

Totally laparoscopic radiofrequency-assisted liver partition with portal vein ligation for hepatocellular carcinoma in cirrhotic liver

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Abstract

Rationale: Adequate future liver remnant (FLR) volume is often a concern for patients with hepatocellular carcinoma (HCC). Associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) procedure can rapidly lead to impressive growth of FLR. We describe the technique of an entirely laparoscopic radiofrequency-assisted liver partition with portal vein ligation for staged hepatectomy (RALPP) in a cirrhotic patient with HCC.

Patient concerns: A 33 year-old female cirrhotic patient with HCC in the right liver was indicated for RALPP as the predicted future liver remnant (FLR) was 21%.

Diagnoses: HCC with liver cirrhosis.

Interventions: The first surgery consisted of ligation of the right portal vein and radiofrequency ablation of the liver without parenchymal transection. Three weeks postoperatively, FLR reached 42%, and the patient underwent right hepatectomy.

Outcomes: Operative times for the both surgeries were 60 and 240 minutes respectively, with negligible blood loss. The patient had an uneventful postoperative course, and the FLR reached 53% 1 week after the second procedure. No recurrence occurred at 10 months.

Lessons: Laparoscopic RALPP is feasible in some cirrhotic patients with liver cancer that in line with the indications and this method may be a superior choice for selected cirrhotic patients with HCC, as it decreases potential morbidity associated with open surgery.

Abbreviations: AFP = α -fetoprotein, ALPPS = associating liver partition and portal vein ligation for staged hepatectomy, FLR = future liver remnant, HBV = hepatitis B virus, HCC = hepatocellular carcinoma, ICG15R = indocyanine green retention rate at 15 minutes, RALPP = radiofrequency-assisted liver partition with portal vein ligation for staged hepatectomy.

Keywords: ALPPS, cirrhosis, hepatocellular carcinoma, laparoscopic

1. Introduction

Adequate future liver remnant (FLR) volume is often a concern for cirrhotic patients with hepatocellular carcinoma (HCC) undergoing assessment for resection. Less than 30% of patients with HCC will be resectable and among these, 20% will be contraindicated for surgery because of insufficient FLR.^[1] Cirrhotic patients

represent a particularly difficult population to manage due to their suboptimal liver function and general health condition, and their requirement for a larger FLR ($\geq 40\%$) to prevent postoperative liver failure.^[2] Associating liver partition with portal vein ligation for staged hepatectomy (ALPPS) can lead to impressive growth of remnant liver volume in a short amount of time, therefore increasing the number of patients who may be eligible for curative resection.^[3] However, ALPPS is a 2-step procedure and when performed via 2 laparotomies, results in considerable morbidity and mortality, especially secondary to biliary and infectious complications.^[4] In total, laparoscopic ALPPS have been described,^[5–7] and although evidence is scarce on this topic, published reports generally describe reduced adhesions during the second stage of the procedure and decreased operative trauma.

A variation of the ALPPS procedure without parenchymal transection termed radiofrequency-assisted liver partition with portal vein ligation (RALPP) has been recently described.^[8] This technique uses a radiofrequency ablation device to create a line of coagulative necrosis in the hepatic parenchyma instead of physical transection. Most of the current literature on ALPPS has focused on colorectal liver metastases, and there are few reports in the literature describing the use of this technique in cirrhotics for HCC, and there is even less evidence on the laparoscopic variant.^[6,9]

2. Technique and results

A 33-year-old female cirrhotic patient with HCC in the right liver was referred to our institution. She is Hepatitis B virus (HBV) positive but otherwise healthy with no other comorbidities.

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Figure 1. Preoperative imaging showing 3 HCC in segments V, VI, and VII. HCC = hepatocellular carcinoma.

Preoperative α -fetoprotein (AFP) levels were increased (>100 ng/mL). Cross-sectional imaging studies revealed 3 tumors in segments V, VI, and VII and signs of chronic liver disease (Fig. 1). Preoperative functional assessment revealed preserved liver function with a Child-Pugh score of A, and indocyanine green retention rate at 15 minutes (ICG15R) was 1.9%. Predicted FLR was calculated to be 21% of standard liver volume. After the discussion with the institutional multidisciplinary team, a laparoscopic RALPP procedure was proposed (see Video, Supplemental Digital Content 1, <http://links.lww.com/MD/C28>, which demonstrates the laparoscopic RALPP technique). This study met the requirements of the Declaration of Helsinki, and was approved by the Research Ethics Committee of the Southwest Hospital. Informed consent was obtained from all participants.

The first stage of the RALPP was performed with 5 ports (1 \times 12 mm, 2 \times 10 mm, and 2 \times 5 mm). Standard cholecystectomy was first performed, and then hilar dissection was carried out with the isolation of the right hepatic artery and right portal vein. The right portal vein was ligated with a silk tie and further secured with a Hem-o-lok (Teleflex, NC). After the ligation of the right portal vein, a line of ischemic demarcation was apparent, and radiofrequency ablation of the liver along this line without parenchymal transection was performed using the Cool-Tip RF Ablation System (Covidien, Boulder, CO). The first stage of RALPP was completed in 60 minutes, and estimated blood loss was negligible. The patient had an uneventful postoperative recovery.

