

## **Giant liver cyst associated with cholelithiasis: literature review and state of art**

## **Cisto hepático gigante associado a colelitíase: revisão da literatura e estado da arte**

## **Quiste hepático gigante asociado a colelitiasis: revisión bibliográfica y estado del arte**

DOI:10.34119/bjhrv7n2-461

Originals received: 03/22/2024

Acceptance for publication: 04/10/2024

### **Marcelo Barros Weiss**

Post-PhD in Psychology by UFLO Universidad  
Institution: Faculdade de Ciências Médicas e da Saúde  
Address: Juiz de Fora, Minas Gerais, Brasil  
E-mail: marcelobarrosweiss@gmail.com

### **Daniel de Souza Weiss**

Graduating in Medicine  
Institution: Faculdade de Ciências Médicas e da Saúde  
Address: Juiz de Fora, Minas Gerais, Brasil  
E-mail: dsweiss13@gmail.com

### **ABSTRACT**

Liver lesions subject to laparoscopic resection are one of the frontiers conquered in surgery today. Even when dealing with surgery, which is often complex, the increase in demand from patients has increased, bringing more and more learning and dexterity to surgery teams with the increasing development of technology. To analytically evaluate the method, based on the most recent publications in the literature, with possible indications and reporting a recently successfully operated case, highlighting the safety, results and fundamental technical aspects. The relevant works from the last 15 years were identified and analyzed in the LILACS and PUBMED databases until August 2023, using the descriptors “ liver resection ”, “ laparoscopic surgery ” and “ liver surgery ”. We don't We found prospective and double-blind studies in the databases, with available data coming from case series, case-control studies and some multicenter studies and meta-analyses. Laparoscopic hepatectomy is a safe surgery and is very standardized in execution, even for major liver resections, with a low morbidity and mortality rate. As an oncological surgical method, it is gaining more and more space without compromising oncological radicality and with advantages for patients. with specific liver diseases. Benign lesions are the best indicated and performed, especially adenoma and cystic lesions, which in the hands of experienced teams have very good results and videolaparoscopic surgery can be considered today as standard treatment.

**Keywords:** liver resection, laparoscopic surgery, liver surgery.

## RESUMO

As lesões hepáticas passíveis de ressecção laparoscópica são uma das fronteiras conquistadas na cirurgia atual. Mesmo em se tratando de cirurgia, muitas vezes complexa, o aumento da demanda de pacientes tem aumentado, trazendo cada vez mais aprendizado e destreza às equipes cirúrgicas com o crescente desenvolvimento da tecnologia. Avaliar analiticamente o método, com base nas publicações mais recentes da literatura, com possíveis indicações e relatando um caso operado recentemente com sucesso, destacando a segurança, os resultados e os aspectos técnicos fundamentais. Foram identificados e analisados os trabalhos relevantes dos últimos 15 anos nas bases de dados LILACS e PUBMED até agosto de 2023, utilizando os descritores "liver resection", "laparoscopic surgery" e "liver surgery". Não Encontrámos estudos prospectivos e duplamente cegos nas bases de dados, sendo os dados disponíveis provenientes de séries de casos, estudos de caso-controlo e alguns estudos multicêntricos e meta-análises. A hepatectomia laparoscópica é uma cirurgia segura e de execução muito padronizada, mesmo para grandes ressecções hepáticas, com baixa taxa de morbidade e mortalidade. Como método cirúrgico oncológico, vem ganhando cada vez mais espaço sem comprometer a radicalidade oncológica e com vantagens para pacientes com doenças hepáticas específicas. As lesões benignas são as mais indicadas e realizadas, especialmente o adenoma e as lesões quísticas, que nas mãos de equipas experientes têm resultados muito bons e a cirurgia videolaparoscópica pode ser considerada hoje como tratamento padrão.

