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ORIGINAL ARTICLE

Comparison between allogenic and autologous vascular conduits in the drainage of anterior sector in right living donor liver transplantation

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Summary

Congestion of the anterior sector may lead to graft failure in right lobe grafts. Selective drainage of the prominent segment 5 and/or 8 veins is proposed to overcome this problem. Different vascular conduits may be used during drainage of the anterior sector. In this study, we evaluated the efficiency of the vascular conduits. Between June 1999 and December 2005, 190 patients underwent living donor right lobe liver transplantation and reconstruction of segment 5 and/or 8 veins was performed in 48 patients (25.2%). Two groups were formed according to the types of vascular conduits. Cryopreserved cadaveric iliac artery ($n = 28$) and cryopreserved cadaveric iliac vein ($n = 8$) were used in group A. In group B, recipient saphenous vein ($n = 6$), recipient umbilical vein ($n = 5$) and recipient collateral omental vein ($n = 1$) were used for reconstruction. The graft-recipient weight ratio, mean duration of anhepatic phase and MELD scores between two groups were not significantly different. All of the conduits were found to be patent just after reperfusion and in the early postoperative period by Doppler ultrasonography. In follow-up period of 1 year, four (11%) patients died in group A, two patients (16%) in group B. One of these patients died because of sepsis started from the saphenous vein incision site. None of the patients dying in the two groups were lost due to venous outflow problems. This study proves the efficacy of drainage of segment 5 and/or 8 veins using cryopreserved cadaveric vascular conduits. Every effort should be employed to store cadaveric iliac vessels, otherwise, whole other additive surgical intervention to ensure vascular conduit may lead uninvited serious complication.

Introduction

Right lobe grafts for living donor liver transplantation (R-LDLT) have emerged as a standard procedure to overcome the matter of insufficient graft volume for adults. Right lobe harvesting may or may not include middle hepatic vein (MHV) [1]. It depends on the venous anatomy of the donor liver and the preference of the transplant surgeon. A right lobe graft including MHV, namely an extended right lobe graft, carries the advantage of having better venous outflow drainage when compared with the right lobes without MHV as the anterior sector (segments 5 and 8 according to Couinaud) is mostly drained into the MHV [1,2]. However, if a right lobe graft without MHV is used because of some reasons, drainage of segment 5 and/or 8 veins by using vascular conduits may be required. Selective drainage of the prominent segment 5 and/or 8 veins is proposed to overcome the congestion of the anterior sector [2]. During the drainage of the anterior sector, several vascular conduits including autologous, homologous, or synthetic patterns can be preferred [3].

In this study, we compared the safety of the cadaveric vascular conduits with the conduits maintained from different autologous recipient's vascular patterns for drainage of anterior sector in the patients who were performed R-LDLT.

Patients and methods

Between June 1999 and December 2005, a total of 190 R-LDLT was performed at Ege University Organ Transplantation and Research Center. The patients who were performed anterior drainage using different vascular conduits were retrospectively analyzed. Forty-eight patients were determined and divided into two groups according to the types of vascular conduit used. Anterior drainage was planned after performing clampage of the segment 5 and 8 veins, ≥5 mm in size and on the cut surface during donor hepatectomy. If marked congestion resulted in clampage, significant drainage was performed. The patients in whom cadaveric vascular conduits were used comprised group A, and the patients in whom their own autologous vascular conduits were used comprised group B. Demographic variables, indications for liver transplantation, MELD scores, graft-recipient weight ratio, anhepatic phase and postoperative complication were recorded. All cadaveric vascular conduits in group A consisted of the iliac arteries and veins obtained during the harvesting procedure and were protected with cryopreservation technique. The cadaveric vascular grafts were obtained from 36 cadaveric donors (20 male and 16 female) with a mean age of 38.4 (3–62) years. The causative factors for death of the cadaveric donors included mostly head trauma and intracerebral hemorrhage.

Technique of cryopreservation

After obtaining culture samples for microbiology and mycology, the prepared vessel grafts were kept in 120 cc distilled water including 80 mg of cefuroxime, 500 mg of vancomycin Hcl, 2 g of piperacillin sodium, 250 mg of amicacin sulphate, 100 000 U of nystatin, 20 ml of medium 199 (Cambrex Biosciences Inc. Verviers, Belgium) and 12 ml HCO_3 for 12–18 h at room temperature keeping the solution away from light. Ten percent dimethyl sulfoxide was added into the cup and after an hour the graft was taken out of the solution and was placed in sterile gauze and then covered with a sterile folio. The folio was put in the cryo-machine and gradually frozen down to −60 °C in 74 min. Then, the frozen graft was stored in the vapor phase of liquid nitrogen tank at −140 °C up to 5 years [4,5].

