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REVIEW

French guidelines on TIPS: Indications and modalities

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Abstract

Transjugular intrahepatic portosystemic shunt (TIPS) has become essential in the treatment or prevention of portal hypertension-related complications. In the early 1990s, the primary indication was refractory bleeding. It is now proposed for the treatment of ascites for the prevention of bleeding and in patients with vascular diseases of the liver. Thus, there are a growing number of patients being treated with TIPS all over the world. The broadening of indications, the involvement of multiple stakeholders, the need for an accurate selection, the positioning in relation to transplantation and the lack of standardization in pre-therapeutic assessment, in the procedure itself and in the follow-up have led the board of the French Association for the Study of the Liver to establish recommendations.

KEYWORDS
cirrhosis, guidelines, portal hypertension, TIPS

1 | PART 1: ASSESSMENT/PREPARATION BEFORE A PLANNED TIPS

1R1.1. When an indication for TIPS has been identified, patients should probably be referred to a TIPS expert centre to assess their eligibility (G2+, strong agreement).

1R1.2. If the TIPS procedure might be technically complex or at high risk of complication, it is recommended to seek the advice of a liver transplant team (expert opinion, strong agreement).

1R2. In patients with cirrhosis and an indication for planned TIPS, liver transplantation should be discussed, before or in case of post-TIPS worsening (G2+, strong agreement).

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The general organization and methodology of the present guidelines are developed in Appendix.

For affiliations refer to page 13.

1R3. In patients with cirrhosis and liver insufficiency, planned TIPS is probably not recommended but may be discussed on a case-by-case basis in patients for whom transplantation is being considered (G2−, strong agreement).

Liver function remains the primary determinant of morbidity and mortality following TIPS. Studies aiming to predict factors of mortality after TIPS often lack consistent categorization of liver-related mortality particularly that linked to post-TIPS liver failure. Studies often exclude patients with severe hepatic insufficiency (e.g. MELD >15 or >18, Child-Pugh C or total bilirubin >50 μmol/L). The prognostic value of INR, bilirubin and platelets count hold well-documented prognostic value.[1] Recently, albumin has garnered interest and was incorporated into the Freiburg Index of Post-TIPS Survival.[2] Although MELD score has been extensively evaluated for predicting post-TIPS mortality, no specific threshold has been definitively established to contraindicate the procedure. Given the risk of exacerbating post-TIPS hepatic insufficiency, experts suggest that TIPS may be considered on a case-by-case basis in patients with impaired liver function (Child-Pugh C, MELD >18, bilirubin >50 μmol/L and platelets <75 G/L), providing that transplantation is a viable option in the case of severe procedural complications. Collaboration between expert TIPS centre and transplant centre is essential during pre-TIPS evaluation to anticipate potential liver transplantation.

1R4.1. Risk factors for hepatic encephalopathy should be investigated before a planned TIPS procedure (G1+, strong agreement).

1R4.2. History of overt hepatic encephalopathy and its triggering factors, minimal hepatic encephalopathy and liver function should be assessed before a planned TIPS procedure (G1+, strong agreement).

1R4.3. Renal function impairment, hyponatraemia, sarcopenia and large portosystemic shunts should probably be screened before a planned TIPS procedure (G2+, strong agreement).

No method definitively identifies patients who will develop hepatic encephalopathy (HE) after TIPS, and as a result, HE still occurs in approximately 35% of selected patients. While the Psychometric Hepatic Encephalopathy Score, Critical Flicker Frequency and animal naming tests hold promise, it is imperative to consider both accuracy and feasibility for routine clinical use. In that sense, further research is warranted to recommend one tool over another definitively. A history of chronic or recurrent HE, especially without a clearly identified triggering factor, and impaired liver function (Child-Pugh score of C or MELD score >18) are considered contraindications to TIPS by the majority of medical teams.[3] Renal dysfunction, hyponatraemia, sarcopenia and advanced age are risk factors for post-TIPS HE and should be evaluated, along with the presence of large portosystemic shunts (LPSS).[4]

1R5.1. It is recommended to perform a cross-sectional imaging prior to a planned TIPS (CT or MRI). If the imaging was conducted more than 1 month before, recent imaging, such as a Doppler ultrasound, may be advisable (expert opinion, strong agreement).

Key points

Transjugular intrahepatic portosystemic shunt is an interventional radiology procedure introduced over 30 years ago and has become an essential treatment for portal hypertension. There is a need to review the indications, patient selection, the procedure itself and the follow-up. These recommendations summarize the level of evidence of scientific data accumulated in recent years.

1R5.2.1. When there is a recent extensive and complete portal vein thrombosis, anticoagulant therapy should be introduced before the planned TIPS procedure (G1+, strong agreement).

1R5.2.2. HCC with proximal vascular invasion or infiltrative HCC should probably be considered as contraindications for planned TIPS (G2+, strong agreement).

1R5.2.3. Bile duct dilatation or polycystic liver diseases are relative contraindications for TIPS (expert opinion, strong agreement).

The radiological evaluation aims to determine the patency of the hepatic veins and the portal trunk, to identify potential anatomical variations and to detect contraindications. Abdominal CT scan with contrast injection appears to be the most suitable radiological assessment for pre-TIPS evaluation, taking into account its accessibility and its spatial resolution, which allows a comprehensive view of hepatic vein anatomy, the detection of PVT, LPSS and HCC. Hepatic vein thrombosis requires an adjusted procedure and may prompt consideration for a trans-caval TIPS placement.[5] Extensive portal trunk thrombosis, involving the splenomesenteric confluence, mesenteric and splenic veins, represents a (temporary) contraindication for TIPS placement. Reassessment may be necessary after administering anticoagulant therapy. Segmental tumour invasion of the portal or suprahepatic system complicating HCC often contraindicate TIPS placement, as well as the presence of polycystic liver disease.

1R6.1. A specialized anaesthesia consultation should be performed before a planned TIPS procedure (G1+, strong agreement).

1R6.2. Scientific data are insufficient to recommend the correction of haemostasis disorders before TIPS insertion (expert opinion, strong agreement).

1R6.3. Antibiotic prophylaxis is not mandatory during TIPS insertion (expert opinion, strong agreement).

1R6.4. It is recommended to postpone TIPS insertion in a patient with a documented or suspected infection (expert opinion, strong agreement).

Specialized anaesthesial evaluation must specifically consider the risks of aspiration, procedural complications due to patient movement, and anticipated difficulties in access to the patient's head for the anaesthesia team. General anaesthesia with orotracheal intubation appears more appropriate in cases of significant ascites and expected prolonged intervention duration (>1 h) to

prevent the risk of aspiration.[6] Conscious sedation, administered by an anaesthesiologist, is also feasible and allows for faster recovery. Haemorrhagic complications during TIPS placement are more often related to technical difficulties rather than haemostatic abnormalities.[7] According to recent European clinical practice guidelines, coagulation tests such as INR, prothrombin time and platelet count do not reliably assess haemorrhagic risk during invasive procedures.[7] The utility of thromboelastography to guide the transfusion of labile blood products remains to be confirmed.[8] Based on current available data, the risk–benefit ratio for routine prophylactic transfusion of fresh frozen plasma does not support its widespread use. Current guidelines suggest that platelet transfusion could be discussed on a case-by-case basis for procedures where local haemostasis is not achievable with platelet counts <50 G/L.[7] The sole randomized controlled trial that compares the incidence of TIPS-related infections with and without antibiotic prophylaxis is dated and did not reveal a significant difference in post-procedure infections between patients who received prophylaxis and those who did not (14% vs. 20%). However, it is important to note that the study was likely underpowered.[9]

1R7.1.1. Assessment of cardiac function should be performed in all candidates for planned TIPS (G1+, strong agreement).

1R7.1.2. TIPS should probably be contraindicated in patients with severe or symptomatic right or left heart dysfunction, in patients with untreated valvular disease and in patients with severe pulmonary arterial hypertension (mPAP≥45 mmHg) (G2+, strong agreement).

1R7.2.1. Porto-pulmonary hypertension (PPH) should be screened during pre-TIPS work-up by TEE (G1+, strong agreement).

