

Totally laparoscopic associating liver partition and portal vein ligation for staged hepatectomy using anterior approach in HCC patient with Type II portal vein anomaly: a case report

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Associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) has gradually developed because of rapid hypertrophy of the future liver remnant volume (FLR) in spite of high morbidity. To minimize the patient's postoperative pain and morbidity including wound complication caused by two consecutive major abdominal operations, we adopted a totally laparoscopic approach and used a composite mesh graft. Also, to maximize the oncologic efficacy, we adopted the "anterior approach" technique. A 44-year-old woman with large hepatitis B-related hepatocellular carcinoma (HCC) in her right lobe was transferred to our hospital for surgical treatment. Preoperatively predicted FLR by a CT scan was 21% and type II portal vein anomaly was detected. A totally laparoscopic approach was planned. During the first stage operation, right anterior and posterior portal veins were meticulously dissected and tied. After parenchymal transection by the "anterior approach" technique, two glissonian pedicles of the right liver were individually isolated. A composite mesh graft was used to prevent severe adhesion on both liver partition surfaces. During the second-stage operation, 9 days after the first stage operation, the two isolated glissonian pedicles were initially transected. After full mobilization of the right lobe, the right hepatic vein was also transected. The right lobe was removed through the Pfannenstiel incision. She was discharged 7 days after the second stage operation. Her postoperative course was uneventful and there was no HCC recurrence for 15 months after hepatectomy. A totally laparoscopic ALPPS procedure can be a feasible technique that ensures patient safety and oncologic superiority, even in patients with complicated anatomical variation. ([Ann Hepatobiliary Pancreat Surg 2017;21:217-222](#))

Key Words: Associating liver partition and portal vein ligation for staged hepatectomy; Hepatocellular carcinoma; Portal vein anomaly; Liver cirrhosis; Future liver remnant; Anterior approach

INTRODUCTION

Small liver remnant volume in hepatocellular carcinoma (HCC)-related liver cirrhosis is associated with significant morbidity and mortality, and it is the main limiting factor for hepatic resection.¹⁻³ To increase the resectability and to reduce the incidence of postoperative complications, it is necessary to increase the volume and function of the planned future liver remnant (FLR).⁴ The associating liver partition and portal vein ligation (ALPPS) procedure was introduced as a potential solution to perform extended resection safely by inducing pre-resection liver hypertrophy in patients with multifocal liver cancer

or non-resectable liver tumors.⁵ But, this technique has a high complication rate and a mortality rate between 12% and 27% according to the initial reports on ALPPS. Because ALPPS consists of an extensive first stage procedure that includes hepatic parenchymal transection combined with portal vein ligation, the complication rate may be higher regardless of successful pre-resection liver hypertrophy. Hence, efforts should be made to reduce the morbidity and mortality while maintaining a more rapid FLR hypertrophy. Laparoscopic surgery is known to alleviate the surgical stress and the systemic inflammatory response to all surgeries.⁶ Therefore, total or partial use of laparoscopy may help to reduce the surgical difficulties

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caused by severe adhesions that will be encountered in the second stage.⁷ The laparoscopic intrahepatic glissonian approach for right hepatectomy is a safe and feasible technique,⁸ but in ALPPS, which requires separate ligation of the portal vein, portal vein variations can pose significant technical demand.

We describe the technical aspects of a totally laparoscopic ALPPS using the anterior approach in a HCC patient with Type II portal vein anomaly.

CASE

A 44-year-old-woman with hepatitis B-related HCC was referred to our hospital. At admission, hepatitis B virus-DNA level was 1.82×10^6 IU/ml. But, she had a relatively well-preserved liver function according to the laboratory tests which showed a serum total bilirubin level of 0.53 mg/dl (normal range, <1.2 mg/dl), aspartate aminotransferase (AST) level of 67 U/L (normal range, <32 U/L), albumin level of 4.1 g/dl (normal range, 3.5-5.2 g/dl), and prothrombin time international normalized ratio (INR) of 0.99 (normal range, 0.85-1.5). Serum creatinine level was 0.71 mg/dl (normal range, 0.6-1.3 mg/dl) and the model for end-stage liver disease (MELD) score was 6. Computed tomography (CT) revealed an 8-cm heterogeneous enhancing mass abutting the right hepatic vein

