transcorreu sem intercorrências e não apresentou conversão nem sangramento. O outro óbito foi decorrente de falha do grameador. Vinte pacientes (18,7%) necessitaram de transfusão sanguínea. O tipo de hepatectomia mais frequente foi a bissegmentectomia, segmentos 2-3, (33 casos), seguida de hepatectomia direita (22 casos). Setenta e duas cirurgias (67,3%) foram realizadas por meio da técnica de acesso Glissoniano. **Conclusão:** a divulgação dos resultados é de extrema importância. As dificuldades técnicas, complicações e mesmo mortalidade, inerentes a este complexo tipo de cirurgia, necessitam ser divulgados com clareza. Este procedimento deve ser realizado em centro especializado e por equipe capacitada. A técnica de acesso Glissoniano por via laparoscópica, descrita pela nossa equipe, facilita a realização de hepatectomias anatômicas.

Descritores: Fígado. Técnicas. Cirurgia geral. Laparoscopia. Hepatectomia.

REFERENCES

- Gagner M, Rheault M, Dubuc J. Laparoscopic partial hepatectomy for liver tumor. *Surg Endosc.* 1992;6(1):97-8.
- Azagra JS, Goergen M, Gilbert E, Jacobs D. Laparoscopic anatomical (hepatic) left lateral segmentectomy-technical aspects. *Surg Endosc.* 1996;10(7):758-61.
- Kalil AN, Giovenardi R, Camargo SM. Hepatectomia regrada por videolaparoscopia. *Rev Col Bras Cir.* 1998;25(4):287-9.
- O'Rourke N, Fielding G. Laparoscopic right hepatectomy: surgical technique. *J Gastrointest Surg.* 2004;8(2):213-6.
- Vibert E, Perniceni T, Levard H, Denet C, Shahri NK, Gayet B. Laparoscopic liver resection. *Br J Surg.* 2006;93(1):67-72.
- Soubrane O, Cherqui D, Scatton O, Stenard F, Bernard D, Branchereau S, et al. Laparoscopic left lateral sectionectomy in living donors: safety and reproducibility of the technique in a single center. *Ann Surg.* 2006;244(5):815-20.
- Koffron AJ, Auffenberg G, Kung R, Abecassis M. Evaluation of 300 minimally invasive liver resections at a single institution: less is more. *Ann Surg.* 2007;246(3):385-92; discussion 392-4.
- Nguyen KT, Gamblin TC, Geller DA. World review of laparoscopic liver resection-2,804 patients. *Ann Surg.* 2009;250(5):831-41.
- Machado MAC, Makdissi FF, Surjan RCT, Teixeira ARF, Bacchella T, Machado MCC. Hepatectomia direita por videolaparoscopia. *Rev Col Bras Cir.* 2007;34(3):189-192.
- Machado MAC, Makdissi FF, Almeida FAR, Luiz-Neto M, Martins ACA, Machado MCC. Hepatectomia laparoscópica no tratamento das metástases hepáticas. *Arq Gastroenterol.* 2008;45(4):330-2.
- Machado MA, Makdissi FF, Galvão FH, Machado MC. Intrahepatic Glissonian approach for laparoscopic right segmental liver resections. *Am J Surg.* 2008;196(4):e38-42.
- Machado MA, Makdissi FF, Surjan RC, Herman P, Teixeira AR, C Machado MC. Laparoscopic resection of left liver segments using the intrahepatic Glissonian approach. *Surg Endosc.* 2009;23(11):2615-9.
- Buell JF, Cherqui D, Geller DA, O'Rourke N, Iannitti D, Fagher I, et al. The international position on laparoscopic liver surgery: The Louisville Statement, 2008. *Ann Surg.* 2009;250(5):825-30.
- Machado MA, Makdissi FF, Surjan RC, Oliveira AC, Pilla VF, Teixeira AR. Intrahepatic Glissonian approach for laparoscopic right trisectionectomy. *J Laparoendosc Adv Surg Tech A.* 2009;19(6):777-8; discussion 778-9.
- Machado MA, Makdissi FF, Herman P, Surjan RC. Intrahepatic Glissonian approach for pure laparoscopic left hemihepatectomy. *J Laparoendosc Adv Surg Tech A.* 2010;20(2):141-2.
- Machado MA, Kalil AN. Glissonian approach for laparoscopic mesohepatectomy. *Surg Endosc.* 2011;25(6):2020-2.
- Machado MA, Makdissi FF, Surjan RC, Kappaz GT, Yamaguchi N. Two-stage laparoscopic liver resection for bilateral colorectal liver metastasis. *Surg Endosc.* 2010;24(8):2044-7.
- Kalil AN, Mastalir ET. Laparoscopic hepatectomy for benign liver tumors. *Hepatogastroenterology.* 2002;49(45):803-5.
- Machado MA, Makdissi FF, Bacchella T, Machado MC. Hemihepatic ischemia for laparoscopic liver resection. *Surg Laparosc Endosc Percutan Tech.* 2005;15(3):180-3.
- Nguyen KT, Laurent A, Dagher I, Geller DA, Steel J, Thomas MJ, et al. Minimally invasive liver resection for metastatic colorectal cancer: a multi-institutional, international report of safety, feasibility, and early outcomes. *Ann Surg.* 2009;250(5):842-8.
- Mala T, Edwin B, Gladhaug I, Fosse E, Sýreide O, Bergan A, et al. A comparative study of the short-term outcome following open and laparoscopic liver resection of colorectal metastases. *Surg Endosc.* 2002;16(7):1059-63.