1R7.2.2. TIPS should not be offered to patients with severe PPH (mPAP≥45 mmHg) confirmed by right heart catheterization and persisting despite optimized medical treatment (G1+, strong agreement).

Cirrhotic cardiomyopathy (CMC) arises from structural and functional myocardial abnormalities induced by cirrhosis. CMC is often asymptomatic at baseline and may manifest during exertion or in cases of hemodynamic stress. Screening for CMC is crucial before initiating a TIPS procedure. The creation of a portosystemic shunt significantly alters haemodynamics, leading to the redistribution of blood volume from the splanchnic territory to the systemic circulation. Consequently, notable changes occur, including (a) increased cardiac preload with elevated right atrial pressures (RAP) and right ventricular pressures (RVP), (b) exacerbation of the hyperkinetic state with heightened contractility and cardiac output (CO), (c) elevation in mean pulmonary arterial pressures (mPAP) and capillary pressures (PCP) and (d) a decrease in systemic vascular resistance (SVR).[10] Studies report a variable incidence of cardiac decompensation post-TIPS, ranging from .9% to 20%.[11] Only one prospective study utilizing recent diagnostic criteria assessed the impact of pre-existing CCM during TIPS placement on post-TIPS cardiac decompensation, revealing that the presence of CCM predicted increased mortality and post-TIPS cardiac events.[11]

For all scheduled TIPS candidates, an assessment of cardiac function is recommended, including:

(i) Gathering cardiovascular history and a clinical examination.
(ii) A 12-lead ECG.
(iii) Measurement of natriuretic peptide (BNP or NT-pro-BNP).
(iv) Transthoracic echocardiography (TTE) performed by a cardiologist aiming to:
  - Detect valvulopathy.
  - Evaluate left ventricular systolic and diastolic functions and right ventricular systolic function.
  - Estimate pulmonary arterial pressures.

Experts recommend performing TTE within 3 months before the TIPS procedure. Additionally, if there are any modifications or the emergence of symptoms between the initial TTE and TIPS placement, a repeat examination is advised.

Table A1 in Appendix provides a summary of the pre-TIPS echocardiographic measurements to be conducted.

If pulmonary arterial hypertension (PAH) is suspected based on transthoracic echocardiography, invasive right heart catheterization should be performed. Due to the adverse prognosis associated with PAH and the risk of severe right heart failure post-TIPS, most experts advise against performing planned TIPS in patients with severe PH (mPAP >45 mmHg). In cases of persistent moderate PAH (mPAP is <45 and ≥35 mmHg) after medical optimization, caution is advised, and the risk–benefit balance should be assessed with cardiologists.

There are limited data in the literature regarding the impact of TIPS on hepatopulmonary syndrome (HPS). Consequently, systematic screening for HPS during the pre-TIPS assessment may not be necessary, unless liver transplantation is being considered. Current scientific evidence does not conclusively support or oppose the use of TIPS for the HPS treatment. Liver transplantation should be considered for patients with HPS.

1R8. In patients with cirrhosis who are candidates for planned TIPS, etiological treatment of cirrhosis, when available, is always recommended (expert opinion, strong agreement).

In patients with hepatitis B or C viral infections, significant improvement in liver function can occur within 6 months of viral suppression.[12,13] During this timeframe, it may be advisable to reassess the potential benefits of a TIPS procedure. Regarding cirrhosis associated with metabolic dysfunction-associated steatohepatitis (MASH), there are currently no validated drug treatments, and the benefits of nutritional management are limited. For alcoholic liver disease, the benefits of alcohol abstinence may vary.[12] In cases where the patient is not abstinent, although there is an increased risk of reduced efficacy and decompensation after a TIPS, this procedure is not formally contraindicated. The decision between etiological treatment of cirrhosis and undergoing a TIPS procedure depends on various patient-specific factors and disease progression and should be closely discussed with the involved healthcare professionals.

1R9. Scientific data do not allow us to determine an age beyond which TIPS would be formally contraindicated (expert opinion, strong agreement).

Table A2 in Appendix outlines the essential pre-procedure work-up and subsequent monitoring protocols.

2 | PART 2: SALVAGE/RESCUE TIPS IN ACUTE VARICEAL BLEEDING

2.1 | Definitions

Refractory bleeding: bleeding that does not stop despite optimal treatment*.

Early bleeding recurrence: clinically significant recurrence of PHT-related bleeding within 5 days of admission after an initial control with optimal treatment*.

*Vasoactive drugs (terlipressin, octreotide or somatostatin) at recommended dosages combined with endoscopic band ligation and/or glue injection and antibiotic therapy.

Of note AASLD guidelines use salvage in patients treated with TIPS for uncontrolled bleeding and rescue TIPS in patients with early recurrence of bleeding.[14]

2R1.1. Salvage and rescue TIPS should be discussed to improve survival in cases of refractory bleeding or early bleeding recurrence related to portal hypertension (G1+, strong agreement).

2R1.2. Tamponade as a bridge (with a preference for self-expandable metal stent) should probably be performed depending on the technical feasibility and the expected delay for TIPS placement (G2+, strong agreement).

2.2 | Impact of salvage/rescue TIPS on mortality and morbidity

An uncontrolled bleeding or early recurrent bleeding (<5 days) despite optimal pharmacological and endoscopic treatment occurs in 10% to 20% of patients. Multiple series have shown the effectiveness of salvage/rescue TIPS for refractory or early recurrent bleeding, with an immediate haemostasis rate after TIPS between 90% and 100%. In these studies (total of 1542 patients), 30-day mortality ranged from 7% to 60%, and recurrent bleeding was reported in 7% to 30% of patients.[14–16] Balloon tamponade or placement of a self-expanding metal oesophageal stent can be performed as a temporary measure in cases of uncontrolled bleeding.[17,18] In patients with early recurrence after an initial control of bleeding, a second endoscopic treatment may be performed, although there is a lack of data regarding the best approach in this situation.

2R2. Salvage TIPS may be futile in patients clearly excluded from liver transplantation and exhibit at least one of the following criteria:

(i) Multiple organ failure,
(ii) or Child-Pugh score ≥14,
(iii) or with a MELD score ≥30 and/or lactatemia ≥12 mmol/L after initial resuscitation.

The decision to perform TIPS in these patients should remain a collaborative one, made on a case-by-case basis, with consultation with an expert centre if deemed necessary (expert opinion, strong agreement).

Indication of salvage or rescue TIPS must be balanced against futility. Futility may make sense in a patient clearly rejected for LT. It does not seem legitimate to use futility criteria in a patient with a potential LT plan. In a recent multicentre trial, the 6-week survival rate after salvage TIPS was 5% in patients with a MELD score ≥30 and lactates ≥12 mmol/L in the 24 h preceding TIPS placement.[19]

3 | PART 3: PRE-EMPTIVE TIPS IN ACUTE VARICEAL BLEEDING

3.1 | Definitions

High-risk patients: patients who meet at least one of the following criteria:

(i) a HVPG >20 mmHg at the time of bleeding;
(ii) Child-Pugh score C;
(iii) Child-Pugh score B with active bleeding at the time of endoscopy*.

Preemptive TIPS is defined as TIPS placement within 72 h following variceal bleeding, which has been initially controlled by optimal care*. The aim is to prevent a recurrence of bleeding in patients at high risk of treatment failure.

*Vasoactive drugs, prophylactic antibiotics and endoscopic variceal ligation.

3R1. For patients with cirrhosis experiencing bleeding due to oesophageal variceal rupture or GOV 1, a preemptive TIPS with a covered stent should be done within 72 h, ideally within 24 h, if:

(i) the patient is Child-Pugh C < 14 or,
(ii) the patient is Child-Pugh B > 7 with active bleeding* at initial endoscopy or (G1+, strong agreement).

*Performed under vasoactive drug.

