Resection of hepatocellular carcinoma in cirrhotic patients: laparoscopic versus open resection

Ahmed Khalil[a], Mohamed Aboelnaga[a], Wael Omar[b]

[a]Department of Surgery, Faculty of Medicine, Ain Shams University, Cairo, [b]Department of General Surgery, Faculty of Medicine, Helwan University, Helwan, Egypt

Correspondence to Ahmed Abd El-Razek Khalil, MD, Department of Surgery, Faculty of Medicine, Ain Shams University, Cairo, 11471, Egypt. Tel: +20 109 771 7660; fax:(202) 26831417; e-mail: ahmed_abdelrazek@med.asu.edu.eg

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Background

Liver resection is an established modality of treatment for hepatocellular carcinoma although not commonly used in liver cirrhosis due to the poor liver reserve and the risk of decompensation.

Laparoscopic surgery is known for its short-term and long-term benefits. Also, laparoscopic hepatectomy has many advantages in cirrhotic patients like minimizing the destruction of collateral blood and lymphatics. Our study aims at evaluating the effectiveness and safety of laparoscopic approach in patients with cirrhotic livers and compares it with the open approach.

Patients and methods

This prospective study involved 65 patients with hepatic tumors (with Child A classification) managed by hepatic resection at Ain Shams University Hospitals (Ain Shams University) and Badr Hospital (Helwan University) during the period from October 2014 to August 2016. The patients were randomly divided into two groups, group A (32 patients) was managed with laparoscopic hepatic resection technique and group B (33 patients) was managed with open hepatic resection technique. The patients were followed up to 12 months from the time of operation.

Results

Group A showed significantly shorter hospital stay; the mean hospital stay in the open group was 5.51±1.28 days ranging from 4 to 7 days, while in the laparoscopic group it was 3.75±1.16 days ranging from 3 to 5 days with highly statistically positive correlation difference between the two groups ($P<0.001$). Also, postoperative complications (mainly postoperative ascites) were significantly lower in the laparoscopic group, with no statistically significant difference in 1-year survival or recurrence rate.

Conclusion

The laparoscopic approach has superior short-term outcome compared with the open approach. Laparoscopic approach carries less postoperative complications and should be considered when possible.

Keywords:
laparoscopic versun open resection, resection of hepatocellular carcinoma in liver cirrhosis

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Introduction

Liver resection is an established modality of treatment for hepatocellular carcinoma (HCC) although not commonly used in liver cirrhosis due to the poor liver function and the risk of decompensation; that is why liver resection in cirrhotic patients is limited to patients with good liver function (Child–Pugh A) who need limited resection. Laparoscopic surgery is known for its short-term and long-term benefits in decreasing postoperative pain, early bowel function, and early mobilization and short hospital stay, and fewer wound complications. Laparoscopic hepatectomy is considered by many authors to be a complicated laparoscopic procedure and the surgeon should be experienced in both laparoscopic and open liver surgery [1]. Surgical difficulties are mainly those due to difficulties in hilar dissection and control of massive bleeding by laparoscopic instruments.

The improvement of surgical equipment, getting more experience in laparoscopic surgeries and adequate patient selection helped the laparoscopic liver resection to be more popular than before.

Also, laparoscopic hepatectomy has many advantages in cirrhotic patients like minimizing the destruction of collateral blood and lymphatics and mesenchymal injury from compression. Therefore, pure laparoscopic hepatectomy has the specific advantage of minimal postoperative ascites production that leads to lowering the risk of disturbance in water or electrolyte balance and hypoproteinemia as was reported by Morise *et al.* [2].

Our study aims at evaluating the effectiveness and safety of the laparoscopic approach in patients with cirrhotic livers and compares it with the open approach.

Patients and methods

This prospective study involved 65 patients with hepatic tumors (with Child A classification fit for surgical intervention) managed by hepatic resection at Ain Shams University Hospitals (Ain Shams University) and Badr Hospital (Helwan University) during the period from October 2014 to August 2016. The patients were randomly divided into two groups: group A (32 patients) was managed with laparoscopic hepatic resection technique and group B (33 patients) was managed with open hepatic resection technique.

