

# Management of extensive retrohepatic vena cava defect in recipients of living donor liver transplantation

Shih-Chao Hsu<sup>1,2</sup>, Ashok Thorat<sup>2</sup>, Ping-Chun Li<sup>1,2,4</sup>, Kin-Shing Poon<sup>3</sup>, Chia-Hao Hsu<sup>1,2</sup>, Chun-Chieh Yeh<sup>1,2,4</sup>, Te-Hung Chen<sup>1,2</sup>, Horng-Ren Yang<sup>1,2,4</sup>, Long-Bin Jeng<sup>1,2,4</sup>

Department of Surgery<sup>1</sup>, Organ transplantation center<sup>2</sup>, Department of Anesthesiology<sup>3</sup>, China Medical University Hospital, Taichung, Taiwan, China Medical University<sup>4</sup>, Taichung, Taiwan

## Introduction

Certain complexities such as extensive vena caval injury, unexpected dense adhesions between liver & retrohepatic vena cava and liver tumour abutting retrohepatic vena cava sometimes warrants resection of vena cava during living donor liver transplantation. As donor graft is devoid of vena cava, reconstruction of retrohepatic cava is required which can be done either by using cryopreserved venous grafts or use of an artificial conduits. Apart from few published reports, the experience in vena cava reconstruction using polytetrafluoroethylene (PTFE) during living donor liver transplantation still remains less. Herein, we present experience of four patients who successfully underwent vena caval resection during liver transplantation which was subsequently reconstructed using PTFE grafts. All these patients recovered well without any undue complications such as thrombosis thus proving this extensive surgical treatment as a successful & life saving procedure although meticulous skills are prerequisite..

## Patients and Methods

Between September 2002 and December 2012, total 362 adult to adult living donor liver transplantation (LDLT) were performed at our institute. Among them, 4 patients underwent caval resection & subsequent reconstruction using polytetrafluoroethylene (PTFE) grafts. Incidental extensive injury of retrohepatic vena cava occurred in two patients while in two patients tumor was found to be encroaching onto the vena cava which warranted vena caval resection for oncological reasons to achieve safety margin & to avoid massive bleeding due to caval injury.

## Brief history

### Case 1-

A 48-year-old woman had end-stage primary biliary cirrhosis and received a right lobe graft from her son. While recipient's surgery during mobilization of liver, the retrohepatic vena cava was divided and ligated in several sequences that rendered the upper and lower ends of the vena cava obliterated with multiple sutures. The donor graft was ready for harvesting when this incident was noted. Still outflow reconstruction was tried first with donor right hepatic vein to suprahepatic vena cava. But after anastomosis was completed and flow was established, the graft appeared congested and became stony hard due to compromised outflow. The graft was removed and reperused with HTK solution. PTFE graft of 10cm length with 16 mm diameter was then used to reconstruct the vena cava after native cava was resected. The graft was re-implanted and the vascular outflow was established using wider ostium on the artificial graft for anastomosis (Figure 1). Rest of anastomosis was done in usual way. However, the patient showed postoperative elevation of liver enzymes due to ischemic reperfusion injury that gradually recovered. She has been well with excellent liver function after follow up for more than 11 years.

### Case 2-

A 67-year-old male had end-stage hepatitis C-related cirrhosis and received a right lobe graft with middle hepatic vein. Thrombocytopenia and coagulopathy were noticed before operation. Intraoperatively during mobilization of liver, the disruption of large caudate veins occurred due to dense adhesions between caudate lobe and inferior vena cava causing extensive injury to vena cava with massive bleeding. At this crucial step to avoid hypovolemic shock, supra and infra hepatic vena cava was clamped & pringle maneuver was performed. Subsequently total hepatectomy was done along with the resection of the retrohepatic vena cava. The reconstruction of vena cava was done using 10 cm length PTFE graft with a 16mm diameter. As total hepatectomy was done before the graft was ready, a temporary Porto-caval shunt was created to avoid bowel congestion and to control bleeding from the collaterals.

When the donor graft was ready, the outflow reconstruction was performed by routine standard technique and porto-caval shunt was taken down. The patient had smooth postoperative recovery with satisfactory inflow and outflow of the graft. Patient was discharged on 12th post-operative day. No anticoagulation was used. During follow up patient showed satisfactory graft functions.