**Palavras-chave:** ressecção hepática, cirurgia laparoscópica, cirurgia hepática.

## RESUMEN

Las lesiones hepáticas que pueden ser resecadas por vía laparoscópica son una de las fronteras que la cirugía actual ha conquistado. Aunque la cirugía sea muchas veces compleja, la demanda de pacientes ha aumentado, trayendo cada vez más aprendizaje y habilidad a los equipos quirúrgicos con el creciente desarrollo de la tecnología. Analizar el método, a partir de las más recientes publicaciones en la literatura, con posibles indicaciones y relatando un caso reciente de éxito, destacando seguridad, resultados y aspectos técnicos fundamentales. Fueron identificados y analizados estudios relevantes de los últimos 15 años en las bases de datos LILACS y PUBMED hasta agosto de 2023, utilizando los descriptores "liver resection", "laparoscopic surgery" y "liver surgery". No se encontraron estudios prospectivos o doble ciego en las bases de datos, y los datos disponibles procedían de series de casos, estudios de casos y controles y algunos estudios multicéntricos y metaanálisis. La hepatectomía laparoscópica es un procedimiento seguro y muy estandarizado, incluso para resecciones hepáticas mayores, con una baja tasa de morbilidad y mortalidad. Como método quirúrgico oncológico, gana cada vez más terreno sin comprometer la radicalidad oncológica y con ventajas para los pacientes con hepatopatías específicas. Las lesiones benignas son las más indicadas y realizadas, especialmente el adenoma y las lesiones quísticas, que en manos de equipos experimentados tienen muy buenos resultados y la cirugía laparoscópica puede considerarse ya el tratamiento estándar.

**Palabras clave:** resección hepática, cirugía laparoscópica, cirugía hepática.

## 1 INTRODUCTION

Technology in medicine and especially in video surgery (VL) and robotics has been advancing very quickly and has transformed surgical therapy for a large number of pathologies, whether benign or oncological. The rapid evolution of imaging and dissection equipment using harmonic energy and selective coagulation has enabled the increase in surgeries in the stomach, colon, kidneys, pancreas, adrenal and spleen and retroperitoneum<sup>1 2</sup>. Laparoscopy and more recently robotics are already established in the treatment of some diseases, such as cholecystolithiasis, gastroesophageal reflux disease, appendicitis, diverticulitis, bariatric surgery and many others, have become the therapy of choice with unquestionable advantages over the conventional approach<sup>41</sup>.

In liver and bile duct surgeries, the use of the VL route has been very well established for some years and in some procedures such as liver biopsies, deroofing of simple hepatic cysts and drainage of abscesses<sup>17</sup>. In the decade from 2000 to 2010, liver resections had great advances and systematization.<sup>7,12,13</sup>.

The difficulties related to procedures on the liver and bile ducts included the theoretical risk of gas embolism, the potential for intra-operative bleeding that is difficult to control by VL and the uncertainties regarding safety margins in oncological surgeries with possible risks of tumor dissemination in cases of malignant diseases, in addition to the need for major incorporation of technology, such as that required to section the liver parenchyma (harmonic scalpel, laparoscopic vascular staplers, etc.), transducers laparoscopic devices for intraoperative ultrasound and the need for specific retractors and instruments for liver mobilization.<sup>7,13,23</sup>.

Historically, the first VL hepatectomy was published by Gagner, et al.<sup>16</sup> in 1992 for the treatment of hepatic focal nodular hyperplasia and, in 1995, Ferzl et al.<sup>14</sup> published the resection of a 9 cm hepatic adenoma in segment IV. The first regulated hepatectomy was published by Azagra et al.<sup>1</sup> in 1996, who performed a left lateral segmentectomy on a patient with hepatic adenoma. Before that, just small group experiences and simple reports, subsequent work was restricted to reports and case series from a few specialized centers. The works began to gain more body and number, mainly between 2005 and 2009. After that, the systematization of techniques and new technologies were consolidated.<sup>1,7,24,38</sup>

