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CASE REPORT

# Extracorporeal Hepatic Resection and Autotransplantation Using Temporary Portocaval Shunt Provides an Improved Solution for Conventionally Unresectable HCC

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Hepatic resection is the gold-standard treatment for hepatocellular carcinoma (HCC). In East Asia, however, only 20 % of patients with HCC are eligible for hepatectomy [1]. In a small subset of patients, surgical resection using conventional techniques is extremely challenging. In these marginal cases, the tumor size, extension of the lesion, and proximity of the tumor to critical structures are important factors determining how to proceed. For tumors considered unresectable by conventional means, extracorporeal hepatic resection with autotransplantation (ECHRA) has been proposed to be an alternative [2].

ECHRA has been used to treat hepatic pathologies including giant hemangioma [3], liver metastases [4], and sarcomas [2]. However, few studies have reported on its application as a treatment for HCC [5]. Herein we report a case series involving three consecutive patients with HCC who were successfully treated with ECHRA as curative therapy for otherwise unresectable HCCs.

## Patient Selection and Pre-operative Evaluation

In 2011, ECHRA was performed in three patients with liver tumors at anatomically critical locations that were deemed technically impossible to resect (Fig. 1). Patient characteristics and indications for this technique are outlined in Table 1. To ensure sufficient liver function after liver resection, we estimated pre- and post-operative liver volumes using 3-D computed tomography volumetry. Indocyanine green (ICG) test was performed in selected patients. None of the patients showed evidence of portal hypertension.

## Surgery

ECHRA was performed as described previously with minor modifications [6]. Unlike previous reports, we employed temporary portocaval shunt during the anhepatic period (Fig. 2). In patients with tumor-invaded major vasculature, the vessel wall was pared and reconstruction with a venous patch harvested from the explanted liver (Fig. 3). Details of the surgery are given in Table 2. The affected segments of liver were resected after total hepatectomy and the autograft was re-implanted orthotopically. Pathology evaluation confirmed all three tumors to be HCC.

## Results and Outcome

The outcomes are outlined in Table 3. Patient 3 had major complications included postoperative biliary leakage and intra-abdominal abscess, which were treated with endoscopic retrograde cholangiopancreatography and surgical drainage of the abscess, respectively. There was no hospital mortality.

Two of the three patients experienced tumor recurrence 8 months after the operation. Patient 2 was treated with radiofrequency ablation while the other was treated by transarterial chemoembolization. All patients are currently alive with stable disease at the most recent follow-up.

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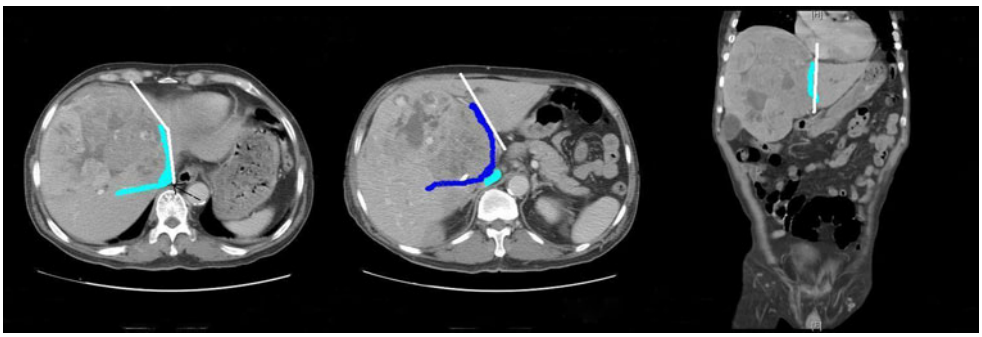

**Fig. 1** CT images of case series. **a** Large liver tumor with compression of the IVC (*arrow*), left hepatic vein and right hepatic vein. The middle hepatic vein has been obscured. The resection line (*white line*) follows the left hepatic vein. **b** Both the portal vein (*navy blue*) and IVC (*dark blue*) are compressed by the tumor. The resection line in this view follows the left portal vein. **c** Coronal illustration of the resection line (*white line*)