and wash out in the delayed venous phase in the right lobe of the liver (Fig. 1A). There were no evidences of ascites and portal hypertension. Alpha-fetoprotein (AFP) level and protein induced by vitamin K absence or antagonist-II (PIVKA-II) level were markedly elevated to 8,423 ng/ml (normal range, <7 ng/ml) and 100,000 mAU/ml (normal range, <40 mAU/ml), respectively. Volumetric CT scan of the liver showed insufficient FLR (remnant left lobe with volume: 213 ml; FLR/total liver volume: 21.9%; FLR/standard liver volume: 20.5%) after right hepatectomy, which indicated that anatomical liver resection with an adequate surgical resection margin was inappropriate for the patient. The anatomic variation of the hepatic portal vein branching was identified as the trifurcation type (Type II) (Fig. 1B).⁹

Surgical procedures

Laparoscopic ALPPS procedure using the anterior approach was planned to induce rapid hypertrophy of the FLR.

In the first stage, the patient was placed in the left semi-lateral decubitus position with the right side elevated approximately 30 degrees. Five trocars were used. The first trocar (12 mm) was inserted in the upper umbilicus for placement of a 10-mm flexible 3-dimensional laparoscope. Four other trocars were placed 2 cm below

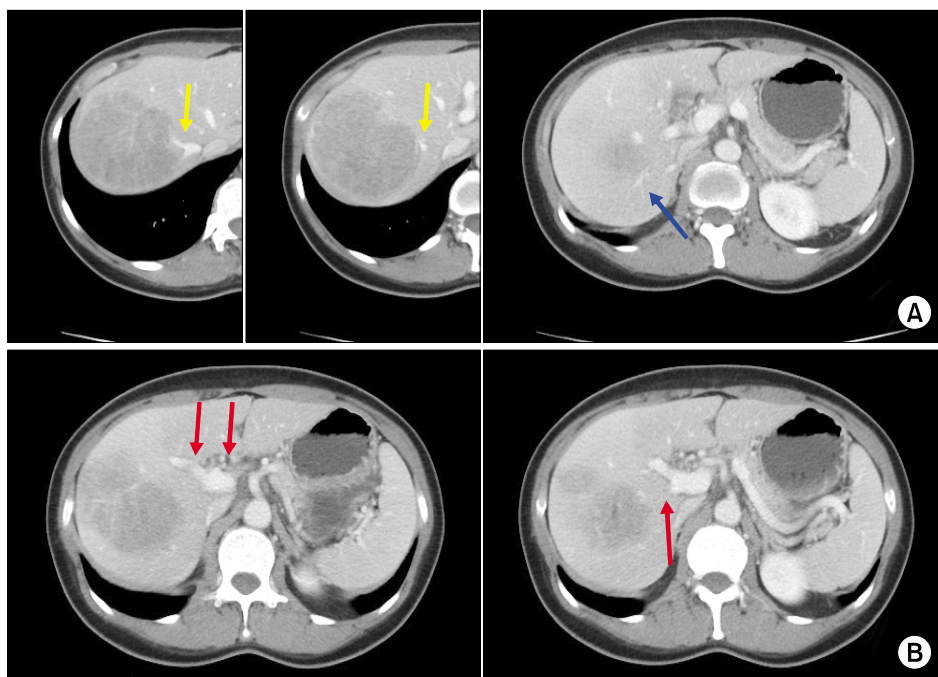


Fig. 1. Preoperative computed tomography scan shows a large mass abutting the right hepatic vein (yellow arrow) and the right posterior portal vein (blue arrow) (A) and type II portal vein (red arrow) anomaly (B).

the costal margin on the right midclavicular line (12 mm), 2 cm below the costal margin on the right axillary line (5 mm), in the subxiphoid position (5 mm), and 2 cm below the costal margin on the left midclavicular line (5 mm). After exploration, a cholecystectomy was performed. The right side of the hepatoduodenal ligament was dissected with lymphadenectomy for the exposure of the hilar structures. The right posterior portal vein and the right anterior portal vein were identified and isolated by meticulous dissection, and preservation of the right anterior and posterior hepatic arteries was also confirmed (Fig. 2A). Without liver mobilization, parenchymal transection was performed along the line that was demarcated after ligation of the right anterior and posterior portal veins and temporary clamping of the hepatic artery. Liver transection was performed using the Cavitron Ultrasonic

Surgical Aspiration (CUSA) and energy-source device (Sonicision[®]; Covidien, Boulder, US) from the anterior surface of the liver to the anterior surface of the inferior vena cava, which was completely exposed. A composite mesh graft was attached to the transection surface of the right liver (Fig. 2C) and a closed suction drain was placed between the transection surfaces to prevent fluid collection including biloma.