VL condition for liver resections was well defined in a safe way and with additional benefits over the conventional approach. Among the advantages of VL liver resections are reduction of postoperative pain, shorter hospital stays, faster return to work and lower rate of incisional hernias<sup>30,38</sup>. Several authors also observed a lower rate of intraoperative bleeding in

patients undergoing VL 30 liver resection. Mortality and complication rates are similar in both procedures in experienced hands.<sup>12,13,30,38</sup>

This review aims to carry out a critical and methodological analysis of the method, exemplified by a case performed via laparoscopy and based on existing work in the most recent literature. We will be able to analyze the “state of the art”, highlighting its indications, safety of the method, results and technical aspects of VL liver resections in the treatment of benign and malignant liver diseases.

## 2 CASE REPORT

Female patient, 26 years old, saleswoman, was admitted to the Surgery Service presenting, for two months, pain in the right hypochondrium, of moderate intensity, radiating to the epigastrium and right flank. He also reported a lot of postprandial fullness, heartburn, vomiting and weight loss of 2kg. He had no personal or family history worth mentioning. Vital signs were normal, the patient had pale mucous membranes (++/4) and was emaciated.

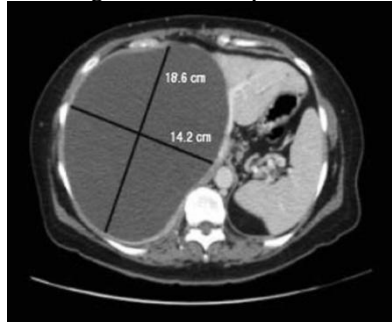
The abdomen was enlarged. On palpation, the abdomen was painful in the right hypochondrium, just below the costal margin and epigastrium, and the liver was enlarged. Traube space free and hydro-air noise present. The laboratory study showed: hemoglobin = 10.5g/dl, gly cemia = 93mg/dl; total bilirubin = 1.2 mg /dl (direct = 0.3mg/dl), albumin = 4.3g/dl; creatinine = 0.7mg/dl, phosphatase alkaline = 124U/l; gamma-GT = 289U/l; AST = 151U/l and ALT = 90U/l. A computed tomography of the upper abdomen showed a large cystic lesion affecting segments VII and VIII, in addition to a gallbladder full of stones (figures 1 and 2). Spleen and kidneys of usual shape, contour and dimensions without liquids.

