

Radical Laparoscopic Treatment for Liver Hydatidosis

Jose M. Ramia · Ignasi Poves · Camilo Castellón ·
Luis Diez-Valladares · Carmelo Loinaz ·
Alejandro Serrablo · Miguel A. Suarez

Published online: 10 July 2013
© Société Internationale de Chirurgie 2013

Abstract

Background There is no scientific evidence to show which surgical technique should be used in treating hydatidosis of the liver; nor is there consensus on whether laparoscopy should be used in hydatidosis, because of the risk of dissemination or anaphylaxis.

Materials We conducted a multicenter study of laparoscopic radical surgery for hydatidosis of the liver (LRSH). The main objectives of the study were to determine the feasibility of LRSH, to examine the associated morbidity, and to evaluate the associated recurrence rate.

J. M. Ramia (✉)
Hepato-Pancreato-Biliary Surgical Unit, Department of Surgery,
Guadalajara University Hospital, Guadalajara, Spain
e-mail: jose_ramia@hotmail.com

I. Poves
Hepato-Pancreato-Biliary Surgical Unit, Department of Surgery,
Hospital del Mar, Barcelona, Spain

C. Castellón
Department of Surgery, Hospital Infanta Elena, Madrid, Spain

L. Diez-Valladares
Hepato-Pancreato-Biliary Surgical Unit, Department of Surgery,
Hospital Clínico Universitario, Madrid, Spain

C. Loinaz
Department of Surgery, Hospital 12 de Octubre, Madrid, Spain

A. Serrablo
Hepato-Pancreato-Biliary Surgical Unit, Department of Surgery,
Hospital Miguel Servet, Saragossa, Spain

M. A. Suarez
Hepato-Pancreato-Biliary Surgical Unit, Department of Surgery,
Hospital Carlos Haya, Malaga, Spain

Materials and methods The present report is based on a retrospective multicenter study of patients with hydatid disease of the liver treated by LRSH. The study period was from January 2000 to April 2012.

Results There were 37 patients (46 % male) with 43 cysts. The median age was 53.1 years. Median cyst size was 5.8 cm. The most common location of the cyst was the left lateral sector (62 %). The median number of trocars used was 4. Protective scolicide-soaked swabs were used in 57 % of patients. We performed 24 total closed cystectomies, 12 left lateral sectionectomies, and 4 liver resections. The median operating time was 185 min and the mean blood loss was 184 mL. The conversion rate was 8 %. Morbidity was 16 % and mortality 0 %. The length of hospital stay was 4.8 days. No cyst recurrence was observed after a follow-up of 30.6 months.

Conclusions Despite the limitations and biases of a retrospective multicenter study, we believe that LRSH is feasible in favorable segments but is technically demanding. The low morbidity and absence of recurrence suggest that LRSH should be performed whenever feasible.

Introduction

Echinococcosis, which has a worldwide distribution, is a zoonosis caused by larvae of the genus *Echinococcus* [1–5]. The organ in which cysts most frequently develop is the liver [1, 5]. The aim of treatment of hydatid cyst of the liver (HCL) is complete elimination of the parasite with minimal morbidity and the prevention of recurrence [5, 6]. A number of therapeutic options exist for HCL: medical treatment, puncture–aspiration–injection–reaspiration, and surgery. Surgery is the treatment of choice and the only

method that completely eliminates the parasite [1, 3–5, 7–12].

The first report of laparoscopic surgery for HCL was published in 1992 [13], and although few series have been published, there has been a slow but progressive increase in the number of cases treated by laparoscopy, usually with conservative techniques [10]. The small number of cases treated by laparoscopy is possibly due to the slow consolidation of laparoscopic liver surgery and the fear of dissemination of the parasite or anaphylaxis during the procedure [3, 4].

There are few data on the feasibility of laparoscopic radical surgery and its associated morbidity and recurrence rate because only a limited number of patients have been treated using this technique, and most of them have been included in series of conservative laparoscopic surgery. The Hepatic–Pancreatic–Biliary (HPB) Surgery Section of the Spanish Association of Surgeons has therefore conducted a retrospective multicenter study on laparoscopic radical surgery for hydatidosis of the liver (LRSH). The main objective of the study was to determine the feasibility of LRSH and its associated morbidity and recurrence rate.