22. Machado MA, Galvão FH, Pompeu E, Ribeiro C, Bacchella T, Machado MC. A canine model of laparoscopic segmental liver resection. *J Laparoendosc Adv Surg Tech A*. 2004;14(5):325-8.
23. Machado MA, Makdissi FF, Surjan RC, Teixeira AR, Sepúlveda A Jr, Bacchella T, et al. Laparoscopic right hemihepatectomy for hepatolithiasis. *Surg Endosc*. 2008;22(1):245.
24. Machado MA, Surjan RC, Makdissi FF. Video: intrahepatic Glissonian approach for pure laparoscopic right hemihepatectomy. *Surg Endosc*. 2011;25(12):3930-3.
25. Tisdale BE, Kapoor A, Hussain A, Piercey K, Whelan JP. Intact specimen extraction in laparoscopic nephrectomy procedures: Pfannenstiel versus expanded port site incisions. *Urology*. 2007;69(2):241-4.
26. Castaing D, Vibert E, Ricca L, Azoulay D, Adam R, Gayet B. Oncologic results of laparoscopic versus open hepatectomy for colorectal liver metastases in two specialized centers. *Ann Surg*. 2009;250(5):849-55.
27. Antonetti MC, Killelea B, Orlando R 3rd. Hand-assisted laparoscopic liver surgery. *Arch Surg*. 2002;137(4):407-11; discussion 412.
28. Koffron AJ, Kung RD, Auffenberg GB, Abecassis MM. Laparoscopic liver surgery for everyone: the hybrid method. *Surgery*. 2007;142(4):463-8; discussion 468.e1-2. Erratum in: *Surgery*. 2008;143(2):301.
29. Nitta H, Sasaki A, Fujita T, Itabashi H, Hoshikawa K, Takahara T, et al. Laparoscopy-assisted major liver resections employing a hanging technique: the original procedure. *Ann Surg*. 2010;251(3):450-3.
30. Dagher I, O'Rourke N, Geller DA, Cherqui D, Belli G, Gamblin TC, et al. Laparoscopic major hepatectomy: an evolution in standard of care. *Ann Surg*. 2009;250(5):856-60.
31. Machado MA, Makdissi FF, Surjan RC, Mochizuki M. Laparoscopic resection of hilar cholangiocarcinoma. *J Laparoendosc Adv Surg Tech A*. 2012 Oct 26. [Epub ahead of print]
32. Machado MA, Makdissi FF, Surjan RC. Totally laparoscopic ALPPS is feasible and may be worthwhile. *Ann Surg*. 2012;256(3):e13; author reply e16-9.

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