REVIEW

Renoportal anastomosis in liver transplantation and its impact on patient outcomes: a systematic literature review

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ABSTRACT

Portal vein thrombosis (PVT) is commonly encountered during liver transplantation (LT). Depending on the grade of thrombosis, varied management strategies are indicated. The aims of this study are to clarify the contemporary role of renoportal anastomosis (RPA) in patients with splanchnic vein thrombosis (SVT) undergoing LT and to systematically analyze all reported cases of RPA. A systematic literature search was performed according to Preferred Reporting Items for Systematic Reviews and Meta- Analyses statement guidelines. The study was limited to studies reported in English between January 1997 and May 2017. Only retrospective single center studies were included in the analysis. A total of 66 patients with SVT were reported to have undergone RPA during LT. Transient renal dysfunction was reported in 12 patients (18.1%), variceal hemorrhage in 2 patients (3%), early portal vein (PV) re-thrombosis in 2 patients (3%), chronic renal dysfunction in 2 patients (3%), and late PV re-thrombosis in 1 patient (1.5%). The overall patient and graft survival were each 80%. This analysis illustrates the decades-long evolution of a technique practiced across the field of transplantation. Postoperative complications and graft survival appear to be encouraging, even in the setting of SVT.

Transplant International 2019; 32: 117–127

Key words

liver transplant, long term outcome, portal vein thrombosis, renoportal anastomosis, short term outcome

Received: 30 May 2018; Revision requested: 28 June 2018; Accepted: 19 October 2018; Published online: 20 November 2018

Introduction

Adequate portal flow to a transplanted liver graft is critical for graft function after both deceased donor whole liver transplantation (LT) and living donor liver transplantation (LDLT). Notably in LDLT, adequate portal flow enables the partial liver graft to regenerate rapidly and to satisfy the recipient's increased metabolic demands during the posttransplant period. Portal vein thrombosis (PVT) is commonly encountered during liver transplantation (LT) with a reported incidence ranging from 2% to 26% [1]. The important objectives of surgical PVT management are to: (i) establish adequate blood flow into the allograft portal vein (PV), (ii)

doi:10.1111/tri.13368

decompress the splanchnic circulation, and (iii) deliver portal trophic factors to the allograft.

In 2000, Yerdel *et al.* [1] proposed a classification of PVT defining four distinct grades. This classification scheme has become a useful tool for planning therapeutic options. Diffuse PVT, defined as complete thrombosis of the PV and proximal and distal SMV (Grade IV), is the most complex grade of thrombosis and necessitates nonphysiologic portal inflow to the allograft. Recently Sarin *et al.* [2] proposed a novel anatomico-functional classification of PVT in cirrhotic patients. This classification provides for a more precise description of the PVT, with categorization guided by site, degree, presentation, and functional relevance of the thrombosis. To date, there is yet a paucity of literature discussing the best approach to management of complete splanchnic vein thrombosis (SVT). The technical approach to these high-grade thromboses is complex, and associated with higher rates of morbidity and mortality. Until approximately 15 years ago, diffuse SVT was recognized as an absolute contraindication to LT, however more recently, a variety of management strategies have been devised. Caval inflow to the graft in the form of either a laterotherminal cavo-portal anastomosis (CPA), or the termino-terminal CPA, arterialization of the PV and combined liver-small bowel transplantation/multi-visceral transplantation (MVT) are techniques that have been proposed to overcome this obstacle. These approaches are associated with significant complications [3–23].

Cavoportal anastomosis has been associated with a number of postoperative complications, including lower torso edema and ascites in >50% of patients [4–8,11–13,17,19–21]. In a large series of 23 CPAs described by Selvaggi *et al.* [22], the incidence of both was as high as 91.4%. Reports from the literature estimate that 20–30% of patients develop postoperative thrombosis, either anastomotic or of the portal system. The high incidence of cavo-mesenteric and portal thrombosis is thought to be related to slower caval flow directed into the graft [22,24,25]. After portal vein re-thrombosis, pulmonary embolism has been reported to be the second most common cause of mortality in patients undergoing CPA [22]. Moreover, up to 30% of patients experience gastrointestinal hemorrhage, and between 40–50% of the patients develop postoperative chronic renal insufficiency [3,18,22,26].

