The use of MELD scores in critically ill cirrhotic patients

Supannee Rassameehiran MD, Tinsay A. Woreta MD MPH

ABSTRACT

The Model for End-Stage Liver Disease (MELD) was originally created to predict survival following transjugular intrahepatic portosystemic shunt and was subsequently found to accurately predict mortality in patients with end-stage liver disease. It has been used in the United States for liver allocation since 2002, and implementation of the MELD score resulted in a reduction in total number of deaths on the waitlist and a reduction in waiting time. Critically ill cirrhotic patients have an in-hospital mortality greater than 50%. Although the MELD score was also found to be an accurate predictor of in-ICU mortality and in-hospital mortality after ICU admission in critically ill cirrhotic patients, the Sequential Organ Failure Assessment (SOFA) score appears to perform better in many studies. The Chronic Liver Failure Consortium Acute-on-Chronic Liver Failure (CLIF-C ACLF) score was later developed by using specific cut-points for each organ failure score system in CLIF patients to predict mortality in patients with ACLF. Neither the MELD nor SOFA score independently predicts post-liver transplantation mortality in cirrhotic patients with extrahepatic organ failure and should not be use as a delisting criterion for these patients. More data are needed to determine the accuracy of the CLIF-C ACLF score in predicting post-liver transplantation outcomes. Prospective evaluation of critically ill cirrhotic patients is needed to optimize liver organ allocation.

Key words—Cirrhosis, MELD score, SOFA score

INTRODUCTION

The Model for End-Stage Liver Disease (MELD) is a numerical scale, ranging from 6 to 40, that was originally created to predict survival following transjugular intrahepatic portosystemic shunt (TIPS) for refractory variceal bleeding or refractory ascites.1 The score is calculated by a formula using serum bilirubin, serum creatinine, and the International Normalized Ratio (INR). It was later adopted by the United Network for Organ Sharing (UNOS) to determine priority for liver organ allocation in the United States in February 2002.2 The MELD score predicts liver transplantation (LT) waitlist mortality with estimated three-month mortality of 4%, 27%, 76%, 83%, and 100% for MELD scores of <10, 10-19, 20-29, 30-39, and ≥ 40, respectively.3 Implementation of the MELD score for organ allocation resulted in a reduction in total number of deaths on the waitlist and a reduction in waiting time.4 In January 2016, the MELD-Na score was implemented for LT allocation, as hyponatremia also strongly predicts mortality in these patients.5-7 Apart from prioritizing the urgency for LT, the MELD score accurately predicts outcomes in cirrhotic patients with infection8-10, variceal bleeding11-12, trauma13, and surgery other than LT, including liver resection.14,15 It is also used as one of the liver-specific prognosis scores for critically ill cirrhotic patients in the intensive care unit (ICU).

Prognostic scoring systems for critically ill cirrhotic patients in ICU

Liver cirrhosis is the 12th leading cause of death in the United States.16 The prevalence of liver cirrhosis is increasing and is estimated to be present in approximately 630,000 adults in the United States.17 Cirrhotic patients are at an increased risk for developing decompensation related to cirrhosis and portal hypertension, including variceal bleeding, ascites, hepatic encephalopathy, hepato-renal syndrome, spontaneous bacterial peritonitis, and sepsis. Patients with cirrhosis admitted to the ICU have a substantially high mortality rate of 50% to 100%.18 Liver-specific prognosis scores [Child-Turcotte-Pugh (CTP) and MELD] and ICU-specific prognosis scores [Simplified Acute Physiology
Score (SAPS) II, Acute Physiology and Chronic Health Evaluation (APACHE), and Sequential Organ Failure Assessment (SOFA) have been proposed to assess disease severity and outcomes in these patients.

