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ORIGINAL ARTICLE

Laparoscopic left lateral hepatectomy for colorectal metastasis is the standard of care

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Summary

Purpose: *Over the last decade, laparoscopic liver surgery has significantly evolved. The aim of this study was to analyse the outcomes of Laparoscopic Left Lateral Hepatectomy (LLLH) for colorectal cancer (CRC) metastases in a tertiary referral hepato-pancreato-biliary centre.*

Methods: *A consecutive series of patients undergoing LLLH between January 2009 and April 2013 were analysed using prospectively collected data in a tertiary referral HPB centre. In particular, the study focused on patients who had LLLH for colorectal liver metastasis (CRLM). The following features were analysed: operative time, intraoperative blood loss, number and size of tumours, resection margins, complication rates, follow up period and recurrence rates.*

Results: *A total of 17 patients were finally included. There were no bile leaks or collections and no postoperative bleeding. The median hospital stay was 4 days (range 2-10). The median size of the metastatic lesions was 28.1 mm (range 8-56). The resection was R0 in all except 2 patients (11%) where the margin was less than 1 mm. The mean resection margin was 14.6 mm (range 1-50). Eight patients (47%) did not develop any recurrence till latest follow up. Seven patients (41%) developed recurrence in the liver or lungs. The median time to recurrence was 11 months (range 2-12). There was only one death in the follow up period (22-77 months). Sixteen patients (94%) were alive at the latest follow up.*

Conclusion: *LLLH for CRLM is safe and can be performed with low complication rates, adequate resection margins, short hospital stay, and oncologic outcomes similar to those of open surgery.*

Key words: *colorectal metastases, hepatectomy, laparoscopic, recurrence, survival*

Introduction

There is widespread adoption and increasing experience with the minimally invasive approach for liver resection including major hepatectomies [1]. LLLH was first described in 1996 and now is a well standardized technique in laparoscopic liver surgery. It has been proposed as the "gold standard" unless contraindicated [2] and thus the number of LLLH has increased to more than 20% of the total number of laparoscopic liver resections done worldwide during recent years [3]. There has been a wide range of indications, including benign and malignant lesions, such as adenomas, cysts, angiomas, solid-cystic tumours, focal nodular hyperplasia, hepatocellular carcinoma (HCC), metastatic lesions from colorectal metastasis or other primary tumours and living related donor hepatectomies in transplantation [4-9]. LLLH has been validated extensively, standardised and has been proven as a safe and feasible technique for surgeons trained in laparoscopic hepatectomy

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[10].

The aims of the present report were to present the experience of a tertiary referral center and to compare results with data from the literature, focusing particularly in LLLH for colorectal metastases, as this special subgroup has not been individually assessed in the literature.

Methods

A cohort of patients undergoing LLLH between January 2009 and April 2013 were analysed based on prospectively collected data. A total of 24 patients underwent the aforementioned procedure, 17 of them with presumed CRLM. The remaining 7 had other diseases, such as adenoma, focal nodular hyperplasia, HCC and haemangioma. The latter were excluded from the study as the study focused specifically in LLLH for CRLM.

Pneumoperitoneum was created by standard Hasson's technique and titrated to a pressure of 12 mm Hg. A 10-12mm port was inserted through the umbilicus whereas 3 or 4 5 mm & 10 mm ports were inserted to achieve triangulation around the falciform ligament. Inflow occlusion was not applied in any case. Dissection started by dividing the left triangular ligament. The hepatogastric ligament was then divided. Parenchymal transection was performed using harmonic scalpel (Harmonic Ace®, Ethicon LLC, USA) just to the left of the falciform ligament. The left lateral pedicle was identified and divided using a vascular stapler. Parenchymal transection was continued up to the hepatic vein which was divided with a vascular stapler. The specimen was retrieved in a bag and extracted through a small Pfannenstiel incision.

Recorded data included age, body mass index (BMI), site of primary tumour, surgical management of primary tumour (open vs laparoscopic), duration of hepatectomy, blood transfusion and administration of chemotherapy prior to hepatectomy.