Materials and methods

We performed a multicenter retrospective study to determine the status of radical laparoscopic surgery for hydatid cysts of the liver (total closed cystectomy or partial hepatectomy) in Spain. A questionnaire was sent to 23 HPB units. All of them responded to the survey, but only 12 Surgical Units had performed LRSH. We included 37 patients who underwent surgery for 43 hydatid cysts of the liver between January 2000 and April 2012. The only inclusion criterion for the study was that LRSH was considered feasible preoperatively.

Information was collected by sending a specifically designed database to participating units. Demographic and clinical data included age, gender, preoperative anesthetic assessment, previous abdominal surgery, clinical manifestations of the cyst, and hydatid serology. Details of the disease included the number, size, and location (intraparenchymal or peripheral) of the cysts, whether they were new or recurrent, and presence of complications. The following information was gathered on the treatment of the cysts: administration of albendazole; type of operation (open total cystectomy, closed total cystectomy, or liver resection); laparoscopic technique (pneumoperitoneum technique [Veress vs. Hasson], number of trocars, use of hand-assisted laparoscopic surgery [HALS], use of intraoperative ultrasound, use of Pringle maneuver, use of Harmonic Scalpel, instrument employed to transect liver parenchyma [hook, Ligasure, ultracision, Linear staplers],

operative time, intraoperative bleeding, and method of extraction of the surgical specimen); and associated surgical procedures.

Morbidity and mortality were determined according to the Clavien–Dindo classification and length of stay was recorded [13]. Possible recurrence was monitored over several months. Data were analyzed with the SPSS statistical package, version 18.0 for Mac. Informed consent was obtained from every patient.

Results

During the study period, 509 patients underwent operation for HCL; 37 (7.3 %) of these operations were performed by LRSH. Over the same period, laparoscopy was used for a total of 486 operations on the liver; LRSH represented 7.6 % of these cases. The data for the 37 LRSH patients are summarized in Table 1.

Of the 37 patients who underwent LRSH, 17 were men (46 %); the mean patient age was 53.1 years (range: 16–77 years). Preoperative assessment according to the American Society of Anesthesiologists (ASA) classification was as follows: ASA I: 13 patients; ASA II: 20 patients; and ASA III: 4 patients. Twenty-one patients (57 %) reported symptoms, the most common of which was abdominal pain (14/37). Hydatid serology (enzyme-linked immunosorbent assay) was positive in 75 % of patients. Eight (22 %) patients had undergone previous infraumbilical abdominal surgery. Thirteen patients (35 %) received albendazole, 6 patients only pre-operatively, 6 pre- and post-operatively, and 1 only post-operatively.

The mean number of cysts per patient was 1.2 (range: 1–3) and the mean cyst size was 5.8 cm (range: 3–12 cm), with the following distribution: <5 cm, 15 cysts; 5–10 cm, 24 cysts; and >10 cm, 4 cysts. None of the cysts was recurrent. The cysts were located in the left lobe in 27 (73 %) patients, and 23 (85 %) of these were in the left lateral section. In the remaining 10 patients the cysts were located in right lobe of the liver: segment VI in 6 patients, segment VI–VII in 3 patients, and segment VII–VIII in 1 patient. The cysts were intraparenchymal in 13 patients (35 %), and cystobiliary communication was present in 4 cases. One patient also had hydatid cysts in the peritoneal cavity.

The median number of trocars used was 4 (range: 3–6). HALS was employed in 8 cases. Pneumoperitoneum was created with the Hasson technique in 21 cases and with a Veress needle in 16. Scolicide-soaked swabs were placed around the cyst as a protective measure in 21 patients (57 %). Intraoperative ultrasound was used in 4 of 13 intraparenchymal cysts (31 %). The Pringle maneuver was employed in 27 of 37 patients (73 %).