Figure 1 – CT hepatic cist



Source: personal file

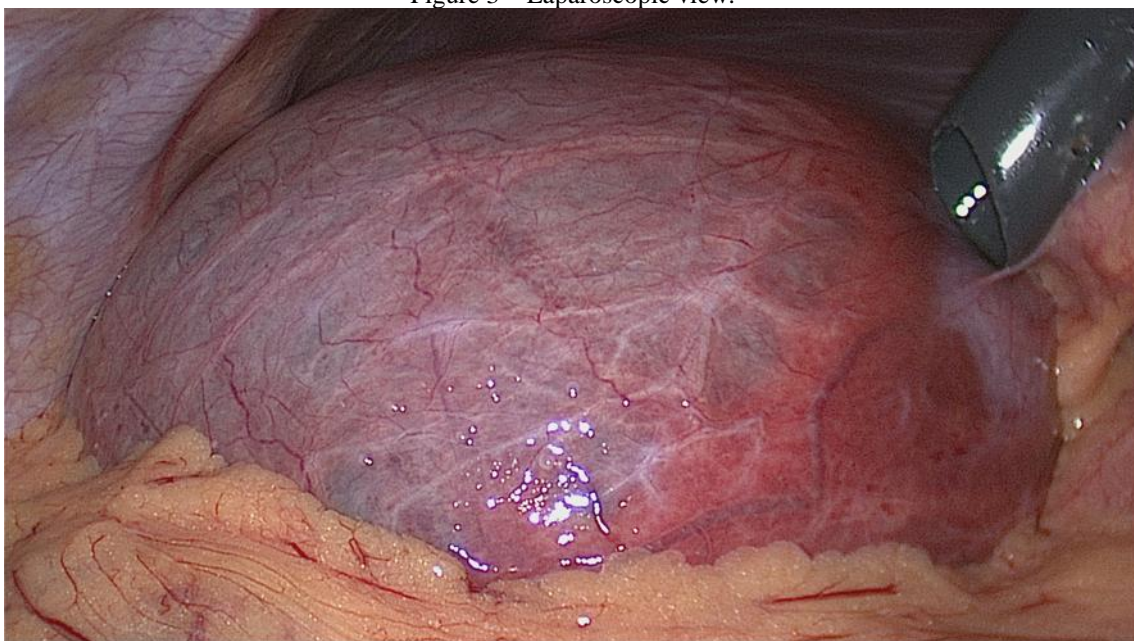
Figure 2 – CT hepatic cyst



Source: personal file

With the diagnosis of hepatic cyst, the patient She was prepared for surgery with improvement in hematimetric parameters and total proteins and was then taken to laparoscopic surgery (Figure 3). The 10mm ports were passed into the umbilical scar, and three other 5mm ports and one 12mm port were passed for its dissection and for the associated cholecystectomy . With the lowering of the hilar plate, isolation of the hepatic pedicle and release of the left triangular, round and falciform ligaments, the cyst was extensively removed and followed by a cholecystectomy without any complications, using harmonic scalpel forceps for this purpose. After completion, the patient was transferred to the intensive care unit, where she received nutritional and hemodynamic support for 24 hours and then released to her room, walking and eating normally. Receiving discharge 48 hours after the procedure, returning 30 days after surgery without complaints. Control using computed tomography revealed complete healing of the liver bed, without other changes.

Figure 3 – Laparoscopic view.



Source: personal file- Surgery on YouTube: marcelobarrosweiss1971



Figure 4 – Gallbladder and calculus



Source: personal file- Surgery on YouTube: marcelobarrosweiss1971

### 3 INDICATIONS

Nowadays, the indications for liver resections by VL have increased a lot and the biggest restriction is in the structuring of the surgical center and the release of materials to carry out the procedures with greater safety. In some specialized services, 50 to 80% of indications are for VL 40.

VL resections They are used in resections of benign and malignant liver lesions <sup>18,29</sup>. The main indications and best results are benign lesions, even the most complex ones. Benign lesions can be treated by removal of simple hepatic cysts, hydatid cysts also have reports of treatment by VL and adenomas <sup>10</sup>. Biliary cystadenomas <sup>17</sup>, which have a high risk of malignant transformation, are indicated for resection and the VL route can be used in selected cases. Peripheral benign tumors have the best indication in the literature <sup>3</sup>.

Hemangiomas and focal nodular hyperplasias, due to their indolent behavior, should only be monitored by imaging and should only be treated with surgery when symptoms appear. Hemangiomas nowadays have very good results with selective embolization by radiointervention. <sup>9,20,38</sup>. More aggressive management will be carried out in cases of

hepatocellular adenomas due to the high rate of malignancy and risk of rupture <sup>22</sup>, the best indication among benign tumors.

Classically, anterolateral liver resections are performed (segments 2, 3, 4b, 5, 6), known by some authors as “laparoscopic segments” <sup>30,40</sup>. Some propose the routine use of VL in left lateral segmentectomies (segments 2 and 3) due to its good results, technical ease and low complication rates <sup>6</sup>. Larger resections have now been performed more easily due to the popularization of endostaplers with vascular loads and harmonic and bipolar energy forceps <sup>1,35</sup>. The method has been also applied in resections for the removal of partial grafts from living liver donors with excellent results <sup>25,37</sup>. The increase we have seen in recent years has mainly helped younger patients who do not require large incisions and which improves surgical expectations <sup>25, 30,38</sup>. However, even though the method is very safe nowadays, it should not expand the indications for benign resections that would only be for clinical monitoring, thus avoiding “super indications” <sup>40</sup>.

