Short-term Total Hepatic Vascular Exclusion in Difficult Caudate Lobe Dissection in Living-donor Liver Transplantation Recipients

W.-F. Li[a], T.-L. Lin[a], T.-J. Tan[a], R.B. Alikhanov[a], C.-C. Yong[a], S.-H. Wang[a], C.-C. Lin[a], Y.-W. Liu[a], C.-C. Wang[a,b,*], and C.-L. Chen[a]

[a]Liver Transplant Program, Department of Surgery, Kaohsiung Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Kaohsiung, Taiwan; and the [b]Division of General Surgery, Department of Surgery, Chiayi Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Chiayi, Taiwan

ABSTRACT

Background. Recipient hepatectomy can be complicated by severe bleeding during caudate lobe dissection in living-donor liver transplantation (LDLT), especially when the inferior vena cava is encased or with dense adhesions from prior interventions. Total hepatic vascular exclusion (TVE) including total hepatic inflow (Pringle maneuver) and occlusion of supra- and infra-hepatic inferior vena cava during the partial hepatectomy has been studied well, but it has not been mentioned regarding recipient hepatectomy in LDLT. The aim of this study is to evaluate hemodynamic impact and surgical outcome by using the technique of TVE in LDLT.

Methods. From April 2010 to June 2010, 30 consecutive LDLT recipients at Kaohsiung Chang Gung Memorial Hospital with TVE (TVE group, n = 14) or without TVE (non-TVE group, n = 16) for the caudate lobe dissection were analyzed retrospectively.

Results. The TVE group had a mean decrease in systolic blood pressure and cardiac index of 21% and 41% during caudate dissection in recipient hepatectomy, respectively. The TVE group had shorter time for caudate mobilization and less blood loss compared with the non-TVE group (3904 mL vs. 5650 mL, $P = .461$). Two patients in the non-TVE group were shifted to TVE as a salvage procedure to control bleeding. Three patients in the non-TVE group underwent relaparotomy for homeostasis.

Conclusions. Short-term TVE is a technically feasible procedure and should be considered during recipient hepatectomy with difficult caudate lobe dissection in LDLT to create a bloodless surgical field. Most patients tolerated the TVE without hemodynamic impact under anesthetic management.

RECIPIENT hepatectomy is a challenging operation in cirrhotic patients undergoing liver transplantation. In addition to congenital caudate lobe (CL) variants enveloping the inferior vena cava (IVC) [1], there may be anatomic adaptations to portal hypertension such as CL hypertrophy secondary to cirrhosis [2–4] or previous partial hepatectomy.

Total hepatic vascular exclusion (TVE) including occlusion of total hepatic inflow (Pringle maneuver) and occlusions of supra- and infra-hepatic IVC has been reported and widely used in hepatectomy [5–9]. To avoid severe blood loss resulting in unstable hemodynamic status during recipient hepatectomy with difficult caudate dissection, TVE has great impact to surgical outcome in living-donor liver transplantation (LDLT). The aim of this study is to evaluate hemodynamic impact and surgical outcome by using the technique of TVE in LDLT.

MATERIALS AND METHODS

From April 2010 to June 2010, the clinical data from 30 consecutive LDLT recipients with TVE (TVE group, n = 14) or without TVE

*Address correspondence to Chih-Chi Wang, MD, Kaohsiung Chang Gung Memorial Hospital, Chang Gung University College of Medicine, 123 Ta-Pei Road, Niao-Song, Kaohsiung 833, Taiwan. E-mail: ufel4996@ms26.hinet.net

360 Park Avenue South, New York, NY 10010-1710

0041-1345/16
http://dx.doi.org/10.1016/j.transproceed.2015.12.112

Table 1. Demographics of 14 Patients Underwent TVE for Caudate Lobe Dissection in Recipient Hepatectomy

LDLT No.	Diagnosis	Prior Abdominal Operation	Encroach IVC (%)	TVE Time (min)	CTP	MELD (PELD)	Blood Loss (mL)
565	HBV	Ectopic pregnancy	30	29	12	18	4000
567	HBV HCC-RFA	Nil	50	22	9	33	1400
569	HCV HCC-RFA	Nil	90	18	10	35	1030
571	HBV	Nil	50	18	11	34	5000
572	HCV PVT	Nil	50	25	6	9	500
574	HBV	Nephrectomy	90	25	11	19	4900
577	HCV HCC-RFA	Nil	50	20	9	34	1000
578	BA	Kasai	90	42	7	5	85
583	BA	Kasai, herniorrhaphy	50	43	8	18	1500
584	HBV HCC-RFA/TAE	Hepatectomy, enterolysis	90	48	5	28	1600
585	HCV HCC-RFA/TAE/PEI	Total hysterectomy	50	25	6	30	7200
587	HCV	Nil	50	29	12	28	6000
589	HBV HCC-RFA/TAE/PEI	Nil	50	64	5	28	17000
590	HCV HCC-TAE PVT	Nil	90	32	7	37	3450

