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Laparoscopic liver resection in the cirrhotic patient

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ABSTRACT

Aim: The adoption of laparoscopic liver resection has been expansive in the last 2 decades with the exception of cirrhotic patients. The current study examines the outcomes of our cirrhotic resections to determine the potential limitations of this technique. **Methods**: Retrospective analysis of 114 cirrhotic patients. Seventy-five (65.8%) laparoscopic resections were compared to 39 open resections. Seventy-six (66.7%) resections in the series were minor resections (less than 3 segments). Surgical approach and extent of resection were analyzed using student's *t* test and regression multivariate analysis with SAS. **Results**: The laparoscopic group had lower operative times (2.4 *vs*. 4.8 h; $P < 0.001$), blood loss (250 *vs*. 609 mL; $P < 0.001$), length of stay (4.4 *vs*. 10.1 days; $P = 0.013$) and complications (28% *vs*. 48%; $P = 0.028$). Subset analysis by technique and extent of resection identified the laparoscopic group lost the advantage in blood loss and lengths of stay when utilized in major resections. Multivariate regression analysis for blood loss further confirmed open resection ($P = 0.014$) and major resection ($P = 0.026$) as significant indicators of bleeding and transfusion. **Conclusion**: Laparoscopic liver resection in cirrhotic patients is safe and efficacious. However, the significant variability in outcomes for major resections in cirrhotics leads us to recommend further examination of the learning curve and significant caution in the selection of cirrhotics requiring major hepatic resections.

INTRODUCTION

Liver resection has dramatically evolved over the last four decades. Initial series incurred high morbidity and mortality rates.[1,2] However, with the introduction of modern anesthesia and improved knowledge of the surgical anatomical segments the mortality decreased to acceptable levels lending to the proliferation of resection programs.[3-5] In the last decade we have witnessed a second proliferation of hepatic resections attributed to the introduction of the laparoscopic technique.[6,7] However, the greatest challenge in the resection of hepatic tumors remains their management in the setting of cirrhotic liver.[8,9]

Despite the introduction of effective antivirals for the treatment of hepatitis C, the incidence of cirrhosis is expected to continually rise worldwide most frequently attributed to the ever increasing prevalence of obesity, fatty liver disease and non alcoholic steato hepatitis.[10] A

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Table 1: Patient demographics

	Open	Laparoscopic	*P*-value
Number	39	75	
Age (years)	58.1 ± 12.8	61.3 ± 9.86	0.152
Male gender (%)	89.7 ± 30.7	66.7 ± 47.5	0.007*
Government insurance (%)	25.6 ± 44.2	32.0 ± 47.0	0.486
BMI	28.2 ± 6.0	27.8 ± 4.9	0.713
HTN (%)	74.4 ± 44.2	80.0 ± 40.3	0.494
DM (%)	33.3 ± 47.8	30.7 ± 40.2	0.664
INR	1.1 ± 0.2	1.1 ± 0.1	0.638
Bilirubin	0.83 ± 0.42	0.691 ± 0.36	0.071
Creatinine	1.05 ± 0.58	0.86 ± 0.24	0.013*
PLT	187.5 ± 87.2	173.4 ± 73.7	0.357
Varicies (%)	33.3 ± 47.7	17.3 ± 38.1	0.054
Ascites (%)	2.6 ± 47.7	10.7 ± 31.1	0.130
ASA score	3.3 ± 0.5	3.1 ± 0.3	0.020*
Tumor size (cm)	6.56 ± 4.26	3.20 ± 2.01	< 0.001*

*Statistically significant. BMI: body mass index; HTN: hypertension; DM: diabetes mellitus; INR: international normalized ratio; PLT: platelet; ASA: American Society of Anesthesiologists

significant proportion of these cirrhotic patients will present for the management of hepatocellular cancer.[11] However, with the incidence of cirrhosis ever rising in the general population, other pathologic lesions will be presented for diagnosis and surgical management including symptomatic benign tumors, colorectal metastases and in the era of increasing resolution imaging indeterminate lesions.

This study examines our experience with laparoscopic liver resection in cirrhotic patients for multiple pathologies. The aim of the current study was to elucidate the potential benefits of laparoscopic liver resection over open hepatic resection in the management of surgically resectable liver lesions in cirrhotic patients.

METHODS

This is a retrospective study analyzing the effect of a laparoscopic approach on the resection of liver tumors in cirrhotic patients. The current study was submitted and approved by an institutional review board at our institution. One hundred and fourteen cirrhotic liver resections were identified in a surgical database performed by a single surgeon. The cohort of cirrhotic resections was evaluated for patient demographics, operative outcomes, morbidity, mortality, and long-term patient survival. The impact of laparoscopic liver resection was then compared to the open liver resection group. Further examination was performed using a subset analysis to evaluate the extent of resection. Major resections were defined as in prior studies as removal of three or greater segments.