### Case 3-

A 35-year-old housewife who had colon cancer with liver metastasis received right colectomy and adjuvant chemotherapy. There was no evidence of systemic metastasis. Right lobectomy was suggested. However, the metastatic tumor was noted to be firmly adhered to retrohepatic cava. To prevent massive bleeding as well as cancer spread during mobilization, total hepatectomy with inferior vena cava resection was done. Cava reconstruction with artificial PTFE (16mm diameter, 8cm length) graft was done first. Right lobectomy was subsequently performed on back table and then left lobe was re-implanted in the patient & outflow was reconstructed by anastomosing left hepatic vein to the artificial cava. Unfortunately, patient suffered liver failure postoperatively. Living donor liver transplantation was done later date electively without any technical difficulties during vascular anastomosis of graft hepatic vein to reconstructed cava. There was not any evidence of liver metastasis at least 2 years after operation.

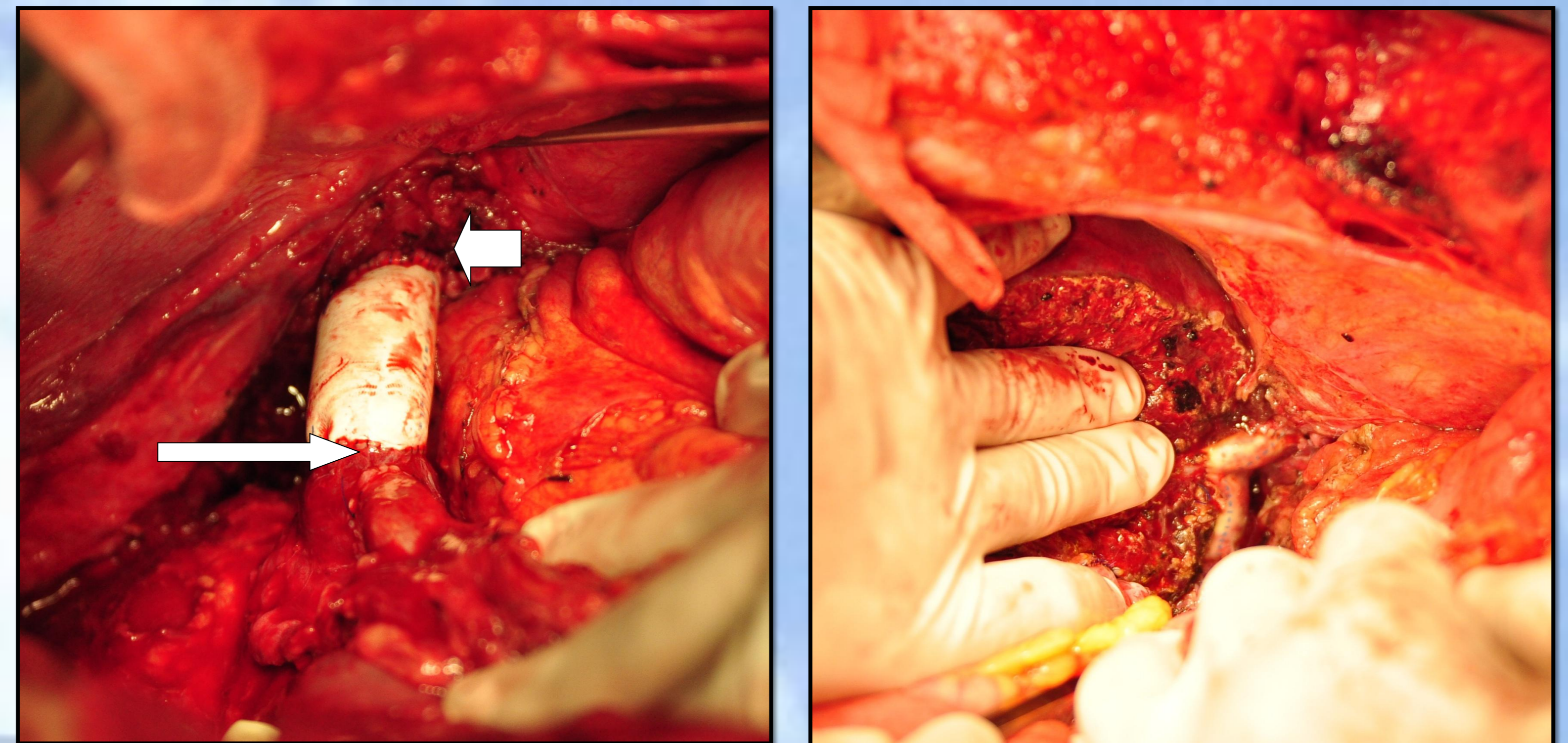


Figure 1.