Abbreviations: LDLT, living-donor liver transplantation; IVC, inferior vena cava; TVE, total hepatic vascular exclusion; CTP, Child-Turcotte-Pugh score; MELD, Model for End-stage Liver Disease score; PELD, pediatric end-stage liver disease; HBV, hepatitis B virus; HCC, hepatocellular carcinoma; RFA, radiofrequency ablation; HCV, hepatitis C virus; PVT, portal vein thrombosis; BA, biliary atresia; TAE, transarterial embolization; PEI, percutaneous ethanol injection.

(non-TVE group, n = 16) for the CL dissection were analyzed retrospectively. Demographics of 14 patients underwent TVE are listed in Table 1.

Technique

The technique of recipient hepatectomy in LDLT with preservation of IVC has been well established [10,11]. The right triangular ligaments are taken down, then the superior retrohepatic IVC is freed, with lateral-to-medial mobilization. The right retroperitoneal and adrenal attachments are taken down with ligation of the right adrenal vein branches to the IVC. The most lateral short hepatic veins on the anterior surface of the IVC are ligated and oversewn sequentially in a caudal-cranial direction to begin the exposure of the IVC.

Makuuchi's ligament (IVC ligament) is divided between ties, with suture ligation on the IVC side to prevent unnecessary bleeding from the often-present small hepatic veins. The right crural attachments are taken down with the Pinch-Burn-Cut technique. The IVC is dissected meticulously and taped 2 cm above the junction of the right hepatic vein (RHV) in preparation for TVE clamp placement.

Dissection is performed between right crus of the diaphragm and the posterior surface of the IVC across to the left retrocaval peritoneum. The subhepatic IVC is mobilized circumferentially for 2 cm to 3 cm and taped. It is important to completely interrupt all retroperitoneal collateral vessels to the IVC to assure an effective TVE.

TVE is used only for a short period to facilitate CL dissection. Test clamping is first performed for 5 minutes to establish hemodynamic tolerance for TVE. Maintaining a slightly higher central venous pressure of 8 mm Hg to 10 mm Hg during the TVE for CL dissection and the administration of fluids permits acceptable hemodynamic stability in the vast majority of recipients. We use a combination of 1L Lactated Ringers Solution with 50 mL 20% albumin to expand the volume judiciously if the cardiac index decreases by more than 50% or the systemic blood pressure decreases by more than 30 mm Hg during the test clamping period. Small bolus doses of inotropes (ephedrine: range, 2 mg to 8 mg) were rarely required and continuous dopamine infusion apart from renal-protective dose (5 μg/kg/min) was not used. Concomitant clamping of the aorta to maintain the systemic blood pressure was not advocated [12].

The clamping sequence is initiated with inflow occlusion of the main portal vein (PV) and hepatic artery. Next, the infrahepatic IVC is occluded, and the suprahepatic IVC is clamped at 1.5 cm to 2 cm above the liver finally (Fig 1). The suprahepatic IVC clamps are placed from right to left to allow unimpeded rotation of the liver to the left to facilitate caudate dissection. We use a short gently curved Cooley vascular clamp for the infrahepatic IVC and the PV as the short handle allows it to be placed intra-abdominally. A long-handled Klintmalm liver transplant clamp is placed in the suprahepatic IVC position. The RHV is divided with a clamp placed towards the liver surface and the IVC origin left open. This exposes the middle and left hepatic veins, collapses the excluded IVC, and allows for a check that complete TVE has been established (Fig 2). The short caudate veins are more easily dissected from the concavity of the collapsed IVC, in a bloodless field, providing adequate exposure for suture ligation of the caudate vessels.

After completion of the caudate dissection, a Cooley vascular clamp is placed across the RHV orifice and the liver is declamped in the reverse sequence of clamping, and the CL and IVC surfaces are checked for bleeding. The right PV is kept clamped to prevent bleeding and congestion from the right hemi-liver. Before implantation of the graft, flow is re-established for a few minutes through

Fig 1. Total vascular exclusion with two clamps at supra- and infra-hepatic inferior vena cava for caudate lobe dissection.