**Table 1** Patient characteristics

| Patient characteristics | Patient 1 | Patient 2 | Patient 3 |
|---|---|---|---|
| Age | 67 | 71 | 60 |
| Sex | M | M | M |
| ECOG | 0 | 0 | 0 |
| Pre-operative data | | | |
| Hepatitis history | Non-B/C, alcoholism | Hepatitis B | Hepatitis C |
| AFP (ng/ml) | 357.59 | >270,000 | 24.25 |
| Platelet count (/μl) | $227 \times 10^3$ | $335 \times 10^3$ | $380 \times 10^3$ |
| INR | 1.22 | 1.28 | 0.93 |
| Evidence of PH | No | No | No |
| Tumor characteristics | | | |
| Maximum diameter (cm) | 18 × 12 | 18 × 13 | 5.8 × 6.8 |
| Tumor location | S 1, 4, 5, 7, 8 | S 2, 3, 4, 5, 8 | S 4, 5, 8; Satellite S7 |
| Indication for ECHRA (vascular involvement/tumor location) | At confluence of LHV, MHV, IVC | At confluence of V7/ RHV into IVC | Centrally located, involve RHV, PV |
| Remnant liver volume (%)[a] | 44.26 | 34.46 | 51.00 |

*ECOG* Eastern Cooperative Oncology Group performance status, *PH* portal hypertension, *S* liver segment, *LHV* left hepatic vein, *MHV* middle hepatic vein, *IVC* inferior vena cava, *V7* hepatic vein to segment 7, *RHV* right hepatic vein, *PV* portal vein

[a] Ratio of remnant liver volume and standard liver volume

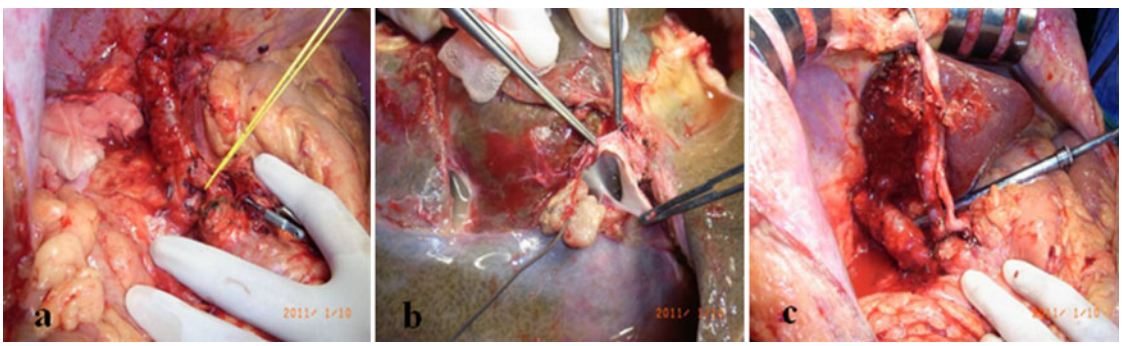


**Fig. 2** **a** Temporary portocaval shunt used during the anhepatic period. **b** Tumor thrombus found in the confluence of the hepatic veins. **c** Re-implantation of the graft

To date, the only large series involving ECHRA was reported by Oldhafer et al. [7]. The difficulty of the surgical technique and the high perioperative and postoperative morbidity impede surgeons from using this procedure. We are the first institution to use preoperative liver volumetry to prevent postoperative hepatic failure, the most serious