CT scan of the liver, which was performed 7 days after the first stage operation, demonstrated that the right anterior and posterior hepatic arteries were patent and the right anterior and posterior portal veins were appropriately ligated. The left portal vein, the left hepatic artery and the middle hepatic vein were well preserved for future liver remnant (Fig. 3).

The second stage operation (Fig. 4) was performed 9

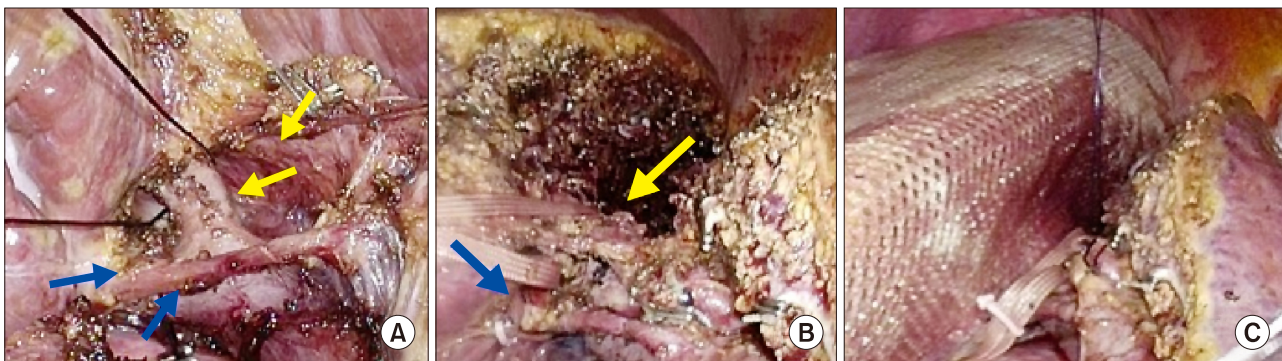


Fig. 2. The first stage operation findings. The right posterior portal vein and the right anterior portal vein were meticulously dissected and preservation of the right anterior and posterior hepatic arteries was also identified (A). After liver parenchymal transection using the anterior approach technique, the right anterior and posterior glissonian pedicles were separately isolated (B). A composite mesh graft was used to minimize adhesions between both transected cut surfaces (C). (Blue arrow, right posterior portal vein and hepatic artery; Yellow arrow, right anterior portal vein and hepatic artery).

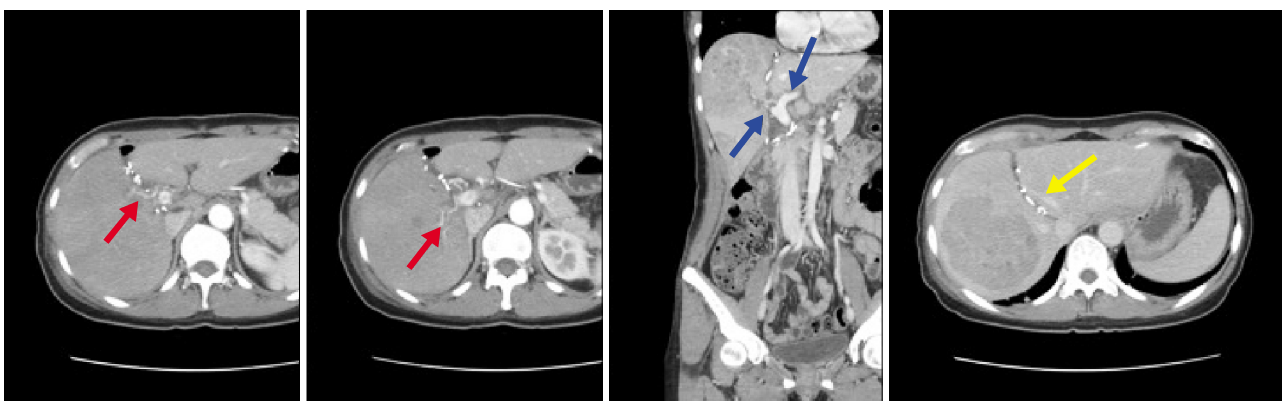


Fig. 3. Computed tomography scans 7 days after the first stage operation show intact right anterior and posterior hepatic arteries (red arrow), an adequately ligated right portal vein and a patent left portal vein (blue arrow), and a well-preserved middle hepatic vein (yellow arrow).

days after the first stage operation and the same trocar sites were used as in the first laparoscopic approach. Initially, the right anterior and posterior glissonian pedicles, which had been isolated during the first stage operation, were transected with laparoscopic staplers, respectively. Next, multiple right inferior hepatic veins were transected with Hem-O-lok clips. The transected right liver was fully mobilized and the right hepatic vein was finally transected with a laparoscopic stapler. The specimen was removed through the Pfannenstiel incision.