The surgical evaluation and resection techniques used during this study were identical throughout the series. All resection candidates were evaluated with an established criterion including: preoperative imaging with triphasic computed tomography scan or contrasted magnetic resonance imaging, estimation of functional liver remnant, confirmation of platelet count, and selective measurement of transjugular wedge pressures. In the setting of high risk patients such as platelet counts less than 100 K or presence of significant varicies, transhepatic wedge pressures and extent of resection dictated the decision to proceed with resection and in marginal cases portal vein embolization was employed. Both open and laparoscopic resections were performed using a parenchymal sparing intent with the aid of low central venous pressures, and parenchymal division with an ultrasonic dissector and stapler hepatectomy.

Patient demographics, tumor characteristics, operative and postoperative outcome data were collected and analyzed. Data was reported with means and standard deviations. Statistical comparisons were calculated and analyzed using SAS software. Significant differences were identified at a *P*-value of < 0.05. Multivariate regression analysis was then applied to evaluate the effects of laparoscopic liver resection on patient morbidity, mortality and readmission.

RESULTS

The study cohort of cirrhotic resection patients was composed of 114 cirrhotic patients. The laparoscopic liver resection group was comprised of 75 patients (65.8%) and the open liver resection group 39 patients. Age, gender, race, and demographics were all similar between the 2 groups [Table 1]. The tumor size was significantly larger in the open resection group while the preoperative diagnosis and etiology of cirrhosis were similar.

The operative outcomes were noted to have significant

Table 2: Patient outcomes by technique of resection

	Open	Laparoscopic	*P*-value
Number	39	75	
Major resections (%)	66.7 ± 47.7	16.3 ± 36.9	< 0.001*
OR time (h)	4.8 ± 2.0	2.4 ± 1.1	< 0.001*
EBL (mL)	609.0 ± 603.8	250.7 ± 344.6	< 0.001*
Transfusion (%)	38.5 ± 49.3	17.3 ± 38.1	0.012*
Margin (cm)	1.05 ± 0.8	0.90 ± 0.6	0.269
ICU admission (%)	89.7 ± 30.7	32.0 ± 49.8	< 0.001*
Complications (%)	48.7 ± 50.5	28.0 ± 45.2	0.028*
LOS (days)	10.1 ± 18.3	4.4 ± 3.8	0.013*
90-day readmissions (%)	15.4 ± 36.6	14.6 ± 35.7	0.926
90-day mortality (%)	5.1 ± 22.4	2.7 ± 16.2	0.502

*Statistically significant. OR: operating room; EBL: estimated blood loss; ICU: intensive care unit; LOS: length of stay

Table 3: Patient outcomes analyzed by extent and technique of resection

	Minor resections (*n* = 76)			Major resections (*n* = 38)		
	Open	Laparoscopic	*P*-value	Open	Laparoscopic	*P*-value
Number	13	63		26	12	
Age (years)	60.1	60.4	0.913	57.1	65.8	0.058
BMI	29.8	27.5	0.171	27.4	28.7	0.533
INR	1.1	1.1	0.846	1.1	1.1	0.599
Bilirubin	0.8	0.7	0.355	0.8	0.6	0.184
Creatinine	1.3	0.9	0.002*	0.9	0.9	0.427
ASA score	3.4	3.1	0.040*	3.3	3.1	0.201
Tumor size (cm)	6.0	3.1	< 0.001*	6.8	3.7	0.023*
EBL (mL)	438.5	215.9	0.033*	694.2	433.3	0.225
OR time (h)	4.8	2.2	< 0.001*	4.9	3.0	< 0.001*
Transfuse (%)	42.9	18.5	0.023*	33.0	0	0.193
ICU utilization (%)	84.6	31.7	0.006*	92.3	33.3	< 0.001*
LOS (days)	16.1	4.1	0.004*	7.0	6.0	0.510
Complications (%)	46.2	23.3	0.103	46.2	50.0	0.831

*Statistically significant. BMI: body mass index; INR: international normalized ratio; ASA: American Society of Anesthesiologists; EBL: estimated blood loss; OR: operating room; ICU: intensive care unit; LOS: length of stay

differences in resection extent, bleeding, transfusions, and operative times [Table 2]. Length of stay, and complications were significantly different while the readmission and mortality rates were not dramatically different [Table 2]. Seventy-six (66.7%) resections were minor in extent with 63 (82.9%) of them performed through the laparoscope. Thirty-eight resections in this series were major as defined by removal of 3 or more segments with 12 (31.6%) removed through the laparoscope. Minor and major resections witnessed a reduction in operative times, ICU utilization and length of stay. Blood loss and complications were significantly less in the laparoscopy group only in minor resection. The previously described advantages were not identified in the major resection subgroup [Table 3]. Multivariate analysis for bleeding identified open resection (P = 0.014) and major resection (P = 0.026) as significant risk factors for blood loss. In subset analysis only international normalized ratio (P = 0.018) was significant in the major resection group. Multivariate analysis identified tumor size (P = 0.023) as a risk for complications. In subset analysis this persisted while in major resections this effect was lost. Multivariate analysis for death identified creatinine (P = 0.016), bilirubin (P = 0.019), and obesity defined by body mass index (BMI) > 35 (P = 0.043). Creatinine (P < 0.001) and BMI (P = 0.019) persisted in significance in minor resection but was lost in major resections.