#### 4 SURGICAL TECHNIQUE

Hepatectomy is a sometimes-complex procedure that requires specific instruments and materials and is often expensive. Furthermore, the team must have training in advanced VL surgery. Regardless of the indication, the good technique should be used in that patient with a good indication with an assessment of risk and benefit. There is a need for a very well done pre-operative procedure.

The most notable indications for laparoscopy in liver resections are nodulectomies, wedge resections or segmentectomies. Mainly in lesions located in the anterolateral segments of the liver. Segments I, IVa, VII and VIII have more restricted access using the method, as do resections of lesions close to the hilum or juxtaposed to the hepatic veins. Cho et al.<sup>9</sup> published a series of 36 patients with lesions located in the postero -superior segments (S7, S8, S4a and S1) resected using a purely laparoscopic approach. Similarly, laparoscopic segment 1 resections have recently been reported <sup>5,24</sup>.

There are those who propose video-assisted surgery (hybrid surgery) or with the aid of the hand (“hand-assisted”) for tumors in these more difficult locations. Major liver resections, such as right and left hepatectomies, can be performed safely, with many reports even of trisegmentectomies performed<sup>24</sup>. The literature is full of series of resections of lesions up to 5 cm or slightly larger than that, but larger lesions cannot be disregarded when indicating VL.<sup>5</sup>. Logically, larger injuries incur a greater risk of rupture and major bleeding.

The VL surgical technique must maintain the precepts of conventional surgery. Hepatic mobilization and vascular control do not change except for shape. Therefore, adequate equipment was developed to perform the procedure. Vascular control is a challenge in laparoscopic surgeries, however, it will be performed in a similar way to traditional surgery. Hilar dissection and isolation of vessels from the right and left hepatic pedicles and the Pringle maneuver can and should be performed safely. The safety of intra-parenchymal control of Glissonian pedicles by videolaparoscopy<sup>27,28</sup>. The pneumoperitoneum itself, (carbon dioxide - CO<sub>2</sub>), is another factor that reduces intra-operative bleeding, mainly venous. Intra-abdominal pressure should be maintained between 12 and 15 millimeters of mercury and may be increased to prevent bleeding. Central venous pressure (CVP) should be kept as low as possible, ideally below 5 mmHg, to minimize the risk of bleeding. The team of anesthesiologists must be very attentive to this detail.

Release of the liver from the inferior vena cava, a procedure that, when performed by VL, provides better visualization of the vein than with conventional surgery (and better vascular control in cases of intra-operative urgency), or traditional media with conventional mono and bipolar energy. Vascular control can be complemented with the use of metallic, plastic clips or laparoscopic vascular staplers. To the Hepatic veins and their vascular pedicles should preferably be sealed with laparoscopic vascular staplers.

When the disease is malignant, in addition to the aspects raised here, it will be necessary to follow oncological principles to prevent tumor spread. We must manipulate the tumor as little as possible and if the disease is advanced, immediate conversion to laparotomy should be considered. Removal of the surgical specimen must be done using “endobags” or low Pfannestiel-type incisions. Control of hemostasis and subsequent closure of the portals and incisions that were made.

## 5 POSSIBLE COMPLICATIONS

When it comes to complications in laparoscopy and, especially in liver surgery, the most feared is bleeding, but current studies are no different from conventional surgeries with morbidity and mortality rates of 0 to 5.9%.<sup>12 13 30 38</sup> Despite the risk of uncontrollable bleeding Being one of the major obstacles to laparoscopic surgery and the main cause of conversion, a low rate of bleeding has also been demonstrated by several authors, including lower rates than conventional surgery<sup>25,30</sup>. Currently, materials and equipment have improved a lot, as has the ability of surgical teams to control them. The magnification of the images facilitates the



identification of vascular structures and the pneumoperitoneum, calibrated with modern equipment, improved performance. An Air embolism is another feared event, but which is being reported less and less and is associated with manipulation of the venous system (injuries) and the use of an argon scalpel, which is rare in practice<sup>12, 38</sup>.

