Surgery 165 (2019) 970–977

Contents lists available at ScienceDirect

Surgery

journal homepage: www.elsevier.com/locate/surg

Transplantation

Passive mesenterico-saphenous shunt: An alternative to portocaval anastomosis for tailored portal decompression during liver transplantation

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ARTICLE INFO

Article history:
Accepted 29 October 2018
Available online 7 December 2018

ABSTRACT

Background: Temporary portocaval shunt has a positive impact on short-term outcomes after liver transplantation. An alternative to temporary portocaval shunt is a distal passive decompression through mesenterico-saphenous shunt. The purpose of this study was to compare outcomes of these two types of surgical portosystemic shunt and discuss their respective place during the anhepatic phase.
Methods: Patients transplanted with portal decompression during a 4-year period were included. Patients were compared according to two types of surgical decompression techniques: temporary portocaval shunt ($n = 44$) and mesenterico-saphenous shunt ($n = 77$). Spontaneous >5-mm portosystemic shunts were described as absent, nonpersistent, distal, or proximal. Intraoperative portal pressure variations and inhospital course were compared between the two groups, with special attention on the impact of competing spontaneous and surgical shunts.
Results: Mesenterico-saphenous shunt and temporary portocaval shunt showed a comparable hemodynamic efficiency, with no significant difference in terms of portal pressure variations. We found no significant difference in terms of reperfusion syndrome ($P = .956$), transfusion rate ($P = .575$), renal failure ($P = .239$) nor early allograft dysfunction ($P = .976$). There was a significantly higher risk of early allograft dysfunction when competing surgical and spontaneous shunts were used ($P = .002$) with a lesser hemodynamic efficiency (analysis of variance test; $P = .04$).
Conclusion: Portacaval or mesenterico-saphenous shunts offer similar hemodynamic efficiency without impacting the outcomes after liver transplantation. Their respective place and the place of portal decompression should be discussed regarding the presence of portal thrombosis and pre-existing portosystemic shunts. Evaluation of the anatomy and the efficiency of these shunts may guide tailored portal decompression.

Introduction

During the anhepatic phase of liver transplantation (LT), splanchnic venous congestion may occur. Whereas portal decompression was systematically applied in the beginning of liver transplantation through veno-venous bypass, the advent of vena cava conservation has led to a decreased attention to this issue. However, Belghiti et al.[1] and Tzakis et al.[2] promoted the use of a temporary portocaval shunt (PCS) to avoid venous congestion during this phase of transplantation. Its use has been widely diffused, but portal decompression is still not always practiced the world over.

Many studies, among them randomized controlled studies, have shown a beneficial impact of portal decompression on transfusion rate, post-transplantation renal failure, and even long-term outcomes.[3] The possibility to dissect the liver without portal inflow may explain a large part of its advantages. Moreover, the use of portal decompression has shown to be associated with a decreased risk of reperfusion syndrome (RPS). The impact of RPS on transplantation outcomes has been demonstrated but its physiopathology is not clear.[4] One of the main hypotheses is a decreased splanchnic congestion responsible for decreased intestinal

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https://doi.org/10.1016/j.surg.2018.10.036

barrier alterations and lesser metabolic disturbances. Reduction of endotoxinemia may be a mechanism for the observed benefit given the significant impact of endotoxinemia during liver transplantation.[5] However the use of portal decompression is still a matter of debate. It is not uniformly used even though considerable evidence tends to promote its use.[6] On the other hand, teams reported their experience with need of portal decompression.[7,8] Some technical arguments against portocaval anastomosis have been raised. Indeed, portocaval anastomosis may be problematic in cases of portal thrombosis and its realization needs pedicle dissection, which can be complicated in cases having a history of cholecystectomy or other supramesocolic surgery or in case of a large segment 1. In view of this, alternatives to classic PCS that avoid pedicle dissection might be of interest. In this report, we present a passive mesenterico-saphenous shunt (MSS) as a distal shunt as an alternative to PCS.

Another question that has not been addressed in the literature is the hemodynamic efficiency of portal decompression, especially in patients with already existing porto-systemic shunt. Indeed, the presence and, most important, the anatomy of the spontaneous shunt may directly impact the benefit of portal decompression.

The goal of this study was to evaluate the hemodynamic efficiency of surgical shunts according to their anatomy and to identify some parameters to tailor portal decompression during liver transplantation when needed. We tested the hypothesis that all spontaneous shunts are not equally efficient during the anhepatic phase, leading to a need for tailored portal decompression according to their anatomy. The absence of portal decompression in the absence of efficient shunts, and competing spontaneous and surgical shunts when completed, may alter graft function.