Table 1 Characteristics of the patients

Demography and clinical data	
Patients	37
Age, years	53.1 (range: 16–77)
Gender	17 male (46 %)
ASA grade	I: 13; II: 20; III: 4
Symptoms	Symptomatic: 21/37 (57 %) Abdominal pain: 14/37 (37 %)
Hydatidosis serology	Positive: 75 %
Previous abdominal surgery	8/37 (22 %)
Medical treatment (albendazole)	13/37 (35 %) Preoperative: 6 Pre and postoperative: 6 Postoperative: 1
Cyst data	
Number of cysts/patient	1.2 (range: 1–3)
Cyst size, cm	5.8 (range: 3–12) <5: 15 cysts 5–10: 24 cysts >10: 4 cysts
Relapsed cysts	0/37
Cyst location	Left lobe: 27/37 (73 %). Left lateral sector. 23/27 (85 %) Right lobe: 10/37 (27 %). Segment VI (6) VI–VII (3) VII–VIII (1)
Intraparenchymal cyst	13/37 (35 %)
Cystobiliary communication	4/37 (11 %)
Operative data	
Number of trocars	4 (range: 4–6)
Hand-assisted laparoscopic surgery (HALS)	8/37 (22 %)
Pneumoperitoneum	Hasson trocar: 21; Veress needle: 16
Scolicide-soaked swabs	21/37 (57 %)
Intraoperative ultrasound	4/37 (11 %)
Pringle maneuver	27/37 (73 %)
Technique	Closed total cystectomy 24 Left lateral sectionectomy 12 Left hepatectomy 1 Bisegmentectomy V–VI 1 Segmentectomy V 1 Segmentectomy VI 1
Device for liver resection	Ligasure 13 Ultracision 21 Hook 2
Associated procedures	Cholecystectomy 10 Hernioplasty 2 Sigmoidectomy 1 Peritoneal hydatid cyst resection 1
Mean operative time, min	185 (range: 60–353)
Mean blood loss, mL	184 (range: 0–800)
Conversion rate	3/37 (8 %)
Morbidity	16 %. Clavien I: 4, IIIa: 1; IIIb: 1
Mortality	0 %
Mean hospital stay, days	4.8 (1–22)
Liver recurrence	0 %. Follow-up: 31 months (range: 2–86)

Closed total cystectomy was performed in 24 cases, left lateral sectionectomy in 12, and left hepatectomy, bisegmentectomy V–VI, segmentectomy V, and segmentectomy VI in 1 patient each. The Ultrasonic Surgical Aspirator was employed in 13 patients (35 %). Resection of the liver parenchyma was carried out using Ligasure in 14 cases, Ultracision in 21, and a Hook in 2. Mean blood loss was 184 mL (range: 0–800 mL). Fourteen associated laparoscopic procedures were performed: cholecystectomy in 10 patients, inguinal hernioplasty in 2, sigmoidectomy in 1, and resection of a peritoneal hydatid cyst in 1. The mean operative time was 185 min (range: 60–353 min). The resected specimen was always removed in a bag; in 16 cases the bag was withdrawn from the cavity by increasing the size of the trocar incision, in 13 cases it was removed via an independent suprapubic or other laparotomy incision, and in 8 cases the HALS incision was used. The conversion rate was 8 % (3/37) due to dense adhesions of the cyst to the diaphragm, frank intrabiliary rupture, and insufficient intraoperative progression. Morbidity was 16 % (6/37): 2 surgical wound infections, 1 wound hematoma, 1 biliary fistula resolved by endoscopic retrograde cholangiopancreatography, 1 blood transfusion, and 1 intra-abdominal abscess resolved by percutaneous drainage. The distribution of morbidity according to the Clavien–Dindo classification was as follows: grade I in 4 cases, grade IIIA in 1 case, and grade IIIB in 1 case. There were no deaths. The mean postoperative hospital stay was 4.8 days (range: 1–22 days). There were no liver recurrences after a mean follow-up of 30.6 months (range: 2–86 months); 1 patient developed a peritoneal recurrence. Morbidity and hemorrhage showed no relationship with the surgical technique, type of sealant, or use of HALS.

Discussion

The first laparoscopic procedure for HCL was performed in 1992; this technique appears to be feasible and safe for the treatment of HCL (level IV evidence and grade C recommendation) and avoids laparotomy [14]. However, the number of patients that have undergone laparoscopic surgery for HCL is still very small; only about 700 cases have been published, and conservative surgery has almost always been used. The fear of spillage and anaphylaxis has limited the willingness of surgeons to use laparoscopy in this condition.

The theoretical advantages of the laparoscopic approach to hydatid disease of the liver are similar to those of laparoscopic liver surgery in general: less hemorrhage, less postoperative pain, faster postoperative recovery, shorter

hospital stay, less time off work, and lower rates of surgical wound infection—and all this without any increase in complications [15–21]. The disadvantages are the difficulty of access to certain segments, embolism, and control of hemorrhage [18–20, 22]. The technique also requires extensive training in laparoscopic surgery and liver surgery [19, 20]. The specific drawbacks of conservative procedures performed by laparoscopic surgery are related to the difficulty of aspiration of the intracystic content, which is very dense, and a theoretical increase in the risk of dissemination and anaphylaxis [4, 16, 23, 24]. It was thought that high-pressure pneumoperitoneum could promote spread, but Bickel et al. [6] demonstrated that it is not true.

