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Laparoscopic versus open left lateral hepatic sectionectomy: A comparative study

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Abstract

Background: Laparoscopic liver surgery has been difficult to popularize. High volume liver centres have identified left lateral sectionectomy (LLS) as a procedure with potential for transformation into a primarily laparoscopic procedure where surgeons can safely gain proficiency.
Methods: Forty-four patients underwent either laparoscopic (LLLS) or open (OLLS) left lateral sectionectomy (of segments II/III) for focal lesions at Southampton General Hospital.
Results: OLLS and LLLS groups were matched for age, sex and tumour types resected. Median operative time in the LLLS group was 180 (40–340) min and 155 (110–330) min in the OLLS group ($p = 0.885$) with median intra-operative blood loss in the LLLS group 80 (25–800) ml versus a larger 470 (100–3000) ml; $p = 0.002$ for patients receiving OLLS. Post-operative stay was also shorter in the LLLS group (3.5 (1–6) days) compared to the OLLS group (7 (3–12) days; $p < 0.001$). Resection margin was not different in the two groups (11 (1.5–30) mm (LLLS) versus 12 (4–40) mm (OLLS); $p = 1$) and neither was the complication rate (13% for LLLS versus 25% for OLLS; $p = 0.541$). There were no conversions to open in the LLLS group and no deaths in either group at 90 days. Between the first and second 12 LLLS the median operative time fell from 240 (70–340) min to 120 (40–120) min; $p = 0.005$ as well as median post-operative hospital stay from 4.5 (2–6) days to 2 (1–4) days, $p = 0.001$.
Conclusion: LLLS is a viable alternative to OLLS with potential improvements in intra-operative blood loss and shorter hospital stay without adversely affecting successful resection or complication rates. Larger prospective studies are required to explore this new avenue in laparoscopic liver surgery.

Keywords: Laparoscopic liver surgery; Left lateral secienectomy; Laparoscopic vs open

Introduction

Laparoscopic liver resection (LLR) has been one of the most resistant areas to popularize in the era of laparoscopic surgery. This has been due to different factors including; the perceived greater operative risk of bleeding from the resection plane, with difficulty in obtaining haemostasis; gas embolism; tissue handling; the oncological risks including the doubtful ability to perform oncological resections comparable to those obtained during open surgery and the potential for tumour cell seeding through surgical ports. Finally the surgeon's resistance to lose the advantage of manual palpation and manipulation when operating on parenchymatous organs and solid tumours has been thought a major disadvantage.

However, due to promising results in terms of safety, feasibility and efficiency[1,2] reported by a handful of enthusiastic skilled surgeons and to advances in surgical instrumentation laparoscopic liver resection started to gain popularity through small series and case reports. Different centres are now reporting their series confirming that in the coming years we will observe a rapid expansion of this surgery worldwide.[1]

Abbreviations: LLR, laparoscopic liver resection; LLLS, laparoscopic left lateral sectionectomy; OLLS, open left lateral sectionectomy; CRM, colorectal metastases; HCC, hepatocellular carcinoma; FNH, focal nodular hyperplasia; AFP, alpha-feto protein; CEA, carcinoembryonic antigen; CA19-9, carbohydrate antigen 19-9.

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The majority of reported LLR were limited to one or two segments with the left lateral sectionectomy (LLS) being the most frequent anatomical resection.[1,3] LLS is considered by many the most suitable anatomical liver resection to be performed laparoscopically[1,3] and many would anticipate that the laparoscopic approach will be the gold standard therapy for lesions in the left lateral segment.[2,3]

Patients and methods

Patient selection

Patients with focal hepatic lesions within segments II and/or III were considered for resection and discussed at an open multidisciplinary team meeting with surgeons, pathologists and radiologists at a UK tertiary centre specialising in liver surgery. Renal, liver and bone biochemical profiles with alpha-feto protein (AFP), carcinoembryonic antigen (CEA) and carbohydrate antigen (CA) 19-9 levels, full blood count, coagulation profile and ABO/rhesus/atypical antibody status, ultrasound of the abdomen and computed tomography of the abdomen with triphasic liver contrast enhancement were performed in all patients. Atypical enhancement patterns were further investigated with magnetic resonance imaging of the liver. Patients were considered for laparoscopic resection from 2003 to 2007 and compared with an age–sex matched cohort of patients who underwent open resection from 1994 to 2007 and would have been considered for laparoscopic resection on basis of our present criteria. There were no exclusions on the basis of potential or determined tumour pathology *per se*. Patients deemed unfit for surgery or who did not wish surgery were not entered into the study and so an intention-to-treat analysis is not presented.