Management strategies for patients undergoing combined liver-small bowel transplantation and MVT are limited by lack of donors and a high mortality rate on the waiting list [27,28]. Waitlist mortality for patients awaiting MVT is substantially higher than that reported for any other solid organ transplant candidate group, and has been reported to be as high as 50% [28,29]. Survival after small intestine transplantation has been estimated to be approximately 86% after 3 months, 77% up to 1 year, 59% after 3 years, and 51% after 5 years [29]. In a large analysis of 98 patients undergoing MVT, Tzakis *et al.* [27] reported posttransplant survival rates at 1, 3, and 5 years to be 65% ± 5%, 49% ± 5%, and 49% ± 5%, respectively. Estimated graft survival at the same time points was similar (63% ± 5%, 47% ± 5%, and 47% ± 5%, respectively). Infection was the leading cause of mortality, reported in 38% of patients, followed by rejection (13% of patients). Seven patients required re-transplantation (7%), and 5 (71%) of these patients subsequently died. Mangus *et al.* [30] recently reported their experience with 84 patients undergoing MVT. The main indication for PVT in adults was complete portal mesenteric thrombosis. At a median mortality-adjusted follow-up of 25 months, 1- and 3-year patient survival was 72% and 57%, respectively. Posttransplant complications included rejection (17% of patients), infection (>90% of patients within the first year), graft versus host disease (13% of patients), and posttransplant lymphoproliferative disorder (5% of patients).

Reno-portal anastomosis (RPA) has been proposed as an alternative strategy to establish a portal inflow in patients undergoing LT with extensive SVT or an obliterated PV as a result of phlebosclerosis [31–45]. An RPA can be performed between the left renal vein and the allograft's PV in an end-to-end or side-to end fashion, with or without an interposition graft. In RPA, adequate portal inflow without the steal phenomenon can be achieved easily in patients with spontaneous or surgical spleno-renal shunt (SRS).

The aims of this review are to clarify the contemporary role of RPA in patients undergoing LT and to systematically analyze all reported cases of RPA, focusing on short- and long-term outcomes.

Materials and methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [46].

Selection criteria

Studies were considered for review if they fulfilled all of the following inclusion criteria: (i) reports of adult/

pediatric recipients of primary deceased donor LT and/or LDLT who underwent RPA, (ii) studies describing outcomes of various operative strategies for grade IV PVT during LT, and (iii) studies reporting at least one perioperative outcome following RPA. If the same institute reported more than one study, only the study with the largest cohort of patients was included. Articles were limited to those published in the English language during a 20-year period from January 1997 through March 2018. There were no study restrictions regarding study type or sample size. Review articles, letters, editorials, abstracts, and case reports in which it was impossible to retrieve or calculate data of interest or without a published article were excluded.

Information sources and search strategy

Three of the manuscript's authors (DG, QC, and DT) conducted the literature search. Eligible studies were identified using the following databases: PubMed, EMBASE, Scopus, and the Cochrane Library Central. The following MESH search headings were used: "portal vein thrombosis AND liver transplantation", "portal vein thrombosis AND renoportal anastomosis", "portal vein thrombosis AND renoportal bypass", "liver transplantation AND renoportal anastomosis", "liver transplantation AND renoportal bypass", "living donor liver transplantation AND renoportal anastomosis", "living donor liver transplantation AND renoportal bypass", "renoportal anastomosis", "renoportal bypass", "renoportal", "splenorenal shunt AND renoportal anastomosis", and "splenorenal shunt AND renoportal anastomosis". The reference lists of all retrieved articles fulfilling the inclusion criteria were cross-checked to further enrich the search. The last search is up to date as of March 31, 2018 in all databases.

Study selection

Following the MeSH keyword and manual searches, three reviewers independently performed screening of all titles and abstracts. Studies were excluded if they did not meet the above eligibility criteria. Consensus for studies included for review was achieved by discussion between reviewers based on the pre-determined inclusion criteria.