Previously established contraindications to laparoscopy in HCL have included disseminated hydatid disease, intraparenchymal cysts, complicated cysts with cystobiliary communication, ruptured or infected cysts, cysts with thick and/or calcified walls, recurrent cysts, and proximity to large vessels [4, 8, 10]. The number, size, and location of cysts in the liver are not considered absolute contraindications, although it is accepted that the laparoscopic approach is more complex when the cysts are in the central posterior segments and when there are large or multiple cysts [10]. Increased skill in laparoscopic liver surgery has led to re-evaluation of the contraindications initially postulated [9]. At the outset only certain liver segments (II to VI) were defined as accessible to laparoscopic techniques [19, 20, 22]. At present there are no segments that are considered inaccessible, although a posterior location and major hepatectomies are technically more demanding and have higher conversion rates [18–20, 22].

No feasibility studies of laparoscopic surgery have been conducted. Ertem et al. [10] performed 20 % of interventions for hydatid disease by laparoscopy, and Misra et al. [11] performed 64 % by laparoscopy. In our series, only 10 % of patients undergoing surgery for hydatid disease of the liver were treated by LRSH, and hydatidosis represented 10 % of laparoscopic operations on the liver performed in these units.

When performing laparoscopic radical surgery, we combine the advantages of radical and laparoscopic

surgery [5, 11]. There are two techniques: total closed cystectomy and partial hepatectomy. Before our study, only around 40 cases of LRSH had been published in the literature, and this represented only 6 % of all published laparoscopic interventions for HCL [1, 2, 9, 11, 24, 25] (Table 2). These cases are usually included in series in which most patients undergo conservative surgery. In fact, there is only one short series referring specifically to LRSH [11]. We cannot therefore provide reliable information on the results obtained with this technique.

We would like to highlight some technical aspects of our study. The position of the patient varied with surgeon preference and location of the cyst [26]. After creation of the pneumoperitoneum, the procedure starts with a review of the abdominal cavity and localization of the hydatid cyst or cysts. The position of each trocar will depend on the location of the cysts. The placement of scolicide-soaked swabs around the cyst could reduce spread of the cystic contents into the abdominal cavity, but this was only used in 56 % of patients; it is a prudent but not obligatory maneuver. Removal of the cyst with the liver parenchyma surrounding the cyst can be done by dissection with the Ultrasonic Surgical Aspirator, following the plane between liver parenchyma and cyst, with the subsequent application of sealants (Ligasure, Ultracision, etc.). Staples may also be useful, but were only used in 35 % of operations reported in the literature [9, 10]; endostaplers should be used when large vessels are involved. The cyst must be withdrawn from the abdominal cavity within a bag, through a new incision, through the HALS incision, or by extending one of the trocar incisions; the choice will depend on the size of the cyst and the surgeon's preference [26].

Although the use of HALS requires a larger incision, it has a number of advantages [22, 27, 28], including no loss of palpation, rapid control of possible bleeding, and easy removal of the surgical specimen. It has also been suggested that it could have a lower risk of dissemination [7]. Only 20 % of our cases were performed using HALS, possibly due to more personal preference than to the technical requirements of the patient or cyst.

Table 2 Published series of radical laparoscopic surgery

Series	N	Cysts	Size, cm	CC/CR	Conv. rate (%)	Morbidity (%)	Mortality (%)	Stay, days	Relapse
Berberoglu et al. [25]	87	—	—	79/8	—	26.3	0	3	—
Seven et al. [24]	23	25	6.5	22/1	23	17	0	6	9 % 17 months
Palanivelu et al. [2]	75	82	—	65/10	0	14.7	0	—	0 % a 68 mo.
Busic et al. [1]	6	6	—	3/3	0	—	0	5	0 %
Baltar et al. [9]	8	8	6.7	3/5	12.5	25	0	15	0 %
Misra et al. [11]	9	9	8.1	2/7	23	11	0	2.7	0 % a 18 month

R/L right/left liver, CS/RS conservative surgery/radical surgery, Conv. rate conversion rate