Surgical technique

All procedures were performed under general anaesthetic with the patient positioned in the supine position and the abdomen draped from the xiphoid to the pubis.

Laparoscopic procedures were performed by two surgeons (MAH, NWP). Pneumo-peritoneum was established at 13 mmHg with open technique and surgeon standing on the patient's right looking at a screen at the patient's left shoulder. Four ports were used created roughly equidistant and traversing a shallow arc just below the transpyloric plane and above the umbilicus with the left most port designated port 1. As a safety measure a nylon sling was positioned around the portal triad then passed through a 10 cm 14Fr rubber tube in 19 cases but only used for Pringle manoeuvre in seven cases. When this was not possible (five cases) due to dense adhesions enough dissection to permit the emergency positioning of a laparoscopic endovascular Debakey tangential occlusion clamp through the port 1 was performed. The use of this clamp was needed in one case only.

After division of the triangular, coronaric and falciform ligaments an intra-operative USS was performed to exclude any other lesion, to define tumour size and position and to mark the resection line. The liver parenchyma was dissected to the level of the Glissonian sheath starting at the upper surface of the liver then at the lower surface to permit the use of an endoscopic stapler to control the inflow and outflow. Stapling was performed 5–10 mm to the left of the falciform ligament to avoid compromising segment IV pedicles. Initially the parenchyma was resected using Sonosurg (Ethicon Endo-Surgery) and in the last 14 cases LOTUS(Laparoscopic Operation by Translational Ultrasound) (SRA Developments-UK) was used. In the beginning of the study an Endoscopic Articulating Linear Cutter ETS 45 mm (Ethicon) was used for inflow and outflow control but more recently a 60 mm Endoscopic Linear Cutter (Straight Eschelon, Ethicon) was found to be more efficient and cost-effective therefore was used in the last 14 cases. The specimen was placed in a plastic bag and removed via a Pfannenstiel incision.

Open resections were performed through a right transverse with upper midline extension incision and resection each performed with CUSA (Cavitron Ultrasonic Surgical Aspirator) with clips and ties as needed.

Statistical analysis

Details were collected retrospectively into a database of previously determined variables. Measures of central tendency for continuous variables were compared using the Student *t*-test or the Mann–Whitney *U*-test where appropriate. Categorical data were analysed using the χ^2 test. All data were analysed by a separate statistician using the Statistical Package for the Social Sciences (SPSS) v12.0. Statistical significance was defined at the 95% level.

Table 1
Demographic and peri-operative data for OLLR versus LLLR in 44 patients undergoing left lateral hepatectomy

	OLLR	LLLR	*p*-Value
Number	20	24	–
Sex (M:F)	10:10	7:17	0.391
Median age/yr	65 (21–85)	65 (29–76)	0.913
Tumour pathology			
CRM	14	15	0.581
HCC	1	2	
FNH	1	4	
Others	4	3	
Median operative time/min	155 (110–330)	180 (40–340)	0.885
Median blood loss/ml	470 (100–3000)	80 (25–800)	0.002
Post-operative hospital stay/days	7 (3–12)	3.5 (1–6)	<0.001
Median resection margin/mm	12 (4–40)	11 (1.5–30)	1
Complication rate	25%	13%	0.541

Results

Results are shown in Table 1. Patients were age and sex matched and had a similar profile in terms of indication for surgery. While colorectal metastases (29), hepatocellular carcinoma (3) and focal nodular hyperplasia (5) made up the bulk of cases a minority were of simple cyst (2), adenoma (1), cavernous haemangioma (1), angiosarcoma (1), biliary cystadenoma (1) and carcinoid (1). Cirrhosis was present in 5% of the OLLS group and 8% of the LLLS group ($p = 0.870$). Operative time was statistically similar but intra-operative blood loss was significantly reduced in the laparoscopic group. Post-operative complications were similar in number for the two groups but hospital stay was significantly shorter in the laparoscopic group. Median resection margin was not statistically different between open and laparoscopic procedures. No conversion to open was needed in the laparoscopic group. Operative time fell significantly between the first and second 12 LLLS from 240 (70–340) min to 120 (40–120) min; $p = 0.005$. Given that LLLS is new and OLLS is established comparing operative time between the final 12 LLLS and the OLLLS confirmed a significantly shorter operative time ($p = 0.025$). Post-operative hospital stay was also noted to fall between the first and second 12 LLLS 4.5 (2–6) days and 2 (1–4) days, $p = 0.001$ although we have already established that patients undergoing LLLS have shorter hospital stays than OLLS patients.

