Orthotopic liver transplantation (OLT) represents a curative treatment option for end-stage liver disease (ESLD). Although epidemiology of ESLD has recently changed due to the rising prevalence of nonalcoholic fatty liver disease and the decreased burden of hepatitis C virus infections due to highly effective antiviral regimens, the management of portal hypertension (PHT) remains a clinical challenge in the pre- and post-OLT setting. The measurement of the hepatic venous pressure gradient represents the most reliable but invasive tool for assessment of the severity of PHT. Although novel liver ultrasound and magnetic resonance–based elastography methods have been developed, their value to screen for liver fibrosis and PHT in transplanted patients remains to be established. Nonselective beta-blockers represent the cornerstone of medical treatment of PHT, but more studies on their effects on clinical endpoints after OLT are needed. Statins are widely used to treat hyperlipidemia, which is a common condition after OLT. Although a growing body of evidence suggests that statins decrease portal pressure and PHT-related complications in ESLD, studies on potential benefits of statins after OLT are lacking. Finally, transjugular intrahepatic portosystemic shunts (TIPS) are effective in decreasing PHT and seem to decrease mortality on the OLT waiting list. Moreover, TIPS does not have an impact on liver function nor complicate the transplant surgical procedures. TIPS may also be used after OLT, but the evidence is limited. In conclusion, whereas the management of PHT in patients with ESLD is based on strong evidence, further data on the value of noninvasive monitoring tools as well as on medical and invasive treatment options in the post-OLT setting are needed to improve management strategies in patients with recurrent PHT after liver transplantation.

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End-stage liver disease (ESLD) in the Western world is mainly caused by alcoholic liver disease and nonalcoholic fatty liver disease (NAFLD) as well as chronic viral hepatitis infections. Most complications in patients with ESLD are related to portal hypertension (PHT). Etiological treatments such as lifestyle modification in NAFLD patients and eradication of hepatitis C virus (HCV) infection are most effective in treating PHT and may prevent ESLD. However, after ESLD has developed, orthotopic liver transplantation (OLT) is the treatment of choice with significantly improved posttransplant outcomes and survival over the last decades.

Although major improvements of graft and patient survival were achieved with the introduction of calcineurin inhibitors as part of the immunosuppressive regimens, more recently highly effective direct-acting antivirals (DAAs) allow pretransplant or posttransplant HCV eradication, even in patients with ESLD. In the case of recurrent HCV after OLT, sustained virological response to DAAs—if achieved early after OLT—prevents significant graft fibrosis and dysfunction.

With a steady increase in the prevalence of the metabolic syndrome, NAFLD is becoming the main indication for liver transplantation worldwide and is associated with several clinical challenges in the pre- and post-OLT care.
Regardless of the underlying etiology, chronic liver damage leads to cirrhosis and PHT with all of its associated complications such as variceal bleeding and ascites. Although PHT is extensively studied in patients with ESLD, recurrence of PHT after OLT due to graft fibrosis/cirrhosis of the transplanted liver have not been investigated to the same extent. Furthermore, specific surgical/mechanical reasons, such as hepatic or portal vein (PV) stenosis or portal vein thrombosis (PVT), have to be considered if patients present with PHT-related symptoms after OLT. However, with recent technical advances in interventional radiology, most of these complications can be treated by semi-invasive, nonsurgical approaches such as balloon dilatation or stent implantation.

In this review, we aim to summarize the evidence for the management of PHT in the pre- and post-OLT setting and outline important fields where further evidence from clinical trials is needed in order to establish guidelines for clinicians.

Assessment of the Severity of Liver Disease and PHT

Liver biopsy is considered as the gold standard for evaluation of liver disease, especially in patients with inconclusive clinical presentation. However, novel noninvasive tools for liver stiffness measurement (LSM) such as transient elastography (TE) are increasingly replacing liver biopsy at least for assessment of the degree of fibrosis because liver stiffness correlates well with the invasively measured hepatic venous pressure gradient (HVPG). Notably, the main disadvantages of TE include the lack of information on the underlying etiology of liver disease and some pitfalls leading to false-positive results with the need of expertise for interpretation of TE results. Several confounders have been identified that can influence the accuracy of the TE measurements, including sex, levels of aminotransferases, histological necroinflammation, mechanical cholestasis, nonfasting state, as well as increased central venous pressure, liver steatosis level, and body mass index. Boursier et al. and others defined reliability criteria that should be used when interpreting TE results. Most importantly, 10 valid LSMs with a low interquartile range interval per median liver stiffness (interquartile range/median < 30%) are required. The reliability of TE results can then be further categorized as very reliable, reliable, or poorly reliable. These TE reliability criteria are well validated for assessment of liver fibrosis but not for PHT in patients with ESLD.