The conversion from VL to conventional surgeries has fallen significantly, ranging from 3.3% to 15%, depending largely on the team and mainly on the correct indication of the procedure via this route<sup>12, 13, 30, 38, 39</sup>. What is most related to high conversion rates are: inadequate exposure, anatomical restrictions and difficult to access location. When necessary, conversion can be done conventionally or with the help of a hybrid technique (hand and video assistance). A VL-related death is rare, but cases may be related to more severe and cirrhotic patients, which compromises risk assessment purely based on the method. Great series like Nguyen et al. found nine deaths in 2804 liver resections, which gives a mortality rate of 0.3%. Considering death broadly, and not just through surgery as a method, liver failure is the main cause in the postoperative period.<sup>32</sup>

## 6 CONCLUSION

VL is a procedure that requires experience and skill from the team, but this is increasingly common in our country. It became part of the therapeutic armamentarium of the hepatologist surgeon. In recent years, the applicability of the technique has only increased and the possibilities for evolving the method are knocking on the doors of robotics with more and more articles demonstrating that it is also feasible (although still very expensive). Surgical indications are basically the same as conventional surgery, with a low morbidity and mortality rate. In a trained team, benign lesions have their main indication and metastatic liver lesions are now common practice in laparoscopic oncological surgeries for colon tumors. In cirrhotic patients, less manipulation allows for greater postoperative comfort and lower rates of complication of the underlying disease.

Surgery: <https://youtu.be/dbynyS5ikng>

## REFERENCES

1. Azagra JS, Goergen M, Gilbert E, Jacobs D. Laparoscopic anatomical (hepatic) left lateral segmentectomy-technical aspects. *Surg Endosc* . 1996; 10: 758-61.
2. Baker TB, Jay CL, Ladner DP, Preczewski LB, Clark L, Holl J, Abecassis MM. Laparoscopy-assisted and open living donor right hepatectomy: a comparative study of outcomes. *Surgery* . 2009, 146:817-23.
3. Belli G, Fantini C, D'Agostino A, et al. Laparoscopic versus open liver re sections for hepatocellular carcinoma in patients with histologically proven cirrhosis: short- and middle - term results. *Surg Endosc* . 2007; 21: 2004-11.
4. Bryant R, Laurent A, Tayar C, van Nhieu JT, Luciani A, Cherqui D. Liver resection for hepatocellular carcinoma. *Surg Oncol Clin N Am*. 2008; 17: 607-33.
5. Buell JF, Thomas MT, Rudich S, Marvin M, Nagubandi R, Ravindra KV, Brock G, McMasters KM (2008) Experience with more than 500 minimally invasive hepatic procedures. *Ann Surg* 248:475-486
6. Chang S, Laurent A, Tayar C, Karoui M, Cherqui D. Laparoscopy as a routine approach for left lateral sectionectomy. *Br J Surg*. 2007; 94:58-63.
7. Cherqui D, Husson E, Hammoud R, Malassagne B, Stéphan F, Bensaid S, Rotman N, Fagniez PL. Laparoscopic liver resections: a feasibility study in 30 patients. *Ann Surg* . 2000; 232: 753-62.
8. Cherqui D, Laurent A, Mocellin N, Tayar C, Luciani A, Van Nhieu JT, Decaens T, Hurtova M, Memeo R, Mallat A, Duvoux C. Liver resection for transplant able hepatocellular carcinoma: long-term survival and role of secondary liver transplantation. *Ann Surg* . 2009 Nov; 250(5):738-46.
9. Cho JY, Han HS, Yoon YS, Shin SH. Feasibility of laparoscopic liver resection for tumors located in the posterosuperior segments of the liver, with a special reference I'm overcoming current limitations on tumor location. *Surgery* 2008; 144: 32-8.
10. Chowbey PK, Shah S, Khullar R, Sharma A, Soni V, Baijal M, Vashistha A, Dhir A. Minimal access surgery for hydatid cyst disease: laparoscopic, thoracoscopic, and retroperitoneoscopic approach. *J Laparoendosc Adv Surg Tech A*. 2003; 13: 159-65.
11. Dagher I, Lainas P, Carloni A, Caillard C, Champault A, Smadja C, Franco D. Laparoscopic liver resection for hepatocellular carcinoma. *Surg Endosc*. 2008; 22: 372-8.
12. Descottes B, Glineur D, Lachachi F, Valleix D, Paineau J, Hamy A, Morino M, Bismuth H, Castaing D, Savier E, Honore P, Detry O, Legrand M, Azagra JS, Goergen M, Ceuterick M, Marescaux J, Mutter D, de Hemptinne B, Troisi R, Weerts J, Dallemagne B, Jehaes C, Gelin M, Donckier V, Aerts R, Topal B, Bertrand C, Mansvelt B, Van Krunkelsven L, Herman D, Kint M, Totte E, Schockmel R, Gigot JF. Laparoscopic liver resection of benign liver tumors. *Surg Endosc* 2003; 17:23-30.

