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ORIGINAL ARTICLE

Parenchyma-sparing liver resection for hepatocellular carcinoma in left lateral section is associated with better liver volume recovery

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Abstract

Background: Left lateral sectionectomy (LLS) is frequently performed for surgical treatment of hepatocellular carcinoma (HCC) located in the left lateral section. However, no reports have described liver resection for such HCCs using a parenchyma-sparing strategy involving anatomic resection (AR) of segment II (S2 AR) or segment III (S3 AR).

Methods: From 1994 to 2014, patients who underwent LLS and S2 AR or S3 AR for HCC were included in the analysis. Short- and long-term outcomes and pre- and postoperative LV were assessed.

Results: Of the 89 patients selected, 49 underwent LLS (LLS group) and 40 underwent S2 AR and S3 AR (S2/S3 AR group). The postoperative LV was not significantly smaller than the preoperative LV in the S2/S3 AR group ($p = 0.114$), whereas the postoperative LV was significantly smaller in the LLS group ($p = 0.019$). The overall survival (OS) and recurrence free survival (RFS) rates were not significantly different between the groups (OS, $p = 0.056$; RFS, $p = 0.102$).

Conclusions: Parenchyma-sparing liver resection for HCC in the left lateral section is associated with better postoperative LV recovery than LLS with similar oncological outcomes. S2/S3 AR can be a reasonable therapeutic option when LLS results in the removal of more parenchyma than necessary.

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Introduction

Left lateral sectionectomy (LLS) is frequently selected for surgical treatment of hepatocellular carcinoma (HCC) located in the left lateral section. Recent dissemination of laparoscopic liver resection may have led surgeons to select technically simpler LLS for such HCCs instead of parenchyma-sparing liver resection involving anatomic resection (AR) of segment II (S2 AR) or segment III (S3 AR). Indeed, the first and second International Consensus Conferences on Laparoscopic Liver Resection recommended that the laparoscopic approach to LLS is associated with the lower level of complexity and should be considered the standard of care.[1,2] According to the survey results from the Consensus Conference, the laparoscopic approach was more frequently used for LLS than for other liver resection procedures.[3] However, LLS should not be indicated merely because of its technical simplicity. Liver resection procedures for HCC should ensure negative surgical margins while preserving as much liver parenchyma as possible. For HCCs located in the left lateral section, we have performed S2 AR or S3 AR as parenchyma-sparing options.[4–9] Additionally, this parenchyma-sparing strategy has gained attention worldwide because it reportedly allows for radical resection and future resections with maximum preservation of the liver parenchyma while decreasing the risk of postoperative liver failure.[10–16]

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In the present study, postoperative liver volume (LV) recovery and short- and long-term outcomes were compared between patients undergoing parenchyma-sparing liver resection for HCC located in the left lateral section (S2 AR or S3 AR) and patients undergoing LLS.

Methods

Patient selection

A total of 1679 consecutive patients with HCC underwent liver resection at the University of Tokyo Hospital from 1994 to 2014. Baseline patient characteristics (demographic data, preoperative risk factors and comorbidities, and type of preoperative management) and operative characteristics (intraoperative incidents, pathological data, and postoperative outcomes) were retrieved from our clinical database. Patients who underwent LLS and S2 AR or S3 AR were included in the present study. In the preparation of this manuscript, all efforts were made to protect the patients' privacy and anonymity. This study was conducted with the approval of the Institutional Ethics Review Board of the University of Tokyo (ID: 2158-5). Written informed consent was obtained from all patients.

Surgical procedures

Before surgical resection, chest and abdominal contrast-enhanced computed tomography (CT), magnetic resonance imaging with Gd-EOB-DTPA (Bayer Schering Pharma, Berlin, Germany), and ultrasonography were routinely performed. Liver resection was similarly indicated during the study period according to criteria based on preoperative liver function parameters such as the presence/absence of uncontrolled ascites, serum bilirubin concentration, and indocyanine green retention rate at 15 min (ICG-R15), irrespective of the presence of cirrhosis and/or portal hypertension.[4,17] Briefly, if the serum bilirubin concentration was normal, our criteria permitted right hepatectomy or trisectoriectomy when the ICG-R15 was <10%, left hepatectomy or sectoriectomy when the ICG-R15 was <20%, subsegmentectomy or monosegmentectomy when the ICG-R15 was <30%, non-anatomic limited resection when the ICG-R15 was <40%, and enucleation when the ICG-R15 was ≥40%. Liver resection procedures for HCC were determined in a meeting of our group, principally based on the hepatic functional reserve parameters mentioned above, the HCC location, and tumor-bearing portal vein. Namely, S2 AR or S3 AR was performed for patients with the ICG-R15 < 30%, when the tumor-bearing portal vein was the portal vein flowing into segment II (P2) or the portal vein flowing into segment III (P3), respectively. S2 AR or S3 AR was indicated even for patients that would have been able to undergo LLS according to their hepatic functional reserve. In contrast, LLS was basically performed for patients with the ICG-R15 < 20%, when both P2 and P3 were the tumor-bearing portal veins for the HCC(s). Non-anatomic limited resection was performed when the hepatic functional reserve was poor and/or when the HCC was located at the edge of the left lateral section. Intraoperative ablation was rarely performed. The selection of laparoscopic approach is made at the final stage of our decision-making process.

Anatomic resection of segments II and III

After mobilization of the left lateral section, the border between segments II and III was identified using temporal clamping of P2 or P3 or injection of dye into P2 or P3 under intraoperative ultrasonographic guidance. Parenchymal transection was performed using the forceps clamp-crushing method with intermittent inflow occlusion.[18] S2 AR and S3 AR were performed while exposing the left hepatic vein (Supplementary Figure 1 and Supplementary Video).

Supplementary video related to this article can be found at https://doi.org/10.1016/j.hpb.2018.03.020.

Postoperative management

Morbidity and mortality were defined as postoperative complications and death within 90 days after surgery, respectively. Postoperative morbidity was graded according to the Clavien–Dindo classification.[19] For follow-up, ultrasonography and measurement of the blood concentrations of the tumor markers alpha-fetoprotein and des-γ-carboxyprothrombin were performed every month after discharge. Contrast-enhanced CT or magnetic resonance imaging was performed every 4 months.

Liver volumetric analysis

LV excluding tumor volume was calculated based on the CT scans using volume analysis software (Synapse Vincent; Fujifilm, Tokyo, Japan). The postoperative remnant LV was assessed approximately 4 months after the liver resection and compared with the preoperative LV.

Statistical analysis

Categorical variables are expressed as n (%) and were compared between groups using Fisher's exact test or the chi-square test as appropriate. Continuous variables are expressed as median (range) and were compared using Wilcoxon's rank-sum test. The overall survival (OS) and recurrence-free survival (RFS) rates were measured from the time of first liver resection after excluding patients who underwent repeated liver resection. Survival curves were constructed using the Kaplan–Meier method and compared using the log-rank test. Recurrence was diagnosed based on the imaging findings, clinical data, and/or histopathological studies. A propensity score-matching analysis[20,21] was used to build a matched group of patients. The propensity score model was estimated using a logistic regression model that adjusted for the variables with a p value of <0.10. A one-to-one match without replacement was

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