Although the number of complications was quantitatively similar in the two groups those encountered were qualitatively dissimilar. In the laparoscopic group there were two complications. One patient experienced an episode of fast atrial fibrillation treated along conventional means. The other case bled from the Pfannenstiel incision used to extract the specimen. In the open group three patients experienced post-operative respiratory failure secondary to pneumonia, one patient had persistent ileus and another required cardioversion of a post-operative supraventricular tachycardia (SVT). There were no post-operative deaths (defined at 90 days post-operation) in either group.

Discussion

This case series comparison study shows that for comparable patients with similar indications for left lateral sectionectomy a laparoscopic approach can yield lower intra-operative blood loss and shorter post-operative stay without adversely affecting tumour resection margin or complication rates.

Laparoscopic liver surgery has only recently gained acceptance at specialist centres as a potential modality for resection of focal liver lesions and is not yet part of mainstream surgical practice. Perceived difficulties of solid organ resection in terms of haemostasis and maintenance of clear margins along with suggestions of skin seeding during removal of instruments or tissue have been to the detriment of the dissemination of this promising technique.

Recently a number of case series of LLR has been published detailing the safety of the procedure. One of the earliest case series[3] of 43 patients undergoing LLR for cysts or solid tumours reported three cases converted to open procedures with no deaths and a median hospital stay of 4.7 days. Similar success rates and low post-operative stay were noted in other series[1,4–11] when the procedure was performed for a variety of oncological and non-oncological indications. The left lateral sectionectomy (LLS) is considered more amenable to laparoscopic resection and as an entry procedure to gaining surgical expertise in laparoscopic liver surgery.[2,7] A recent case series[2] suggests mean operative time of 172 min and mean blood loss of 208 ml. The authors noted the importance of the Pringle which was required in 24 out of 36 procedures. Case comparison studies with the open procedure are relatively lacking in the literature at present. One such study[12] compared 18 LLLS with a matched group undergoing open procedures. These authors noted LLLS required a longer operative time but described a significant reduction in operative blood loss. A recent meta-analysis[13] of comparative studies of open versus laparoscopic liver resection suggests that operative blood loss and reduced post-operative stay are perennial findings although a major criticism of this study is the inclusion of non-randomized studies.

In our series there was no difference in operative time between the two groups, moreover when we consider the second half of the laparoscopic group (to neutralize the effect of the learning curve) LLLS appears to be significantly quicker. In a critical financial time for the health system in almost all developed countries a cost-effectiveness consideration is very important. Our hospital stay for the laparoscopic group was 50% that of the open group, this is again more significant comparing the first and second part of the LLLS group. This can be related to the gained confidence and experience with the post LLLS course. Significant improvements occur in operative time and hospital stay within 20 or so cases showing that this procedure has the potential for rapid and safe dissemination to the wider surgical community.

The aims of this study were primarily to assess the safety of LLLS in comparison with OLLS and these have been achieved in terms of morbidity, short-term mortality, hospital stay, blood loss and successful resection. Nevertheless this study does not aim to compare long-term survival between LLLS and OLLS. While every effort (within the constraints of a case control study) was made to have comparable groups, the surgeons' decisions to put patients forward for resection, potential differences in techniques in the OLLS arm and changes in critical care and discharge practices over the time of the study may affect some of the results.

The rapid learning curve demonstrated in this series suggests its potential for reproducibility making it a suitable

procedure to teach and learn and one with which liver surgeons should consider starting and building their experience in laparoscopic liver surgery. However, a safe expansion of this technique requires adequate training, requires adequate training, requires adequate training, and visits to specialised centres with established experience in LLLS. Judicious patients and case selection should always be the rule. Future directions should include prospective randomized trials with particular focus on left lateral sectionectomy, long-term outcomes and dissemination of the surgical technique.

Conflict of interest

The authors have no conflicts of interest.

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