Autologous vascular conduits of the recipients in group B consisted of different vascular patterns including umbilical vein or collateral vein ≥5 mm in size. In case of improper usage of these veins, saphenous vein was preferred. After extracting the saphenous vein for reconstruction, a standard negative pressured hemovac drain was placed in the vascular bed. All the autologous vascular conduits were irrigated with isotonic solution and heparinized solution respectively. ABO compatibility between the recipient and cadaveric vascular grafts was not taken into consideration.

After donor hepatectomy, venous interposition grafts were anastomosed to the segment 5 and/or 8 vein on the back table using 5/0 or 6/0 continuous polypropylene sutures. During the implantation of the graft in the recipient, after finishing the right hepatic vein anastomosis, the interposition grafts draining segment 5 and/or 8 were anastomosed to the vena cava using 5/0 or 6/0 polypropylene in a running fashion again. Patency of vascular conduits was confirmed by Doppler ultrasonography (DUS) immediately after reperfusion intraoperatively and on the postoperative days 1, 3 and 7. The data were analyzed using SPSS 13.0 for Windows (SPSS Inc. Chicago, IL, USA). Sample *t*-test was used for comparison of the two groups.

Results

During the study period, 48/190, 25% patients were performed drainage of anterior sector. The main indication for R-LDLT in both groups was chronic hepatitis B (n = 33, 68%) and (n = 15 32% hepatitis C, alcoholic, cryptogenic). The clinical data of both groups are shown in Table 1. All of the donors and recipients were ABO identical or compatible. In group A and B, there were 25/11 males and 7/5 females with a mean age of 45.6/45.4 years respectively. The venous drainage for the right anterior sector of right-lobe graft was provided by using segment 5 (19, 39%) or segment 8 vein (11, 22%), or both of them (18, 37%). In group A, interpositional venous grafts which were all cadaveric vascular grafts included cryopreserved cadaveric iliac artery (n = 28, 58%) and cryopreserved cadaveric iliac vein (n = 8, 16%). In group B, all interpositional venous grafts were obtained from the recipient and consisted of recipient saphenous vein (n = 6, 12.5%), recipient umbilical vein (n = 5, 10%) and recipient collateral omental vein (n = 1, 2%). In group B, all the patients were submitted to an additional surgical procedure, but six patients who had undergone saphenous vein extraction were performed a skin incision in a different operation site. Seroma was prevented with a drainage catheter. The mean duration of hemovac drain that was placed in the saphenous vein incision site was 16 days (range: 7–32 days).

Table 1. Clinical data of group A and group B.

	Group A ($n = 36$)	Group B ($n = 12$)	*P*-value
Median age (years)	45.6	45.4	0.95
Male/female	25/7	11/5	
Mean MELD score	25.2 (range: 6–43)	21.0 (range: 11–26)	0.31
Graft/recipient weight ratio (%)	1.02 (0.7–1.4%)	1.04 (0.8–1.5%)	0.68
Mean duration of anhepatic phase (minutes)	55.5 (46–91)	57.4 (42–86)	0.49
Segments drained			
Segment 5	20	4	
Segment 8	6	1	
Segment 5 and 8	10	7	
Additive intervention*	0	12	
Drainage catheter out of the routine†	0	6	
Mortality	4	2	

*Dissection of the interpositional grafts from the recipient.

†Placing the hemovac drain in the vascular bed of saphenous vein.

Table 2. The results of the standard usage of the Doppler ultrasonography and the flow patterns.

	Flow pattern					
	Group A ($n = 36$)			Group B ($n = 12$)		
	MP	BP	TP	MP	BP	TP
Intraoperative	0	17	19	0	5	7
Day 1	1	18	17	0	6	6
Day 3	1	18	17	1	6	5
Day 7	2	18	16	1	7	4

MP, monophasic; BP, biphasic; TP, triphasic.

All of the conduits were found to be patent after reperfusion and in the early postoperative period by DUS which was routinely performed on day 1, 3 and 7 (Table 2). In addition, as can be seen in Table 2, there was a flow in all the vascular conduits, and the triphase flow pattern classically observed in the hepatic vein was detected in most of the cases. There were no statistically significant differences between the two groups. None of the patients in the two groups died from venous outflow problems. In the follow-up period of 1 year, four (11%) patients in group A died of pneumonia (three) and tumor recurrence (one) and two patients (16%) in group B died of septic complications. One of these patients died because of sepsis that started in the saphenous vein incision site, which was considered procedure-related mortality. No donor mortality or major morbidity occurred in both groups.

Discussion

In adult to adult LDLT, right lobe grafts are usually used without MHV for donor safety [2]. However, a right lobe graft without MHV may be associated with severe congestion which may result in hepatic dysfunction and serious complications, including liver failure and sepsis [6]. Congested area of the liver may be so large that remaining functioning area may not be sufficient for the metabolic demands of the recipient [7]. In our study, one of the predictors of the need for venous drainage to the right anterior sector was the extent and severity of the congested area of the liver after the occlusion of both the right hepatic artery and MHV.

