

Portal vein variation and thrombosis in right lobe living donor liver transplantation

Canlı vericili sağ lob karaciğer naklinde portal ven varyasyonları ve trombüsleri

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Abstract

Aim: The only definitive treatment of end stage liver disease is liver transplantation. In countries where cadaveric liver transplants are limited, living donor liver transplantation is performed. However, the presence of a variation in the portal vein of the donor, or a thrombus in the portal vein of the recipient, requires specific consideration. In this study, both of these potential limitations to living donor liver transplantation were evaluated.

Patients: We designed a retrospective cohort study. From April 2014 to December 2017 we retrospectively evaluated 129 patients who underwent right lobe living donor liver transplantation in Organ Transplantation Center, Medipol University Faculty of Medicine, Istanbul, Turkey.

Results: Nine (7%) of the patients underwent portal venous reconstruction due to either portal vein variation or portal vein thrombosis. In six patients (67%) reconstruction was performed due to the presence of a double PV in the right lobe graft. In three (33%) patients, a thrombus in the PV necessitated a reconstruction. Early postoperative morbidity occurred in one patient (11.1%) and mortality in one patient (11.1%).

Conclusions: In this study, we found portal vein reconstructions using safely frozen iliac vein grafts.

Keywords: Right lobe living donor liver transplantation, Portal vein variation, Portal vein thrombosis, Portal vein reconstruction

Öz

Amaç: Son dönem karaciğer hastalığının kesin tek tedavi yöntemi karaciğer naklidir. Kadavra karaciğer naklinin sınırlı olduğu ülkelerde, canlı donör karaciğer nakli yapılır. Bununla birlikte, donörün portal veninde bir varyasyonun veya alıcının portal veninde bir trombüsün varlığı özel bir dikkat gerektirir. Bu çalışmada, canlı vericili karaciğer nakli için bu potansiyel sınırlamaların her ikisi de değerlendirildi.

Yöntemler: Retrospektif kohort çalışma planlandı. Nisan 2014 - Aralık 2017 tarihleri arasında Medipol Üniversitesi Tıp Fakültesi, Organ Nakli Merkezi'nde sağ lob canlı vericili karaciğer nakli yapılan 129 hastayı retrospektif olarak değerlendirdik.

Bulgular: Hastaların dokuzuna (%7) portal ven varyasyonu veya portal ven trombüsünden dolayı portal venöz rekonstrüksiyon uygulandı. Altı hastada (%67) sağ lob greftinde çift portal ven açıklığının olması nedeniyle rekonstrüksiyon yapıldı. Üç hastada (%33) portal vende trombüs nedeniyle rekonstrüksiyon yapıldı. Bir hastada (%11,1) ameliyat sonrası morbidite ve bir hastada (%11,1) mortalite görüldü.

Sonuçlar: Bu çalışmada, dondurulmuş iliac ven greftlerinin portal ven rekonstrüksiyonları için güvenli bir şekilde kullanılabileceği saptanmıştır.

Anahtar kelimeler: Canlı vericili sağ lob karaciğer nakli, Portal ven varyasyonu, Portal ven trombüsü, Portal ven rekonstrüksiyonu

Introduction

Currently, the only treatment for end stage liver disease is liver transplantation. In countries where cadaveric liver transplants are limited, living donor liver transplantation (LDLT) is performed. The first such procedure using the right hepatic lobe was reported in 1994 [1]. Since then, right lobe LDLT has become standard practice in adult patients. However, thrombus in the portal vein (PV) of the transplant recipient and anatomic variation in the PV of the donor are crucial determinants of the surgical strategy in right lobe LDLT.

If, in the recipient, a thrombus in the PV has led to an area of venous deterioration, anastomosis should be completed using a vein graft. In the presence of an anatomic variation in the PV of the donor, the anastomosis is also completed using a vein graft and does not pose any risk to the donor [1,2].

In this study evaluated portal venous reconstructions using frozen iliac vein grafts in right lobe LDLTs.