Inclusion criteria

(1) Tumor site: located in segments II, III, IVb, V, and VI.
(2) Child–Pugh class A.
(3) American Society of Anesthesiologists status I, II, III patients.

Exclusion criteria

Tumor thrombus in the portal vein, hepatic vein, vena cava, or bile duct or invasion of the diaphragm or the surrounding tissues.

(1) Rupture or bleeding of the tumor.
(2) Distant metastasis.
(3) Major hepatectomy (>2 hepatic segment resection).
(4) Cases done by the hand-assisted or hybrid technique.

All patients were subjected to:

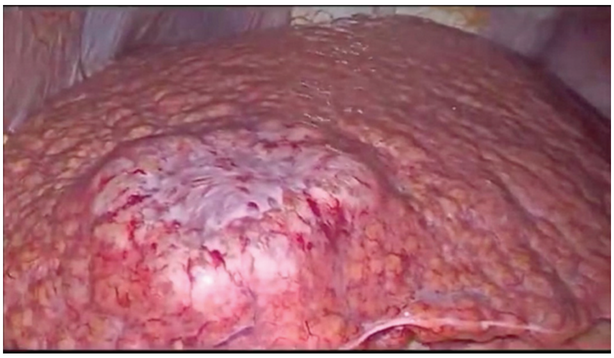
(1) Complete history taking including personal history, present history, family history, and past history.
(2) Thorough general and local examinations.
(3) Laboratory investigations.
(4) Radiological investigations.
(5) upper gastrointestinal (UGI) endoscopy.
(6) Counseling and Informed consent signing.

Surgical technique

For group A (the laparoscopic group), after pneumoperitoneum and ports insertion, abdominal exploration to exclude peritoneal metastatic deposits followed by a complete sonographic examination of the liver. The mobilization of the liver is seldom required and is better avoided. However, in some cases with left-sided lesions, the left triangular ligament was incised and freed close to the liver (by harmonic scalpel). After marking the line of dissection by monopolar diathermy (with safety margins 1–2 cm), hepatic dissection was undertaken using the harmonic scalpel or Habib 4×sealer. Extraction of the resected part of the liver was done after its placement in a plastic bag (Endobag, Covidien, Dublen, Irland) by extending the subcostal incision (about 5 cm) or small Pfannenstiel incision in some cases (Figs 1–3).

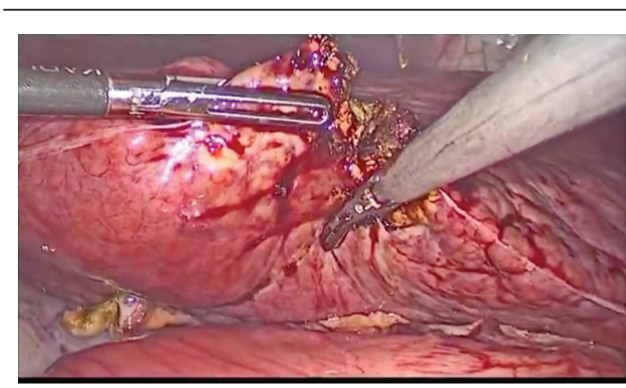
For group B (the open group), the operation was done through the right subcostal incision with midline extension. The liver was carefully palpated and intraoperative ultrasonography was undertaken, if needed, to confirm the position of the tumor and to assess its relationship with adjacent vascular structures. The mobilization of the liver is seldom required and is better avoided, although sometimes needed. Hepatic vascular inflow control was used in selective cases in the form of Pringle's maneuver. After marking the line of dissection by monopolar diathermy (with safety margins 1–2 cm), hepatic dissection was undertaken using Habib 4× sealer or the harmonic scalpel followed by hemostasis with monopolar or bipolar diathermy.

Figure 1



Hepatic focal lesion (HFL) visualization during laparoscopic resection.

Figure 2



Dissection using the harmonic scalpel.