Thus, the evidence for using TE in liver transplanted patients for screening of fibrosis and PHT is limited. Recently, a few studies assessed the value of TE for the evaluation of post-OLT graft disease (see Table 1). All of these studies focused on specific etiologies of post-OLT recurrence and, thus, cannot be generalized to unselected patients after liver transplantation. The reported cutoff values for identification of “posttransplant problems” differ substantially, and most studies lack a valid comparison to histological results. Therefore, results of TE should only be interpreted cautiously in the post-OLT setting.

Because cellular rejection also leads to hepatocyte injury and hepatocellular inflammation with balloononing, TE may also be useful for diagnosis of acute rejection episodes. In a very elegant study by Crespo et al., LSM was evaluated in post-OLT patients who had histologically proven rejection and were compared with HCV recurrence/cirrhosis and stable patients. When a TE cutoff value of >8.5 kPa was used, LSM had a positive predictive value of 100%, indicating another important area of potential clinical use for noninvasive liver stiffness assessment by TE. After 90 days and adequate treatment of rejection, LSM values declined in 93% of patients with severe rejection, respectively. These data strongly suggest that LSM may be used as a screening method for therapeutic efficacy of rejection treatment. Notably, patients with recurrent HCV had even higher stiffness values. Thus, clinical discrimination and knowledge about other factors contributing to post-OLT stiffness represents a clinical challenge and requires a high expertise both in
<table>
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<tr>
<th>Author</th>
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<th>Patient Number</th>
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<th>Limitations</th>
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</thead>
<tbody>
<tr>
<td>Carrón et al. (2006)</td>
<td>HCV recurrence after OLT</td>
<td>&gt;8.5 kPa</td>
<td>n = 124 patients with 169 liver biopsies and 129 hemodynamic studies</td>
<td>Detection of ≥F2 with 90% sensitivity, 81% specificity, 79% negative predictive value, and 92% positive predictive value</td>
<td>Results only for HCV-infected recipients</td>
</tr>
<tr>
<td>Karlas et al. (2015)</td>
<td>Screening for graft fibrosis and graft steatosis in post-OLT patients with alcoholic liver disease and nonalcoholic cirrhosis</td>
<td>&gt;7.9 kPa was defined as advanced fibrosis, ≥252 dB/m for mild steatosis (S2), and ≥300 dB/m for advanced steatosis (S3) with CAP</td>
<td>n = 204 patients with 157 valid measurements (77%)</td>
<td>Advanced fibrosis correlates with increased CAP values. Steatosis is associated with graft fibrosis, component of the metabolic syndrome, and recipient PNPLA3 rs738409 genotype.</td>
<td>No liver biopsies available</td>
</tr>
<tr>
<td>Lutz et al. (2015)</td>
<td>Screening for graft fibrosis in post-OLT patients 12 months after OLT Comparison of HVRI of the right hepatic vein with TE and 1 year (+2 months) protocol biopsy</td>
<td>&gt;8.35 kPa for F2 of higher underlying etiologies</td>
<td>n = 48 patients with mixed underlying etiologies</td>
<td>Detection of F2 fibrosis with a sensitivity of 84.62% and a specificity of 91.43%. No significant difference in reliability of HVRI and TE measurements</td>
<td>Small sample size</td>
</tr>
<tr>
<td>Crespo et al. (2016)</td>
<td>Evaluation of LSM in diagnosis of acute cellular rejection in the early post-OLT setting</td>
<td>&gt;8.5 kPa</td>
<td>n = 27 patients with suspected acute cellular rejection, n = 30 as control group with mixed underlying etiology, n = 30 patients with recurrent HCV</td>
<td>A TE value of &gt;8.5 kPa yielded a positive predictive value of 100% to diagnose moderate/severe rejection.</td>
<td>Mixed underlying diseases, exclusion of HCV patients for analysis of rejection, small sample size</td>
</tr>
</tbody>
</table>
the management of post-OLT patients and interpretation of TE results.

ASSESSMENT OF GRAFT STEATOSIS

Additionally, measurement of the controlled attenuation parameter (CAP) has been introduced to quantify hepatic steatosis.\(^{27}\) However, data on evaluation of graft steatosis in patients with suspected NAFLD disease after liver transplantation are missing.