The time for the first-stage operation was 260 min and the time for the second-stage operation was 130 min. During the two stage operation, blood transfusion was not necessary.

Changes in functional liver remnant volume and liver function

After the first stage operation, her liver function test gradually improved until reaching the normal range. CT scan 7 days after the first stage operation showed a sig-

nificant increase in FLR (remnant left lobe with volume: 339 ml; FLR/total liver volume: 30.2%; FLR/standard liver volume: 32.6%). FLR growth was 60% in 6 days. Liver function of the patient, including aspartate aminotransferase, alanine aminotransferase, total bilirubin and prothrombin time after the first stage operation, gradually improved (Fig. 5). The volume of the remaining left liver continuously increased after the second stage operation, and it was confirmed that the volume increased to 403 ml at 7 days and 604 ml at 2 months after the second stage operation. More stable liver function was obtained after the second stage operation (Fig. 5).

Postoperative course

Postoperative liver function of this patient steadily improved and complications did not occur. The patient was discharged 7 days after the second stage operation and she had recovered well. On follow-up at postoperative 15 months, imaging studies including a CT scan revealed no tumor in the remnant liver, and AFP and PIVKA II levels

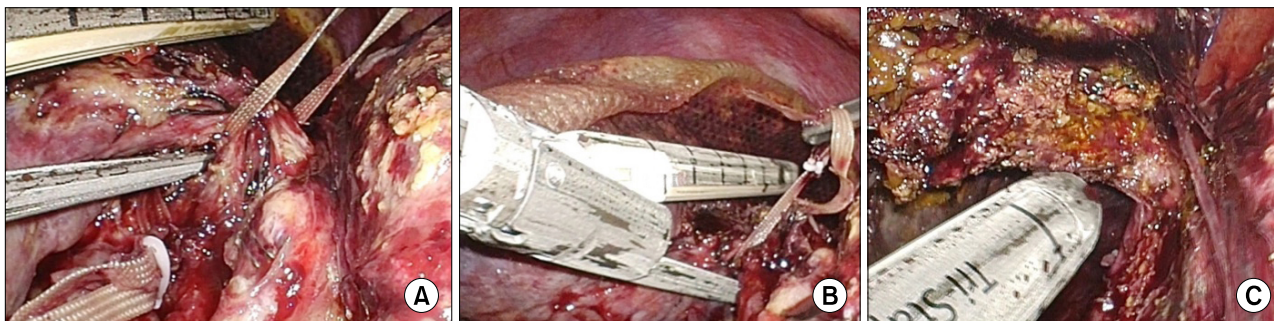


Fig. 4. The second stage operation findings. The right anterior glissonian pedicle (A) and the posterior glissonian pedicle (B) were sequentially transected with laparoscopic staplers (A). Finally, the right hepatic vein (C) was transected.