The patients were followed up to 12 months from the time of operation on a weekly basis visit in the first month, then at 2-week intervals in the following 2 months, then monthly for the next 9 months. Follow-up included clinical evaluation, important laboratory investigations (including tumor markers), and imaging diagnosis with abdominal ultrasonography and/or computed tomography. The long-term follow-up was done on a 3-month basis for 12 months. Every 3 months, alpha-fetoprotein (AFP) and triphasic computed tomography (CT) were done for all patients to detect recurrence. The recurrence-free survival probability was calculated. Mortality and the survival probability were also recorded.

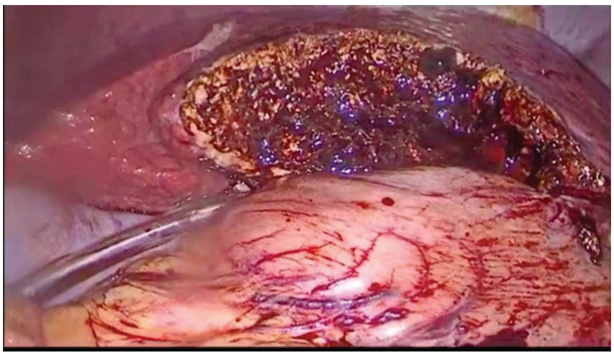
Results

The mean age in the laparoscopic group was 62.44 years which ranged between 53 and 70 years while in the open group was 60.3 which ranged between 47 and 66 years with no statistically significant difference between the two groups (P=0.223).

Regarding the sex, there were 15 (46.9%) men and 17 (46.9%) women in the laparoscopic group and 14 (42.2%) men and 19 (57.6%) women in the open group. The difference was not significant.

Regarding the past history of hepatic diseases, the majority of patients in both groups were found to have a positive history of hepatitis viruses. Fifty-eight (89.2%) patients had hepatitis C virus (29 patients in each group) while only one (1.53%) patient had hepatitis B virus. There were three patients in each group showing negative viral markers. The difference was not significant. However, with regard to the past history of medical diseases rather than hepatitis, in the laparoscopic group 15 (46.8%) patients had no medical comorbidities, 10 (31.3%) patients had associated hypertension, five (15.6%) patients had diabetes mellitus while in the open group 17 (51.5%) patients had no medical comorbidities, six (18.2%) patients had associated hypertension, five (15.2%) patients had diabetes mellitus, and three (9.1%) patients had both combined hypertension and diabetes mellitus (Table 1).

Figure 3



Cut surface after resection.

For the α-fetoprotein, the median level in the laparoscopic group was 56.4 ng/ml ranging between 1 and 625 ng/ml, while the median level in the open group was 20.1 ng/ml ranging between 2 and 652 ng/ml showing no statistically significant difference between both groups (Table 2).

Preoperative upper endoscopy done in all hepatitis-positive patients showed in the laparoscopic group 14 (44.1%) cases with portal hypertensive gastropathy or antral gastritis or submucosal vein, three (9.45%) cases with superficial erosions, eight (25.2%) cases with esophageal varices grade 1 and five (15.6%) cases with grade 2 banded varices while in the open group 16 (48.8%) cases with portal hypertensive gastropathy or antral gastritis or submucosal vein, three (9.1%) cases with superficial erosions, eight (24.4%) cases with esophageal varices grades 1 and 3 (9.1%) cases with grade 2 banded varices.

All the patients included in both groups of this study were classified to be Child grade A. The median model for the end-stage liver disease (MELD) score in the laparoscopic group was 8.34±1.86 ranging from 6 to 12 while in the open group the median MELD score was 7.7±1.33 ranging from 6 to 10. There were no

Table 1 Demographic data of the patients included in the study

	Group A (n=32) [n (%)]	Group B (n=33) [n (%)]	P-value
Sex			
Male	15 (46.9)	14 (42.4)	0.718
Female	17 (53.1)	19 (57.6)	
Smoking			
Nonsmoker	21 (65.6)	20 (60.6)	0.675
Smoker	11 (34.4)	13 (39.4)	
Comorbidity			
Non	15 (46.8)	17 (51.5)	0.457
HTN	10 (31.3)	6 (18.2)	
DM	5 (15.6)	5 (15.2)	
Others	2 (6.3)	2 (6.1)	
HTN and DM	0 (0)	3 (9.1)	

DM, diabetes melitus; HTN, hypertension.