3.2 | Impact of p-TIPS on mortality and morbidity

The use of p-TIPS has been positioned in the therapeutic algorithm since the publication of a RCT in 2010.[20] Besides reducing recurrence of bleeding, this study showed a significant decrease in mortality at 6 weeks and 1 year compared to standard therapy. Subsequent studies and MA confirmed the survival benefit. Patients with Child-Pugh scores of 10–13 and patients with Child-Pugh scores of 8–9 who had active variceal bleeding at initial endoscopy are patients at high risk who would likely benefit from p-TIPS.[21] The survival benefit is less pronounced in patients without severe liver dysfunction (Child-Pugh class A and B7).[21,22]

MA also supports that p-TIPS is better than standard therapy for the prevention of a further decompensation.[23]

3R2.1. When indicated, preemptive TIPS placement should probably be done in patients with ACLF and/or hepatic encephalopathy at admission (G2+, strong agreement).

3R2.2. To date, no criterion for futility of preemptive TIPS has been demonstrated concerning age, MELD score or serum creatinine (expert opinion, strong agreement).

3R2.3. Preemptive TIPS may not be recommended in patients with a history of severe heart failure, severe valvulopathy, uncontrolled sepsis or anatomical abnormalities precluding shunt creation (expert opinion, strong agreement).

No data currently define futility criteria to identify the most severe patients who will not benefit from p-TIPS. Lv et al.'s study shows that p-TIPS reduced the absolute risk of 1-year mortality by −33% for MELD ≥19.[22] Similarly, the subgroup analysis in Nicoara-Farcau et al.'s MA (i.e. 84 patients with bilirubin >10 mg/dL) shows that p-TIPS remains beneficial with significantly higher survival in the TIPS group.[21] Data from observational studies suggest that HE, jaundice or ACLF at the time of bleeding has no significant impact on these results.[24–26]

Most studies exclude patients under 18 or over 75 years old, pregnant women, severe liver dysfunction (CP > 13), HCC beyond Milan criteria, bleeding from isolated gastric or ectopic varices, total PVT, severe renal failure (creatinine >3 mg/dL), heart failure and recurrent HE. Therefore, very little data are available for these patient groups. It should be noticed that the observed benefits of p-TIPS were achieved without patient selection based on the risk of post-TIPS heart failure.

3R3.1. It is recommended to perform Doppler ultrasound at a minimum or cross-sectional imaging before TIPS placement to detect splanchnic venous thrombosis and hepatocellular carcinoma and to guide treatment (expert opinion, Strong consensus).

3R3.2. In cases of complete/extensive portal vein thrombosis, preemptive TIPS should be discussed on a case-by-case basis with an expert operator (expert opinion, strong agreement).

The technical feasibility is assessed by studying liver vascularization and anatomy. Cross-sectional imaging should be preferred over hepatic Doppler ultrasound. The presence of PVT/cavernoma cannot be an absolute contraindication and warrants discussion with an expert radiologist. The minimal assessment should allow for the technical feasibility evaluation of TIPS placement and the identification of absolute contraindications mentioned above.

3R4. There is not enough scientific evidence to recommend preemptive TIPS after the 72 h window (expert opinion, strong agreement).

4 | PART 4: TIPS IN PREVENTION OF REBLEEDING

4R1.1. TIPS should not be performed as a first-line treatment in the context of secondary prophylaxis of variceal bleeding (oesophageal varices or GOV1), due to a lack of survival benefit and an increased risk of hepatic encephalopathy (G1−, strong agreement).

4R1.2. TIPS can be discussed in cases of portal hypertension-related bleeding despite a well-conducted secondary prophylaxis (expert opinion, strong agreement).

4.1 | Impact of TIPS on mortality and morbidity

Eleven randomized controlled trials, and four meta-analyses analysed the impact of TIPS on patient mortality in secondary prophylaxis.[23,27–29] In all these studies, except one where the control group did not receive non-selective beta-blockers, there was no survival benefit of TIPS in secondary prophylaxis over 1 to 3 years, but an overall benefit on bleeding recurrence. In all these studies, the risk of hepatic encephalopathy was increased in the TIPS group. One RCT showed a benefit of TIPS on the risk of ascitic decompensation.[30] Finally, in a recent IPD-MA, it has been shown that TIPS halved the risk of further decompensation (events including recurrent bleeding, hepatic encephalopathy or jaundice).[23] No RCT assessed the role of TIPS after failure of adequate secondary prophylaxis.

4R2.1. TIPS is recommended if secondary prophylaxis cannot be carried out adequately (intolerance, contraindication or non-adherence to NSBB or EBL) in patients with recurrent ascites (expert opinion, strong agreement).

4R2.2. TIPS should be performed as secondary prophylaxis in the case of associated portal vein thrombosis (G1+, strong agreement).

4R2.3. TIPS is not recommended as first-line secondary prophylaxis after rupture of GOV2 and IGV (expert opinion, strong agreement).

4R2.4. TIPS could be discussed for secondary prophylaxis of rupture of ectopic varices. Variceal embolization during the TIPS procedure must be discussed (expert opinion, strong agreement).

4R2.5. TIPS should probably be considered in cases of portal hypertensive gastropathy requiring repeated transfusions despite treatment with NSBB and endoscopic therapy (G2+, strong agreement).

R2.6. TIPS should probably not be considered in cases of recurrent bleeding from gastric antral vascular ectasia (G2−, strong agreement).

4.2 | Inadequate secondary prophylaxis

If first-line secondary prophylaxis cannot be appropriately applied, consideration may be given to secondary prophylaxis as monotherapy (EBL or NSBB). In a RCT, TIPS was compared to monotherapy with BBNCS or EBL and was associated with a significant reduction in the risk of recurrent bleeding, with no difference in survival.[31] Therefore, the placement of TIPS in secondary prophylaxis should be considered in patients receiving monotherapy only if there is another indication for TIPS, such as recurrent ascites.

4.3 | PVT

Two RCT and one retrospective observational study assessed the role of TIPS in preventing rebleeding in patients with concurrent non-tumoral PVT.[32,33] TIPS was associated with a decrease in recurrent bleeding and an increased rate of portal vein recanalization, without survival benefit in this context.

4.4 | Gastric varices

Gastric varices, specifically GOV2 and IGV1, were addressed in a single randomized controlled trial (RCT) comparing TIPS and repeated glue injection in secondary prophylaxis. The study demonstrated the superiority of TIPS in preventing recurrent bleeding, although no survival benefit was observed, and there was an increased risk of hepatic encephalopathy (HE).[34] Another recently published study, albeit with a limited sample size of 21 patients, argues for the superiority of TIPS over glue injection for survival without recurrent bleeding.[35] The place of TIPS and RTO warrants further investigation.

4.5 | Ectopic varices

Insufficient data are available to endorse a specific secondary prophylaxis strategy. A retrospective observational study involving 21 patients with ectopic varices revealed a high rate of recurrent bleeding (42% within 48 h after TIPS) despite satisfactory hemodynamic results, suggesting the necessity of concurrent embolization of ectopic varices during TIPS placement.[36]

5 | PART 5: TIPS IN VASCULAR LIVER DISEASES

5R1.1. It is recommended to conduct MRI with hepato-specific contrast injection to detect/characterize nodules prior to planned TIPS for Budd-Chiari syndrome (expert opinion, strong agreement).

5R1.2. TIPS for Budd-Chiari syndrome or portal cavernoma should be performed by an experienced operator in centres with expertise in vascular liver diseases (expert opinion, strong agreement).

5R2.1.1. TIPS should probably be discussed in Budd-Chiari syndrome after failure of medical treatment and ineffective/impossible angioplasty +/− stenting or in cases of vena cava or hepatic vein stenosis (G2+, strong agreement).

5R2.1.2. TIPS should probably be discussed in patients with fulminant Budd-Chiari syndrome. Evaluation for LT eligibility must be conducted as soon as TIPS is indicated (G2+, strong agreement).

5R2.2. Long-term anticoagulation, justified by Budd-Chiari syndrome, should probably be maintained after TIPS creation (G2+, strong agreement).

5R3. Following TIPS for Budd-Chiari syndrome or chronic portal vein thrombosis without cirrhosis, it is recommended to perform a Doppler ultrasound early and then every 6 months to detect thrombosis or TIPS dysfunction (expert opinion, strong agreement).