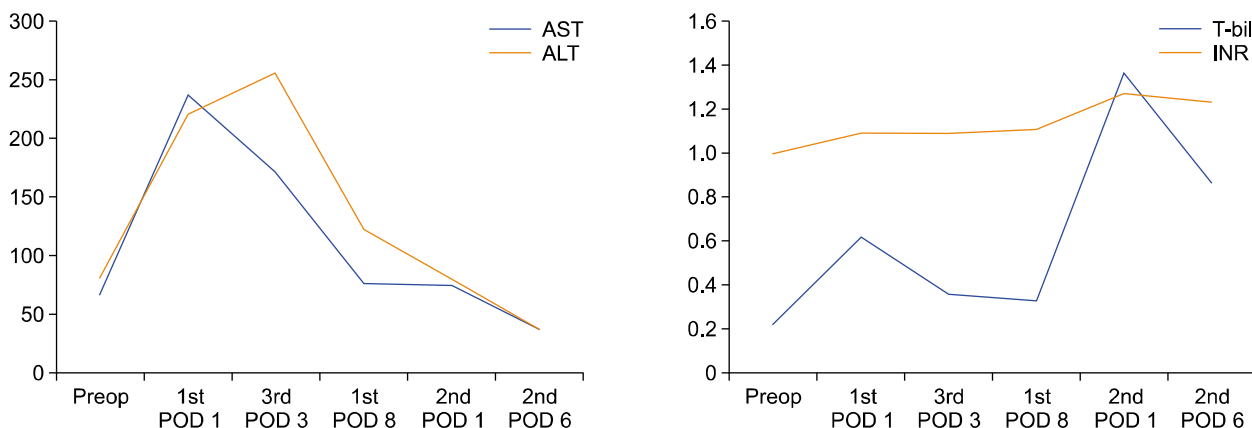


Fig. 5. Postoperative liver function.

were 7.2 ng/ml and 17.07 mAU/ml, respectively, which indicated an absence of tumor recurrence.

DISCUSSION

In patients who require an increase in volume of the planned future liver remnant to enable a potentially curative resection, induction of hypertrophy of the tumor-free lobe prior to resection may mitigate morbidity and mortality.⁴ Preoperative portal vein embolization or ligation has been commonly used to achieve hypertrophy of remnant liver volume. But, these techniques are associated with some problems, including delay (between 3 and 8 weeks)^{10,11} or the absence of hypertrophy and the risk of tumor progression between the two stages. The delay or absence of sufficient hypertrophy may be related to the formation of intrahepatic vascular collaterals. Hence, a few reports have suggested that simultaneous occlusion of the intrahepatic collateral circulation and portal vein allows a rapid FLR growth of 40% to 160% in only 6 to 9 days.^{4,12-15} We were also able to complete this hepatectomy with a much shorter interval of 9 days between the first and second stage operations.

ALPPS can achieve rapid FLR hypertrophy. However, the reported mortality in the initial series from Germany was 12% and 15% in a subsequent multi-centric analysis, reaching a rate of even 27% in experienced hepatobiliary centers.^{5,16,17} Extensive experience of laparoscopic liver resection suggests that laparoscopy may reduce operative severity and complications such as blood loss, adhesion, and bile leakage.^{18,19} Machado and colleagues believed that laparoscopic ALPPS, as an easy solution for adhesions and difficulties that may be encountered during the second stage, is feasible and does not appear to be inferior to the open approach in experienced hands.^{7,20} The treatment of the cut surface of the “deportalized” part of the liver and the use of devices to reduce adhesions for the second stage operation are significant points of concern. The use of foreign bodies such as plastic bags or sheets around the liver, as a solution to avoid adhesions and facilitate the second stage, requires a reoperation for their removal, even if the second stage operation cannot be performed because of clinical complications or insufficient hypertrophy of the remnant liver.⁷ Keeping this in mind, we used a composite mesh which offers a collagen barrier

on one side to limit visceral attachment and is able to completely avoid adherence to the cut surface of the remnant liver.

Laparoscopic ALPPS was introduced as the default procedure for patients with very small FLR, and it is a very recent but a quite promising technique.²⁰ Laparoscopy reduces the extent of surgery and can minimize the risk of vascular or biliary injury because of the optimal visualization of the transection area.¹⁹ However, extensive dissection of the hepatic hilum is essential for ligation of the portal vein and preservation of the hepatic artery. Awareness regarding the variations in portal vein branching patterns is very important in order to avoid major catastrophic events during laparoscopic hepatectomy. We believe that the magnification achievable via laparoscopy considerably facilitates separate dissection of the right hepatic pedicle with improvement in laparoscopic surgical skills and surgical instruments.

ALPPS was supposed to be an “all-touch” technique that would reduce the oncologic treatment efficacy for liver malignancy.¹⁶ But, totally laparoscopic associating liver tourniquet and portal ligation for staged hepatectomy via the anterior approach for cirrhotic HCC²¹ and totally laparoscopic ALPPS, conforming to the “No-Touch” principle²² were reported. We experienced that laparoscopic ALPPS using the anterior approach technique could be a less invasive procedure that provides improved surgical and survival outcomes.

In conclusion, ALPPS has emerged as a new strategy to increase the resectability of hepatic malignancies. Laparoscopic ALPPS using the anterior approach technique can provide a minimally invasive modification as a “no-touch technique” that has greater oncologic efficacy. The laparoscopic ALPPS technique seems to be feasible and safe in the hands of surgeons with expertise, even in patients with anatomical variation of the liver.

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