Data analysis

After reviewing the full-texts of eligible studies, three independent authors (DG, HA, and DT) performed the data extraction and cross-checked all results. Study characteristics, including author, year of publication, country of enrollment, study design, number of patients, and duration of study follow-up were collected. Demographic patient data consisting of age, gender, co-morbidities, etiology of liver disease, and indication for LT were recorded. Surgical variables, including grade of PVT, surgical intervention to enable LT in the setting of PVT, type of PV anastomosis, postoperative complications (ascites, transient renal dysfunction, infection, variceal hemorrhage, bile leak, hepatic artery thrombosis, PV re-thrombosis, and chronic renal dysfunction), morbidity, mortality rate, cause of death, and postoperative survival rates were also noted. Any disagreements encountered during data coding were adjudicated by a third reviewer (CQ). Data were tabulated, and cumulative analysis was performed when possible. Categorical variables were extracted as numbers and reported as proportions. Regarding continuous variables, the method proposed by Hozo *et al.* [47] was utilized when data were presented as medians with a range to estimate the respective means and standard deviations. Descriptive statistics were used for data presentation and analysis.

Results

Search results and study characteristics

The results yielded by the initial search algorithm and the subsequent selection process are described in Fig. 1. Thirteen studies were excluded as obvious overlaps or duplications. From the 61 records retrieved, 16 studies were considered for final inclusion. Data from the 16 studies were collected, retrospectively. Full details and results of the reviewed articles are provided in Tables 1–4. All included studies were retrospective single center reports. The largest cohort of patients in any single study was (n = 17) [38,43].

Patient demographics and characteristics

A total of 66 patients who underwent LT combined with RPA in the presence of diffuse PVT were identified and included in the analysis. The demographic and clinical data of these patients are summarized in Table 1. The mean age of the population was 47 $\pm$ 13.2 years, the mean Model for End-Stage Liver Disease score was 22.2 $\pm$ 7.4, and 72.7% of the patients were male. One patient was a 14-year-old child. The most common indications for LT were viral hepatitis, alcoholic liver disease, and cryptogenic cirrhosis.

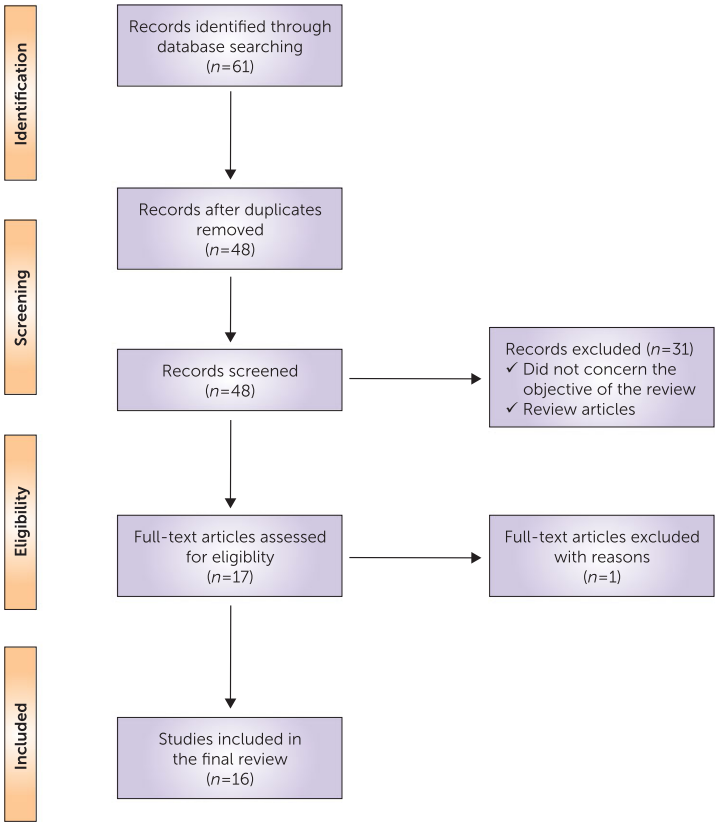

Figure 1 Preferred reporting items for systematic reviews and meta- analyses flowchart for the selection of studies according to inclusion criteria.