13. Descottes B, Lachachi F, Sodji M, Valleix D, Durand-Fontanier S, Pech in Laclause B, Grousseau D. Early experience with laparoscopic approach for solid liver tumors: initial 16 cases. *Ann Surg* . 2000; 232: 641-5.
14. Ferzli G, David A, Kiel T. Laparoscopic resection of a large hepatic tumor. *Surg Endosc*. 1995; 9:733-5.
15. Fong Y, Brennan MF, Turnbull A, et al. Gallbladder cancer discovered during laparoscopic surgery – potential for iatrogenic dissemination. *Arch Surg* . 1993; 128:1054-6.
16. Gagner M, Rheault M, Dubuc J. Laparoscopic partial hepatectomy for liver tumor. *Surg Endosc* . 1992; 6:99.
17. Gamblin TC, Holloway SE, Heckman JT, Geller DA. Laparoscopic resection of benign hepatic cysts: a new standard. *J Am Coll Surg*. 2008; 207: 731-6.
18. Gigot JF, Glineur D, Santiago Azagra J, Goergen M, Ceuterick M, Morino M, Etienne J, Marescaux J, Mutter D, van Krunkelsven L, Descottes B, Valleix D, Lachachi F, Bertrand C, Mansvelt B, Hubens G, Saey JP, Schockmel R. Laparoscopic liver resection for malignancy liver tumors: preliminary results of a multicenter European study. *Ann Surg* . 2002; 236: 90-7.
19. Gigot JF, Hubert C, Banice R, Kendrick ML. Laparoscopic management of benign liver diseases: where are we? *HPB (Oxford)* 2004; 6: 197-212.
20. Herman P, Costa ML, Machado MA, Pugliese V, D'Albuquerque LA, Machado MC, Gama-Rodrigues JJ, Saad WA (2005) Management of hepatic heman giomas: a 14-year experience. *J Gastrointest Surg* 9:853-859
21. Herman P, Perini MV, Coelho F, Saad W, D'Albuquerque LA. Half-Pringle maneuver: a useful tool in laparoscopic liver resection. *J Laparoendosc Adv Surg Tech A*; 2010 Feb ;20(1):35-7
22. Herman P, Pugliese V, Machado MA, Montagnini AL, Salem MZ, Bacchella T, D'Albuquerque LA, Saad WA, Machado MC, Pinotti HW. Hepatic adenoma and focal nodular hyperplasia: differential diagnosis and treatment. *WorldJ Sur*. 2000; 24: 372-6.
23. Koffron A, Geller D, Gamblin TC, Abecassis M. Laparoscopic liver surgery: Shifting the management of liver tumors. *Hepatology*. 2006; 44: 1694-1700.
24. 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: 385-92
25. Koffron AJ, Kung R, Baker T, Fryer J, Clark L, Abecassis M. Laparoscopic assisted right wolf donor hepatectomy . *Am J Transplant*. 2006; 6:2522-5.
26. Lai EC, Tang CN, Ha JP, Li MK (2009) Laparoscopic liver resection for hepatocellular carcinoma: ten years' experience in a single center. *Arch Surg* 144(2): 143-147
27. Machado MA, Makdissi FF, Galvão FH, Machado MC. Intrahepatic Glissonian approach for laparoscopic right segmental liver resections. *Am J Surg*. 2008;196(4):38-42.