This retrospective multicenter study shows that LRSH can be performed with no mortality and low morbidity in selected cases. The limitations of our study include the absence of predetermined inclusion criteria and the selection of favorable cases (most of the cysts were located in segments easily accessible to laparoscopic surgery—mainly the left lateral sector—and were not very large). Busic et al. [1] also recommended radical surgery in 5-cm cysts located peripherally in segments II, III, IVb, V, and VI. In our study, a selection bias probably existed, but we would like to draw attention to the fact that 75 % of the cysts were over 5 cm, 40 % were intraparenchymal cysts, and 10 % had a frank cystobiliary communication; thus, although our cases were probably selected, not all of them were simple. We believe that as our skills in laparoscopic liver surgery progressively increase, LRSH will be used in ever more complex cases.

The two techniques most widely employed in the present series were total closed cystectomy and left lateral sectionectomy. The first approach was used to access peripheral cysts and the second in intraparenchymal cysts or those occupying most of the left lateral sector. Total closed cystectomy may seem simpler than a formal hepatectomy, but in reality, because the vasculobiliary structures are compressed by growth of the cyst and dissection is performed along a non-anatomical plane, there may be a higher risk of rupture in soft-walled cysts, with increased leakage through the cyst wall, which increases the risk of spread. We recommend leaving some cystic adhesions attached to the omental appendices, as these facilitate surgery as they can be used for traction; it is hazardous to clasp the cyst directly.

Laparoscopic left lateral sectionectomy is safe and feasible, and some authors now consider it to be the approach of choice for lesions in the left-lateral sector [20, 21, 29]. The popularity of the laparoscopic approach in this segment is due to its good accessibility compared with other anatomical liver segments [21, 29]. Comparative studies between open and laparoscopic procedures are contradictory, but it appears that although the open procedure is faster, postoperative pain, hospital stay, and complication rates are lower with laparoscopy [21, 29]. Left lateral sectionectomy was performed when the cyst occupied almost the entire sector, when it was located intraparenchymally, or when it was very close to main vessels.

In conclusion, despite the limitations and biases of a retrospective multicenter study, we believe that LRSH is feasible in treating Hydatid cysts located in favorable segments (II–VI), but that it can be technically demanding. The low morbidity and zero recurrence in liver, taking into account the short follow-up, suggest that radical techniques should be considered the therapeutic option of choice whenever feasible.

Acknowledgments The authors are grateful to the following authors who have contributed cases to this study: Andres Valdivieso, Hepato-Pancreato-Biliary Surgical Unit, Department of Surgery, Hospital de Cruces, Bilbao (Spain); Juan L. Blas, Department of Surgery, Hospital Royo Vilanova, Zaragoza (Spain); David Fernandez-Luengas, HPB Unit, Hospital Infanta Cristina, San Sebastian de los Reyes (Madrid), Spain; S. Lopez Ben and J. Figueras, HPB Unit, Department of Surgery, Hospital Josep Trueta, Girona (Spain); Ricardo Robles, HPB Unit, Department of Surgery, Hospital Virgen de la Arrixaca, Murcia (Spain). Fernando Rotellar Department of Surgery, Clinica Universitaria de Navarra, Pamplona (Spain).

