

Associating microwave ablation and portal vein ligation for staged hepatectomy for the treatment of huge hepatocellular carcinoma with cirrhosis

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Associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) could induce extensive and rapid future liver remnant hypertrophy. However, the morbidity for ALPPS is very high. This paper reports a modified ALPPS (associating microwave ablation and portal vein ligation for staged hepatectomy, AMAPS), which was successfully applied in the treatment of huge hepatocellular carcinoma with cirrhosis, and the procedure of operation was greatly simplified. Hence, AMAPS is feasible and safe in selected patients with primary hepatocellular carcinoma and cirrhosis.

[Ann Surg Treat Res 2016;90(5):287-291]

Key Words: Hepatectomy, Hepatocellular carcinoma, Liver cirrhosis

INTRODUCTION

Since the article about associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) was published in March 2012 [1], this novel technique has been drawing the attention of surgeons. Although it had been demonstrated that ALPPS could induce extensive and rapid future liver remnant (FLR) hypertrophy [1,2], the morbidity form ALPPS was as high as 33% to 64% [3]. To decrease the morbidity rate and simplify the procedure of ALPPS, we performed a modified ALPPS, which used microwave ablation to replace the *in situ* splitting of the liver. We named this novel technique "AMAPS" (associating microwave ablation and portal vein ligation for staged hepatectomy). This paper demonstrates that AMAPS was successfully applied in the treatment of huge hepatocellular carcinoma with cirrhosis.

CASE REPORT

A 43-year-old man (weight, 60.0 kg; height, 171.0 cm; body mass index, 20.5 kg/m²) was admitted to our hepatopancreatobiliary surgery department, an asymptomatic 14.0-cm mass in the right liver was diagnosed by ultrasound. The patient was infected by chronic HBV 20 years prior. The α -FP level was 1,000.00 ng/mL and the liver function was normal (Child-pugh A). CT scan showed that the liver was cirrhotic with a huge lesion in the right liver, which was considered as hepatocellular carcinoma, and a small lesion in the left liver was a typical hemangioma (Fig. 1). The FLR volume was calculated to be 356.0 cm³ (29.1% of 1,223.3 cm³ of the stander liver volume) based on the preoperative CT scan. It is reported that an FLR >30% of the stander liver volume is considered as a safe scope for hepatoectomy [4]. However, our criteria is FLR >45% of the stander liver volume for patients with cirrhosis. Given the high risk of postoperative liver failure for the patient, a 2-stage surgery should be adopted to increase the

Received December 8, 2015, Revised January 23, 2016,
Accepted March 2, 2016

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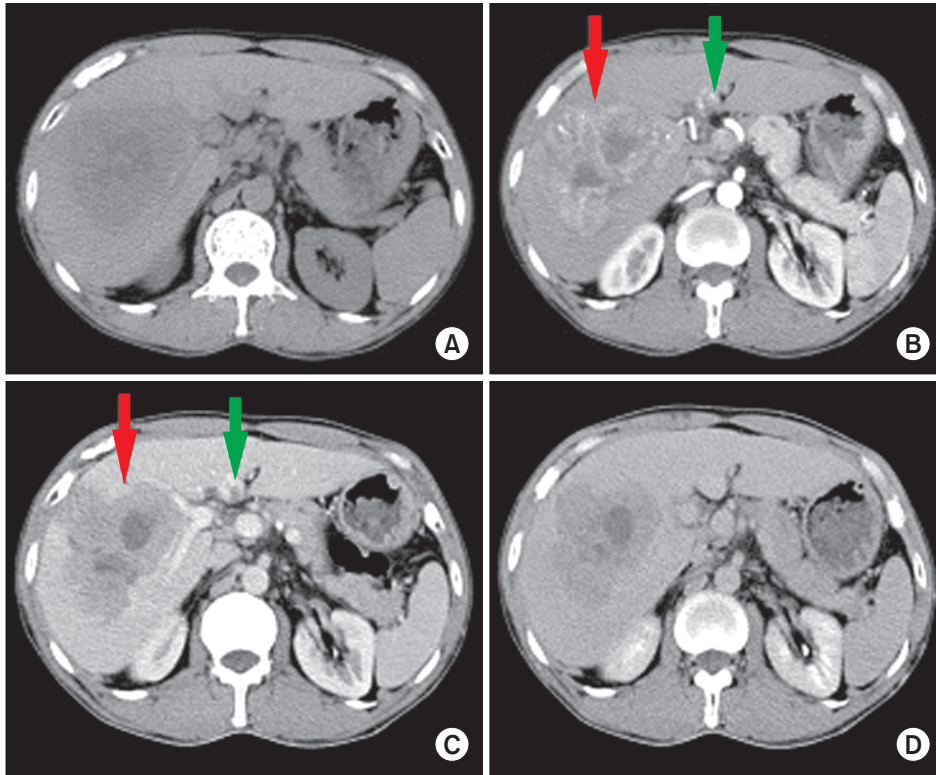