Although TE and CAP are readily available and based on easy-to-use and rapid methodology, magnetic resonance elastography (MRE), and proton density fat fraction (PDFF) are more expensive and demanding. However, in 2 recently published studies, MRE and PDFF have been compared with TE and CAP and showed better accuracy in identifying fibrosis and improved detection rates of steatosis than TE and CAP, respectively.\(^{28,29}\)

Imajo et al. found that MRE and PDFF could obtain valid results in all 142 patients, whereas CAP failed to achieve valid results using the M probe in 10.6% of Japanese patients (15/142 patients).\(^{28}\)

Park et al. used the XL probe for TE in a Western population and compared results with MRE.\(^{26}\) MRE detected any grade of fibrosis significantly better than TE, and magnetic resonance imaging (MRI)–PDFF was more accurate in detecting any grade of steatosis than CAP. However, the high costs and the expertise needed for accurate quantitative assessments currently limit the use of MRE and MRI–PDFF to specialized centers, and their clinical superiority needs to be proved outside the clinical trial setting.

Interestingly, data are scarce on the impact of significant fibrosis on the occurrence of acute upper gastrointestinal bleeding episodes after OLT. Therefore, additional research on the value of noninvasive methods for the evaluation of post-OLT PHT is necessary before TE, MRE, or other noninvasive methods can be considered as valuable diagnostic tools for assessment of liver disease and PHT after OLT.

Notably, a study by Blasco et al. has shown that even subclinical HVPG values of ≥6 mm Hg were associated with disease progression in patients with HCV recurrence after OLT and thus suggested PHT monitoring as a valuable tool after OLT.\(^{30}\) However, additional considerations, such as PV stenosis/PVT or active versus cured recurrent HCV infection need to be additionally considered when interpreting HVPG values in liver-transplanted patients.

PHT Treatment Recommendations

Guidelines for the medical treatment of PHT exist for the pretransplant setting for patients with PHT both by the American Association for the Study of Liver Disease and the European Association for the Study of the Liver.\(^{1,31}\) Although the treatment algorithms will not be discussed in detail, the most important management strategies will be summarized:

1. In patients without varices, there is no indication to use nonselective beta-blockers (NSBBs).
2. In patients with small varices without additional risk factors (absence of red spot signs or advanced liver dysfunction, ie, Child-Pugh C cirrhosis), NSBBs may be used for primary prophylaxis of variceal bleeding.
3. In patients with large varices and red spot signs and in Child-Pugh C patients, either NSBBs or endoscopic band ligation should be used for primary prophylaxis.
4. In patients with acute variceal bleeding, vasoactive drugs, antibiotic prophylaxis, restrictive transfusion policies, and early endoscopic treatment should be applied.
5. For secondary prophylaxis of variceal bleeding, the combination of NSBBs and endoscopic band ligation should be used.

MEDICAL TREATMENT OF PHT AFTER TRANSPLANTATION

The evidence for most of these recommendations are derived from patients with ESLD in general and not specifically from studies in liver transplant candidates. However, some well-designed studies have also been conducted to provide evidence for the efficacy of NSBB specifically in patients on the OLT waiting list.\(^{32}\)

In contrast to the well-established treatment algorithms in patients with ESLD and PHT, the efficacy and safety of NSBB on the PHT and occurrence of variceal bleeding has not been well studied after liver transplantation.

In a study published by Schepis et al., propranolol administration was tested in a case-control study design of 41 patients; 21 transplanted patients with PHT due to recurrent HCV and 20 nontransplanted patients with cirrhosis were included.\(^{33}\) The
investigators showed a similar decrease in HVPG 20 minutes after intravenous propranolol administration in transplanted versus nontransplanted patients (−14.1% ± 8.0% versus −16.9% ± 9.5%; P = 0.31) and therefore similar efficacy. However, in this study there were no data on clinical outcomes during follow-up. Moreover, the baseline HVPG was lower in transplanted patients than in nontransplanted patients, whereas significantly more transplanted patients suffered from ascites. Notably, as mentioned before, clinical decompensation seems to occur “earlier” in case of HCV recurrence after OLT. Nevertheless, this represents a discrepancy that cannot be easily explained and might indicate important differences in the pathophysiology of PHT in liver disease prior versus after OLT. Importantly, this study also found an increase in arterial pressure with propranolol in transplanted patients but not in the nontransplanted control group. The authors concluded that there might be an increased sensitivity to the vasoconstrictive effects of NSBBs in the systemic circulation after liver transplantation as suggested by a marked increase in systemic vascular resistance.