5R4. In cases of chronic portal vein thrombosis or cavernoma and severe complications linked to portal hypertension (recurrent variceal bleeding despite endoscopic and medical treatment, symptomatic portal cholangiopathy), it is recommended to discuss portal vein recanalization with or without TIPS (expert opinion, strong agreement).

5R5. TIPS is recommended for patients with PSVD who present with refractory GI bleeding, recurrent GI bleeding despite adequate secondary prophylaxis or recurrent/refractory ascites (expert opinion, strong agreement).

5R6.1.1. In cirrhotic patients with portal vein thrombosis, candidates for LT, TIPS is recommended when thrombosis extends or does not regress under anticoagulant therapy (expert opinion, strong agreement).

5R6.1.2. In cirrhotic patients with portal vein thrombosis, TIPS +/− associated with portal vein recanalization is recommended if portal hypertension complications (ascites or recurrent variceal bleeding) persist despite well-managed anticoagulant therapy (expert opinion, strong agreement).

5R6.1.3. In cirrhotic patients, the benefit of long-term anticoagulation after TIPS has not been demonstrated (expert opinion, strong agreement).

5.1 | Budd-Chiari syndrome

Approximately 40% of patients with Budd-Chiari syndrome exhibit hypervascular liver nodules. These nodules commonly include focal nodular hyperplasia, adenomas and, less frequently, HCC. The typical radiological criteria used for non-invasive diagnosis of HCC may not apply to Budd-Chiari syndrome, making the characterization of these nodules challenging. In a study assessing MRI techniques with hepatospecific contrast agents, a homogeneous hypointense signal during the hepatobiliary phase was consistent across all HCCs but was only present in 2% of benign lesions.[37] Hence, pre-TIPS screening for nodules using MRI with hepatospecific contrast agents in non-emergency situations for Budd-Chiari syndrome patients is essential with the aim optimizing patient's surveillance.

In cases of vascular liver disease, there are specific hepatic vascularization patterns and liver dysmorphia that alter the standard TIPS procedure. Moreover, the perioperative management involves anticoagulant therapy and specific treatment for a potential underlying prothrombotic state. The pharmacokinetics of these treatments are modified after TIPS placement. It is reasonable to recommend that TIPS placement in cases of liver vascular disease be carried out within an expert centre, featuring specialized teams in radiology, interventional radiology, haemostasis, pharmacology, anaesthesiology, hepatology and liver transplantation surgery.

Therapeutic management for patients with Budd-Chiari syndrome follows a sequential algorithm supported by several observational studies. The initial step involves medical treatment, combining curative anticoagulation, addressing the underlying cause and managing complications of PHT.[38] If the stenosis is singular and short, restoring hepatic venous drainage via angioplasty, possibly with stent placement, is recommended. If angioplasty proves unfeasible or if clinical manifestations persist despite its application, or reoccur later, consideration should be given to TIPS placement. Ultimately, in cases of TIPS failure, LT becomes a consideration.[39,40] Budd-Chiari syndrome may manifest as acute liver failure, particularly with complete obstruction of the three hepatic veins. Hepatocellular insufficiency is not a contraindication for TIPS placement in these cases. The creation of a TIPS for severe acute liver insufficiency in Budd-Chiari syndrome may obviate the need for LT.

Treatment of the underlying cause of Budd-Chiari syndrome and long-term curative anticoagulation should be continued after TIPS placement to enhance patient prognosis.

5.2 | PVT without cirrhosis

Due to insufficient data, a high rate of severe complications and the absence of clear benefit in preventing intestinal resection, portal recanalization techniques with or without TIPS in cases of recent PVT cannot be recommended.

In cases of chronic extensive PVT, five retrospective studies evaluated the feasibility of portal recanalization alone or combined with TIPS placement in 112 non-cirrhotic patients with chronic PVT. The indications for recanalization were mostly complications of PHT. These studies demonstrated a high success rate of recanalization with both techniques (from 60% to 100% with TIPS, and 87% without TIPS). No procedure-related deaths were observed, and initial symptoms improved in the vast majority of cases.[41] A more extensive thrombosis within the liver was significantly associated with failed recanalization without TIPS and with an early stent thrombosis.[42] Overall, in cases of chronic PVT without cirrhosis, it might be preferable to combine TIPS with recanalization in cases of extensive intrahepatic portal occlusion or intrahepatic block.

5.3 | PVT in cirrhotic patients

In a MA comprising eight studies with over 350 patients, complete portal system recanalization was observed in only half of the patients treated with anticoagulants. Moreover, PVT progressed in 9% of patients on anticoagulants. Therefore, when anticoagulant therapy fails, TIPS placement may be proposed to achieve portal trunk recanalization. In a MA involving 399 patients, 92% with cirrhosis and PVT, TIPS placement was technically feasible in 95% of cases.[43] One-year post-procedure, the portal vein remained patent in 80% of patients, and the TIPS remained patent in 85% of patients. However, a major complication occurred in 10% of patients, which was significantly associated with thrombolysis during the procedure. The 1-year post-procedure cumulative incidence of HE was around 25%. Talwar et al. conducted a study involving 35 cirrhotic patients with occlusive PVT awaiting LT, where TIPS placement associated with portal vein recanalization was performed.[44] At the time of transplant, a portal-to-portal anastomosis was possible in 91% of them, while a physiological anastomosis was achieved using a graft vein in the remaining 9%.

Several studies have assessed portal vein recanalization after TIPS placement for complications of PHT. In a cohort of 70 cirrhotic patients with PVT, TIPS creation for secondary prevention of variceal bleeding or refractory ascites resulted in partial or complete portal system recanalization in 90% of patients.[45] In a RCT, 49 cirrhotic patients with PVT were treated with curative anticoagulation along with either TIPS or elastic band ligation plus propranolol for secondary prevention of variceal bleeding.[33] The 1-year rate of rebleeding was lower in the TIPS group (15% vs. 45%), the rate of portal vein recanalization was higher in the TIPS group (95% vs. 70%), and there was no significant difference in the occurrence of HE. Similar outcomes were observed in another RCT comparing TIPS to EBL plus propranolol.

In a RCT, curative anticoagulation was continued after TIPS creation in 31 patients with PVT and discontinued in 33 patients.[46] The rate of complete portal system recanalization did not significantly differ between the two groups (84% vs. 72%). These results aligned with Lv et al. and Rodrigues et al.'s studies, suggesting that continuing anticoagulation after TIPS does not confer benefits in cirrhotic patients.

5.4 | Portosinusoidal vascular disorder (PSVD)

Several retrospective studies have suggested the efficacy of TIPS in cases of gastrointestinal bleeding in patients with PSVD.[47] The rates of TIPS dysfunction and rebleeding are similar to those observed in cirrhotic patients, with lower mortality rate and a reduced risk of HE. Post-TIPS mortality varies between 0% and 30% across studies. The main factors associated with death are the presence of ascites, thrombosis, HE, renal failure, along with age and underlying comorbidities. The presence of ascites in patients with PSVD is associated with reduced survival. In a multicentre study, two-thirds of patients no longer exhibited residual ascites, and one-third required low doses of diuretics at the conclusion of the follow-up period. Another study reported the complete resolution of refractory ascites in all patients following TIPS placement.

6 | PART 6: TIPS IN RECURRENT/REFRACTORY ASCITES

6R1.1. TIPS should be considered for all patients with recurrent (≥3 LVP) or refractory ascites to improve control of ascites (G1+, strong agreement).

6R1.2. TIPS should probably be considered early in the history of the disease, as soon as recurrent or refractory ascites is identified, to improve transplant-free survival (G2+, strong agreement).

6R2. TIPS should probably be considered in all patients with refractory hydrothorax to improve control of pleural effusion. For individuals at high risk of complication following TIPS placement, liver transplantation should probably be discussed as the primary option (G2+, strong agreement).