Fig. 1. The preoperative CT scan showed a huge hepatocellular carcinoma in the right liver (red arrow), and a typical hemangioma in the left liver (green arrow). (A) The plain CT scan. (B) The hepatic arterial phase. (C) The portal venous phase. (D) The equilibrium phase.

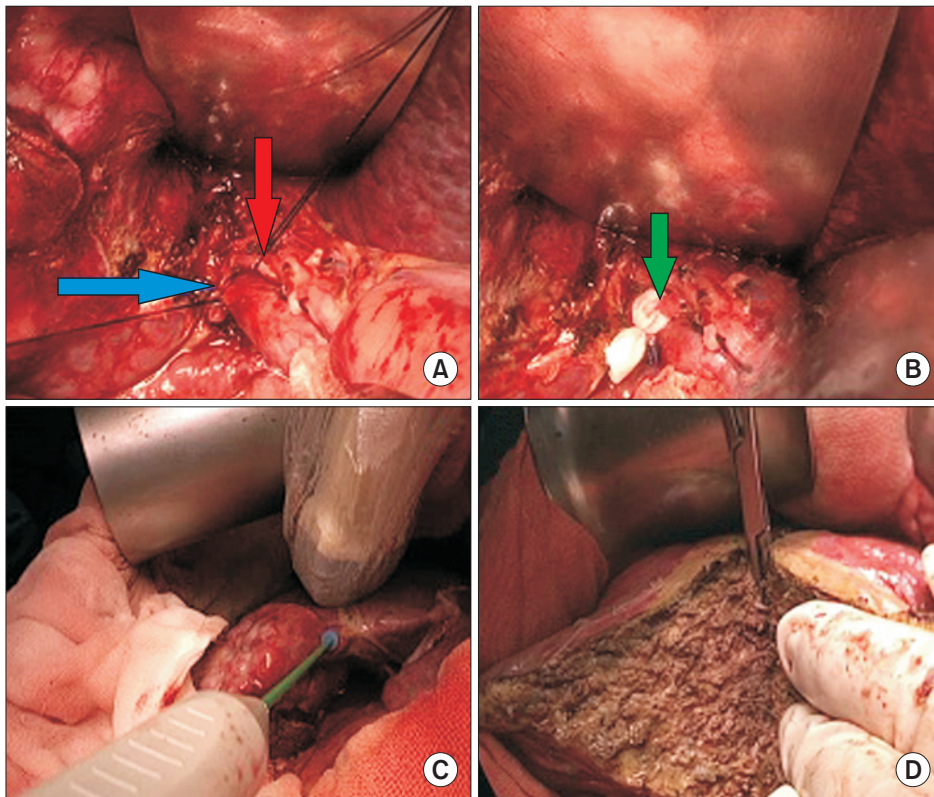


Fig. 2. Surgical procedure. (A) The hepatic pedicle was dissected, the right hepatic artery (red arrow) and the right portal vein (blue arrow) were isolated in the first-stage operation respectively. (B) The right hepatic artery was tagged by the homemade rubber strip in the first-stage operation (green arrow). (C) The microwave ablated the future transection plane with the ultrasound-guided in the first-stage operation. (D) The bloodless blunt liver resection in the second-stage operation.

FLR. Although compared with portal vein embolization, ALPPS provides a better chance of complete resection for patients with primarily unresectable liver tumor, the morbidity from ALPPS was very high [2]. Thus, we decided to perform an AMAPS (a modified ALPPS) for this patient.

In the first stage of operation, abdominal laparotomy was performed under general anesthesia. After abdominal exploration and cholecystectomy, the right hepatic pedicle was dissected carefully, and the right hepatic artery was isolated and tagged with the homemade rubber strip, which also reduced adhesion around the right hepatic artery by the large flat area. Then, the right portal vein was freed and ligated (Fig. 2A, B). After the falciform ligament was divided, the future transection plane was marked with ultrasound guiding. The microwave antenna, which was guided by ultrasound, was inserted into the liver parenchyma on the right future transection plane, setting a 4-minute and 70 watts output cycle (Fig. 2C). This manner was repeated step by step every 2.5 cm to create an avascular groove along the future transection plane.