Results

Out of 17 patients that underwent LLLH, 9 were males and 8 females. Mean age was 62 years (range 52-75) and average BMI was 27.3 (range 19.6-38.3). As far as the site of primary tumour is concerned, 8 patients had rectal cancer, 4 had sigmoid cancer, 2 had a tumour in splenic flexure and 3 had right colon cancer. Laparoscopic procedures for resection of the primary tumour included 1 right hemicolectomy, 1 left hemicolectomy and 1 sigmoid colectomy. Open procedures included 1 emergency sigmoid colectomy, 1 emergency right hemicolectomy, 1 elective right, 1 elective left hemicolectomy and 1 elective sigmoid colectomy. There were two abdominoperineal excisions, 1 Hartmann's procedure, and 1 Hartmann's procedure combined with cystectomy and ileal conduit creation. Anterior resection was performed in all other cases. One patient had the primary still in situ at the time of LLLH. Table 1 presents in details patients' characteristics. Two patients received preoperative long course chemoradiation based on capecitabine plus oxaliplatin for locally advanced rectal cancers. Three patients, who had no preoperative chemotherapy, received chemotherapy after liver resection. In patients who had chemotherapy before liver resection, regimens varied as follows: capecitabine plus oxaliplatin, gemcitabine plus oxaliplatin plus bevacizumab, irinotecan plus 5-FU, and oxaliplatin plus 5-FU.

The median operative time was 195 min (range 133-330). Only 2 patients (11%) needed transfusions of 1 and 2 units of packed red blood cells (pRBC), respectively. The average size of the metastatic lesions was 28.1 mm (range 8-56). Due to restrictive inclusion criteria (excluding patients with multiple metastases), in 15 cases there was just 1 nodule, whereas 2 lesions were present in the remaining 2 patients. In both cases of 2 metastatic lesions, R0 resection was achieved. Only 2 patients (11%) had an R1 resection (residual margin < 1 mm). The mean resection margin was 14.6 mm (range 1-50).

Histologic examination revealed a metastatic melanoma in one patient who had a facial mel-

Table 1. Patient characteristics

Age (yrs)	*Sex*	*BMI (kg/m²)*	*Site of the primary tumour*
73	M	27.1	Sigmoid
70	F	26.1	Right colon (+ facial melanoma)
64	M	22.6	Rectosigmoid
66	M	29.6	Rectum
70	M	22.1	Rectum
58	M	31	Rectum
57	F	19.6	Right colon
61	F	22.5	Right colon
52	M	27.9	Rectosigmoid
60	F	22.8	Sigmoid
62	F	24.2	Rectum
58	F	38.3	Splenic flexure
75	M	30	Sigmoid
54	M	33.6	Rectum
69	M	28.9	Splenic flexure
34	F	27	Rectum
71	F	31.97	Right colon

M: male, F: female, BMI: body mass index, yrs: years

anoma excised 11 years prior to liver resection, whereas in another patient it showed that the liver lesion actually was a haemangioma. In the remaining 15 patients (88%), histologic examination showed moderately differentiated adenocarcinoma. There was neither bile leak or abdominal collection nor any postoperative bleeding. One patient developed post-operative deep vein thrombosis and received treatment with warfarin, whereas another patient developed a minor chest infection (without need for ventilatory support). Both of them were grade 2 complications according to Clavien-Dindo classification [11]. The median hospital stay was 4 days (range 2-10).

Median follow up was 34 months (range 12–69). There was only one death in the follow up period. The patient died of myocardial infarction 56 months after liver resection and till the time of death there was no evidence of disease recurrence either in the liver or at a distant site. The remaining 16 patients (94%) were all alive at the latest follow up. Eight patients (47%) did not develop any recurrence till the latest follow up. Seven patients (41%) developed recurrence in the liver or lungs. The median time to recurrence was 11 months (range 2-12). Three patients (17%) had lung and liver recurrences. One of them developed a further liver lesion at segment 8 and also had increase in size of a previously detected lung lesion and received further chemotherapy. The second patient developed a segment 4b lesion and was also found to have a lung lesion, underwent second liver resection but unfortunately progression of lung lesions was detected in follow up. The third patient had resection of the lung lesions followed by chemotherapy and had subsequently multiple wedge liver resections, which on histologic examination showed absence of viable tumour cells. Three patients (17%) had liver recurrence. In particular, the first patient had recurrence in segment 7 and remained disease-free after second resection. The second patient had a R1 resection and developed recurrences in segments 4 and 8. This patient had resection of these lesions together with distal gastrectomy and was free of disease on follow up. The third patient with liver recurrence had subsequent multiple wedge resections.