6.1 | Impact of TIPS on mortality and morbidity

Seven RCT, involving 452 patients, and eight MA compared TIPS with LVP and albumin infusion in patients with refractory or recurrent ascites.[48–55] TIPS placement achieved complete or partial ascites control in 60%–80% of cases. Two MA reported improved overall survival and transplant-free survival in TIPS-treated patients.[52,54] Two other MA reported improvement only in patients with recurrent ascites.[50,53] While TIPS provided better ascites control than standard treatment, the survival benefit appeared more pronounced in patients with recurrent ascites. In the recent Baveno VII conference, recurrent ascites is defined by ascites recurrence requiring at least 3 LVP within a year.[15] Interestingly, in the study exclusively including recurrent ascites patients and finding improved LT free survival at 1 year (93% vs. 52%), patients requiring more than 6 large-volume paracenteses in 3 months were excluded.[56] This suggests that early consideration of TIPS in the natural history of ascites may yield survival benefits.

TIPS placement was associated with a decreased risk of hepatorenal syndrome in one trial and three MA[50,52,54] and a decreased risk of PHT-related bleeding in one trial and one meta-analysis.[52,56] However, an increase in the number and/or severity of HE episodes in TIPS-treated patients compared to the control group was reported in all trials and MA except for two.[56,57] These two studies included the highest percentage of patients with recurrent ascites. A recent IPD-MA showed that TIPS decreases the risk of further decompensation.[23] Finally, TIPS was associated with an improvement in body composition, especially muscle mass, in patients with refractory ascites. Improvement in muscle mass after TIPS placement was associated with a decreased risk of mortality and HE.

7 | PART 7: TIPS AND KIDNEY

7R1. TIPS should probably not be performed in patients with type 1 HRS/HRS-AKI with or without a liver transplantation plan, as the mortality in these patients remains related to liver failure (G2−, strong agreement).

7R2. TIPS should probably be discussed for type 2 HRS/HRS-NAKI associated with refractory or recurrent ascites (G2+, strong agreement).

7.1 | HRS-AKI

Limited literature is available on the use of TIPS in patients with HRS-AKI. Most studies rely on the outdated classification using a serum creatinine threshold sCr >1.5 mg/dL.[58] A MA of nine studies showed a 47% 1-year survival for HRS-1, dropping further for those ineligible for LT, reaching 20% at 1 year.[59] Despite vasoconstrictor treatment response, LT remains the optimal treatment. However, limited graft availability restricts patient access.[60] Moreover the feasibility of TIPS in this clinical context is limited because, in most of these patients, TIPS is contraindicated due to the severity of liver failure.

7.2 | HRS-NAKI

No RCT has assessed the risk–benefit balance of TIPS placement for HRS-NAKI. In a MA, 1-year survival for HRS-2 was 64%.[61] Studies, in refractory/recurrent ascites, indicate that TIPS improves haemodynamics and renal function significantly.[62] A recent RCT comparing TIPS ($n=29$) to paracentesis and albumin infusions ($n=33$) in the treatment of recurrent ascites showed improved renal function in the TIPS group only.[56]

7.3 | Non-HRS-AKI/NAKI

Regarding Non-HRS-AKI/NAKI, in chronic kidney disease (CKD), further investigation is recommended to identify renal aetiologies beyond HRS-NAKI. Collaboration with nephrologists for renal biopsy may be considered to detect glomerular/microvascular pathology. No absolute threshold for serum creatinine or CKD stage contraindicating TIPS has been established. However, most studies exclude patients with organic renal failure and creatinine >3 mg/dL and renal failure is associated with a high risk of HE.[63]

8 | PART 8: TIPS BEFORE SURGERY

R2.1. In patients with cirrhosis candidates for non-hepatic abdominal surgery, TIPS can be considered to improve postoperative outcomes, particularly in patients with decompensated cirrhosis (expert opinion, strong agreement).

R2.2. TIPS cannot be routinely recommended in patients with compensated cirrhosis, even with severe portal hypertension (expert opinion, strong agreement).

R2.3. TIPS cannot be routinely recommended before cardiothoracic surgery, hepatic resection, endoscopic resection or endoscopic retrograde cholangiopancreatography, whether portal hypertension is related to cirrhosis or portosinusoidal vascular disorder (expert opinion, strong agreement).

8.1 | Non-hepatic abdominal surgery

Available studies comprised uncontrolled case series and three small sample size retrospective case–control studies that compared

postoperative outcomes in patients with TIPS to those without TIPS. There is a great heterogeneity across studies regarding type of surgery (emergency or scheduled, types of intervention), severity of cirrhosis and study endpoints. Some studies included patients for whom TIPS was specifically implemented for surgery, and others included patients who had a TIPS for another reason.[64–70] In all studies except one, results are not reported on an intention-to-treat basis, and no study provided a flowchart mentioning criteria used for patient selection.

Altogether, preoperative TIPS was associated with a lower incidence of postoperative complications (ascites, infections and renal failure) and a lower mortality. The benefit was mainly observed in patients with decompensated cirrhosis or with a CLIF-C AD score greater than 45 at the time of surgery.[64] However, preoperative TIPS was associated with an increased MELD score and HE, so that approximately 15% of patients did not undergo planned surgery.

8.2 | Hepatic surgery

In one retrospective study gathering seven patients who had TIPS before hepatic resection, two did not undergo surgery, and two had persistent decompensation at 3 months.[67]

8.3 | Other situations

In a recent MA of 3244 patients who underwent endoscopic resection, cirrhosis was associated with an increased risk of bleeding (13% vs. 5%), but not mortality.[71] The benefit of TIPS before endoscopic resection has only been reported in case reports. The role of TIPS before endoscopic retrograde cholangiopancreatography has not been evaluated. Only one retrospective cohort study including 44 patients has assessed the outcome after abdominal surgery in patients with PHT related to PSVD.[72] Among them, only four patients had preoperative TIPS so that no conclusion can be drawn.

9 | PART 9: PATIENT CLINICAL FOLLOW-UP AFTER TIPS

Given the dearth of substantial data in this field, all guidelines presented herein are based on "expert opinion" with a strong agreement.

Following the TIPS procedure, it is imperative to assess effectiveness and to detect adverse effects. Concurrently, screening for HCC remains crucial.

Proposed follow-up is presented in Table A2 of the Appendix.

9R1. Outpatient TIPS procedure is not recommended.

9R2. Clinical efficacy should be assessed based on the capacity to manage and prevent the PHT-related complications.

9R3. A clinical examination should be conducted before discharge at 1 month and every 3 months during the initial year with a focus on identifying signs of liver and heart decompensation.

9R4. Liver function tests should be conducted before discharge, at 1 month and every 3 months during the first year.

9R5. Hepatic encephalopathy should be systematically assessed at each clinical visit.

9R6. Renal function should be evaluated using creatinine clearance before discharge at 1 month and every 3 months during the first year.

The failure of TIPS for bleeding is defined by recurrence of PHT-related rebleeding.[15,73] The failure of TIPS for ascites is defined by the absence of response after 4 weeks or a new episode later. Some experts make the difference between partial response (controlled ascites) and complete response (total resolution of ascites). In the former, a significant PHT is still present and could be associated with a worst prognosis.[73,74]

The incidence of liver failure is very variable according to the situation (scarce in planned TIPS for selected patients vs frequent for emergency procedure).[75] The incidence of cardiac decompensation was observed in up to 20% of patients. In addition, PHT-related signs must be looked for liver failure (jaundice and HE) and cardiac decompensation (lower limb oedema, dyspnoea) must be detected.[11]

Child-Pugh and MELD scores should be regularly calculated for assessing liver function.

HE occurred in 35%–50% of the patients and remains the main drawback of TIPS. HE must be graded by using the West Haven classification.[76] Animal naming test could be used for the screening of minimal HE.

9R7.1. Endoscopic screening for oesophageal varices is not recommended when post-TIPS PPG is below 12 mmHg and in the absence of sign of PHT-related complication (bleeding, ascites).

9R7.2. It is recommended to discontinue non-NSBB after TIPS when the PPG is below 12 mmHg after the procedure.

9R7.3. NSBB could be initiated after a TIPS procedure when shunt dysfunction cannot be resolved.

9R7.4. Preemptive furosemide could be employed to prevent cardiac decompensation in patients at risk.