Materials and Methods

Patient selection and liver transplantation

All patients transplanted between January 2014 and January 2017 were retrospectively analyzed after approval by the ethics committee at the University of Strasbourg (France) in accordance with the 1975 Declaration of Helsinki. Patients who benefited from portocaval shunt or MSS during this period were included in an efficiency analysis to compare the two types of surgical shunts. In addition, patients for whom portal pressure and central venous pressure were available before and within 5 minutes after portal clamping and shunt opening were included in a hemodynamic study. A group of 92 patients not undergoing portal decompression during the same study period was used as a control population.

Patients were selected for liver transplantation after standard workup according to the European Association for the Study of the Liver (EASL) guidelines for liver transplantation. Patients with hepatocellular carcinoma were listed when they met the French multicentric study criteria according to the Duvoux score. Patients with alcoholic cirrhosis and acute alcoholic hepatitis were considered for transplantation when they met the already published criteria.

Liver transplantation was performed with vena cava preservation in all cases. The use and type of portal decompression was left to the surgeon's discretion. The graft was reperfused after washout with albumin at room temperature and after the completion of caval and portal anastomosis. Liver grafts were classically reperfused with caval and portal unclamping before arterial anastomosis was performed.

Spontaneous shunts were ligated in cases of poor portal flow after arterial reperfusion evaluated on visual flow at unclamping and Doppler ultrasonography waves.

Surgical portal decompression technique

Figure 1 presents the surgical portal decompression technique. Portocaval anastomosis was performed according to the already published technique.[1] Briefly, a termino-lateral portocaval anastomosis was fashioned with 2 hemisutures of 5-0 prolene and unclamped during the entire anhepatic phase. Portal pressures were measured by inserting a 23Fr catheter—connected to the central venous pressure transducer—in the portal trunk.

MSS was performed by dissecting the inferior mesenteric vein (IMV) a few centimeters under the duodeno-jejunal angle. IMV was ligated on its proximal part to insert a 16Ch Argyle canula (Covidien, Elancourt, France) as during liver procurement. The cannula was inserted 2–3cm into the IMV to avoid completely occluding the splenic vein and to clear the hepatic pedicle. A second 16Ch Argyle cannula was inserted in the saphenous vein after dissection of the Scarpa area. The cannulas were connected through a 25-cm 30Ch tubular drain to avoid kinking of the shunt. To continuously measure portal pressure during LT a ¼ - ¼ adapter shunt (Diderot, Drancy, France) was used to connect the mesenteric cannula to the tubular drain. The pressure head captor was connected to the anesthesiology machine to measure portal pressure. This shunt achieves a left-sided distal surgical shunt in opposition to the portocaval shunt, which achieves a proximal shunt. The time needed for realization is between 5 and 15 minutes.

Spontaneous portosystemic shunt analysis

Spontaneous portosystemic shunts were analyzed on pretransplant computed tomography (CT) scans that were systematically practiced. The portal phase was used for the analysis with frontal and sagittal maximum intensity projection reconstruction to detail the type of shunt. The anatomic description of the shunts were used according to Saad.[9] In brief, the six types of shunts were as follows: umbilical vein, indirect splenorenal shunt through the retrogastric venous collaterals, direct splenorenal shunt (SRS), left gastric shunt (LGS), transjugular intrahepatic portosystemic shunt, and mesenteric and retroperitoneal shunts (inferior or superior MS/RPS). The shunt was considered significant when its diameter was more than 5 mm. Shunts were first classified according to the caval territory of drainage (superior or inferior vena cava). Second, shunts were classified according to their persistence during LT after portal clamping. Hence, ombilical vein shunts and transjugular intrahepatic portosystemic shunt were considered nonpersistent shunts (NPS), whereas splenorenal, LGS, and MS/RPS were considered persistent shunts (PS). Among PS, left-sided shunts (SRS, inferior MS/RPS) were designated as distal and distinguished from right-sided shunts (LGS, superior MS), which were designated as proximal.

Definitions

Early allograft dysfunction was defined according to Olthoff's criteria: day 7 bilirubin > 170 µmol/L, day 7 international normalized ratio > 1.6 or peak transaminases > 2,000 during the first week.[10]

Primary nonfunction was defined as the necessity of retransplantation or death within the first 7 days after LT, after excluding surgical complications.

Design of the study

Among 232 transplanted patients and after excluding associated kidney, lung, and heart transplant and emergency retransplantation, 121 patients (52%) having received PCS or MSS were included and compared in terms of intraoperative and short-term

Fig. 1. Intraoperative views of the two types of surgical shunts: portocaval anastomosis (*left*) and mesenterico-saphenous shunt (*right*).

outcome in a retrospective analysis. The hemodynamic efficiency of portal decompression was evaluated in a series of 48 patients for whom portal pressure measurements were available before and after clamping of the portal vein. A group of 92 patients transplanted without portal decompression during the same period was used as control.

The impact of the presence and type of spontaneous portosystemic shunts was evaluated on the hemodynamic efficiency of portal decompression. Outcomes were compared according to the type of portal decompression used and the anatomy of spontaneous shunts.