Left figure shows artificial PTFE graft interposed between two cut ends of IVC (short arrow). Portocaval shunt was also performed (long arrow). Right figure shows completed outflow reconstruction of the graft liver.

### Case 4-

A 65-year-old male with alcoholic liver cirrhosis, Child B and hepatocellular carcinoma received living donor liver transplantation. Dense adhesions were noted between liver segment bearing HCC & diaphragm in the region of inferior vena cava. Mobilization of liver caused massive bleeding leading to hypovolemic shock. To salvage the patient & to deal with such operative complexity, central diaphragm was opened to gain access to intra-thoracic portion of vena cava. Liver was explanted with segment of inferior vena cava after controlling the supra and infra hepatic vena cava. PTFE graft with 16mm diameter was used to reconstruct the inferior vena cava. The donor liver was transplanted using routine inflow and outflow reconstruction techniques. Post-operatively patient suffered ischemic brain infarction that prolonged the recovery and increased the intensive care unit stay. However, patient eventually recovered with satisfactory graft function.

## Results

Three patients had uneventful recovery after operation. There was no evidence of graft infection or thrombosis of graft vena cava during the follow up period from 11 months to 127 months. Antiplatelet or anticoagulation medications were not used in any of these four cases. One patient had suffered diffuse brain ischemic infarction postoperatively due to prolonged hemorrhagic shock before removing the diseased liver. Patient's recovery was however delayed. In all of the four patients the graft liver function was satisfactory during follow up.

## Discussion

The patients undergoing liver transplantation for end stage liver disease usually have multiple underlying problems such as hyperdynamic circulation, portal hypertension, coagulopathy, thrombocytopenia, collaterals that increases operative blood loss. The pre-operative bridging therapies for patients with HCC while they were wait-listed for liver transplantation add further complexities by causing dense adhesions, collaterals in retro-hepatic area that makes liver mobilization difficult and making the retro-hepatic cava prone to injuries making graft implantation challenging. However, in this case series we have proved that in unavoidable circumstances vena cava can be safely resected and reconstructed with artificial grafts if cryopreserved venous grafts not available. Though technically complex, in experienced hands this procedure is safe and produce good results. In our case series, two patients had cava injury during mobilization. Two of the four patients had tumour encroaching onto the vena cava.

Dower et al. (1) stated in their report that when residual tumor cannot be completely removed by partial hepatectomy after preoperative chemotherapy, total hepatectomy and liver transplantation are required. Christophe and co-workers (2) used allogenic vein grafts procured from the living donors for reconstruction of the vena cava in 4 children who underwent living donor liver transplantation for hepatoblastoma. Thus, extrahepatic tumour extension without systemic metastasis can still be treated by liver transplantation. However, in our series we used artificial PTFE grafts in all the patients with success. No form of anti-coagulation was used. In our patients the graft patency was good without any undue complications, the longest survival being 11 years.

## Conclusion

In emergency situations of caval injury during mobilization of liver or in case of tumor extension to inferior vena cava, liver transplantation can still be performed after resection & reconstruction of native vena cava. Use of artificial venous graft is safe and allows satisfactory outflow, but it warrants high surgical skills and experience in the field of transplantation.

## References

1. Dower NA, Smith Lj. Liver transplantation for malignant liver tumours in children. *Med Pediatr Oncol* 2000; 34(2): 136.
2. Christophe Chardot, Jean-Bernard Otte et al. Living Related Liver Transplantation and Vena Cava Reconstruction after Total hepatectomy including the vena cava for Hepatoblastoma. *Transplantation* 2002; 73(1): 90-92.