Table 1. Characteristics of the 16 studies selected for data extraction

	Center	Type of study	Patients number	Journal	Year
Sheil	Australia	R	1	Clin Transplantation	1997
Kato	USA	R	5	Arch Surg	2000
Miyamoto	Japan	R	1	Transplantation	2003
Marubashi	Japan	R	3	Transplantation	2005
Moon	Korea	R	5	Hepato-Gastroenterology	2008
Perumalla	UK	R	1	Transpl Int	2008
Gonzalez	UK	R	1	Transplantation Proc.	2009
Moon	Korea	R	1	J Am Coll Surg	2011
Bhangui	France	R	17	Annals of Surgery	2011
Uchida	Japan	R	1	Case Report in Surgery	2012
Matsumoto	Japan	R	1	Surg Today	2013
Quintini	USA	R	10	Liver Transplantation	2015
Golse	France	R	17	Transplantation	2015
Mori	Japan	R	1	J Hepatobiliary Pancreat Sci	2015
Ozdemir	Turkey	R	1	World J Transplantation	2017

R, retrospective.

Operative data

Among those studies that provided details on donor classification, 63% of grafts transplanted were a whole liver, 18% were split, 7.5% were derived from living donors, and 4.5% were domino grafts. The mean operative time was 608 ± 193.3 minutes, mean hospital length of stay was 33.1 ± 23.23 days, and mean

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Table 2. Operative data

	MELD	SRS	Type of liver graft	Interposed vein graft	Vein graft	Technique	LOS (Days)	OR Time (minutes)	Blood loss (ml)	PRBC (Units)
Sheil	–	1		0	–	End to end	–	–	–	–
Kato	–	5	Deceased donor	5	Iliac vein	End to end	31 ± 35	643.4 ± 99	–	9.8 ± 3.3
Miyamoto	–	1	Split	1	IJV	End to end	63 ± 58	–	–	
Marubashi	28 ± 3.6	3	Split	3	IJV	End to end	84	996 ± 169	17433 ± 20733	
Moon	18.8 ± 6	5	Split	5	Iliac vein Aorta/GSV	Side to end End to end	34 ± 7.5	999 ± 206	–	18.8 ± 35
Perumalla	–	1	–	0	–	End to end	21	–	–	
Gonzalez	–	1	–	1	Iliac vein	End to end	48	–	–	–
Moon	22	1			ES-PTFE	Side to end	–	–	–	
Bhangui	–	13	Cadaveric (n = 13) Split (n = 1) Domino (n = 2) LDLT (n = 1)	4	–	End to end	48 ± 25	505 ± 143	–	6.5 ± 5
Uchida	–	1	LDLT	1	–	End to end	–	636	1669	
Matsumoto	–	1	LDLT	1	IJV	End to end	23	819	6300	
Quintini	23.7 ± 6	10	Cadaveric(n = 9) Split (n = 1)	10	Iliac vein	End to end	16 ± 16	450 ± 30	3550 ± 1631	4.7 ± 3.4
Golse	21 ± 7	17	Cadaveric(n = 15) LDLT (n = 1) Domino (n = 1)	0	–	End to end	34 ± 19	594 ± 180	–	7.3 ± 6.9
Mori	–	–	–	–	–	–	–	–	–	–
Ozdemir	33	1	LDLT	1	Iliac vein	End to end		636	2400	

intensive care unit length of stay was 11 ± 13.12 days. The mean estimated operative blood loss was 6010 ± 6500 ml and the mean packed red blood cells transfusion requirement was 8.8 ± 11.41 units. The left renal vein was always used. A renoportal end-to-end anastomosis between the native left renal vein and the PV of the graft was performed in 91% of patients, whereas a side-to-end anastomosis was performed in 9% of patients. Venous interposition grafts were used in 51% of patients. Donor iliac vein was the most commonly used graft. Seventy per cent of these patients had a preexistent patent spontaneous SRS, 23% of patients had a surgically constructed distal spleno-renal or renal-lieno shunt, and 7.5% of the patients had no SRS. Operative data are reported in Table 2.