To further refine the indications for each technique, competing surgical and spontaneous shunts were considered at risk of graft dysfunction owing to a lesser efficiency. Competing surgical and spontaneous shunts were considered when a persistent spontaneous shunt was in the opposite territory as the surgical shunt. For patients with complete portal thrombosis, MSS was considered the optimal technique. Decompression strategy was considered as potentially inefficient when no shunt was made in the absence of a persistent shunt or when a competing surgical shunt was fashioned.

Statistical analysis

The results are reported as the mean ± standard deviation or the median (range) for the continuous variable according to the distribution of the variable. Continuous variables are compared between groups, using a paired Student *t* test or a Mann-Whitney *U* test as appropriate. Categorical variables are compared using a χ^2 test. Analysis of variance was used when more than two groups were being compared. Significant difference between groups was considered when the P value $< .05$. Statistical analyses were performed with Statview version 5.0 for Windows (SAS Institute, Cary, NC, USA).

Results

The demographic characteristics of the 213 studied patients according to the type of surgical decompression are reported in Table 1. Of note, patients not undergoing portal decompression had less severe liver disease as shown by lower Model for End-Stage Liver Disease score at LT and had significantly more frequently preexisting shunts and portal thrombosis ($P = .0005$).

Hemodynamic study

Hemodynamic efficiency of spontaneous portosystemic shunts

Portal clamping was associated to a median increase in portal pressure of 11 mmHg (–6 to 43). Of note, two patients presented with a decrease in portal pressure at portal clamping, one of whom had Rendu-Osler disease and the other a 5-mm indirect splenorenal shunt. Portal pressure elevation was significantly lower in patients presenting persistent shunts (4.7 ± 6) compared with patients with nonpersistent shunts (12.1 ± 8; $P = .047$) or no spontaneous shunt (15.8 ± 11; $P = .001$). There was no significant difference in portal pressure elevation between patients with no shunt or nonpersistent shunt ($P = .282$). In patients with persistent shunts, there was a trend toward better hemodynamic efficiency of distal shunts compared with proximal shunts (namely, LGS and superior MS), shown by a lower increase in portal pressure at portal clamping (8 ± 7 vs 19 ± 1; $P = .051$).

Hemodynamic efficiency of surgical portosystemic shunts (Table 2)

After the unclamping of a surgical temporary shunt, the mean portal decrease was 16.7 mmHg (–5 to 25). The 2 types of shunts presented a similar hemodynamic efficiency as a portal pressure decrease of 17.7 ± 11 and 15.4 ± 10 ($P = .517$) for MSS shunt or PCS, respectively. When analyzing only patients without persistent shunt, there was still no difference between the 2 types of shunts ($P = .962$).

Portal pressure decrease was compared for each type of surgical shunt according to the type of preexisting shunts. For PCS, the presence of distal shunt (mostly splenorenal shunt) was associated with a significantly lower portal pressure decrease (ie, lesser hemodynamic efficiency compared with proximal shunts; $P = .006$). For MSS, there was no significant difference in the portal pressure decrease, although it tended to be more efficient in the absence of spontaneous persistent shunt ($P = .194$; Table 3; Fig. 2)

Table 1
Description of the 213 included patients according to the type of surgical shunt

	Shunted population		P	Nonshunted	P value (versus
	MSS ($n = 77$)	PCS ($n = 44$)	value	population ($n = 92$)	shunted)
Age (years)	54 ± 11	52 ± 11	.58	55 ± 10	.372
Male sex	53 (69%)	29 (66%)	.741	72 (78%)	.09
Body mass index (kg/m^2)	25.9 ± 4	27.7 ± 5	.033	26.5 5	.987
Etiology of cirrhosis					
Alcohol	39 (51%)	27 (61%)	.255	48 (52%)	.731
Hepatitis B	1	1		3	
Hepatitis C	15 (19%)	7 (16%)	.624	12 (13%)	.311
Metabolic	8	6	.629	11	.931
Autoimmune	2	4		5	
Fulminant hepatitis	6	2	.435	0	.012
Other					
Hepatocellular carcinoma	22 (29%)	12 (27%)	.879	31 (34%)	.406
Retransplantation	1 (1%)	1 (2%)	.686	7 (8%)	.032
Waiting time (days)	120 ±27	95 ± 23	.519	184 ± 47	.117
Lab-MELD at LT	25.8 ±12	27 ± 11	.579	24 ± 11	.171
Lab-MELD > 35	25 (32%)	14 (32%)	.99	20 (21%)	.073
Bilirubin at LT (μmol/L)	168 ± 23	210 ± 32	.276	150 ± 23	.283
INR at LT	2.91 ± 2.4	2.62 ± 1.3	.519	2.31 ± 1.3	.094
Creatinine at LT (μmol/L)	131 ± 19	82 ± 8	.095	125 ± 20	.689
Pre-LT IL6 ($n = 84$)	325 ± 290	44 ± 8	.451	35 ± 7	.345
Ascites	42 (55%)	24 (55%)	> .99	51 (55%)	.902
Platelet count (/mm^3)	91,118 ± 61,000	90,209 ± 51,000	.935	77,147 ± 7,155	.200
Major spontaneous shunt	30 (43%)	22 (55%)	.246	53 (74%)	.0005
No major spontaneous shunt	39 (56%)	18 (45%)		19 (26%)	
Persistent shunt after portal clamping ($n = 77$)	21 (42%)	11 (49%)	.694	61 (66%)	.043
Distal persistent shunt	13	10		38	
Proximal persistent shunt	8	1		23	
Portal vein thrombosis	5 (6%)	2 (5%)	.659	12 (14%)	.048
Partial thrombosis	4	2	.495	10	
Total thrombosis	1	0		2	
Extended criteria donor*	42 (55%)	28 (64%)	.42	63 (68%)	.112
Donor age	54 ± 18	56 ± 20	.566	61 ± 17	.043

