The Evaluation of the Patient Undergoing an Elective Transjugular Intrahepatic Portosystemic Shunt Procedure

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ABSTRACT

In its early stages, the transjugular intrahepatic portosystemic shunt (TIPS) was utilized as a lifesaving procedure to treat uncontrollable esophageal variceal bleeding. Most of the initial cases were performed in an emergency situation in the worst possible conditions. The experience gained over the past 15 years has established TIPS as an important therapeutic option in the management of patients with complications of portal hypertension such as variceal bleeding or refractory ascites who do not respond to medical therapy. In current medical practice, 80 to 90% of TIPS procedures are performed in an elective or semielective fashion and only a small percentage of cases are now performed on an emergency basis. The experience gained has demonstrated that certain patients do not benefit from a TIPS procedure and furthermore, their baseline condition may even worsen after a TIPS. This article reviews the most important aspects of the clinical evaluation of patients undergoing an elective TIPS procedure.

KEYWORDS: MELD score, portal hypertension, Child-Pugh score, transjugular intrahepatic portosystemic shunts

Objectives: Upon completion of this article, the reader should (1) understand the most important aspects of patient evaluation before an elective TIPS procedure, (2) be able to identify the most important poor prognostic factors in these patients, and (3) be able to identify clinical situations in which it would be better to defer the TIPS.

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When the transjugular intrahepatic portosystemic shunt (TIPS) was in its early stages, it emerged as a lifesaving, minimally invasive procedure to treat uncontrollable esophageal variceal bleeding.^{1,2} Interventional radiologists would perform a TIPS in a patient even if the anticipated prognosis was dismal.³ As more experience was gained with the procedure, poor outcomes and

procedure-related complications began to be identified and reported in the literature⁴ and this prompted the establishment of specific indications and contraindications for TIPS.^{5,6} The experience gained over the past 15 years has allowed the TIPS procedure to gain a well-established role in the management of patients with complications of portal hypertension such as

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variceal bleeding or refractory ascites who do not respond to medical therapy.^{5,7-9} Physicians with an interest in the management of portal hypertension have come to agree that there are some patients that will benefit from a TIPS, whereas there are other patients in whom TIPS may be harmful.^{9,10} The trend in current medical practice is to recommend withholding a TIPS in those patients with severe liver derangement in whom a poor outcome may be predicted.^{10,11} The final decision to proceed or withhold a TIPS procedure is of course a joint decision between the referring physicians (most commonly a gastroenterologist/hepatologist, or a transplant surgeon), operators (an interventional radiologist), patient, and family members. The purpose of this review is to provide an overview of the most important steps in the clinical evaluation of a patient undergoing an elective TIPS procedure and to determine whether the patient is a suitable candidate for such a procedure. The clinical condition of patients with acute variceal bleeding needing an emergency TIPS differs from the clinical condition of patients in whom an elective TIPS can be performed. The decision-making process is entirely different and for this reason, the assessment and decision-making process for an emergency TIPS will be discussed in a separate article in this issue.

PATIENT EVALUATION

More than 90% of TIPS procedures are performed for the management of either variceal bleeding or refractory ascites.⁵ Less common indications for TIPS include

management of Budd-Chiari syndrome,¹² hepatic hydrothorax,¹³ hepatorenal syndrome,¹⁴ hepatopulmonary syndrome¹⁵ and ectopic varices¹⁶ but the role of TIPS in the management of these clinical entities has not been defined with precision.^{9,17} The first step to a successful TIPS is a thorough patient evaluation (Table 1). The evaluation must include: (1) a clinical assessment including a problem-focused clinical history, assessment of the hemodynamic status, respiratory status, mental status, and patient's quality of life; (2) evaluation of the laboratory data with special attention to liver function, kidney function, and coagulation status; (3) evaluation of the imaging studies (either a three-phase computed tomography scan or a Doppler ultrasound) to assess the patency of the portal vein, splenic vein, hepatic artery, and hepatic veins and to exclude the presence of liver lesions that may preclude the creation of the shunt¹⁸; (4) exclusion of major contraindications to the procedure such as right heart failure, multiple hepatic cysts, unrelieved biliary obstruction, severe pulmonary hypertension, and severe hepatic failure⁹; and (5) application of prognostic scores to decide whether the patient is actually a good candidate to undergo a TIPS procedure.¹⁸ When the patient evaluation is completed the risks and benefits of performing a TIPS must be discussed with the referring physicians, the patient, and the patient's family to reach a therapeutic decision. The operator needs to be sure that the patient has a condition that is treatable with a TIPS and that the patient has a very good chance of receiving a clinical benefit after the procedure is completed.