9R7.5. Anticoagulant and antiplatelet therapy are not recommended to prevent shunt dysfunction, except in particular cases, mainly in vascular diseases of the liver.

The risk of variceal bleeding is negligible when the PPG is below 12 mmHg. Consequently, it is useless to assess the presence or size of oesophageal varices,[77] and to maintain NSBB previously prescribed for PHT after an effective TIPS.

When shunt dysfunction is confirmed (PPG > 12 mmHg) but revision not feasible, NSBB can be used.[78] The use to furosemide might prevent cardiac overload.[60] The initiation and the dosage are individualized and should be adjusted during each visit.

Anticoagulant or antiplatelet therapy is not useful to prevent shunt obstruction.[79] Anticoagulant might be considered in patients with PVT or those with vascular liver diseases.

10 | PART 10: TECHNICAL CONSIDERATIONS FOR THE TIPS PROCEDURE

10R1.1.1. Occluded and free hepatic venous pressures, inferior vena cava (IVC) pressure and right atrium pressure (RAP) should be measured before the creation of the shunt. Hepatic venous pressure gradient (HVPG) should be calculated by subtracting free hepatic venous pressure from occluded hepatic venous pressure (G1+, strong agreement).

10R1.1.2. Following the creation of the shunt, PPG (=portal vein pressure—IVC pressure) should be measured to guide subsequent procedural steps (G1+, strong agreement).

10R1.1.3. At the end of the procedure, the final PPG (portal vein pressure—IVC pressure) should be measured (G1+, strong agreement).

10R1.2. It is recommended to check the PPG early whenever there is a doubt about the validity of the measurement at the procedure's end (expert opinion/strong agreement).

For accurate PPG calculation, measurement of free hepatic or IVC at the shunt outflow should be used. The prognostic value of PPG is more reliable[80] when calculated in this manner rather than using RAP.[81] PPG should be measured both before and after the creation of the shunt to guide stent expansion and again at the end of the procedure (final PPG). In particular conditions, some factors (deep sedation, hypo or hypervolemia, treatment with vasoactive agents, procedural difficulties, PVT, etc.) may influence PPG. For these reasons, immediate PPG may not reflect the "basal long-term" PPG.[82,83] In such cases, it is advisable to conduct PPG measurement promptly under optimal conditions from 24 h to 1 month based on local facilities.

10R2. Utilizing real-time US guidance or CT/scan fusion method should probably be recommended for the puncture of the portal vein (G2+, strong agreement).

10R3.1.1. PTFE-covered stents should be used (G1+, strong agreement).

10R3.1.2. The shunt should initially be expanded to 8 mmHg, followed by a step-wise approach based on the target PPG, patient comorbidities and TIPS indication, with consideration for expansion to 10 mm if necessary (G1+, strong agreement).

10R3.2. Covering the hepatic vein up to the ostium should probably be done (G2+, strong agreement).

10R3.3. The caudal end of the stent should probably be positioned downstream of the portal junction or just upstream, to avoid compromising future liver transplantation (G2+, strong agreement).

10R4.1.1. The expansion of the stent should be determined by the hemodynamic result (G1+, strong agreement).

10R4.1.2. It is recommended to thoroughly discuss the hemodynamic target before the procedure in a collaborative approach involving the expert team (expert opinion/strong agreement).

10R4.2.1. A final PPG < 12 mmHg should be achieved in patients treated for PHT-related bleeding (G1+, strong agreement).

10R4.2.2. A final PPG < 12 mmHg should probably be achieved in patients treated for ascites (G2+, strong agreement).

The use of US guidance or CT scan fusion method has been associated with fewer procedural difficulties and shorter procedures.[84] Covered stent with polytetrafluoroethylene is now considered due to decreased shunt dysfunction and improved outcome.[85–87] Controlled expansion stents allow gradual dilatation, optimizing the PPG reduction and limiting the risk of overshunting-related adverse events (HE, liver and heart failure).[88] It is recommended to expand to 8 mm initially and potentially to 10 mm according to the final haemodynamical objective. The choice of target PPG depends on the indication, the patient's comorbidities and the expected risk of overshunting-related adverse events. This should be discussed by an expert team in a multidisciplinary approach and ideally before the procedure. A PPG below 12 mmHg offers near-complete protection against bleeding and ascites but must be balanced with a higher risk of adverse event associated with a very low PPG absolute value. However, one final PPG does not fit all patients and predicting the individual benefit/risk ratio remains very challenging. It is imperative to ensure that the stent does not extend to the right atrium and to the main portal vein not to compromise LT procedure.[89,90]

10R5.1. Variceal embolization should be not systematically performed after the shunt creation (G1−, strong agreement).

10R5.2. Variceal embolization should probably be proposed in the context of refractory bleeding when there is a persistent downhill flow through the varice after the creation of the shunt (G2+, strong agreement).

There are no sufficient data to recommend systematically variceal embolization. Such a procedure could be proposed in patients with active bleeding especially when the final PPG is above 12 mmHg and there is a persistent downhill flow through the varice despite the shunt procedure.[91]

11 | PART 11 MORPHOLOGIC FOLLOW-UP OF THE SHUNT

Given the dearth of substantial data in this field, all guidelines presented herein are based on "expert opinion" with a strong agreement.

11R1.1. A Doppler US is not routinely recommended the day following shunt creation. A Doppler US is recommended every 6 months after the shunt for HCC screening and in cases of PHT-related complication recurrence.

11R1.2. Venography and PPG measurement during follow-up are not systematically recommended. It is carried out when a shunt dysfunction is suspected taking into account clinical background and initial TIPS indication.

11R2.1. During routine follow-up, shunt revision is recommended when a shunt insufficiency is suspected or because of persistence or recurrence of PHT symptoms. The benefit/risk ratio should be assessed again as when the shunt was created. A gradual expansion

of the stent is recommended. A lack of coverage (on the portal or hepatic side) can be managed by inserting a new covered stent.

11R2.2. When the maximal expansion fail to achieve hemodynamic target, the subsequent step relies on a case-by-case basis discussion (associated treatment, liver transplantation, second shunt, etc.).

11R3. A reduction of the shunt is recommended in cases of early severe liver failure or chronic encephalopathy or cardiac failure refractory to medical therapy. No particular technic can be recommended for the shunt reduction.

There are two opposite problems associated with shunt dysfunction:

(i) either *insufficient shunting* (due to inadequate expansion of the endoprosthesis or the development of stenosis/occlusion) or
(ii) *excessive shunting*[92]

Rather than performing systematic venography, Doppler ultrasound (US) is the preferred primary screening/assessment tool of shunt (dys)function given the fact that it is widely available, non-invasive, serially repeatable and does not require ionizing radiation. Yet, one should be aware of the weak performance of Doppler in detecting an increase in the porto-caval gradient. Normal and aberrant velocity parameters are outlined in Table A3 of the Appendix. Pragmatically, follow-up of shunt function is suggested 6-monthly, at the same occasion of HCC screening. Venography with pressure measurements is the gold standard for confirming shunt dysfunction (gradient ≥12 mmHg). It is used when suspicion arises based from Doppler results or in cases of recurrence of PHT-related complications.[77,87,93,94]

11.1 | Insufficient shunting

Progressive dilation of a controlled expansion stent is the least invasive approach to achieve adequate haemodynamic targets. A coverage defect (hepatic vein or intraparenchymal tract on the portal side of the shunt) can be treated by angioplasty or a new stent. In exceptional cases, a new shunt may be considered in parallel.[95,96]

11.2 | Excessive shunting

Approximately 3% to 8% of patients develop refractory hepatic HE. Refractory HE is associated with increased mortality, impairs patients' quality of life and necessitates costly hospitalizations.[97] Consequently, reducing the shunt (improvement HE in 92%, disappearance HE 66%) concurrently with evaluating for liver transplantation should be considered.[96,98] Regarding other complications related to excessive shunting, such as right heart failure or hepatic insufficiency, data are limited, but clinical success was observed in 67% and 33%, respectively.[96] TIPS reduction can be achieved by various techniques.[98,99]

12 | PART 12 TIPS AND HEPATIC ENCEPHALOPATHY

12R1. Rifaximin (550 mg bid) should probably be initiated in patients for a planned TIPS, 2 weeks before the shunt creation for decreasing the risk of post-TIPS overt hepatic encephalopathy (Grade 2+, strong agreement).