Another aspect that needs to be considered when using anti-adrenergic drugs for the medical treatment of PHT after transplantation is the fact that hepatic microcirculation is denervated and vasoressiveness might be different as compared with nontransplanted patients. Previously, it was shown that patients with cirrhosis have a different pattern of responsiveness to alpha- and beta-adrenergic signals in vessels from cirrhotic livers and from donor grafts. Indirectly, this may also suggest that vasoressiveness is likely different in the absence of sympathetic and parasympathetic innervation of the hepatic vasculature. One could speculate that, eg, the effectiveness of additional alpha-1 adrenergic blockade by carvedilol could be different in patients after OLT. Therefore, additional studies on the impact of NSBB on the clinical outcomes, such as incidence of variceal bleeding, and survival are needed in patients with PHT after OLT.

As another epidemiologically relevant drug class, statins are explored in their use to lower portal pressure in patients with cirrhosis although they may be associated with hepatic injury in some cases. Although their effect is described in multiple prominent studies, its use in the post-OLT setting is insufficiently defined although experimental studies in rats have proven a graft-protecting effect when added to the cold storage solution and there seems to be no increase in adverse events in the post-OLT setting. However, although statins are used widely after OLT because of the deteriorating effects of calcineurin inhibitors on the metabolic status and the high incidence of hypercholesterinemia, data are scarce on the effect of post-OLT fibrosis and PHT development, which demands further investigation.

**PV Stenosis as Cause of PHT**

Certain specific aspects of liver transplant patients need to be considered when symptoms of PHT occur after OLT. These include surgical complications, such as PV stenosis or PVT that may occur early but also later after transplantation due to intimal hyperplasia and vascular Anastomosis stenosis (Table 2).

Prevention of PV stenosis or PVT is critical during and after OLT because low portal venous blood flow affects postoperative outcome with higher rates of biliary strictures and worse short-term and longterm graft survival. Although reanastomosis with all associated perioperative increased risk was the only treatment option in the past, interventional radiology nowadays allows minimally invasive treatment options. Recently, there have been several reports on safe and successful management using balloon dilation and stent implantation with transsplenic or transhepatic approaches in post-OLT PV complications. Wang et al. have published a case series of 13 patients who were treated with percutaneous balloon angioplasty and/or stent implantation for PV occlusion. In their report, technical and clinical success could be achieved in 11/13 patients (84.6%). Decision to use either balloon angioplasty with subsequent stent implantation (7/13) or balloon angioplasty with stent and additional percutaneous thrombolysis was based on the severity of PV occlusion, namely, partial or extensive thrombosis. Interestingly, the authors also performed embolization of portosystemic collaterals with subsequent clinical improvements, such as improved liver function and disappearance of signs/symptoms of PHT. In the published series, in 2 patients, recanalization could not be performed due to impossibility to traverse the occluded PV and 2 patients suffered from severe procedure-related bleedings.

Ohm et al. also evaluated safety and efficacy of percutaneous approaches in patients with surgical PV complications after OLT. The authors used either a transhepatic or transsplenic approach in case of collapsed PV in order to reduce the risk of liver injury. In
In their study, 18 patients were analyzed of which 8 underwent therapy by transhepatic access and 10 by transsplenic access. The authors based their decision on whether the spleen was located in a normal position, the splenic vein was preserved, and the target lesion did not involve confluence of the superior mesenteric and splenic veins. Success was achieved in all patients, using stents in 12/18, balloon angioplasty in 3/18, variceal embolization in 2/18, and variceal embolization with subsequent stent placement in 1/18. A periprocedural complication occurred in only 1 patient with transsplenic approach. In 11 patients with ascites, abnormal liver function tests and hepatic encephalopathy clinical improvements were noted. In the other 7 patients, the intervention was performed with successful prevention of PHT-related complications.

In a multi-institutional study, balloon-occluded retrograde transvenous obliteration (BRTO) of gastric varices was evaluated in post-OLT patients. In the study by Saad et al., 11 patients underwent BRTO of which all were technically successful; complete variceal obliteration was successful in 10/11 patients; 2/11 patients suffered from major complications, ultimately leading to death in 1/11 due to consumptive coagulopathy; 1/11 suffered from delayed gastrointestinal bleeding 1.5 years after the procedure. In conclusion, PV complications after OLT are mostly due to surgical complications and can be treated by semi-invasive interventional techniques without the need for surgical reintervention. To date, however, although radiological semi-invasive interventions seem safe, randomized controlled trials are not available, and existing case series are usually small. Moreover, few follow-up data are published on the postinterventional occurrence of variceal bleedings, hepatic encephalopathy, and long-term stent patency rates. Importantly, it has to be noted that interpretation of HVPG in cases of prehepatic PHT (such as in the case of PV stenosis or PVT) the HVPG cannot be used and direct portal venous puncture and measurements would be needed for proper diagnosis of PHT.

