

Extended central hepatectomy with preservation of segment 6 for patients with centrally located hepatocellular carcinoma

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BACKGROUND: In order to preserve functional liver parenchyma, extended central hepatectomy (segments 4, 5, 7 and 8 resection) was proposed for the management of centrally located hepatocellular carcinoma invading the right and middle hepatic veins, reconstructing segment 6 outflow in the absence of the thick inferior right hepatic vein. The present study was to describe our surgical techniques of extended central hepatectomy.

METHODS: Between 2008 and 2012, 5 patients with centrally located hepatocellular carcinoma invading or in the vicinity of the right and middle hepatic veins underwent extended central hepatectomy. The thick inferior right hepatic vein was preserved during dissection. Gore-Tex graft was used for segment 6 outflow reconstruction in the absence of the thick inferior right hepatic vein.

RESULTS: The mean future remnant liver volume for segments 2 and 3 was 28% versus 45% on segment 6 preservation. The mean tumor diameter was 7.4 cm. The thick inferior right hepatic vein was found in 1 patient. Outflow reconstruction from segment 6 was performed in 4 patients. Postoperative complications included bile leakage (1 patient), pleural effusion (2) and liver failure (1). The rate of graft patency was 75%. There was no perioperative mortality.

CONCLUSION: Extended central hepatectomy is a safe alternative for extended hepatic resection in selected patients attempting to preserve the functional liver parenchyma.

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KEY WORDS: hepatectomy;
hepatic vein thrombosis;
hepatocellular carcinoma;
liver cirrhosis;
liver imaging

Introduction

Surgical management of centrally located hepatocellular carcinoma (HCC) is a challenging issue. Extended hemihepatectomy is considered to be the first curative option for the treatment of centrally located liver tumors.^[1, 2] However, hepatic resection for HCC in cirrhotic liver is associated with a high mortality rate primarily because of inadequate hepatocellular reserve and limited capacity for regeneration in case of cirrhosis.^[3, 4] Even with normal non-tumorous parenchyma, posthepatectomy liver failure (PHLF) may occur after extensive resection.^[5, 6] Hence, hepatic parenchyma preservation should be considered in each case, provided that oncological aspect is not severed.

Extended central hepatectomy (resection of Couinaud's segments 4, 5, 7 and 8^[7]) was proposed by Makuuchi et al^[8] for the management of centrally located HCC involving the right hepatic vein (RHV) and middle hepatic vein (MHV), depending on the thick inferior right hepatic vein (IRHV) for drainage of segment 6. However, the thick IRHV is present only in 20%-24% of cases.^[7, 9] Hence segment 6 venous outflow should be reconstructed when the RHV is divided and the IRHV is absent or not sufficient for drainage.^[10] Lessons learned

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from the anterior section drainage of right liver graft in living donor liver transplantation were the motive for outflow reconstruction in those patients with hepatic venous congestion that may result in serious complications like sepsis, liver failure, and even death.^[11] In this study, we described our techniques and outcomes of extended central hepatectomy with or without reconstruction of segment 6 outflow performed in 5 consecutive patients.

Methods

Between June 2008 and February 2012, 5 patients underwent central liver resections including Couinaud's segments 4, 5, 7 and 8^[7] in Kaohsiung Chang Gung Memorial Hospital by the same experienced surgeon. Data of the patients were collected prospectively and analyzed retrospectively. The mean follow-up period of the patients was 2 years.

Preoperative diagnosis and assessment

The preoperative work up for HCC in our patients was discussed in a previous report.^[12] Abdominal ultrasound, computed tomography (CT), magnetic resonance imaging (MRI) and hepatic angiography were used for the diagnosis of the patients. In patients without hepatitis, either serum alpha fetoprotein (AFP) level of >400 ng/mL or histopathological confirmation was needed in addition to typical imaging findings. After resection, diagnosis of HCC was confirmed by histopathological examination.