* ECD according to EASL definition.*IL6*, interleukin-6; *INR*, international normalized ratio; *MELD*, Model for End-Stage Liver Disease; *MSS*, mesenterico-saphenous shunt; *PCS*, portocaval anastomosis.

Table 2
Hemodynamic efficiency of the two types of surgical shunt ($n = 51$)

	MSS ($n = 31$)	PCS ($n = 20$)	P value univariate (uni)
Pressures at beginning of LT			
Portal pressure	28 ± 8	30 ± 7	.445
Central venous pressure	13 ± 5	14 ±6	.459
HVPG	15 ± 7	15 ± 5	.905
Pressures at the end of LT			
Portal pressure	21 ±8	21 ± 5	.938
Central venous pressure	13 ± 4	13 ± 5	.857
HVPG	8 ± 5	8 ± 5	.934
Evolution of pressures during LT			
Portal pressure elevation at clamping	13.4 ± 10	9.1 ± 8	.125
Decrease in PP after shunt unclamping	16.3 ± 11	16.9 ± 10	.86
Decrease in PP at the end of LT	7.7 ± 2	7 ± 2	.78

HVPG, hepatic venous pressure gradient; *PP*, portal pressure; uni, univariate.

Impact of surgical decompression technique on intra- and postoperative course (Table 4)

We found no significant major differences in terms of intraoperative course between PCS or MSS, except for the intervention duration, which was longer in the MSS ($P = .011$). Intraoperative transfusions were comparable between the groups regarding red blood cell count, fresh frozen plasma, and platelets. Of note, lactate levels at reperfusion were higher in the group with the MSS than with the PCS without significant impact in terms of reperfusion syndrome or postoperative outcome.

Indeed, the rate of medical complications were similar between both groups, and the median hospital stay was comparable ($P = .99$). There was a nonsignificant trend toward lower day 7 bilirubin and international normalized ratio in the MSS group, but this did not reach significance.

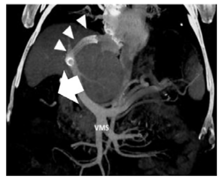
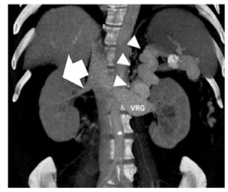
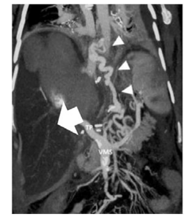
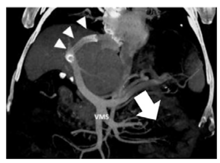
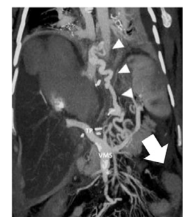
Patients without portal decompression had a higher quantity of transfusion ($P = .049$) and a trend toward higher 90-day mortality ($P = .061$).

When considering only a shunted population, early allograft dysfunction was significantly more frequent (67% vs 13%; $P = .002$) when the optimal shunt was not used. The difference was mainly observed because of a higher day 1 transaminases (Fig. 3). When considering a nonshunted population, there was a significantly higher rate of early allograft dysfunction ($P = .0001$) when the optimal strategy was not used.

Discussion

The most used technique of portal decompression during liver transplantation is temporary PCS. This technique has rapidly

Table 3
Impact of surgical and spontaneous shunt matching on intraoperative and short-term outcomes, including patients with available hemodynamic data

	No persistent shunt	Persistent distal shunt	Persistent proximal shunt
PCS ($n = 23$)	13	9	1
			
Delta PP	21 ± 3 mmHg	12 ± 4 mmHg *	17 mmHg*
EAD	50%	45%*,†	20%*
MSS ($n = 32$)	20	9	3
			
Delta PP	18 ± 12 mmHg	22 ± 5 mmHg	13 ± 4 mmHg
EAD	45%	23%#	19%

* $P = .002$.
† $P = .047$. *EAD*, early allograft dysfunction; *PP*, portal pressure.