Materials and methods

Patients

From April 2014 to December 2017 we retrospectively evaluated 129 patients who underwent right lobe living donor liver transplantation in our center.

Triphasic abdominal computed tomography (CT) of the vascularity was performed preoperatively to evaluate the relevant vascular structures. Retrospective review of these examinations and the operative notes were used to determine the number of PV reconstructions and the indications for the procedure.

Liver transplantation recipients were classified according to the Yerdel classification [2] for the evaluation of a thrombus in the PV, and graft donors according to the Cheng classification [3] of variations in the PV of the right lobe (Figure 1, 2).

Yerdel classification [2];

- Grade 1: Minimally or partially thrombosed PV, in which the thrombus is mild or at most confined to <50% of the vessel lumen with or without minimal extension into the superior mesenteric vein (SMV)
- Grade 2: >50% occlusion of the PV, including total occlusion, with or without minimal extension into the SMV
- Grade 3: Complete thrombosis of both the PV and the proximal SMV but an open distal SMV
- Grade 4: Complete thrombosis of the PV as well as the proximal and distal SMVs

The Cheng classification [3] of PV configurations is as follows;

- Type I: A short right common neck formed by the right anterior branch and the posterior branch (normal)
- Type II: Early division of the anterior and posterior sectoral branches, trifurcation
- Type III: Independent posterior sectoral branching from the main trunk
- Type IV: Anterior sectoral branching from the left PV and unclassified types

Reconstruction of the PV was performed in all right lobe grafts. Portal system Doppler ultrasonography was performed once a day for the first postoperative week to evaluate anastomosis of the portal venous system. The portal venous pattern was assessed using Doppler ultrasonography during the

monthly follow-ups conducted during the first postoperative year.

Iliac vein grafts removed from cadavers and stored at -80°C in RPMI 1640 medium (Life Technologies Inc., Gaithersburg, MD, USA) were used in the reconstructions.

Surgical procedure

Patients with anatomic variation or thrombus in the portal venous system underwent a reconstructive surgical procedure. For portal vein reconstruction, iliac vein grafts from cadaveric donors were used.

The receiving patient with portal vein thrombus was first cleared of the portal vein thrombus. The damaged portal vein part was expelled. The frozen iliac vein was used to lengthen the graft portal vein, and the graft portal vein was implanted using 6/0 prolene sutures.

Patients with graft-type II portal vein variation were treated by cutting the two portal vein sidewalls, using a side-by-side 6/0 prolene suture with a single lumen. The frozen iliac vein graft, cut into the perimeter of this single lumen, was stitched using a 6/0 prolene suture. A circumscribed elongated graft portal vein was achieved.

Y-shaped frozen iliac vein grafts were used in patients with graft-type III portal vein variability. Two portal vein openings in the graft were implanted and anastomosed using y-shaped iliac vein 6/0 prolene sutures (Figure 3).

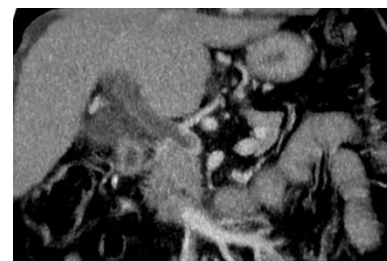


Figure 1: Portal vein thrombosis

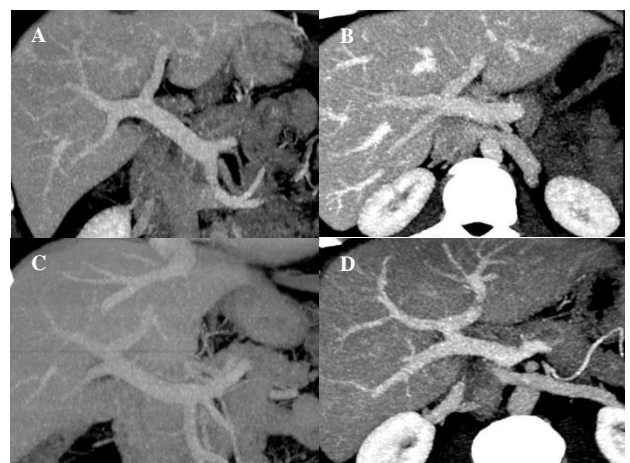


Figure 2: Portal vein variation, A: Type I (normal), B: Type II variation, C: Type III variation, D: Type IV variation