### Table 2. Interventional Radiology Before and After OLT

<table>
<thead>
<tr>
<th>Author</th>
<th>Patient Characteristics/ Setting</th>
<th>Patient Number</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wang et al. (44) (2015)</td>
<td>Interventional treatment for post-LT PV occlusion</td>
<td>n = 13 patients; 10/13 with PHT-related signs and symptoms</td>
<td>Technical and clinical success in 11/13 patients (84.6%). Either balloon angioplasty with stent or balloon angioplasty with stent and percutaneous thrombolysis was used.</td>
</tr>
<tr>
<td>Ohm et al. (45) (2017)</td>
<td>Endovascular management of post-OLT PV complications, comparison between transhepatic and transsplenic approach</td>
<td>n = 18 patients: n = 8 with transhepatic and n = 10 with transsplenic approach</td>
<td>Technical success in all patients (100%), 12/18 with stent, 3/18 balloon angioplasty, 2/18 variceal embolization, 1/18 variceal embolization with stent placement; 1 major complication (splenic vein tear with necessity of temporal balloon occlusion and red blood cell transfusion)</td>
</tr>
<tr>
<td>Saad et al. (47) (2017)</td>
<td>Evaluate BRTO of gastric varices after OLT</td>
<td>n = 11 post-OLT patients with gastric varices</td>
<td>Technical success in all patients (11/11), complete obliteration in 10/11 patients (91%); 2/11 experienced major complications (1 PVT, 1 consumptive coagulopathy with subsequent death)</td>
</tr>
<tr>
<td>Thornburg et al. (43) (2016)</td>
<td>PV recanalization and TIPS placement before OLT</td>
<td>n = 61 patients awaiting liver transplantation</td>
<td>Technical success in 60/1 patients. Recanalized PV remained patent during follow-up in 55/60 patients; 23/60 underwent OLT, 22/23 with end-to-end physiologic PV anastomosis.</td>
</tr>
<tr>
<td>Pulitano et al. (47) (2015)</td>
<td>PRESS in post-OLT patients with variceal hemorrhage</td>
<td>n = 2 acutely bleeding post-OLT patients</td>
<td>Technical and clinical success in 2/2 patients (100%)</td>
</tr>
</tbody>
</table>
Invasive Methods for Treatment of PHT

Once OLT patients develop more advanced PHT with recurrent variceal bleeding and/or refractory ascites, more invasive methods such as implantation of a transjugular intrahepatic portosystemic shunt (TIPS) may be needed. TIPS is feasible in transplant recipients in cases of PHT due to allograft cirrhosis or venoocclusive disease, as reviewed by Bonnel et al.\(^\text{(49)}\) Although hepatic decompensation might occur after TIPS implantation in OLT patients that might even require retransplantation, TIPS remains a valuable tool in selected patients with PHT after OLT.\(^\text{(50,51)}\)

In the post-OLT setting, however, close monitoring of immunosuppression systemic through levels is warranted due to potentially modified metabolism of calcineurin inhibitors, which may cause serious adverse effects.\(^\text{(52)}\)

Pretransplant Indications for TIPS Implantation

Currently, the indications for TIPS implantation undergo steady evaluation and some (relative) contraindications are questioned. TIPS is now indicated in cirrhosis for severe acute variceal bleeding (“early TIPS” strategy) and uncontrollable/recurrent variceal bleeding (“rescue TIPS” strategy).\(^\text{(53)}\) Some reports exist on recanalization of PVTs (including some cases with total oblitative PVT)\(^\text{(54)}\) using a transsplenic approach,\(^\text{(43)}\) allowing liver transplantation with a physiological anastomosis when necessary although PVT has been considered a relative contraindication in the past. Notably, PVT can impair TIPS implantation and in the case of variceal bleeding, new interventional radiological techniques such as percutaneous retroperi- toneal splenorenal shunt (PRESS) or direct intrahepatic portocaval shunt have been described as salvage therapy,\(^\text{(68)}\) widening the possibilities to not only bridge patients but use TIPS as definitive therapy.