The duration of the first-stage operation was 210 minutes with a blood loss of 100 mL with no need for blood transfusion or intensive care unit (ICU) admission. The postoperative FLR was re-evaluated by CT scan weekly. The FLR was estimated at 430.6 cm³ (35.2% of the stander liver volume) after 1 week, and was increased to 500.3 cm³ (40.9% of the stander liver volume) after 2 weeks. On postoperative day 20, the volume of left hepatic was increased to 626.3 cm³ (51.2% of the stander liver

volume; FLR increase 75.9%; daily FLR increase 13.5 cm³/day), without any metastatic tumors (Fig. 3).

The second-stage operation was performed 21 days after the first-stage operation. Little adhesion was found during the laparotomy. The right hepatic artery was easily identified and divided through the homemade rubber tag. The right portal vein was found below the right hepatic artery and was divided. Then, a bloodless blunt liver resection was performed along the future transection plane with an anterior approach (Fig. 2D). The right biliary duct was indentified and sutured during the parenchymal transection. The median and right hepatic veins were divided and sutured last.

The duration of the second-stage operation was 100 minutes with a blood loss of 200 mL, and there was no need for blood transfusion or ICU admission. The result of pathology demonstrated a hepatocellular carcinoma with poor differentiation, and the resection margin was tumor-free (R0). The patient recovered without any complications and was discharged on postoperative day 7. No tumor relapse or metastasis was detected (Fig. 4), and the α -fetoprotein level was normal at three months after the surgery.

DISCUSSION

In 2012, Schnitzbauer et al. [1] report a 24% bile leakage and 12% 90-day mortality for ALPPS. Because of the high occurrence rate of bile leakage, the safety of ALPPS has been

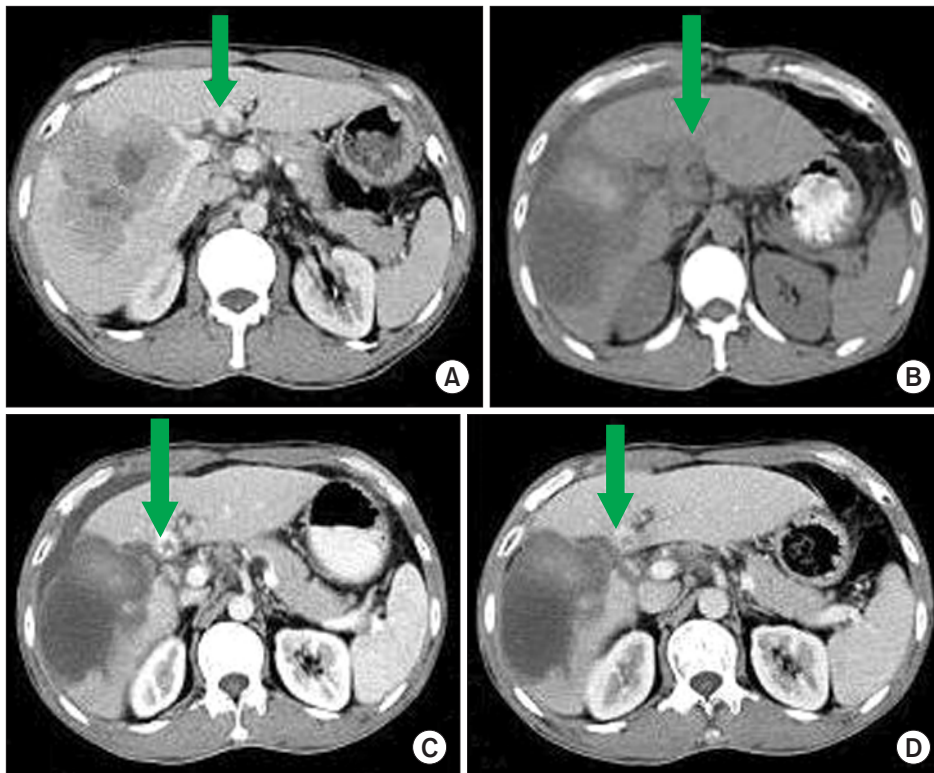


Fig. 3. Comparison of the future liver remnant at different time after the first-stage operation. (A) The preoperative CT image. (B) The image after 1 week. (C) The image after 2 days. (D) The image after 20 days. All images were at the same layer with the marker of hemangioma in the left liver (green arrow).