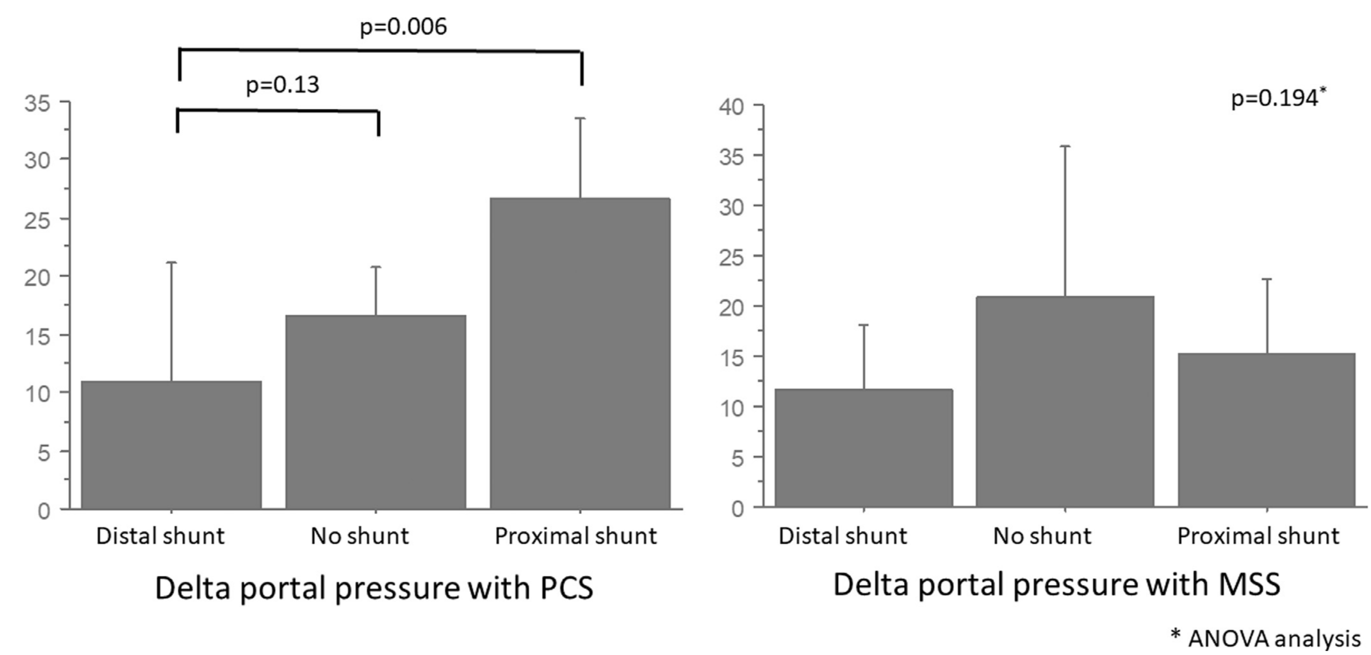


Fig. 2. Impact of the anatomy of spontaneous portosystemic shunts on surgical shunt efficiency. Portal pressure decrease after surgical shunt opening is significantly lower in patients receiving PCS in case of distal shunt (*left*). MSS hemodynamic efficiency does not seem dependent on spontaneous shunt anatomy. *MSS*, mesenterico-saphenous shunt; *PCS*, portocaval shunt.

spread, mainly in European centers because it is an easy and secure technique in most patients.[6] However, in patients with large segment 1 and, most important, in patients with portal thrombosis and portal cavernoma or in a case of important portal hypertension with peribiliary varices and history of upper GI surgery, temporary PCS may become dangerous or at least may lose its main purpose, which is to decrease blood loss.

The technique of the MSS enables effective portal decompression without the need for portal pedicle dissection. Indeed, MSS achieves similar hemodynamic efficiency in decompressing the splanchnic area, as shown by the analysis of a portal pressure decrease at shunt unclamping. Most important, MSS has similar results in short-term outcomes, particularly in terms of blood transfusion, reperfusion syndrome, and early allograft dysfunction. This original technique is as expedient as portocaval shunt with no learning curve because it is derived from mesenteric cannulation as for liver procurement or veno-venous bypass.