Results

From April 2014 to December 2017 we retrospectively evaluated 129 patients who underwent right lobe living donor liver transplantation in our center. Portal vein reconstruction was performed in nine (7%) patients (seven male and two female) due to an anatomic variation in the PV of the donor, or a thrombus in the PV of the recipient. Patients had a mean age of 32.3 (22–64) years. The indications for liver transplantation are

Hepatitis B virus in four (44.5%) patients, Hepatitis C virus in two (22.2%) patients, non-alcoholic steatohepatitis in two (22.2%) patients and ethanol in one (11.1%) patient (Table 1).

In 6 patients (67%) reconstruction was performed due to the presence of a double PV in the right lobe graft. In three (33%) patients, a thrombus in the PV necessitated a reconstruction (Table 2).

Table 1: Indications for right lobe living donor liver transplantation

	n	%
Hepatitis B	4	44.5
Hepatitis C	2	22.2
Non-alcoholic steatohepatitis	2	22.2
Ethanol	1	11.1
Total	9	100

Table 2: Indications for portal vein reconstruction

	n	%
Portal Vein Variations	6	66.7
Portal Vein Thrombus	3	33.3
Total	9	100

According to the Yerdel classification [2], the PV thrombosis was grade 2 in all three (33.3%) patients. After clearance of the thrombus, the damaged PV segment was excised and the anastomosis completed by reconstruction using a frozen iliac vein graft.

According to the Cheng classification [3], two (33.3%) of the variations in the PV of the right lobe liver graft were type II and four (66.7 %) were type III. For the type II variations, a collar was made using frozen iliac vein (Figure 2). Reconstruction of the type III variation was performed using a y-shaped frozen iliac vein graft (Figure 3).

Early PV thrombosis developed in one (11.1%) patient, and the patient treated by surgical thrombectomy. One (11.1%) patient died due to sepsis. The mean follow-up time was 22.9 (0.5– 44) months. The overall survival rates of the patients were 88.9%.

End stage liver disease is treatment by liver transplantation worldwide. In countries where cadavers are rare, LDLT is performed. Since the first report of right lobe LDLT in 1994 [1], it has served as the standard treatment in nearly all adult LDLT patients.

Careful assessment of the recipient and donor before LDLT is essential. During the surgical preparations, triphasic abdominal CT is performed to evaluate the PV of both the recipient and the donor. Triphasic abdominal CT is standard practice, including in our center, and is used to determine the branching features of the PV and to detect a thrombus within the vein. Individuals with severe anatomic variations, such as type IV, are not considered as donors, as the risk of serious complications is high.

PV thrombosis is a common complication of end-stage liver disease. The underlying cause is often cirrhosis (1–26% of patients), which is particularly prevalent among patients with hepatocellular carcinoma (35%) [4-7]. Although the pathogenesis of PV thrombosis against a background of cirrhosis is not well understood, abnormal portal blood flow due to portal hypertension, periportal lymphangitis, and fibrosis are probable contributing factors, as are decreases in the levels of coagulation factors such as protein C, protein S and antithrombin3, all of which are synthesized in the liver [8].

For many years, a thrombus in the PV was a relative, and in some cases an absolute, contraindication to LDLT. However, following the report of Shaw et al. [9] in 1985, and with advances in thrombectomy and graft interposition as well as acquired experience in LDLT, many patients with a PV thrombosis are candidates for this type of transplantation. Nonetheless, this complication may increase postoperative morbidity and mortality. In our series of LDLT patients, a PV thrombosis was present in 3 patients (2.3%) with who had developed end-stage liver disease. After clearance of the thrombus, the involved PV segment was removed and the anastomosis completed using frozen iliac vein graft.