12R2.1. After TIPS, it is recommended to add oral disaccharides in patients treated with rifaximin who experience overt hepatic encephalopathy (expert opinion, strong agreement).

12R2.2. In case of OHE refractory to medical treatment (lactulose + rifaximin), it is recommended to carry out a reduction of the shunt first, rather than an occlusion straight away. It is recommended to systematically consider liver transplantation (expert opinion, strong agreement).

Three RCTs evaluated the efficacy of prophylactic treatment. The first compared lactulose, rifaximin and a placebo in 75 patients. It did not show a difference in the cumulative incidence of HE (HE) at 1 month. The second trial, assessing L-ornithine L-aspartate in 21 patients, did not demonstrate superiority over placebo in the occurrence of HE 1 week after TIPS placement. The last trial compared the efficacy of rifaximin versus placebo, started 15 days before TIPS placement and continued for 6 months afterward, in 197 patients.[100] Clinical HE occurred in 34% of patients in the rifaximin group versus 53% in the placebo group (OR = .48, 95% CI: .27–.87). If HE occurs after TIPS placement, it should be treated conventionally using available treatments such as lactulose,[101] and if unsuccessful, rifaximin alone or in combination with lactulose if well-tolerated.[102] In patients already treated with rifaximin before TIPS placement, adding lactulose may be proposed, although no data are available in this situation.

HE is termed refractory when signs persist despite well-managed medical treatment. Modifications of the shunt (recalibration and occlusion) can be considered.[96,98,103–105] Complete shunt occlusion was sometimes necessary after recalibration. It is important to note that in a series of 29 patients where TIPS occlusion was the first-line treatment, three patients died within a week following the procedure. Therefore, it is suggested to consider reducing the calibre before complete shunt occlusion. Considering the poor prognosis of refractory HE after TIPS, LT should be promptly discussed.

13 | PART 13 TIPS AND LIVER TRANSPLANTATION

13R1. A complete assessment (including at least abdomen CT scan, cardiovascular examination, splanchnic hemodynamic study and liver biopsy) is needed in case of PHT relapse after liver transplantation (expert opinion, strong agreement).

13R2. TIPS is feasible after liver transplantation. It is recommended to make the decision of TIPS versus liver retransplantation in a multidisciplinary approach with hepatologist, radiologist and surgeons (expert opinion, strong agreement).

Beyond LT, the two main causes of PHT are recurrent graft cirrhosis from the initial disease and porto-sinusoidal vascular disorders.[106–109] Some observations suggest that TIPS could be an option if retransplantation is not feasible. Consequently, a comprehensive work-up is essential to understand the mechanisms of PHT. A CT scan allows the examination of vascular relationships and vessel patency to assess the technical feasibility. This imaging is part of the etiological assessment for post-liver transplant PHT, providing visualization of the afferent and efferent vessels of the graft.[110–112] Hepatic hemodynamic study combined with a liver biopsy is recommended for both positive and aetiological diagnosis.[113,114] The decision to proceed with a TIPS after a liver transplant should consider the duration since the transplant, whether PHT is an isolated complication or not, the response to medical treatment, cardiovascular and renal comorbidities, and liver function of the graft. A multidisciplinary discussion is essential to choose between TIPS and retransplantation.[115] The primary indication for TIPS is recurrent and/or refractory ascites. After a liver transplant, TIPS leads to a lower clinical response rate, ranging from 15% to 80%, compared to the pre-transplant period, especially in those undergoing the procedure for refractory ascites.[111,116]

14 | PART 14: TIPS IN CHILDREN

14R1. Until now, there is no indication of TIPS in children with cirrhosis but without PHT-related complications.

14R2. TIPS should probably be discussed in children with recurrence of PHT-related bleeding despite standard prophylaxis (band ligation + beta-blockers) or refractory bleeding or refractory ascites (expert opinion).

14R3. It is recommended that TIPS insertion should be performed by an expert physician. The procedure and the device must be adapted to each case (expert opinion).

In children, the role of TIPS is far less established than in adults. Data from retrospective studies, including three MA, have shown that TIPS was technically feasible in 93% to 95% of cases, with hemodynamic success in 89% and clinical success in 93% of cases.[117–119] The risk of HE seems lower than observed in adults.[117] Thus, TIPS can be considered a feasible and safe technique in children when performed by experienced individuals. Results from a meta-analysis show that bleeding related to PHT is resolved in 99.5% of cases and ascites improves in 96% of cases after TIPS placement.[119] Data from other MA are more heterogeneous, with variceal bleeding occurring in 0% to 67% of cases post-TIPS placement, depending on the studies.[117–119] Other reported indications lack compelling evidence regarding efficacy. It is probably not recommended to place a TIPS in cases of hypersplenism. Moreover, a prospective study evaluated the early placement of a TIPS in patients with cystic fibrosis showing signs of PHT. It was prematurely discontinued due to minor benefits for patients and considering the procedure risks.[120]

The child's age and size may present technical challenges. Retrospective studies have demonstrated successful TIPS placement in infants. Several studies have reported successful placements as early as 4 months of age with a minimum weight of 6 kg (1–3). In this patient category (age < 2 years, weight < 10 kg), particular attention should be paid to the type of equipment used.[121]

The main causes of TIPS placement failure in children are as follows: (a) the presence of extrahepatic PVT with portal cavernoma, (b) portal trunk hypoplasia and (c) the presence of anatomical peculiarities (especially in syndromic biliary atresia with azygos continuation of the inferior vena cava) (1–3). Therefore, it is crucial to thoroughly assess the anatomy before considering TIPS. The most commonly used TIPS are covered stents with a diameter of 8–10 mm (6–12 mm) and an average final dilation of 7–8 mm (6–12 mm).[117–119] Using a covered stent is associated with a significantly reduced risk of variceal bleeding recurrence compared to using uncovered stents ($p = .01$; coefficient: −1.813; 95% CI 3.26–.41).[117] Therefore, using a covered stent is probably recommended in this indication.

15 | PART 15: TIPS AND NUTRITION

15R1. Malnutrition, sarcopenia and frailty are associated with increased morbidity and mortality in cirrhotic patients undergoing TIPS. It is advised to assess for malnutrition/sarcopenia and frailty prior to the TIPS procedure (G1+, strong agreement).

15R2. Awaiting the TIPS procedure, it is recommended to manage diet with the assistance of a dietician to address deficiencies, meet energy requirements and prevent fasting periods, especially at night (expert opinion/strong agreement).

15R3. It is recommended to assess nutritional status (weight change, hand grip strength and frailty assessment) of the patient at each follow-up visit post-TIPS procedure (expert opinion/strong agreement).

Malnutrition, sarcopenia and frailty are associated with increased morbidity and mortality in patients with cirrhosis.[122–124] In cirrhotic patients, current prevalence rates of malnutrition, sarcopenia and frailty range from 20% to 65%, 40% to 70% and 18% to 43%, respectively, depending on studied populations, assessment methods and definitions used. The presence of sarcopenia and/or malnutrition before TIPS placement appears associated with an increased risk of HE,[125] ACLF,[126] TIPS dysfunction[127] and post-TIPS mortality.[127–129] Hence, screening for these conditions should be routine for all candidates to TIPS placement.

Several studies suggest an improvement in nutritional status and body composition following TIPS placement.[129–131] Considering the risks associated with malnutrition, sarcopenia and frailty, regular nutritional assessment seems advisable, preferably at each patient consultation, at least every 6 months. Although no specific tool is currently recommended, the hand dynamometer and the Liver Frailty Index™ may serve as simple, practical and reliable tools to assess frailty in cirrhotic patients.

While no study has specifically evaluated the impact of nutritional management before or after TIPS placement, the recommendations for cirrhotic patients could be considered applicable.