DISCUSSION

Liver resection in the cirrhotic patient is significantly more complex than in the non cirrhotic patient.[12-14] Cirrhotic patients are frequently metabolically compromised, coagulopathic and may suffer from a degree of portal hypertension. However, the most dreaded complication of hepatic resection in the cirrhotic patient is post-operative liver failure resulting from an inadequate functional liver remnant. Decades of efforts in preoperative assessment including metabolic challenge of the liver with indomethacin green and calculated functional liver remnant have been critical in reducing operative mortality.[15,16]

Since the initial Louisville Consensus Conference, there have been over 500 cases of laparoscopic resection for hepatocellular carcinoma reported in the literature.[17-21] Most patients in this group are cirrhotic, but a considerable percentage were non-cirrhotic or pre-cirrhotic arising in the setting of chronic

hepatitis. Multiple studies have confirmed the benefits of laparoscopic liver resection in decreasing operative times, bleeding, complications and length of stay in non cirrhotic patients.[22-25] Most cirrhotic resection data has been included into larger hepatocellular cancer reports making assessment of this data questionable at best. However, a recent meta analysis of laparoscopic resection of hepatocellular cancer in cirrhotic patients confirmed this approach was associated with a reduced risk of transfusion, decreased length of stay and wider surgical margins but failed to identify a difference in operative times, and morbidity.[26] This is in contrast to a smaller French case-controlled study that identified laparoscopic resection resulted in shorter operative times, hospital stays and lower morbidity rates.[27]

Our current data presented in this study confirms laparoscopic resection in cirrhotics provide shorter operative times, blood loss, transfusion, intensive care utilization, length of stay, and post operative complications. However, when operative outcomes were analyzed in regard to the extent of resection the laparoscopic group persisted in shorter operative times with less intensive care utilization while reduction of blood loss and shorter lengths of stay were not realized in the major resection group.

Multiple studies have attributed the advantages of laparoscopic liver resections to a less aggressive approach, minimizing peritoneal dissection, and bleeding leading to lower incidence of ascites and post-hepatectomy liver failure.[19-22] Two authors have even suggested laparoscopic liver resection may extend the indication of liver resection into selected Child B patients.[20,28] Our experience with would support this supposition in well selected Child B patients. An additional advantage of laparoscopic liver resection of was reduction in postoperative adhesions facilitating subsequent liver transplantation with decreased morbidity. This observation was advanced in an article on salvage transplantation after laparoscopic liver resection for hepatocellular cancer.[29] Alternatively, the results reported from the meta analysis indicate all groups have not witnessed such a clear and dramatic advantage with laparoscopic liver resection.[26]

Our data would support these general suppositions but identified significant differences in outcome related complications after major laparoscopic resections. This may arise from the significantly increased need for dissection, bleeding and transfusion. Alternatively, this may reflect a steeper and longer learning curve required in the performance of laparoscopic cirrhotic liver resections and most importantly major laparoscopic liver resections in cirrhotics. As observed in early open resection of cirrhotic tumors, these challenges have resulted in greater difficulty in achieving wide resection margins and performing formal anatomical resections, as well as increasing the difficulties in mobilization and in particular parenchymal transection, with risk of massive bleeding. These concerns and potential issues have been the major obstacles to the widespread adoption of laparoscopic liver resection in the management of liver tumors in cirrhotics.

In conclusion, laparoscopic liver resection in cirrhotic patients appears safe and efficacious in experienced centers resulting in overall significantly shorter operative times, lower blood loss, and shorter hospital stays and few complications. In subset analysis several advantages of the laparoscopic approach are lost including lower blood loss and few complications. Our current experience in laparoscopic major resections in cirrhotics has leaded us to reconsider the learning curve and temper our enthusiasm for major resection in cirrhotics. Perhaps with increasing experience these benefits will be realized but currently our group advocates a tempered and highly selective approach to the laparoscopic approach to major cirrhotic resections.

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Conflicts of interest
There are no conflicts of interest.

Patient consent
Not involved.

Ethics approval
Approved by an institutional review board at authors' institution.

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