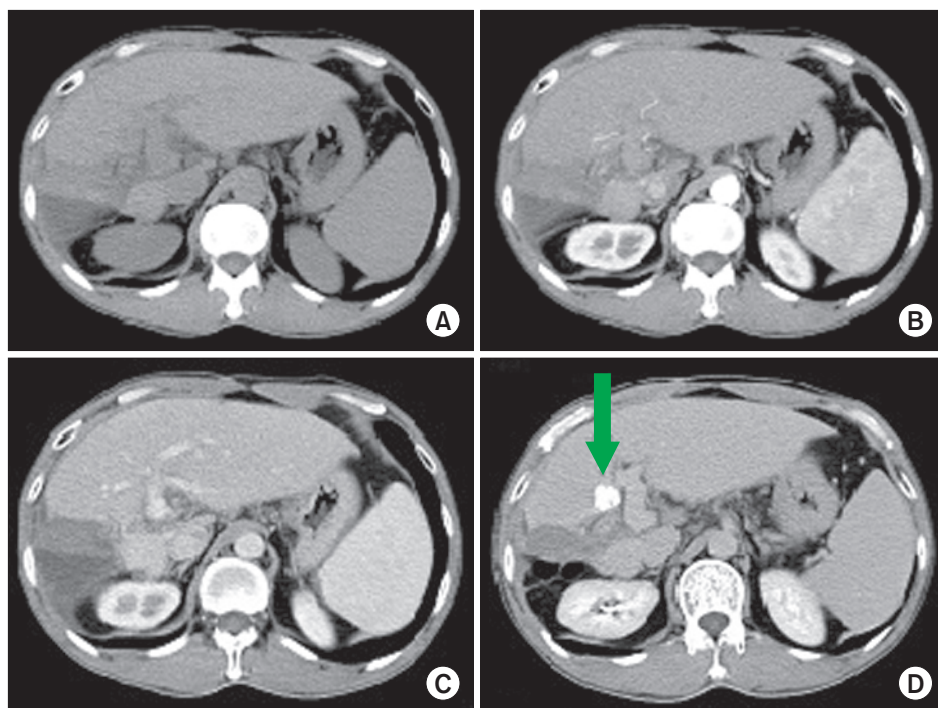


Fig. 4. Follow-up computed tomography scan 3 months later showed no recurrence or metastasis. The left liver lesion with high density was hemangioma (green arrow). (A) The plain CT scan. (B) The hepatic arterial phase. (C) The portal venous phase. (D) The equilibrium phase.

questioned by some surgeons [5]. Thus, some modified ALPPS have been performed, such as using tourniquet to ligate the future transection plane, which replaced the *in situ* splitting of the liver [6,7]. Although this method could help avoid the complication of bile leakage, it requires creating a hole between the right hepatic vein and the liver surface in the first-stage operation, which increases the risk of hemorrhage, and requires more skillful surgeons. Compared with this method, our AMAPS not only avoided postoperative bile leakage, but also reduced the risk of hemorrhage, as it does not require dissection of the hepatic vein in the first-stage operation. Furthermore, as microwave ablation creates an avascular groove, it might greatly simplify the procedure and decrease surgical trauma in the second-stage operation, which finally led to a better recovery.

Another potential advantage of our method would be to better meet the "no-touch" standard. By our method, we only microwave ablated the transection plane under ultrasound guiding, which did not require dissection of the second hepatic hilum or the right coronary ligament or the right triangular ligament. That could at most avoid tumor-touch. It might improve the prognosis of the patients.

To our knowledge, this is the third case of microwave abla-

tion applied in the ALPPS. The previous two cases were performed successfully without serious complications as well. [8,9]. However, unlike their cases, our patient had a comorbidity of cirrhosis, which could increase the risk of postoperative liver failure. Thus, we did not perform the second-stage operation until the FLR increased to 51.2% of the standard liver volume. In the report of Cillo et al. [9], the FLR increased 35 cm³/day in a patient who was diagnosed with liver metastases and underwent microwave ablation assisting ALPPS, but the FLR hypertrophy was only 13.5 cm³/day in our patient. The major reason for this difference should likely be the comorbidity of liver cirrhosis. Thus, when AMAPS is applied in patients with cirrhosis, a longer time should be provided for liver regeneration.

In conclusion, AMAPS is feasible and simplified in selected patients with primary hepatocellular carcinoma and cirrhosis. Further studies are needed to evaluate this modified ALPPS.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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