The MSS technique does have some technical limitations. First, patients who have recurrent ascitic infections may make access to the inferior mesenteric vein problematic. A small proportion of

Table 4
Intraoperative data and outcomes, according to the type of surgical shunt

	Shunted population ($n = 121$)		P	Nonshunted	P
	SMS ($n = 77$)	PCS ($n = 44$)	value	population ($n = 92$)	value
Cold ischemia time (minutes)	497 ± 117	445 ± 101	.016	457 ± 9 2	.344
Anhepatic phase (minutes)	98 ± 45	104 ± 41	.474	79 ± 39	< .0001
Operative time (minutes)	366 ± 126	316 ± 98	.036	315 ± 94	< .0001
Reperfusion syndrome ($n = 145$)	21 (44%)	19 (43%)	.956	24 (45%)	.833
ASAT at unclamping	1,267 ± 1,409	1,018 ± 801	.304	1,208 ± 1,782	.88
ALAT at unclamping	793 ± 648	684 ± 540	.365	786 ± 1,007	.781
K+ at unclamping	3.74 ± 0.7	3.75 ± 0.8	.922	3.82 ± 0.8	.496
Lactates at unclamping (µmol/L)	4.78 ± 2.7	3.42 ± 2.3	.009	3.67 ± 2	.096
IL6 at unclamping	1450 ± 615	663 ± 112	.328	1,942 ± 1,152	.480
RBC units*	6 (0–18)	6 (0–21)	.575	8 (0–40)	.049
FFP units*	8 (0–24)	7 (0–32)	.89	11 (0–36)	.13
Platelets concentrates*	0.5 (0–6)	0 (0–5)	.922	1.5 (0–12)	.066
Primary nonfunction	0 (0%)	1 (2%)	.184	0 (0%)	.382
Early allograft dysfunction	19 (25%)	11 (25%)	.976	30 (35%)	.114
Day 7 bilirubin (µmol/L)	79 ± 10	90 ± 10	.508	103 ± 13	.174
Day 7 INR (IU)	1.19 ± 0.2	1.34 ± 1	.198	1.3 ± 0.4	.446
Peak ASAT d1-d7	660 ± 153	868 ± 153	.252	984 ± 257	.302
Peak ALAT d1-d7	710 ± 74	729 ± 89	.877	709 ±672	.971
90-day mortality	4 (5%)	3 (7%)	.716	12 (13%)	.061
Ventilation duration (days)	4 ± 1	4 ± 1	.92	5 ± 1	.876
Necessity of reintubation	15 (21%)	8 (19%)	.819	14 (15%)	.245
Acute kidney injury (within 15 first days)	44 (66%)	24 (55%)	.239	63 (68%)	.152
Need for postoperative dialysis	20 (29%)	12 (27%)	.627	36%	.205

ALAT, alanine aminotransferase; *ASAT*, aspartate aminotransferase; *FFP*, fresh frozen plasma; *IL6*, interleukin-6; *INR*, international normalized ratio *IU*, international unit; *RBC*, red blood cell.
* Intraoperative transfusions.

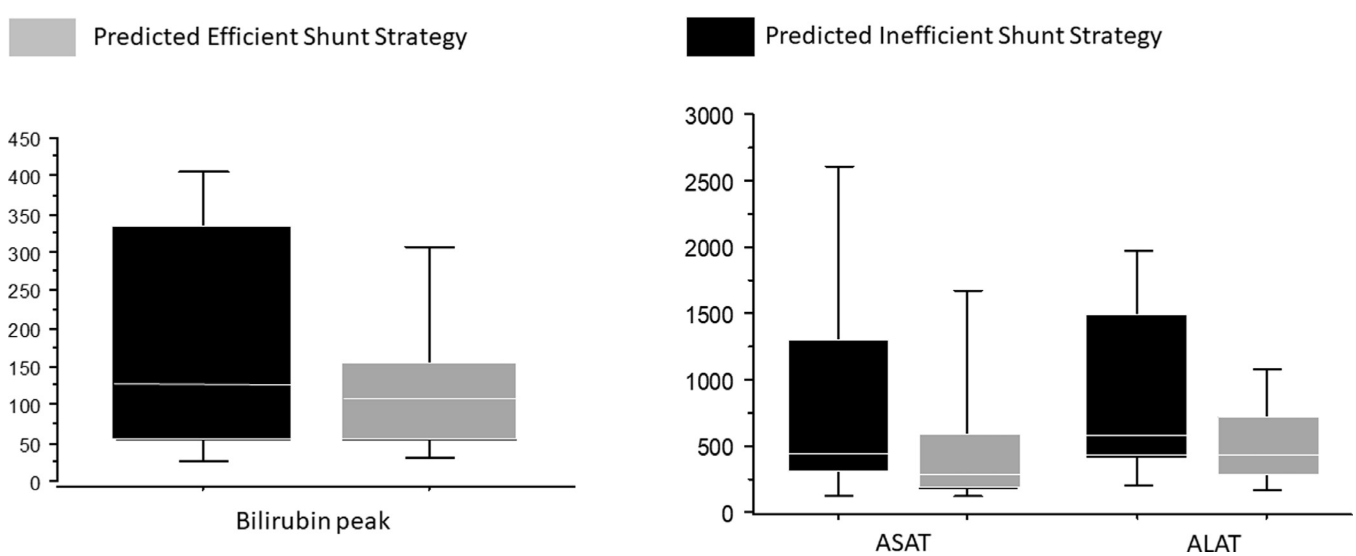


Fig. 3. Short-term outcomes in terms of day 7 bilirubin (*left*) and transaminases peak (*right*), according to proposed surgical shunt strategy regarding portosystemic shunts anatomy. There was a significantly higher risk of early allograft dysfunction when surgical shunt decompression was predicted to be inefficient, according to the competing shunt hypothesis.