Table 2 Preoperative α-fetoprotein levels in both groups

	Group A (n=32)		Group B (n=33)		P-value
	Median	Range	Median	Range	
AFP	56.4	1–625	20.1	2–652	0.14

AFP, alpha-fetoprotein.

statistically significant differences (*P*<0.111) (Table 3, Fig. 4).

Intraoperative data

The mean operative time in the open group was 160.15±31.29 min, while the laparoscopic group means time was 127.3±39.2 min with statistically significant difference between the two groups (*P*<0.001) with decreased operative time in the laparoscopic group.

The mean blood loss in the open group was 380.3±197.62 ml while the laparoscopic group means blood loss was 350±355.6 ml with no statistically significant difference relations between the two groups (*P*=0.671). Five (15.6%) cases only needed an intraoperative blood transfusion in the laparoscopic group compared with six (18.25%) cases in the open group. Eleven (34.4%) cases showed no need for plasma transfusion in the laparoscopic group compared with only six (18.2%) cases in the open group (Tables 4 and 5).

There were three cases converted from the laparoscopic to open technique with a percentage of 9.4% of group A. Intraoperative bleeding occurred in two (6.3%) cases in the laparoscopic group and was converted to the open technique; also another case (3.1%) was converted due to difficult localization by the laparoscopic intraoperative ultrasound probe.

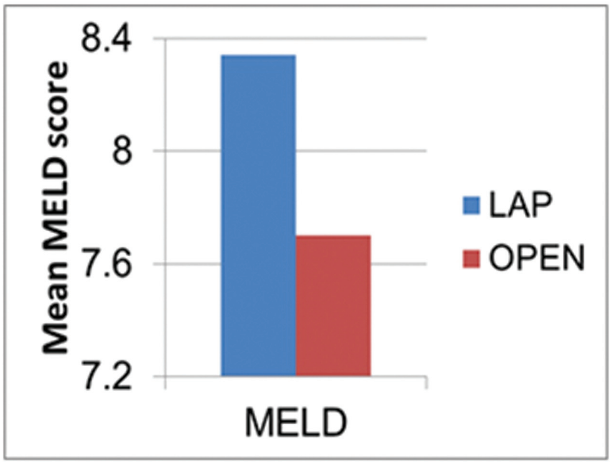
Among group A, 30 (93.8%) patients had nonanatomical wedge resection while the remaining two patients had an anatomical resection in the form of segmentectomy in one (3.15%) patient and left lateral sectionectomy in the other one (3.15%). Among group B, 30 (90.9%) patients had nonanatomical wedge resection while the remaining three patients had an anatomical resection in the form of segmentectomy in one (3.05%) case and left lateral sectionectomy in the other one (6.1%). All cases within the laparoscopic group underwent intraoperative ultrasonography. Five cases in the open group were in need for intraoperative ultrasonography.

Habib 4× device was the most common resection technique in both groups especially open resection group with a percentage of 63% followed by the harmonic scalpel device resection technique in the laparoscopic resection group with a percentage of 34.4% with no statistical significance (*P*=0.698) (Table 6).

Table 3 Characteristics of hepatic lesions studied using triphasic computed tomography and intraoperative ultrasound

	Group A (*n*=32) [*n* (%)]	Group B (*n*=33) [*n* (%)]	*P*-value
Size (cm)			
≤3	12 (37.5)	6 (18.2)	0.081
3–5	17 (53.1)	18 (54.5)	
>5	3 (9.4)	9 (27.3)	
No.			
1	30 (93.7)	33 (100)	0.114
2	2 (6.3)	0 (0)	
Segment 2	7 (21.7)	8 (24.2)	0.821
Segment 3	13 (40.6)	11 (33.5)	0.919
Segment 4B	2 (6.3)	2 (6)	1.00
Segment 5	2 (6.3)	3 (9.1)	1.00
Segment 6	10 (31.5)	9 (27.3)	0.535

Figure 4



Difference in model for the end-stage liver disease (MELD) score between both groups.