16 | CHAPTER 16: TIPS AND HCC

16R1. In a patient with HCC, there is no specific technical issue regarding TIPS creation, except the need to avoid shunting through the tumour if a curative treatment is anticipated (expert opinion/strong agreement).

16R2. There is no contraindication to performing percutaneous ablation in patients with both a TIPS and HCC (expert opinion/strong agreement).

16R3. TACE is not recommended in a patient with a TIPS unless the patient is on a waiting list for liver transplantation (expert opinion/strong agreement).

16R4. TARE in a patient with TIPS is feasible given a lower hepatic dysfunction than TACE.

16R5. Patients with TIPS and HCC can undergo systemic therapy. Indications and cautions are the same as in patients without TIPS (expert opinion/strong agreement).

16R6. TIPS can be a therapeutic option in patients with HCC and tense ascites in order to facilitate curative treatment (such as percutaneous ablation) (expert opinion/strong agreement).

16R7. TIPS can be a therapeutic option in patients with HCC and refractory bleeding or with criteria for a preemptive TIPS (expert opinion/strong agreement).

The indication for a TIPS in patients with HCC is an increasingly debated option considering the rising number of HCC cases and the improved overall survival due to emerging treatments like local interventional radiology methods for early and intermediate stages, as well as immunotherapy for advanced stages. Literature data regarding the impact of preemptive and salvage TIPS in patients with HCC are limited. However, considering the near 100% mortality rate in cases of refractory bleeding and the beneficial impact of preemptive TIPS on the survival, it seems reasonable to question access to salvage and preemptive TIPS in patients with HCC, if technically feasible. Moreover, some studies showed a regression of ascites/hydrothorax after TIPS placement and a survival benefit compared to patients without TIPS.[132,133] Thus, TIPS should also be weighed in cases of HCC, especially for patients listed for LT who cannot undergo HCC bridging therapies due to PHT. However, the complexity arising from the presence of HCC makes this procedure more intricate, and its feasibility should be determined by experts.

The available literature on TIPS and TACE comprises 11 studies, including 10 retrospective studies and one MA. In the MA (PMID 34318755) reporting results from 536 patients, a risk of hepatic decompensation was noted in 13% of patients. This significant risk of hepatic decompensation or severe complication is certainly lower than expected but remains noteworthy. TACE may thus present more risks than benefits, especially in patient ineligible for LT. Few data are available involving patients with a TIPS who underwent TARE for HCC.[134] Safety data are reassuring and do not suggest different toxicity profiles of TARE in presence or absence of a TIPS. This is likely due to a more limited embolic effect of TARE compared to TACE.

The systemic treatment for HCC currently relies on first-line immunotherapy and subsequent multi-targeted tyrosine kinase inhibitor (TKI) therapies for later lines of treatment. In a retrospective observational study, 84 patients were matched in two groups.[133] In the group of patients with a TIPS who received sequential systemic TKI therapy ($n=42$), the rate of ascites control was higher: 92% vs 28% ($p<.001$), along with improved overall survival: 9.6 months vs 4.9 ($p<.001$). In multivariate analysis, the combination of TIPS and sequential systemic treatment was independently associated with overall survival.

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APPENDIX A

A.1 | METHODOLOGY OF THE GUIDELINES

These guidelines are the result of the collaborative efforts of an expert panel convened by the French Association for the study of the liver (AFEF). A comprehensive literature review was conducted on the international PubMed database by bibliography managers (E Desjonquères, LC Ntandja Wandji, N. Nguyen). The relevant studies were assessed using the GRADE (Grade of Recommendation Assessment, Development and Evaluation) method, enabling the establishment of scientific evidence levels through an internationally validated process. This involved considering the study type, methodological quality, coherence of results across different studies, the direct or indirect nature of evidence and the relative significance of outcomes. A "strong" level of evidence supported a "strong" recommendation (GRADE 1+ or 1−) such as "it should" or "it should not." A moderate, weak or very weak overall level of evidence led to the formulation of an "optional" recommendation (GRADE 2+ or 2−), such as "it should probably" or "it should probably not."

When the available literature was insufficient for GRADE 1 or 2 proposals, expert opinions were considered ("it is recommended…; it is not recommended"). Draft recommendations were presented and discussed with all experts before being subjected to a vote. Each expert independently rated all recommendations on a scale from 1 (complete disagreement) to 9 (complete agreement).

On 13 December 2022, experts presented draft guidelines, which were discussed and voted (January 2023) upon to finalize the text. Voting has been expanded to independent experts from the group of guidelines. Recommendations were presented at a dedicated meeting (01–02 June 2023) with the participation of a panel of European experts to identify converging and diverging opinions or indecision. To validate a recommendation, at least 50% of experts had to express a similar opinion, with less than 20% expressing contradictory views. For a recommendation to be strong, at least 70% of experts

had to agree. In the absence of strong agreement, recommendations were revised and resubmitted for scoring to reach consensus. Three scoring rounds were necessary for the … recommendations presented, including … with strong evidence (GRADE 1+/−), …with weak evidence (GRADE 2+/−) and … based on expert opinions. Overall, there was strong agreement all recommendations. The final text was approved by the governing board of AFEF and the governing board of the Club Francophone pour l'étude de l'hypertension portale.

TABLE A1 Main parameters used for cardiac assessment during transthoracic echocardiography ([normal values]).

Left ventricular systolic function	Diastolic function	Right ventricular systolic function and pulmonary pressures
• LVEF [*N* >50%] • Longitudinal Ventricular strain [*N* ≥ −18%] • Aortic valve area [>1.5 cm^2]	• E/e' ratio [*N* ≤ 14] • e' septal [*N* ≥ 7 cm/s] • Left atrial volume index [≤34 mL/m^2] • peak early (E) and late (A) diastolic mitral inflow velocity and its ratio (E/A)	• TAPSE [*N* >17 mm] • Maximal velocity of tricuspid regurgitation [*N* ≤ 2.8 m/s] • Peak systolic tricuspid annular velocity [>10 cm/s] • Mean Pulmonary arterial pressure [<20 mmHg]

Abbreviations: LVEF, left ventricular ejection fraction; TAPSE, systolic displacement of the lateral portion of the tricuspid annular plane.

TABLE A2 Minimal work-up before and follow-up after a planet TIPS (to be tailored to each particular case).

	Pre-TIPS work-up	Before discharge	M1	M3	M6	M9	M12
Clinical exam and patient history	✓	✓	✓	✓	✓	✓	✓
Screening of minimal HE	✓	✓	✓	✓	✓	✓	✓
Lab: Haemoglobin, Platelets, AST, ALT, γGT, Alkaline phosphatases, bilirubin, INR, albumin, accelerin, serum sodium and creatinine, serum glucose	✓	✓	✓	✓	✓	✓	✓
Child-Pugh and MELD scores	✓	✓	✓	✓	✓	✓	✓
Anaesthesia consultation	✓						
TTE <3 months	✓						
A 12-lead ECG	✓						
Nt-pro-BNP / BNP	✓						
Cross-sectional imaging (CT scan or MRI) with contrast injection	✓						
Doppler US (if CT scan >1 month)	✓				✓		✓
Frailty, nutrition and sarcopenia assessment (Hand grip test…)	✓				✓		✓

Abbreviations: BNP, brain natriuretic peptides; ECG, electrocardiogram; HE, hepatic encephalopathy; M1, month 1; TTE, transthoracic echocardiography.

TABLE A3 Main parameters used during Doppler US surveillance of the shunt.

Normal parameters	Suspicion of shunt dysfunction
• Shunt velocity: 90–200 cm/s • Portal vein velocity: ~30 cm/s • Phasic waveform • Hepatofugal flow in portal vein branches directed towards the shunt	• Colour Doppler aliasing at the stenosis site • Velocity >200 cm/s at the level of stenosis • Velocity <90 cm/s at the non-stenotic segment • Portal vein velocity <30 cm/s • No Doppler signal within the shunt • Ascites • Hepatopetal flow in portal vein branches especially when hepatofugal in previous exams • Complete occlusion: absence of colour Doppler flow