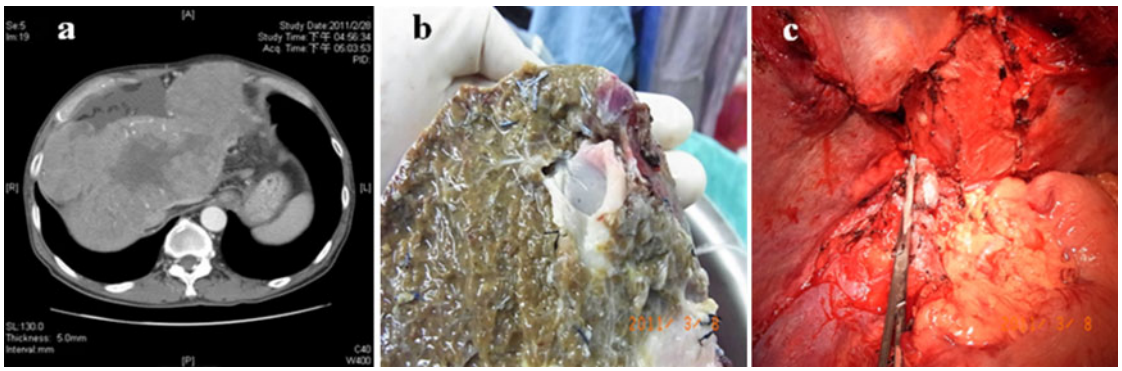


**Fig. 3** **a** Large HCC compressing the juncture of left hepatic vein and IVC. **b** Part of the IVC wall was excised and repaired with a venous patch (*arrow*). **c** Unification of V7 and right hepatic vein, which was later widened with a venous patch

**Table 2** Operation characteristics

| Operation (OP) details | Patient 1 | Patient 2 | Patient 3 |
|---|---|---|---|
| Replanted graft segments | S 2, 3, and partial S 4 | S 5–8 | S 2, 3, and S 6, 7 |
| Graft weight (g) | 440 | 696 | 961 |
| Blood loss (ml) | 1,500 | 5,300 | 7,000 |
| Cold ischemic time (min) | 120 | 202 | 162 |
| Warm ischemic time (min) | 40 | 14 | 43 |

complication. The preoperative evidence of preserved liver function and without liver cirrhosis or portal hypertension were other determinants for a good outcome. The three patients did well after the operation. In the literature reporting patients with HCC receiving ECRHA, our first patient had the longest survival [5, 7].

Unlike other studies, we used a temporary portocaval shunt instead of venovenous bypass to facilitate hemodynamic stability during the anhepatic period. Temporary portocaval shunts have been shown to improve hemodynamic status, reduce requirement of intraoperative blood transfusion, and preserve renal function during orthotopic liver transplantation [8]; however, it has not been reported to be used in ECHRA. We believed that the relatively short cold ischemic time and preservation of the inferior vena cava enhanced the functionality of the temporary portocaval shunt during the anhepatic period.

**Table 3** Postoperative data

| Post-op data | Patient 1 | Patient 2 | Patient 3 |
|---|---|---|---|
| ICU days (days) | 8 | 7 | 8 |
| Length of stay (days) | 30 | 22 | 39 |
| Ishak score | 3 | 3 | 4 |
| Metavir fibrosis score | F2 | F2 | F3 |
| Post-op complication | 1. Sepsis | 1. Sepsis | 1. Sepsis |
| | 2. Transient hepatic insufficiency | 2. Transient hepatic insufficiency | 2. Transient hepatic insufficiency |
| | | | 3. Biliary leakage |
| | | | 4. Intra-abdominal abscess |
| Intervention | None | None | ERCP for biliary leakage |
| Reoperation | None | None | Laparotomy for drainage of abscess |
| Long-term follow-up | | | |
| Recurrence | None | In post-op 8 month | In post-op 8 month |
| Management for recurrence | None | RFA | TACE |
| Current status | Alive (28 months) | Alive (26 months) | Alive (23 months)[a] |

*RFA* radiofrequency ablation, *TACE* transarterial chemoembolization

[a] Alive until May, 2013

## Conclusions

ECHRA represents an additional surgical option in the treatment of unresectable hepatic tumors, including HCC. In addition, the use of a temporary portocaval shunt is a feasible alternative to venovenous bypass during the anhepatic period.



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