The incidence of portal vein variations is between 5 % and 35 % in deferent series [10-13]. All of these variations were double PVs of right lobe liver grafts and reconstruction was carried out using Y-grafts [14,15].

Possible variation in the anatomy of the PV needs to be well examined in the preoperative period due to the potential risk to the donor and the greater likelihood of complications in the recipient. Patients receiving a graft with a variant PV need close follow up after surgery, especially in transplants with type III branching, because of the need for a double portal anastomosis. The use of frozen vascular grafts is becoming the standard treatment protocol and has allowed LDLT even with double PV grafts. With a larger pool of donors, surgery for a greater number of patients has thus become possible. However, in these cases, extensive surgical and institutional experience with this type of graft is extremely important [15].

Morbidity after LDLT in a recipient with preoperative PV thrombosis is extremely rare (1–2%) [16]. In our series, PV thrombosis resulted in the early morbidity of 1 (11.1%) patient who underwent PV reconstruction and patient was treatment with surgical thrombectomy.

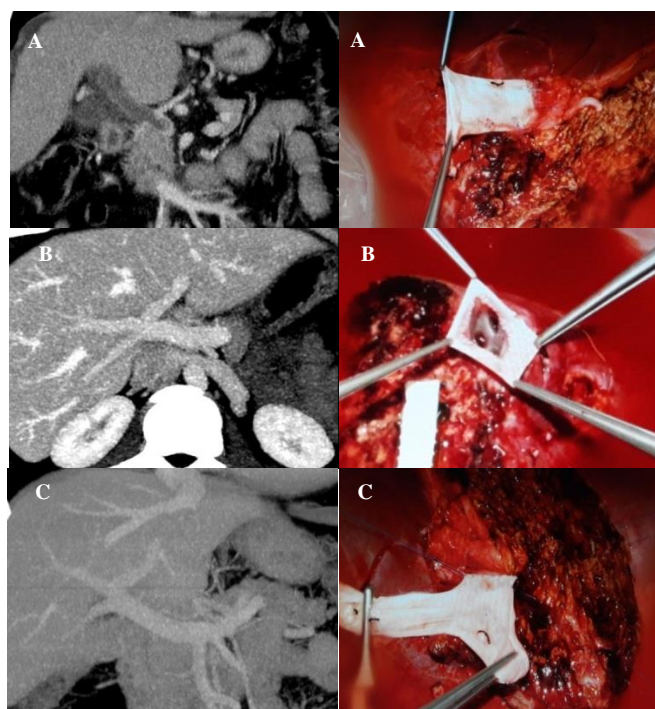


Figure 3: Portal veins reconstructions, A: Portal vein thrombus and reconstruction, B: Type II portal vein variation and reconstruction, C: Type III portal vein variation and reconstruction

Discussion

In this study, we evaluated portal vein reconstruction using frozen iliac vein grafts in right lobe LDLTs.

The PV in the right lobe of a liver transplant mediates portal flow. Manipulations of the length of the PV to reduce tension in the anastomosis site may lead to a reduced portal flow, after stasis and thrombus or even graft loss or death. Suzuki et al. [17] reported that a PV diameter of <3.5 mm was a risk factor for portal venous occlusion. Kanazawa et al. [18] and Moon et al. [19] determined that a PV diameter <4 mm and <5 mm, respectively, increased the rate of PV complications, mainly thrombus. Thus, patients at high risk of PV complications should be regularly evaluated with PV Doppler ultrasonography. In our center Portal system Doppler ultrasonography were performed once a day for the first postoperative week to evaluate anastomosis of the portal venous system. The portal venous pattern was assessed using Doppler ultrasonography during the monthly follow-ups conducted during the first postoperative year.

In our study one (11.1%) patient died, due to sepsis. The mean follow-up time was 22.9 (0.5–44) months. The overall survival rates of the patients were 88.9%, respectively.

Conclusion

In this study, we found portal venous reconstructions using safely frozen iliac vein grafts in right lobe LDLTs involving a portal vein variation or portal vein thrombosis.

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