Table 4 Difference in intraoperative data between both groups

	Group A (*n*=32) (mean±SD)	Group B (*n*=33) (mean±SD)	*P*-value
Operative time (min)	127.3±39.2	160.15±31.29	0.001
Blood loss (ml)	350±355.6	380.3±197.62	0.671
Blood transfusion	0.25±0.97	0.24±0.65	0.961
Plasma transfusion	2.2±2.28	2.88±1.78	0.578

Table 5 Required transfusions in both groups

	Group A (*n*=32) [*n* (%)]	Group B (*n*=33) [*n* (%)]	*P* value
Blood transfusion			
No	27 (84.4)	27 (81.8)	1.00
Yes	5 (15.6)	6 (18.2)	
Plasma transfusion			
No	11 (34.4)	6 (18.2)	0.248
Yes	21 (65.6)	27 (81.8)	

Postoperative data

As regards hospital stay, the mean hospital stay in the open group was 5.51±1.28 days ranging from 4 to 7 days, while in the laparoscopic group it was 3.75±1.16 days ranging from 3 to 5 days with highly statistically positive correlation difference between the two groups ($P<0.001$). Also, the drain was removed in the laparoscopic group earlier showing the highly statistical difference between the two groups ($P<0.001$) (Table 7).

For postoperative complications according to Clavien–Dindo classification, 26 patients (nine in group A and 15 in group B) were of grade I with no additional intervention required during the postoperative course. Thirteen (four in group A and nine in group B) patients required pharmacological treatment with drugs, so they were classified as grade II. Two patients in group A required surgical intervention (6.3%) versus one patient in group B (3%), so they were classified as grade III (Table 8).

The most frequent complication was postoperative ascites which was seen in 22 (66.7%) cases in the open group and in 11 (34.4%) cases in the laparoscopic group with a highly significant difference between both groups with a much more lower incidence in the laparoscopic group ($P<0.009$). It was recorded that the complications occurred all over both groups in relation to the technique of resection, which was more in the open group than in the laparoscopic resection group but without statistically significant relations. It was also noted that the complications occurred in both groups with the use of Habib 4× sealers in hepatic parenchyma dissection were more than the use of a harmonic scalpel in general but with no statistically significant difference relations (Table 9).

Table 6 Operative details in both groups

	Group A (*n*=32) [*n* (%)]	Group B (*n*=33) [*n* (%)]	*P*-value
Resection technique			
Habib 4×	20 (63)	22 (66.7)	0.698
Harmonic scalpel	11 (34.4)	11 (33.3)	
Combined	1 (3.1)	0 (0)	
Resection type			
Non anatomical	30 (93.7)	30 (90.9)	1.00
Anatomical	2 (6.3)	3 (9.1)	

There was a case of histologically proved port-site metastasis in the laparoscopic group at the right subcostal port where the specimen is extracted with a percentage of 3.15% (P=1.00).

Histopathological data

The histologic analysis of the open group showed that 14.3% of the cases were well-differentiated HCC and 79.1% of the cases were moderately differentiated HCC and 6.1% cases were poorly differentiated. In the laparoscopic group, there were 21.7% cases of well differentiation, moderate differentiation in 75.2% of the cases, and poor differentiation in 3.1% cases and all cases had clear surgical margins with a mean resection margin of 8.38±2.35 mm in the laparoscopic group while 7.62±2.28 mm in the open group.

The recurrence rate was detected by triphasic CT during the 12-month follow-up period. It is either recurrence at operative site or de-novo lesions and occurred in four (12.5%) patients in the laparoscopic group, while occurred in 9.1% of patients in the open group with no statistical significance and for mortality, only one patient had died (3.05%) in the open group with no statistical significance (Tables 10 and 11, Fig. 5).