Table 1 Steps to Take in the Evaluation of the Patient Undergoing an Elective TIPS

1. Problem-focused clinical history and physical exam
 - a. Review the patient's history and current clinical condition (are there external signs of liver failure? is the patient intubated? ascites encephalopathy, active bleeding, quality of life)
 - b. Determine the cause and type of portal hypertension
 - c. Evaluate the electrocardiogram; find out if there are any signs of right heart failure or pulmonary hypertension
 - d. Determine the indication for the TIPS procedure
2. Evaluation of laboratory data
 - a. Evaluate a recent liver function test panel (within 1 week of the procedure)
 - b. Evaluate the kidney function; determine if the patient is on dialysis
 - c. Evaluate a recent complete blood count (determine if the patient will need transfusions prior to TIPS)
 - d. Evaluate the coagulation status; determine if the patient will need transfusions
3. Evaluation of imaging studies
 - a. Find out if the patient has a computed tomography scan or abdominal ultrasound
 - b. Evaluate the patency of the splenoportal and mesoportal systems
 - c. Evaluate patency of hepatic artery
 - d. Make sure there are no cysts or masses that may interfere with the creation of the shunt
4. Make sure that the patient does not have any condition that will contraindicate the TIPS
5. Apply a risk score to determine if the patient is at high risk to have a poor outcome after TIPS
 - a. Child-Pugh score
 - b. MELD score
6. Discuss the potential risks and benefits with the referring physician, the patient, and the family members

Table 2 The Child-Pugh Classification

	Points		
	1	2	3
Ascites	None	Easily controlled	Poorly controlled
Albumin (g/dL)	> 3.5	2.8–3.5	< 2.8
Bilirubin (mg/dL)	< 2	2–3	> 3
Encephalopathy	Absent	Grades 1–2 (minimal)	Grades 3–4 (advanced)
Prothrombin (seconds > control)	< 4.0	4–6	> 6

Note: Point modification for bilirubin values in patients with primary biliary cirrhosis—bilirubin (mg/dL): 1–4 = 1 point; >4–10 = 2 points; > 10 = 3 points.

Child-Pugh score: A: 5–6, good prognosis; B: 7–9, moderate; C: 10–15, poor prognosis.

Prognostic Scores

THE CHILD-PUGH SCORE

The Child-Pugh score (Table 2) has been employed to predict outcomes in patients undergoing portal hypertensive surgery since 1973 and was adopted to predict outcomes in patients undergoing TIPS since 1989.¹ The application of the Child-Pugh score divides the patients in three groups—class A (score: 5 to 6), class B (score: 7 to 9), and class C (score: 10 to 15)—depending on the degree of derangement of the liver function.¹⁹ Patients with low scores (5 and 6) are considered to be good operative candidates and patients with high scores (10 to 15) are poor operative risks.²⁰ Disadvantages of this scoring system include: (1) the calculation of the Child-Pugh score may be influenced favorably or unfavorably by two subjective variables: degree of ascites and encephalopathy;¹¹ and (2) the so-called “ceiling effect” impedes patient stratification. This happens because it is not possible to differentiate patients with high bilirubin levels (i.e., a patient with a serum bilirubin of 25 mg/dL and a patient with a serum bilirubin of 5 mg/dL would both obtain a score of 3 for bilirubin); however, at least in theory, the patient with the higher serum bilirubin is in worse clinical condition.²¹ Despite these theoretical disadvantages, the Child-Pugh scoring system has withstood the test of time and is still very effective in predicting outcomes in patients with end-stage liver disease undergoing TIPS procedures.^{22,23} The Child-Pugh score has been compared with other recently described predictive scoring systems and has performed very well in patients undergoing both emergency²² and elective TIPS.²³

In general, most authors coincide in the opinion that a Child-Pugh class C patient with a score of 12 or higher is at a very high risk of having an early death after a TIPS procedure,^{9,24–26} and it would probably be advisable to withhold the procedure in those patients.⁹

THE MODEL OF END-STAGE LIVER DISEASE SCORE

Malinchoc et al developed a model specifically designed to predict mortality in patients undergoing elective TIPS procedures.¹¹ The model was developed based on a

group of 231 consecutive patients with cirrhosis who underwent an elective TIPS procedure; patients undergoing an emergency TIPS were excluded.¹¹ Four variables were identified as predictors of survival using the Cox proportional-hazards regression: serum creatinine, serum bilirubin, international normalized ratio (INR), and cause of cirrhosis.¹¹ These investigators developed a formula to calculate a risk score by using these four prognostic variables; the study found that patients with a risk score > 1.8 had a median survival of 2.8 months and patients with a risk score < 1.8 had a median survival of 1.3 years. In this manner, a risk score > 1.8 was identified as a poor prognostic factor. A nomogram was also developed by using logistic regression and the same variables. The nomogram was designed to be applied at the bedside and in theory, its application was more simple than the risk score formula. The authors found this model to be quite effective in the prediction of patient survival after elective TIPS, with a sensitivity of 77%, specificity of 79%, positive predictive value of 63%, and negative predictive value of 88%.¹¹ In the original publication, the nomogram was found to be accurate, with very good correlation between the predicted and observed 3-month mortality.¹¹ This original model was applied by two different authors in two separate institutions and it was found that the application of the risk score was better than the nomogram to predict patient outcome after elective TIPS. In both of these studies, the application of the nomogram showed that the predicted mortality was higher than the observed mortality.^{27,28} The original model developed by Malinchoc was slightly modified: minor changes in the formula included deletion of the cause of cirrhosis as an adverse factor and multiplying the score by 10 to make it easier to apply.²⁹ The new model was called the Model for End-Stage Liver Disease score, better known as the MELD score. The current formula for the calculation of the MELD score is:

$$\text{MELD} = 9.6 \times \log e (\text{Cr}) + 3.8 \times \log e (\text{bilirubin}) + 11.2 \times \log e (\text{INR}) + 6.4$$

where Cr = creatinine.