The approach to the left renal vein was described in 10 out of 15 papers (67%). In 9 of these studies [31–36,39,41,45], the anterior surface of the inferior vena cava was dissected after the lateral border of the duodenum was mobilized (termed the Kocher maneuver), and the root of the left renal vein was exposed. Quintini *et al.* [42] described a new approach, wherein the dissection of the left renal vein was achieved by caudal mobilization of the soft tissue present on the anterior wall of the vena cava (exposed during the hepatectomy) until the left renal vein was reached at its insertion with the inferior vena cava. This maneuver was facilitated by the early transection of the recipient's thrombosed PV along with the rest of the hilar structures.

Anticoagulant and antiplatelet use after LT

Only four papers (27%) reported the use anticoagulants after RPA. Golse *et al.* [43] and Bhangui *et al.* [38] reported the use of heparin infusion initiated in the intensive care unit. The rate of the heparin infusion was adjusted to obtain an activated partial thromboplastin time 1.5 to 2 times higher than the reference level. This was replaced by a daily dose of low-molecular weight heparin once the patient had moved to the ward and was administrated until discharge. After their discharge, prophylactic long-term aspirin therapy (250 mg/day) was given to all patients. Moon *et al.* [35,39] reported the use of daily aspirin to prevent prosthetic graft thrombosis.

Postoperative complications

Overall, 71% of patients developed postoperative complications, including ascites (18 patients, 27.2%), transient renal dysfunction (12 patients, 18.1%), infection (13 patients, 19.6%),variceal hemorrhage (2 patients, 3%), bile leak/stenosis (4 patients, 6.1%), early hepatic artery thrombosis (3 patients, 4.5%), early (diagnosed during the same admission) PV re-thrombosis (2 patients, 3%), late (after 12 months) PV re-thrombosis (1 patient,1.5%), and chronic renal dysfunction (2 patients, 3%) (Table 3). All cases of postoperative ascites and transient renal dysfunction resolved within 3 months of LT.

Vascular complications

Hepatic artery thrombosis was reported in 3 patients as an early event (defined as during the same admission as LT), and was associated with fungal thrombosis in a patient with human immunodeficiency virus, ileal perforation complicated by peritonitis, and biliary leak from hepaticojejunostomy. Re-operation was needed in 2 of these patients, whereas the remaining patient required re-transplantation. PV re-thrombosis was discovered as an early event in 2 patients, with the earliest diagnosis made on postoperative day 3. One of these patients required portal angioplasty with stenting (resulting in a satisfactory outcome), whereas the other patient succumbed to multi-organ failure. One patient was reported to have PV re-thrombosis as a late event (defined as having occurred 12 months after LT) and died while awaiting re-transplantation as a result of multi-organ faliure.

Follow-up data

The mean follow-up of these patients was 35.2 ± 29.7 months. The study with the longest duration of follow-up was 12 years [38]. At the time of the last available follow-up, all-cause mortality was reported to be 19.6% (13 patients) and overall patient and graft survival were each 80%. Notably, mortality related to thrombosis of the RPA was only 7.7% (1 patient). Causes of death after LT included sepsis (4 patients, 30.7%), cerebral hemorrhage (4 patients, 30.7%), hepatocellular carcinoma recurrence (2 patients, 15.4%), multi-organ failure (1 patient, 7.7%), variceal hemorrhage (1 patient, 7.7%), and sudden cardiac arrest (1 patient, 7.7%). No patients died from complications directly related to the surgical procedure (Table 4).

Discussion

Portal vein thrombosis has been a historically unfavorable condition for performing LT. Over the course of

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Table 3. Post operative complications

	Ascites	HA thrombosis	Cerebral hemorrhage	ARF	Renoportal thrombosis	Variceal bleeding	Infection	Biliary leak/stenosis	Portal stenosis	HA Stenosis
Sheil							1			
Kato		1*					2	1		
Miyamoto										
Marubashi	2									
Moon	2			1						
Perumalla										
Gonzalez	1									
Moon										
Bhangui	4	1*	1	5	1†	2	2	1		
Uchida										
Matsumoto	1									
Quintini	5			3			1	1	1	
Golse	2	1*		3	2*		5			1
Mori							1			
Ozdemir	1						1	1		

HA; hepatic artery, ARF; acute renal failure.