Criteria of resectability and eligibility

Criteria of resectability were absence of distant metastases, anatomically resectable lesion on preoperative imaging, absence of the main portal vein or inferior vena cava tumor thrombus and sufficient functional reserve as estimated by indocyanine green retention rate at 15 minutes (ICGR-15). Future remnant liver volume was estimated using CT volumetry and then standardized to the total liver volume (TLV), which was calculated from the patient's body surface area (BSA) using a mathematical formula $TLV (mL) = 706.2 \times BSA (m^2) + 2.4$.^[13]

Patients with tumors located in the right anterior and/or left medial section, invading or in the vicinity of the RHV and MHV with tumor-free Glissonian pedicle of the posterior section as confirmed on preoperative imaging and/or intraoperative Doppler ultrasonography (DUS) were considered for extended central hepatectomy (Figs. 1A and B, 2A and B). Patients were also selected for the procedure when the standardized future remnant liver volume (FRLV) was less than 30% if extended right

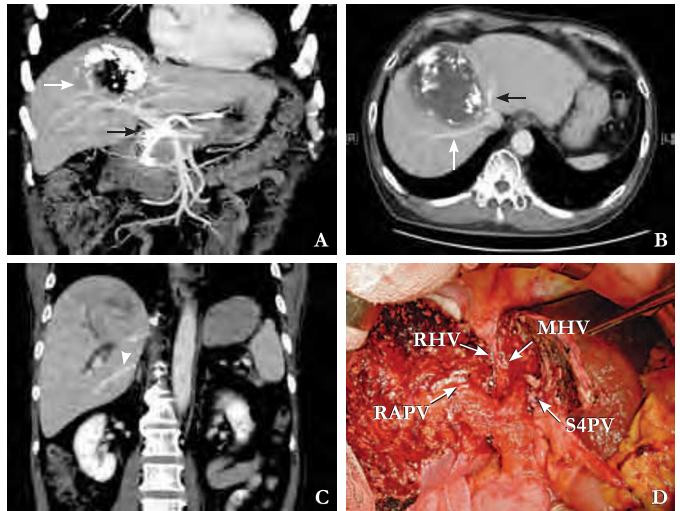


Fig. 1. Patient 1. **A:** Incomplete response to intra-arterial chemotherapy of tumor was shown (white arrow). The right and left portal veins were not invaded. The black arrow points to an intra-arterial chemotherapy catheter; **B:** The tumor in contact with the right hepatic vein (white arrow) and middle hepatic vein (black arrow); **C:** The thick inferior right hepatic vein (arrow head) shown by preoperative contrast enhanced CT; **D:** Vascular stumps after extended central hepatectomy. RHV: right hepatic vein; MHV: middle hepatic vein; RAPV: right anterior portal vein; S4PV: segment 4 portal vein.

hepatectomy was the selected procedure^[14] and this cut-off value was increased in case of cirrhosis.

No reconstruction of RHV was performed in case 1 because the thick IRHV was sufficient for segment 6 drainage (Fig. 1C). Outflow reconstruction from segment 6 was considered in cases lacking the thick IRHV, when cyanotic changes of segment 6 were noticed after transection of the RHV and when the absence of flow in segment 6 RHV remnant was confirmed by DUS.

Method of hepatectomy

Our surgical techniques for liver resection were described in a previous report.^[12] A reverse-L incision was used in all cases. We routinely performed DUS to define the limits of the tumor and to identify major vascular structures, diameter of the IRHV if existed, vascular invasion and lesions missed on preoperative evaluation. Mobilization of the right hemiliver was performed with preservation of the thick IRHV which was encircled and tapped. Hilar dissection was performed to identify right and left Glissonian pedicles. The area drained by the IRHV was estimated by inspecting the non-congested area on the posterior section on simultaneous clamping of the RHV and the right hepatic artery (RHA).

Because double transection plane usually takes more time than a single one, alternate clamping for inflow control was used in 3 cases, including the left Glissonian

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