28. Machado MA, Makdissi FF, Surjan RC, Herman P, Teixeira AR, Machado C MC. Laparoscopic resection of left liver segments using the intrahepatic Glissonian approach. *Surg Endosc* . 2009 Mar 19.
29. Mala T, Edwin B, Gladhaug I, Fosse E, Søreide O, Bergan A, Mathisen O. A comparative study of the short-term outcome following open and laparoscopic liver resection of colorectal metastases. *Surg Endosc* . 2002; 16:1059-63.
30. Morino M, Morra I, Rosso E, Miglietta C, Garrone C. Laparoscopic vs open hepatic resection: a comparative study. *Surg Endosc* . 2003; 17: 1914-8.
31. Nguyen KT, Gamblin TC, Geller DA. World Review of Laparoscopic Liver Resection-2,804 Patients. *Ann Surg*. 2009; 250: 831-41.
32. Nguyen KT, Laurent A, Dagher I, et al. Minimally invasive liver resection for metastatic colorectal cancer. A multi-institutional, international safety report, feasibility, and early outcomes. *Ann Surg* 2009; 250: 842-8.
33. O'Rourke N, Shaw I, Nathanson L, Martin I, Fielding G. Laparoscopic resection of hepatic colorectal metastases. *HPB*. 2004; 6: 230-5.
34. Polignano FM, Quyn AJ, de Figueiredo RS, Henderson NA, Kulli C, Tait IS. Laparoscopic versus open liver segmentectomy: prospective, case-matched, intention-to-treat analysis of clinical outcomes and cost effectiveness. *Surg Endosc*. 2008; 22: 2564-70.
35. Saint Marc O, Cogliandolo A, Piquard A, Famà F, Pidoto RR. Early experience with laparoscopic major liver resections : a case-comparison study . *Surg Laparosc Endosc Percutan Tech*. 2008; 18:551-5.
36. Santambrogio R, Opocher E, Ceretti AP, et al. Impact of intraoperative ultrasonography \_ liver surgery. *Surg Endosc* . 2007; 21(2): 181-8
37. Soubrane O, Cherqui D, Scatton O, Stenard F, Bernard D, Branchereau S, Martelli H, Gauthier F. Laparoscopic left lateral sectionectomy in living donors: safety and reproducibility of the technique in a single center. *Ann Surg* . 2006; 244: 815-20.
38. Troisi R, Montalti R, Smeets P, Van Huysse J, Van Vlierberghe H, Colle I, De Gendt S, by Hemptinne B. The value of laparoscopic liver surgery for solid benign hepatic tumors. *Surg Endosc*. 2008; 22: 38-44.
39. Vigano L, Laurent A, Tayar C, Tomatis M, Ponti A, Cherqui D. The learning curve in laparoscopic liver resection: improved feasibility and reproducibility. *Ann Surg*. 2009 Nov; 250(5):772-82.
40. Vigano L, Tayar C, Laurent A, Cherqui D. Laparoscopic liver resection: a systematically review. *J Hepatobiliary Pancreat Surg* . 2009; 16:410-21.
41. Watson DI. Laparoscopic treatment of gastro-oesophageal reflux disease . *Best Pract Res Clin Gastroenterol*. 2004; 18: 19-35. Source of financing: none Conflict of interest: none.