*Early during the same admission.

†Late after 12 months.

the last two decades, various surgical approaches have been described, which have facilitated LT in the case of PVT. A major factor in the selection of an optimal surgical strategy in the setting of PVT is the capability to exactly assess the localization and extension of PVT. The ideal technique to address the complexity of PVT during LT remains controversial, especially for diffuse SVT. The clinical decision depends primarily on the degree of PVT and the experience of the surgeon.

D'Amico *et al.* [48] and Paskonis *et al.* [3] have previously summarized the different approaches to obtain an adequate portal vein inflow according to the grade of PVT. For Grade I, Grade II and Grade III PVT, portal vein thrombectomy, extra-anatomic venous graft interposition between superior mesenteric vein and portal vein, and the use of coronary vein or large, unnamed collateral veins, have been proposed. In the case of diffuse SVT (Grade IV), combined liver-intestine transplantation, CPA, and RPA have been considered as technical alternatives for reconstruction of the graft portal inflow.

In recent years, the overall results of combined liver-intestine transplantation have been improved with a three-year survival rate of approximately 60% at experienced centers [29,49]. However, this combined approach should be reserved as the last resort in the presence of diffuse SVT.

The most commonly observed complications after CPA have been ascites, renal dysfunction, variceal hemorrhage, and PV re-thrombosis [7–9,11–22]. Variceal bleeding has been reported in approximately 30% of patients, PV re-thrombosis in 20–30% of patients, and chronic renal dysfunction in 40–50% of patients [4–6,22]. Some of these phenomena are pathophysiological, as prehepatic portal hypertension can persist after LT with CPA. In principle, LT with CPA transforms the condition of diffuse PVT in a patient with liver disease into a condition of diffuse PVT in patients with a healthy liver allograft.

Renoportal anastomosis was first described in 1997 by Sheil *et al.* [31] and further modified with interposition grafts by Kato *et al.* [32]. A total of 66 cases are reported in the literature. The contribution of the SRS to the outcome after RPA is evident. The SRS (surgical or spontaneous) enables all three of the important objectives of the surgical management of PVT to be achieved; the SRS provides an adequate amount of blood flow into the allograft PV, decompresses the splanchnic vasculature, and delivers portal trophic factors to the allograft. Additionally, according to our center's experience, decompression of the portal vasculature facilitates a less complex and essentially bloodless hilar dissection. A major factor when approaching this surgical strategy is the preoperative

Table 4. Follow-up data

Author	Patients (n = 66)	Mortality n = 13 (20%)	Cause of death	Graft survival n = 53 (80%)	Patients survival n = 53 (80%)	Follow-up (month)
Sheil	1	0	–	1	1	60
Kato	5	1	Sepsis	4	4	17.7 ± 15.4
Miyamoto	1	0	–	1	1	3
Marubashi	3	0	–	3	3	28 ± 17
Moon	5	1	Cerebral hemorrhage	4	4	19.4 ± 16.1
Perumalla	1	0	–	1	1	12
Gonzalez	1	0	–	1	1	1.5
Moon	1	0	–	1	1	8
Bhangui	17	6	Cerebral Hemorrhage Sepsis (n = 2) Myocardial Infarction HCC Recurrence Variceal Bleeding	11	11	62 ± 45.6
Uchida	1	0	–	1	1	36
Matsumoto	1	1	–	1	1	4
Quintini	10	0	–	10	10	42.2 ± 21.1
Golse	17	4	Cerebral Hemorrhage (n = 2) HCC Recurrence Multi-organ failure	13	13	36
Mori	1	0	–	1	1	–
Ozdemir	1	1	Sepsis	0	0	2

assessment of the localization and extension of SRS and other collaterals (including esophageal, gastric, pancreatic, and duodenal), in order to have a complete mapping of the portal venous system. However, the technique is also associated with certain disadvantages. The large splenorenal collateral is preserved, therefore any collaterals, such as varices, will remain present and may deteriorate and hemorrhage; this risk is of special concern in the case of LDLT with a small graft. Variceal bleeding in patients with SRS is rare after deceased whole graft LT [50]. Other possible disadvantages include injury of the liver graft from the elevated portal venous flow, renal dysfunction, anastomotic strictures or thrombosis of the interposition graft, and hypersplenism.