In the post-OLT setting, less literature is available due to small sample sizes. However, a MELD score of \(\geq 16\) is associated with increased mortality in OLT recipients and TIPS implantation should be avoided in these patients as efficacy seems to be lower in post-OLT patients than in pre-OLT patients.\(^\text{(61,62)}\)

Special Considerations for Patients on the Orthotopic LT Waiting List

- Although guidelines are well defined for patients with cirrhosis and PHT, patients with ESLD on the waiting list require special considerations. For example, the type and doses of NSBBs need to be carefully evaluated because NSBBs might increase mortality in patients with refractory ascites\(^\text{(63)}\) and peritonitis.\(^\text{(64)}\)

- The presence of ascites per se is not a contraindication against NSBB therapy for PHT.\(^\text{(65,66)}\)

- In scenarios where vasopressor and inotropic drugs are needed, eg, in hepatorenal syndrome type of acute kidney injury or septic shock, NSBB treatment should be discontinued in order to allow for beta-adrenergic–driven hemodynamic (re-)compensation.\(^\text{(64,67)}\)

- If a decision to reduce, pause, or discontinue NSBBs in patients with PHT is made, adequate prophylaxis for variceal bleeding must be implemented. These include endoscopic band ligation, other pharmacological approaches (such as terlipressin in case of hepatorenal syndrome), or TIPS in patients with severe or refractory ascites.\(^\text{(68)}\)

- When suffering from HCV and receiving DAAs, MELD score decreases, leading to a longer wait-list time with potential negative impact on mortality. In a recent study by Chhatwal et al, high Model for End-Stage Liver Disease (MELD) score, TIPS patients had improved transplant-free survival when the patient lived for longer than 2 months after the procedure.\(^\text{(58)}\) It is important to add that TIPS implantation itself has no effect on MELD scores and does not alter the natural evolution, thereby guaranteeing no effect on wait-list time.\(^\text{(59)}\) Moreover, PTFE-coated TIPS led to an increase in transplant-free survival in patients with cirrhosis and recurrent ascites in a recent randomized, controlled study,\(^\text{(60)}\) widening the possibilities to not only bridge patients but use TIPS as definitive therapy.

In the post-OLT setting, less literature is available due to small sample sizes. However, a MELD score of \(\geq 16\) is associated with increased mortality in OLT recipients and TIPS implantation should be avoided in these patients as efficacy seems to be lower in post-OLT patients than in pre-OLT patients.\(^\text{(61,62)}\)
MELD scores between 23 and 27 were identified as optimal time point (in the US setting)\(^\text{(69)}\) to better defer DAA treatment to the early post-OLT period.

- Currently, there exists no specific medical treatment for NAFLD, thus lifestyle interventions and physical activity should be recommended. Mild strength training seems beneficial because this might counteract sarcopenia, which is associated with significantly worse outcomes both on the waiting list and after OLT.\(^\text{(70,71)}\)

- Contrary to the common opinion that statins should be avoided in patients with liver disease, they seem to be similarly effective in patients with cirrhosis for established indications and may also be used in conjunction with other medical treatments of PHT.\(^\text{(72)}\)

- TIPS implantation as a well-established technique should be considered for the management of PHT on the waiting list. TIPS may even reduce mortality on the waiting list, as shown by a recent UNOS database analysis of Berry et al.\(^\text{(56)}\)

- Importantly, TIPS had no negative effect on perioperative surgical outcome or wait-list time\(^\text{(57,73,74)}\) and does not impact (neither improve nor decrease) the MELD score. Thus, TIPS seems useful for the management of severe PHT-related complications on the waiting list, such as recurrent variceal bleeding and refractory ascites.

In conclusion, substantial progress has been made in the treatment of PHT and its associated complications. Although diagnosis of cirrhosis and PHT can be made using novel noninvasive tools, the value of TE/CAP and magnetic resonance–based fibrosis and steatosis assessment remains to be evaluated for the post-OLT setting. Although medical treatment algorithms for PHT in patients with ESLD are based on well-designed studies, the evidence for the use of NSBBs for treatment of OLT patients is scarce. Although beneficial effects of statins on liver fibrosis and PHT have been reported, there is no sufficient evidence for a beneficial effect of statins on graft fibrosis and PHT after OLT. More invasive treatment options for PHT such as TIPS implantation are effective and feasible in patients awaiting liver transplantation because they do not complicate transplantation itself, but TIPS indications and potential difficulties in the post-OLT setting have not been evaluated to the same extent. Furthermore, prospective trials in patients developing PHT after OLT are warranted.

REFERENCES