Also, there was no statistically significant difference for α-fetoprotein between the two groups in the follow-up period (Table 12).

Discussion

Hepatic resection is a common procedure for both malignant and benign hepatic tumors. Historically, liver resection was associated with high morbidity and mortality, but with improvement in the experience and adequate preoperative and postoperative management, liver resection now can be safely performed with a good outcome.

Sposito *et al.* [3] reported that the laparoscopic approach is an ideal approach for liver resection and primary liver cancer currently represents the main indication for laparoscopic liver resection (LLR) among malignancies.

Table 7 Postoperative data of the patients included in the study

	Group A (*n*=32)		Group B (*n*=33)		*P*-value
	Mean±SD	Range	Mean±SD	Range	
ICU stay (days)	1.03±0.47	0–1	1.1±0.38	1–2	0.579
Hospital stay (days)	3.75±1.16	3–5	5.51±1.28	4–7	<0.001
Drain removal (days)	2.88±0.98	3–5	4.12±0.99	4–7	<0.001

Table 8 Postoperative complications according to Clavien–Dindo grading in both groups

	Group A (*n*=32) [*n* (%)]	Group B (*n*=33) [*n* (%)]	*P* value
Clavien–Dindo grading			
I	9 (28.3)	15 (45.5)	0.122
II	4 (11.5)	9 (27.3)	
III	2 (6.3)	1 (3)	

Table 9 Postoperative complications in both groups

	Group A (*n*=32) [*n* (%)]	Group B (*n*=33) [*n* (%)]	*P*-value
Bleeding	1 (3.15)	0 (0)	0.053
Ascites	11 (34.4)	22 (66.7)	0.009
Wound infection	1 (3.15)	3 (9.1)	0.613
Port-site metastasis	1 (3.15)	0 (0)	1.00
Incisional hernia	0 (0)	1 (3)	

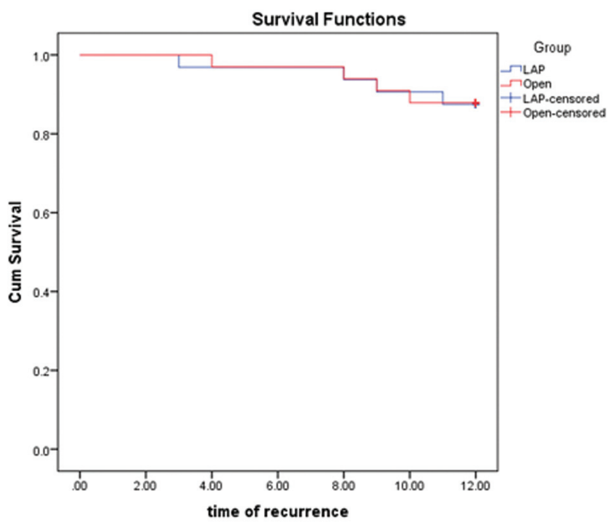
Table 10 Shows recurrence in both groups

Item	Group A (*n*=32) [*n* (%)]	Group B (*n*=33) [*n* (%)]	*P*-value
Computed tomography			
Recurrence at operative site	2 (6.3)	1 (3.05)	0.391
De-novo lesions	2 (6.3)	2 (6.1)	

Table 11 Mortality over the 12-month follow-up

Mortality	Group A	Group B	*P*-value
1 year [*n* (%)]	0 (0.0)	1 (3.05)	1.00

Figure 5



Recurrence-free survival by Kaplan–Meier.

Also, Chen *et al.* [4] reported that with the refinements in laparoscopic instruments and accumulated experience with open liver surgery and laparoscopic surgery for various liver resections, LLR has become a common method of treatment for HCC but it remains challenging because it requires adequate handling of bleeding and important structures.

Table 12 The level of AFP at the 1 year follow-up between two groups had no difference with no statistical significance

	Group A (*n*=32) [*n* (%)]	Group B (*n*=33) [*n* (%)]	*P*-value
AFP			
Declining	26 (81.9)	24 (73.2)	1.00
Rising	4 (12.5)	4 (12.1)	

AFP, alpha-fetoprotein

Egypt has the highest prevalence of HCV in the world (14.7%) [5] ranging from 6% to more than 40% in different regions whereas 30–60% of the infected patients develop a chronic liver disease and a substantial percentage develops cirrhosis or even HCC [6].