patients present retroperitoneal venous derivations around this vein, causing its dissection to be dangerous. In these cases, the use of PCS may be preferable. In retransplanted patients with the use of veno-venous bypass during the first LT, dissection of the IMV may be problematic, especially if the vein has been dissected close to the duodenojejunal angle. Finally, the MSS technique has its own complications mainly attributable to the saphenous access. In our experience, the occurrence of complications in the Scarpa dissection is acceptable. The theoretic risk of shunt thrombosis has never led to significant complications. Of note, venous embolism has not been reported during the study period. It should be noted that the pressure within the shunt progressively achieves a steady state with central venous pressure during the anhepatic phase. Partial clamping of the vena cava is associated with a significant increase in the pressure within the shunt. In this view, pressure measurement through the shunt may be used to monitor the impact of caval clamping.

Surgical portal decompression has been advocated in prospective and randomized trials. They have shown to be associated with better outcomes in terms of transfusion, renal failure, and even overall survival.[11–13] Figueras et al.[3] have shown that the benefit of the PCS in terms of renal function was particularly positive in patients with an increased pretransplant porto-caval gradient >16 mmHg. These patients may be those without effective spontaneous shunts. Whether the presence and type of spontaneous portosystemic shunts impacts the efficiency of surgical temporary portal decompression has never been specifically addressed in the literature.

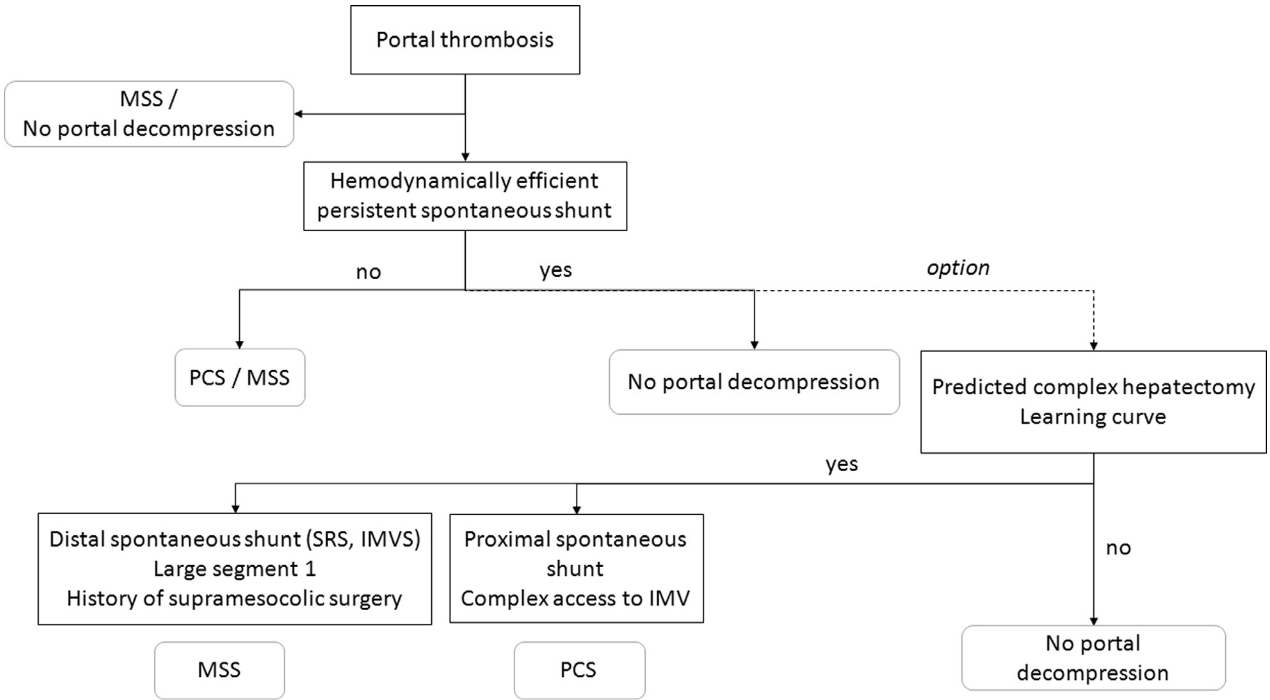


Fig. 4. Proposed algorithm for tailored portal decompression. Patients with portal thrombosis could be shunted with MSS to decrease portal pressure and enable safe portal thrombectomy with decompressed mesenteric pressure. In patients with a persistent and hemodynamically efficient shunt, no portal decompression can be proposed. However, some circumstances may indicate the use of portal decompression. In these cases, anatomy of the shunts should be carefully analyzed on preoperative CT to choose the most efficient way to achieve portal decompression. *MSS*, mesenterico-saphenous shunt; *PCS*, portocaval shunt.