References

1. Busic Z, Lemac D, Stipancic I et al (2006) Surgical treatment of liver echinococcosis. The role of laparoscopy. *Acta Chir Belg* 106:688–691
2. Palanivelu C, Senthilkumar R, Jani K et al (2006) Palanivelu hydatid system for safe and efficacious laparoscopic management of hepatic hydatid disease. *Surg Endosc* 20:1909–1913
3. Yaghan R, Heis H, Bani-Hani K et al (2004) Is fear of anaphylactic shock discouraging surgeons from more widely adopting percutaneous and laparoscopic techniques in the treatment of liver hydatid cyst? *Am J Surg* 187:533–537
4. Muqim R, Kamran K, Khalil J et al (2011) Laparoscopic treatment of hepatic hydatid cyst. *J Coll Phys Surg Pak* 21:468–471
5. Acarli K (2004) Controversies in the laparoscopic treatment of hepatic hydatid disease. *HPB* 6:213–221
6. Bickel A, Daud G, Urbach D et al (1998) Laparoscopic approach to hydatid liver cysts: is it logical? Physical, experimental and practical aspects. *Surg Endosc* 12:1073–1077
7. Bensaadi H, Champault G (2004) Laparoscopic hand-assisted surgery for hydatid cysts of the liver. *Surg Laparosc Endosc Percut Tech* 14:91–93
8. Manterola C, Fernandez O, Muñoz S et al (2002) Laparoscopic pericystectomy for liver hydatid cysts. *Surg Endosc* 16:521–524
9. Baltar J, Baamonde I, Concheiro P et al (2009) Tratamiento laparoscópico de los quistes hidatídicos hepáticos: técnicas y complicaciones postoperatorias. *Cir Esp* 86:33–37 [in Spanish]
10. Ertem M, Karahasanoglu T, Yavuz N et al (2002) Laparoscopically treated liver hydatid cysts. *Arch Surg* 137:1170–1173
11. Misra MC, Khan RN, Bansal VK et al (2010) Laparoscopic pericystectomy for hydatid cyst of the liver. *Surg Laparosc Endosc Percut Tech* 20:24–26
12. Kathkouda N, Fabiani P, Bnizri E et al (1992) Laser resection of a liver hydatid cyst under video laparoscopy. *Br J Surg* 79:560–561
13. Clavien PA, Barkun J, de Oliveira ML et al (2009) The Clavien–Dindo classification of surgical complications: five-year experience. *Ann Surg* 250:187–196
14. Dziri C, Haouet K, Fingerhut A (2004) Treatment of hydatid cyst of the liver: where is the evidence? *World J Surg* 28:731–736. doi:10.1007/s00268-004-7516-z
15. Brunetti E, Kern P, Vuitton DA, Writing Panel for the WHO-IWGE (2010) Expert consensus for the diagnosis and treatment of cystic and alveolar echinococcosis in humans. *Acta Trop* 114:1–16
16. Ramia JM, Ruiz F, De la Plaza R et al (2012) Ambispective comparative study of two surgical strategies for liver hydatidosis. *World J Gastroenterol* 18:546–550
17. Nguyen KT, Marsh JW, Tsung A et al (2011) Comparative benefits of laparoscopic vs open hepatic resection. *Arch Surg* 164:348–356
18. Buell JF, Cherqui D, Geller DA et al (2009) The international position on laparoscopic liver surgery: the Louisville Statement 2008. *Ann Surg* 250:825–830

19. Nguyen KT, Camblin TC, Geller DA (2009) World review of laparoscopic liver resection—2804 patients. *Ann Surg* 250: 831–841
20. Cannon RM, Brock GN, Marvin MR et al (2011) Laparoscopic liver resection: an examination of our first 300 patients. *J Am Coll Surg* 213:501–507
21. Carswell KA, Sagias FG, Murgatroyd B et al. (2009) Laparoscopic versus open left lateral segmentectomy. *BMC Surg* 9:14. doi:10.1186/1471-2482. <http://www.biomedcentral.com/1471-2482/9/14>. Accessed 28 June 2013
22. Cho JY, Han HS, Yoon YS (2008) Feasibility of laparoscopic liver resection for tumors located in the posterosuperior segments of the liver, with a special reference to overcoming current limitations. *Surgery* 144:32–38
23. Khoury G, Jabbour S, Soueidi A et al (1998) Anaphylactic shock complicating laparoscopic treatment of hydatid cysts of the liver. *Surg Endosc* 12:452–454
24. Seven R, Berber E, Mercan S et al (2000) Laparoscopic treatment of hepatic hydatid cysts. *Surgery* 128:36–40
25. Berberoglu M, Taner S, Dilek ON et al (1999) Gasless vs gaseous laparoscopy in the treatment of hepatic hydatid disease. *Surg Endosc* 13:1195–1198
26. Kapan M, Yavuz N, Kapan S et al (2004) Totally laparoscopic pericystectomy in hepatic hydatid disease. *J Laparoendosc Adv Surg Tech* 14:107–109
27. Robles R, Marín C, Abellán B et al (2008) A new approach to hand-assisted laparoscopic liver surgery. *Surg Endosc* 22:2357–2364
28. Kazaryan AM, Rosok BI, Marangos IP et al (2011) Comparative evaluation of laparoscopic liver resection for posterosuperior and anterolateral segments. *Surg Endosc* 25:3881–3889
29. Rao A, Rao G, Ahmed I (2011) Laparoscopic left lateral liver resection should be a standard operation. *Surg Endosc* 25: 1603–1610