In this study, a comparison between laparoscopic resection and open resection was done to compare short-term results between laparoscopic hepatectomy and open hepatectomy. This study focused on the perioperative period of patients undergoing minor liver resection and on assessing its results.

This study was conducted on 65 patients with hepatic focal lesions of whom 32 (49.3%) patients were treated by laparoscopic liver resection (group A) while the other 33 (50.7%) patients were treated by open liver resection (group B).

In this study, both groups were homogeneous as regards age, sex, etiology of liver cirrhosis, the presence of associated medical conditions, laboratory results, and AFP levels. No significant differences were found between both groups regarding demographic data.

In our study, the mean operative time in the laparoscopic group was 127.3±39.2 min, while in the open group the meantime was 160.15±31.29 min with statistically highly significant difference between the two groups, (P<0.001); duration of operation in the LLR group was significantly shorter compared with the open liver resection (OLR) group.

Similar results of significantly shorter operative time in the LLR group when compared with the OLR group were found in many different comparative studies such as that of Leong *et al.* [7] (250.43 vs. 349.90 min, P<0.001), Chen *et al.* [4] (200 vs. 220 min, P<0.001), Untereiner *et al.* [8] (185 vs. 250 P<0.001), and Lai *et al.* [9] (120 vs. 160 min, P<0.05). Contrary to our result which was supported by previously mentioned studies, other respectable studies have shown significantly longer operative time in the laparoscopic group. This is stated in different studies comparing laparoscopic versus open minor liver resections carried out by Jiang *et al.* [10] and Takahara *et al.* [11].

In our study, as well as in other studies done by Komatsu *et al.* [12] and Hu *et al.* [13] there were no significant differences in intraoperative blood loss and blood transfusion, while Cheung *et al.* [14], stated that blood loss tends to be lower at laparoscopic approach than at open resection.

Several factors may contribute to the decreased blood loss in laparoscopic surgery. First, major resection is rare which may have significant effects in reducing severe venous bleeding risks. Second, the use of high-definition laparoscopy camera allows meticulous hemostasis, achieving clear view with magnification. Third, the raised intra-abdominal pressure results in a relative reduction in venous pressure. Fourth is the use of intraoperative ultrasonography which helps in the identification of intrahepatic vessels.

In our study, we have to underline the conversion rate of laparoscopy to open hepatectomy (9.4%). The main causes of conversion were excessive intraoperative bleeding in two cases and the inability to view the third lesion and failure of its localization by laparoscopic intraoperative ultrasound probe.

The reported conversion rate is in the range of 0–20%, varying mostly according to the indication for LLR. In patients with cirrhosis the reported conversion rates ranged from 7 to 19.4% [15].

Hasegawa *et al.* [16] reported that the conversion rate is also related to the complexity of the surgical procedure and accumulated experience. However, with surgical expertise the conversion rate can be reduced to less than 5% in high-volume expert centers.

As regards the mean hospital stay in our study, it was revealed that in the laparoscopic group it was 3.7 days ranging from 3 to 5 days, while the open group was 5.51±1.28 days ranging from 4 to 7 days with highly statistically positive correlation difference between two groups ($P<0.001$).

As stated the study done by Lee *et al.* [17] showed high significance in a shorter hospital stay in the laparoscopic group (5 vs. 7 days, $P<0.001$). Similar studies shared the same result with him and successively with our result such as that of Zhang *et al.* [18] (5 vs. 8 days, $P<0.001$) and Wang *et al.* [19] (5 vs. 10 days, $P<0.001$).

In our study, regarding postoperative complications, postoperative ascites was the most frequent complication in 22 (66.7%) cases in the open group and in 11 (34.4%) cases in the laparoscopic group showing a highly significant difference between two groups as it occurred much more frequent in the open group.