According to the literature, approximately 50% of patients with diffuse SVT will have a detectable SRS; this suggests that almost half of Grade IV thromboses may be suitable for a RPA. This option may serve to expand the recipient pool. Our systematic review of the existing literature demonstrates that complications in patients with RPA are limited (Table 3). Three patients (4.5%) experienced PT re-thrombosis and only one patient (1.5%) died because of RPA thrombosis and variceal hemorrhage. Despite concerns regarding renal flow after RPA and subsequent renal congestion, only 2 patients (3%) developed chronic renal insufficiency.

This analysis begs an important question: is RPA a relevant approach even in the case of diffuse SVT without a SRS? We propose that RPA may be an option in highly selected cases. In this clinical setting, available options include a CPA with multi-visceral transplantation and a RPA. To date, five cases (7.5%) of RPA in the absence of a SRS have been reported in the literature, four of which were reported by Bhangui *et al.* [38], and one case was reported by Gonzalez-Pinto *et al.* [37]. Three patients out of five died. None of the deaths were related to the procedure or complications of the RPA. The RPA was patent in all patients up until the time of death, and no patients manifested evidence of portal hypertension. We estimate, according to the data reported in literature, that approximately 5–10% of all cases with PVT without SRS could be successfully transplanted.

Renoportal anastomosis ensures adequate portal perfusion with a flow rate matching that of the native PV, and carries additional advantages such optimal coaxiality, congruence of the anastomosed vessels, and preservation of the retrohepatic inferior vena cava flow. Moreover, RPA obviates the specific and frequent

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complications associated with CPA [4–22]. In addition, as Bhangui *et al.* [38] hypothesized, over a period of time, the flow of blood may be directed from the high-pressure splanchnic system to the low-pressure caval system, thereby decompressing the portal circulation and resolving the portal hypertension.

A key component in the selection of the patients who would be suitable candidates for RPA in the setting of diffuse SVT is the measurement of intraoperative flow. The measurement of intraoperative flow has been shown to be a useful tool for assessing PV flow, hepatic artery flow, and the need for shunt ligation if there is a significant collateral steal [51–53]. However, the use of intraoperative flow measurements is still not universally accepted. Normally, the liver receives a total blood flow of 100 to 130 ml/min/100 g of parenchyma, 20% to 30% of which is supplied by the hepatic artery, and the remainder by the PV [54]. The left renal vein flow represents approximately 12.5% of the cardiac output. A normal resting cardiac output of 5.6 l/min for a 70 kg patient would translate to a left renal vein flow of 700 ml/min; for a cirrhotic patient, the left renal vein flow can reach up to 900 ml/min. The additional contribution of a SRS can account for up to a 1000 ml/min flow (range 350–1000 ml/min) [55]. The ideal target PV flow for a partial graft has been proposed to be twice the perfusion observed in the full-size graft (260 ml/min/100 g). A graft with adequate hepatic artery flow (≥100 ml/min) and PV flow values (90 to 260 ml/min/100 g according to the graft type) represents the best-case scenario. Interpreting this data, we speculate that RPA could be performed even without SRS, in the case of a small size graft, if the flows permit it. A slightly lower renoportal flow (because of the absence of SRS) can be easily compensated by a higher arterial flow.

In summary, RPA is not a revolutionary technique; this analysis demonstrates the decades-long evolution of an efficacious technique practiced across the field of transplantation. Postoperative outcomes and survival appear to be encouraging, even in the setting of diffuse PVT. We encourage other transplant centers to embrace this technique with confidence in the management of patients with diffuse PVT.

Funding sources

No funding.

Conflict of interest

The authors have no financial or proprietary interest in the subject matter or materials discussed in the manuscript.

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