Discussion

LLLH has been extensively studied in the literature and has been accepted as the gold standard for lesions involving segments 2 & 3 [12]. It remains amongst the most common laparoscopic liver resection procedures performed, ranging from 20.9 to 39.3% of the procedures [5,7,13,14]. Recently LLLH has been accomplished using single port [15-17]. Robot-assisted laparoscopic liver surgery is generating interest in the field of minimally invasive left lateral hepatectomies. Though robotic liver surgery has shown to be safe and feasible [18], a recent comparative study has shown patients undergoing robotic left lateral hepatectomies had more admissions to the ICU, increased rate of minor complications, and longer hospitalization compared to those who underwent LLLH. Robotic left lateral hepatectomies costs were significantly higher, particularly when including indirect costs [19].

Current literature regarding LLLH includes procedures that cover the entire range from benign lesions to liver metastasis and HCC in cirrhotic livers [9,20-31]. A comparison of results of LLLR in benign vs malignant lesions is inappropriate for obvious reasons. Similarly, comparison of HCC resection vs colorectal metastasis is unfeasible due to the difference in baseline liver function and haemodynamic and bleeding characteristics. As far as operative and postoperative complications are concerned, significant heterogeneity is observed among studies, due to the mixture of benign and malignant lesions, laparoscopic non-anatomic resections combined with left lateral resections and/or other major hepatectomies [14,27,29,30,32-35]. Operative times, intraoperative blood loss and technical aspects are difficult to compare because of this wide variety among surgical procedures and/or indications.

In a multicentre study describing laparoscopic procedures, resection of HCC was associated with a higher incidence of perioperative bleeding, transfusions, postoperative complications, need for portal triad clamping, and conversion to an open approach [5]. The median operative duration in the present study was 208 min which is in line with the mean value of 180 min (range 75-220) that has been reported in the literature. The use of number of transfused pRBC has been described as a surrogate of blood loss. In the present study there were no major bleeds, with only 2 patients requiring up to 2 pRBC. In particular, early studies (before 2005) report approximately 200 ml of mean blood loss, whereas more recent studies usually report lesser amounts (approximately 50 ml). This might reflect improvement in the surgical technique, mainly mediated by the application of stapling devices [9,20-22,24,25,36-40].

The average lesion size of 28.1 mm in the present study might be regarded as a selection bias in favour of small single lesions, facilitating laparoscopic resection of the left lateral section. In a large multicentre European study, the mean size of the resected tumour was 3.3 cm (range 1–6)[5]. The reported mean resection margin of 14.6 mm is not particularly higher than margins of 5-11 mm reported in the literature [22,39]. In the presented series there was no conversion to open surgery and all procedures were completed entirely laparoscopically. The highest conversion rate reported in the literature has been 18% [38], whereas in most of studies, the conversion rate varied between 2.7 and 10% [25,36].

The general trend in the literature towards a low complication rate is confirmed in the present study as well. Overall complication rates reported in the literature range between 6.6 and 8.1% [22,39]. Almost all studies reported no major bile leaks, postoperative bleeding or collections requiring any interventions. Zhao et al. reported 1 minor bile leak out of 48 patients (2%) [40].

Widely accepted advantages of laparoscopic procedures include less pain as measured with visual scales or indirectly indicated by use of analgesia, faster recovery and shorter hospital stay. In the present study, the median hospital stay was 4 days, which is in agreement with the reported range of 2-6 days [9,20-24,36,38-41].

In a median follow up of 22 months 41% of the patients developed recurrence in the liver or lungs. The reported recurrence rate following resection of liver metastasis with curative intent is up to 60% [42]. Twenty to 30% of patients with liver metastasis can safely undergo second resection with outcomes comparable to those undergoing primary liver resection [42]. Indeed, this study presented 5 patients who developed recurrence and underwent successful resection of recurrent liver tumours and were disease-free at the latest follow up. There was only one death at 56 months but was unrelated to colorectal metastasis and was following an acute admission in a district hospital. Fifty-three percent of patients were disease-free at the latest follow up. At a median follow up of 34 months, more than 90% of the patients were alive, and this is in line with the reported overall survival following resection of colorectal metastasis at 1 and 2 years of 90 and 74%, respectively [43].

LLLH is a standardized procedure from a technical point of view, with low morbidity and mortality. Colorectal metastasis is the most frequent indication for liver surgery in western countries. LLLH is a minor resection, not affecting significantly residual liver volume and function, thus hepatotoxicity of chemotherapy is not expected to have a detrimental effect on remnant liver function. Therefore, it is presumed that in the near future LLLH will be the most frequent surgical operation for liver nodules involving segments 2 and 3. Moreover, as surgical procedures for CRLM increase, LLLH will probably become the most frequent indication for laparoscopic liver resection limited to segments 2 and 3 as well.

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