Truant *et al.* [20] showed similar lower rates of postoperative ascites and liver failure in the LLR group as well.

Although laparoscopic liver resection for HCC theoretically carries the risk of seeding at the port site, reports of port-site metastasis of HCC are rare. We have a case of port-site metastasis of HCC of a female patient of 67 years old presented with a 2 cm nodule in the left subcostal abdominal wall, where the 10 mm laparoscopic port had been inserted 10 months after performing LLR for a 3 cm HCC in segment III in the left lobe of the liver mostly due to contamination of the port wound during extraction of the resected tumor. After triphasic CT was done, local excision of the nodule was performed. Histological examination of the excised nodule confirmed moderately differentiated HCC, which was consistent with a recurrence of the laparoscopically resected HCC.

The first known published report of port-site recurrence or related peritoneal seeding in LLR for HCC was in 2011. Chen and Yen [21] reported one case of subcutaneous seeding of HCC appearing over the surgical wound 12 months after LLR. Also, Maarschalk *et al.* [22] reported one such case after laparoscopic liver resection in 2015 and then Kihara *et al.* [23] reported a third case in 2016. The incidence of port-site metastasis of HCC is unclear but seems very low. Tumor cell contamination during surgery is a conceivable underlying mechanism of port-site metastasis after laparoscopic HCC resection.

Takemura *et al.* [24] reported that surgical resection of implanted HCC may improve survival in selected patients provided that intrahepatic disease is absent or predicted to be locally controllable; ascites is absent and sufficient hepatic functional reserve exists.

Our experience indicates that the risk of port-site metastasis of HCC should be considered carefully, and greater attention should be paid to developing techniques for tumor isolation.

As regards the resection margin, our study showed that there was no difference in resection margins in both series. We are able to make up for the lack of palpation in LLR and hence achieve the intended margins laparoscopically, with preoperative surgical planning using a variety of imaging techniques and the use of intraoperative ultrasonography to demarcate surgical margins. This data is supported by meta-analysis of different studies done by Yin *et al.* [25] Twaji *et al.* [15], and Rao *et al.* [26] which stated that the patients operated with LLR have no increased risk of positive surgical margins which can be explained by the fact that LLR is carried out under a magnified field of view, which implies in augmented perception of operative blood loss and induces surgeons to be more meticulous.

In our study, local recurrence was found to be more frequent after LLR than OLR with no significant difference (*P*=0.391). In the LLR group, local recurrence at the site of the treated tumor occurred in two (6.3%) patients and those patients were treated with transarterial chemoembolization (TACE) in one case and RFA in the other. In the OLR group, it had occurred in only one (3.05%) patient who were treated by TACE.

Also in our study, during the follow-up period, de-novo lesions were found in two (6.3%) patients in the LLR group and two (6.1%) patients in the OLR group and all of them were treated by TACE.

In the laparoscopic group, the 1-year survival was 100%, while in the open group it was 97% (*P*=1.00). In the laparoscopic group, the 1-year disease-free survival was 86.7%. The open group had the corresponding rate at 90.3% (*P*=0.329).

In a study done by Kim *et al.* [27] conducted on 58 patients (29 patients in the LLR group and 29 patients in the OLR group) showed that the 1-year survivals were 100%, in LLR, and 96.5% in OLR (*P*=0.267), while the 1-year disease-free survivals were 81.7% in LLR and 78.6% in OLR, respectively (*P*=0.929).

Several factors contributed to reducing mortality after hepatectomy from 5% to almost 0%. Among these factors, better knowledge of both liver anatomy and physiology, including liver regeneration and preoperative volume modulation, better morphological assessment, advances in parenchymal transaction with the selective use of vascular control, and sophisticated perioperative management have all contributed to reduce the risks associated with liver resection [28].

Conclusion

Surgical resection is an accepted and effective local treatment for HCC in properly selected patients. The laparoscopic approach has superior short-term outcomes compared with the open approach. Laparoscopic approach carries less postoperative complications (mainly the postoperative ascites) and significantly lower length of stay with no difference in blood loss or recurrence rate.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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