Portosystemic shunts are often present in decompensated cirrhotic patients, especially in patients with ascites. They may occur in more advanced liver diseases or in liver diseases associated with significant activation of neoangiogenesis. Spontaneous portosystemic shunts develop according to unknown determinants. However, the anatomy of these shunts may be of particular importance when deciding whether portal decompression is indicated. A reasonable hypothesis would be that the development of shunts decreases this gradient and may lower the benefit of portal decompression.

The indication for portal decompression is beyond the scope of this study and we deliberately focused on patients who benefited from a surgical shunt and used the criteria that have been proven to be improved by portocaval shunt in the literature. Indeed, although not programmatic, the retrospective data show that non-shunted patients were different from the shunted ones. They more frequently presented advanced portal hypertension with spontaneous shunts, which led to the absence of a significant difference in outcomes as they are actually naturally shunted. A short anhepatic phase with portal clamping at the end of the hepatectomy may also lead to the absence of metabolic consequences of splanchnic congestion. However, a higher number of transfused red blood cells are observed because of either a higher blood loss during dissection or a more complex procedure owing to more frequent portal thrombosis. One could argue that patients with hemodynamically efficient spontaneous shunts could have been transplanted without any surgical decompression. In a recent series by Gomez-Gavara et al. the rate of portal decompression in patients with spontaneous SRS is actually low, reinforcing the lack of a need for decompression in the majority of these specific patients.[14] However the hemodynamic data shown in our present report underline the variability in spontaneous shunt “hemodynamic efficiency.”

An original point of the study is the evaluation of hemodynamic efficiency of spontaneous persistent shunts. First, it should be stressed that, even in the case of large portosystemic shunts, portal decompression leads to a significant decrease in splanchnic pressure in some cases, revealing a genuine benefit of temporary portal decompression. There seem to be no significant difference in terms of portacaval gradient between the types of spontaneous shunts, although proximal shunts seemed associated with higher initial portal pressure and higher decompression efficiency. Although the studied population is small, this observation should be kept in mind. The hemodynamic efficiency of spontaneous shunts may differ according to their anatomic localization and it may be of interest for future studies.

The question of whether portal decompression should be guided by the presence of efficient shunts may be of interest in future studies. Indeed, whereas the tenants of systematic portal decompression put forward the absence of a proven deleterious effect and the existence of evidenced-based medicine data to promote portal decompression, others have shown the feasibility of LT without portal decompression. Other than the question of the role of portal decompression in patients with a preexisting shunt—which is beyond the scope of this study—the nonshunt tenants put forward a time-consuming, unnecessary surgical step. Given the retrospective aspect of the study, it was not possible to compare the duration of a PCS and an MSS. The risk of hemorrhagic dissection of the hilar structures in portal hypertension and the shortening of the portal vein for the subsequent portal decompression are other arguments against PCS. In this view, an MSS may be an elegant alternative that overcomes both limitations.

Figure 4 presents a proposal for a personalized surgical shunt strategy according to spontaneous shunt anatomy. Patients with portal thrombosis could be considered as better candidates for the MSS rather than the PCS, given the absence of the need for portal pedicle dissection. Patients with no persistent shunts should have portal decompression and are considered to benefit in the same way from the MSS and the PCS. No decompression can be considered if there is a spontaneous shunt with a proven hemodynamic efficiency. Portal pressure measurements should therefore be conducted in these cases. However, if portal decompression is considered as a routine technique in specific cases of predicted complex hepatectomy or at the beginning of the surgical experience (to have time for liver dissection and limit bleeding from the perfused liver), tailored portal decompression is an option. In these cases, patients do not benefit from a surgical shunt when there is a "competing" spontaneous shunt (ie, a preexisting efficient shunt in the opposite territory), especially in the case of PCS use, which seems particularly dependent on preexisting shunts (eg, inferior MS for PCS). In case of a PCS, ligation of hemodynamically efficient spontaneous shunt should be proposed at the end of LT.

In conclusion, the passive MSS shunt is a feasible and safe alternative to the PCS, which may provide advantages in some particular circumstances. Hemodynamic efficiency of spontaneous and surgical shunts should be evaluated in future studies regarding portal decompression.

Acknowledgments

We wish to thank Dr Artzner for the language editing and Dr Molière for the CT reconstructions of preoperative PCS.

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