The MELD score can be easily calculated using a website. There are multiple sites that are user-friendly

Table 3 C-statistics for Prediction of Survival: Comparison of the MELD and Child-Pugh Scores in Three Series of Patients Undergoing Elective TIPS

	1 Month	3 Months	6 Months	12 Months
Salerno et al (2002) ²⁷				
MELD score	—	0.84*	0.81	0.71
Child-Pugh score	—	0.70	0.69	0.66
Angermayr et al (2003) ²³				
MELD score	0.73	0.72	—	0.66
Child-Pugh score	0.78	0.70	—	0.66
Ferral et al (2004) ³²				
MELD score	0.75	0.76	0.75	—
Child-Pugh score	0.68	0.78	0.81†	—

The table compares the application of the c-statistic in three large series of patients who underwent elective TIPS. Salerno studied 140 patients in Italy; Angermayr 475 patients in Austria; and Ferral 166 patients in the United States. A c-statistic value of 0.7–0.8 indicates acceptable diagnostic accuracy. A c-statistic of 0.8–0.9 indicates excellent diagnostic accuracy. Overall, the results are similar, with only a few differences. Salerno found the MELD score to be significantly better than the Child-Pugh to predict survival at the 3-month interval. No differences were found at the 6- and 12-month intervals. Angermayr found no significant difference in the predictive powers between the two scores at the specified times. Ferral found the Child-Pugh score to be significantly better than the MELD score for the prediction of survival at the 6-month interval.

* $P=0.03$.

† $P\leq 0.05$.

and allow fast MELD score calculation. Our preferred site is www.thedrugmonitor.com/meld. The MELD score has been validated in patients undergoing elective TIPS and its application appears to be useful from the clinical standpoint.^{23,29–32} Angermayr and colleagues evaluated a total of 475 patients who underwent elective TIPS placement in five different hospitals in Austria in a 10-year period. These authors confirmed that patients with a MELD score >18 have significantly poorer survival rates. The 3-month survival was 40% for patients with MELD scores ≥ 18 compared with 90% for patients with MELD scores ≤ 18 ; the difference was statistically significant ($P=0.002$).²³ The authors compared the predictive power of the MELD score to the predictive power of the Child-Pugh score and found that using the Cox model, MELD was better in predicting survival but both scores were equally predictive when using the curve for the receiver operating characteristics curve (concordance c-statistics) for 1-month, 3-month, and 1-year survival.²³ Ferral et al tested the MELD score in a group of 166 patients who underwent elective TIPS in two different institutions in the United States.³² In this series, the c-statistics for the prediction of the 30-day mortality and 3-month mortality were essentially similar for the Child-Pugh score and the MELD score.³² Based on c-statistics, the MELD score is roughly equivalent to the Child-Pugh score in predicting patient survival.^{22,23,27,32} Statistics from different authors have shown small differences in the predictive power of the Child-Pugh score when compared with the MELD score (Table 3), however, the Child-Pugh score still has the disadvantage of the “ceiling” effect and this makes the MELD score easier to apply.²⁹ Probably the biggest advantage of the MELD score is that it allows a better stratification of patients into very low risk

and very high risk because low MELD scores (<10) are clearly associated with a good prognosis^{23,32} whereas very high MELD scores (>25) are clearly associated with a very poor prognosis.³² Angermayr and his colleagues found that patients with low MELD scores, with a predicted probability of death of 0 to 25%, did much better than patients with a predicted mortality of 75 to 100%.²³ In their series, the patients with a predicted mortality of 0 to 25% had a 9.5% 3-month mortality rate whereas patients with a predicted mortality of 75 to 100% had a 3-month mortality of 60%.²³ In a similar fashion, Ferral et al found that the 30-day mortality was 0% in patients with MELD scores ≤ 10 as opposed to an early mortality of 42% in patients with MELD scores ≥ 25 .³² Furthermore, the 3-month and 6-month mortality rates were 65.5% and 74.2%, respectively, for patients with MELD scores ≥ 25 and 0% for patients with MELD scores <10 .³² Irrespective of the method employed, these scores provide a rough idea of the expected outcome in cirrhotic patients undergoing an elective TIPS procedure. This information is very useful in the discussion of risks and benefits of the proposed procedure with the referring physicians, patient, and patient’s family members.

CONCLUSION

The interventional radiologist performing TIPS should be familiar with at least one of the available scoring systems to predict outcomes in a patient undergoing an elective TIPS procedure. This provides the referring physician, the patient, and his or her family a more objective information of what to expect after the procedure and assists them in making a well-informed medical decision. Based on the current literature, we think that it is advisable to withhold an elective

TIPS in patients with a Child-Pugh class C with a score of 12 or higher or in patients with MELD scores higher than 25.

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