Twenty-one days after the first stage, repeat imaging and liver function tests revealed an increased FLR at 42%, and ICG15R of 4.7% (Fig. 2). On the 22th day after the first stage of RALPP, the patient underwent laparoscopic right hepatectomy using the same port sites. Peritoneal adhesions were minimal during the

second surgery. The right hepatic artery that was previously dissected was double ligated with a silk tie and Hem-o-lok. A tourniquet was applied to the hepatic hilum, should the need arise for the Pringle manoeuvre. After complete mobilization of the right liver, hepatic parenchymal transection was performed with the Harmonic Scalpel (Ethicon Endo-Surgery, Cincinnati, OH), along the line previously established with radiofrequency ablation. Branches of the middle hepatic vein were ligated with titanium clips then divided. The right hepatic vein and the right liver's Glissonian pedicle were transected with an Endo GIA 45 stapler (Medtronic, Minneapolis, MN). The surgical specimen was removed via a mini midline laparotomy incision. An operative time for the second stage of RALPP was 240 minutes, and blood loss was estimated at 100 mL. The Pringle manoeuvre was applied for 8 minutes. Intraoperative blood transfusions were not required.

The patient was observed overnight in the intensive care unit, then returned for routine postoperative care at the regular surgical ward. One week after second-stage RALPP, repeat cross-sectional examination showed a liver volume of 53% (Fig. 3) and adequate liver function (ICG15R 6.7%). The patient was discharged on the 10th day after the second surgery. She experienced no morbidity at 30 days postoperatively. Pathological analysis of the surgical specimen revealed 3 foci of moderately differentiated HCC. The patient was in excellent condition at 10 months post-RALPP, and repeat imaging investigations showed no hepatic or extrahepatic recurrence.

3. Discussion

Many patients with HCC are not eligible for curative resection due to inadequate FLR volume. The gold standard technique to increase preoperative liver size is PVE, but this method generally

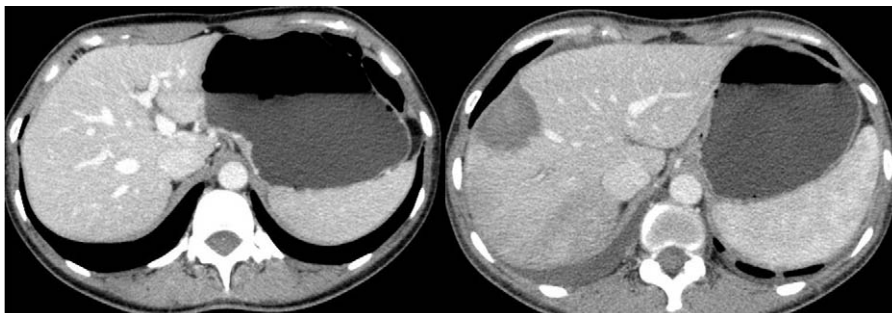


Figure 2. Repeat imaging showing an increased FLR at 42% 3 weeks after stage I RALPP. FLR = future liver remnant, RALPP = radiofrequency-assisted liver partition with portal vein ligation for staged hepatectomy.



Figure 3. One week after stage II RALPP, repeat cross-sectional examination showing further FLR increase to 53%. FLR = future liver remnant, RALPP = radiofrequency-assisted liver partition with portal vein ligation for staged hepatectomy.

results in suboptimal rates of hypertrophy, and many weeks may be required before the results become detectable.^[10] ALPPS is an innovative surgical technique that have resulted in impressive hypertrophy rates in a relatively short period of time (average of 9 days), but with considerable morbidity and mortality mostly related to biliary and septic causes.^[3] Many variants of the ALPPS technique exist, and there is currently no evidence on the superiority of 1 technique over the others. RALPP is a new technique that has the potential for decreased postoperative complications compared with classic ALPPS, since it does not require parenchymal transection, which has been identified as an independent predictor of postoperative complications.^[11] For cirrhotic patients, this may be a good method to increase the rate of resectability, while reducing operative risk and postoperative morbidity in this vulnerable population. This report described the technique of totally laparoscopic RALPP for HCC in a cirrhotic patient, which has not been previously described.

In this report, laparoscopic RALPP resulted in satisfactory parenchymal hypertrophy in a relatively short period of time (21 days). The second stage was also performed laparoscopically with minimal difficulty, as very little adhesions resulted from the first stage. Operative times and outcomes in terms of FLR growth compare well to those described in the literature for similar procedures.^[7] The patient did not experience any postoperative morbidity, and recovery was reported to be less painful and faster compared with ALPPS performed via laparotomy. The potential benefits of a laparoscopic RALPP include less operative trauma, less blood loss since parenchymal transection is not performed, and shorter operative times (especially for stage I) in the hands of surgeons experienced in laparoscopic procedures, compared with open RALPP.^[3,12] These benefits are of particular value for cirrhotic patients with HCC, as they are at higher operative risk than patients without chronic liver disease, and require larger FLR to avoid postoperative liver failure. Consequently, many of such patients are deemed unresectable. Therefore, methods such as laparoscopic RALPP may increase resectability rate in this population, while decreasing the risk for postoperative

complications such as bile leaks and sepsis. We suggest however that total laparoscopic RALPP be limited to patients with HCC smaller than 5 cm, to decrease the risk of tumoral rupture during manipulations.

Animal studies have shown that transection of hepatic parenchyma leads to increased circulating growth factors and cytokines, contributing to subsequent liver hypertrophy.^[13] Extrapolating from these results, coagulative destruction of a portion of liver parenchyma should theoretically result in successful hypertrophy due to the release of such growth factors after inflammatory insult from radiofrequency ablation. Although radiofrequency ablation is difficult to completely block all collateral, but it could still lead to a rapid increase in FLR. The results in our previous study showed that RALPP is safe and effective in open surgery.^[13] It may be proved the importance of cytokines in liver regeneration.

In this patient, laparoscopic RALPP was feasible and induced sufficient liver hypertrophy. This method may be a superior choice for selected cirrhotic patients with HCC, as it decreases potential morbidity associated with open surgery. Larger, preferably randomized studies are needed to confirm these observations.

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