Nakamura *et al.* stated that right hepatic vein drains the posterior segment (segment 6 and 7) and a small part of the anterior segment, particularly segment 8 and the remaining larger area of the anterior segment is drained through the MHV [8]. However, drainage of segment 5 and 8 veins were also found to be mainly through MHV in approximately two-thirds of Kyoto University series [9]. Inclusion of the MHV in the graft or reconstruction of prominent segment 5 and 8 veins has been proposed to avoid congestion and to increase functional capacity[10,11].

In the right lobe grafts without MHV, indications for segment 5 and 8 veins reconstruction are regarded as the degree of venous congestion after parenchymal transection, small right lobe grafts having relatively larger right anterior segment than the posterior segment, prominent segment 5 and 8 hepatic veins, graft to recipient body weight ratio, severe portal hypertension of the recipient, and technical feasibility and availability of venous conduits [8,12]. Various interpositional vein grafts have been used for reconstruction of the anterior segment. There are four different sources to obtain such a vascular conduit: recipients own vessels (e.g. the umbilical vein, portal vein, any collateral vein, saphenous vein, iliac veins); radial artery may also be used for arterial interposition vessels procured from the living donor besides the allograft (the ovarian vein, inferior mesenteric vein), cadaveric vessels (the iliac artery and veins or any other vessels procured from the cadaver) and synthetic vascular grafts [2,12–19]. Initially, saphenous veins were preferred as an interposition graft, but Lee *et al.* reported that saphenous vein might not be large enough to drain anterior sector; thus, they recommended dilating the vein hydrostatically or reconstructing two sheets together to have a larger diameter. However, these modifications have also a higher rate of failure [10]. Furthermore, venous graft harvesting site related problems such as intraoperative bleeding, postoperative hematoma, seroma and infection may complicate the postoperative course of the patients, and vessels procured from the donor or the recipient may extend the limits of the procedure and lead to procedure related problems [20]. In our study, the patients in group B required an additional surgical intervention and subsequently a drainage catheter was used for a long time in all the patients with extracted saphenous vein. One of our recipients experienced an infection starting from the saphenous incision site, which spread to retroperitoneal space, and the patient died due to septic complications. The synthetic grafts have the risk of higher rate of thrombosis [21]. There are advantages of using the cadaveric vascular grafts of proper length, width, and 'Y' shaped for drainage of both segments 5 and 8 at any time. In our series, DUS controls were revealed no problem with the patency of the cadaveric grafts in the early period. As vascular conduits remain patent for a short time before they become nonfunctional following transplantation procedure, we had no need for further investigation. Notwithstanding during this short time the graft has the possibility to regenerate and to develop alternatives ways, venous collaterals in approximately 1 week, to drain the anterior sectors [22]. Cadaveric sources that we used for the patients in group A did not cause any morbidity both in donors and recipients. Nevertheless, the scarcity of cadaveric donors may limit the availability of cadaveric vascular conduits. Cryopreservation technique may allow storing these vessels for years and seem to work fairly well in most centers having cadaveric sources [12].

We believe that cadaveric iliac vessels provide the best option for interpositional vascular conduits in terms of patency of the conduit and safety of both recipient and donor. Use of cadaveric iliac artery may be advantageous in that internal and external branches can be anastomosed to segment 5 and 8 veins separately, and the main trunk can be anastomosed to the vena cava as a single anastomosis. Recipient's own vessels, mainly the umbilical vein, can be a good alternative to cryopreserved cadaveric iliac vessels, but they are not constant and cannot be harvested in every case. They should be assessed from the beginning of the surgery and preserved if they are suitable for venous reconstruction. It should be kept in mind that they may lead to uninvited complications for recipient in the postoperative period.

In conclusion, this study has proved that the cadaveric iliac vessels are the best option as a venous conduit without causing any morbidity to both donor and recipient who has undergone R-LDLT. In R-LDLT, in case of mandatory drainage of anterior/medial sectors of the graft and impossibility to harvest the MHV, the use of cadaveric vascular conduits (in countries where cadaveric donation is allowed) is preferable to the autologous recipient's ones. Every effort should be made to reinforce the storage of cadaveric vessels especially in the centers running both cadaveric and LDLT programs. Because these patients are immuno-compromised, any intervention which may bring additional morbidity and even mortality should be avoided.

Authorship

KM: designed the study, helped to perform data collection, and contributed important reagents; AU: helped to perform the data collection; SM: contributed important reagents; OI: helped in the data collection; TS: helped to perform and performed the Doppler ultrasonography; DG: helped to perform and performed the Doppler ultrasonography; AY: contributed important reagents and helped to maintain the cadeveric vascular graft; AM: helped to perform, contributed important reagents; ZM: helped to perform and contributed important reagents.

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