**MELD score as a prognostic predictor for cirrhotic patients in ICU**

The MELD score is calculated by the formula $3.8 \times \log_e(\text{serum bilirubin [mg/dL]}) + 11.2 \times \log_e(\text{INR}) + 9.6 \times \log_e(\text{serum creatinine [mg/dL]}) + 6.4$. It contains only objective values that eliminate intra- and inter-observer variability. Unfortunately, other than renal dysfunction, the MELD score does not directly account for other complications of portal hypertension, such as ascites, variceal bleeding, hepatic encephalopathy, hepatopulmonary syndrome, portopulmonary hypertension, and cirrhotic cardiomyopathy. Thus patients with significant decompensation from complications of portal hypertension may have low MELD scores that do not accurately reflect the severity of their liver disease and are at a disadvantage with our current method of organ allocation using the MELD score. A system of exception points has been implemented for those patients with complications of portal hypertension that are not captured by the MELD score, such as hepatopulmonary syndrome and portopulmonary hypertension, to increase their waitlist priority.

The MELD score can also be influenced by acute illnesses that alter bilirubin, creatinine, or INR values (Table 1).

**Comparing MELD score and ICU-specific scores (SAPS II, APACHE II, SOFA)**

Many studies have compared MELD scores with ICU-specific prognosis scores in predicting in-ICU mortality and in-hospital mortality for cirrhotic patients after ICU admission. Most studies have shown that SOFA scores correlate with mortality better than MELD scores, APACHE II scores, and SAPS II scores. Das et al reported the presence of five non-hematologic organ failures in the SOFA score at the admission to the ICU was associated with 100% in-hospital mortality. Moreover, the accuracy of SOFA scores was improved when reassessed at 48 to 72 hours after the admission to the ICU. However, Boone et al reported that both SOFA scores and MELD scores did not perform well in predicting 28-day mortality in the surgical ICU patients. Each of the six different organ failures in the SOFA score has a different weight in cirrhotic patients. Hematologic failure in SOFA score defined by platelet count ≤ 50 k/μL has no impact on the prognosis in cirrhotic patients. New cut-off values for SOFA scores dedicated to cirrhotic patients were proposed resulting in a development of new scoring systems: the Chronic Liver Failure-SOFA (CLIF-SOFA) score and the Chronic Liver Failure Consortium Acute-on-Chronic Liver Failure (CLIF-C ACLF) score.

The CLIF-C ACLF score was specifically developed using data from patients with the diagnosis of ACLF, which was defined as an acute deterioration in liver function in an individual with pre-existing chronic liver disease and hepatic and extrahepatic organ failures. Validation of the score was confirmed with external single center prospective cohort study of ACLF patients admitted to the ICU. Jalan et al reported that CLIF-C ACLF score correlates with mortality better than the MELD score, MELD-Na score, CTP score, and CLIF-SOFA score in patients with ACLF. Sequential use of the score also improves the predictive performance and should be considered as a good prognostic predictor for cirrhotic patients.

Evidence for the MELD score, SOFA score, and CLIF-C ACLF score predicting post-LT outcome is lacking. A systematic review by Cholongitas et al found that the MELD score does not predict post-LT mortality. A recent study by Karvellas et al reported that the SOFA score was not associated with an increased risk of 90-day post-LT mortality. Optimal organ allocation in cirrhotic patients with extrahepatic organ failure should be prospectively evaluated.

**CONCLUSION**

The MELD score predicts liver transplantation waitlist mortality and has been used in the United States for liver allocation since 2002. Prior studies have compared the MELD score with ICU-specific prognosis scores in predicting in-ICU mortality and in-hospital mortality of cirrhotic patients after ICU admission.
Although the MELD score was found to be an accurate predictor of mortality in critically ill cirrhotic patients, the CLIF-C ACLF score correlates with mortality better than the MELD score, MELD-Na score, CTP score, and CLIF-SOFA score in patients with ACLF. Thus we recommend the CLIF-C ACLF score as a prognostic predictor for patients with acute-on-chronic liver failure.
Table 1 Influencing factors of MELD score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Influencing factors</th>
</tr>
</thead>
</table>
| Bilirubin | Increased indirect bilirubin  
             Hemolysis  
             Blood transfusion  
             Drug or sepsis-induced cholestasis\textsuperscript{19,20} |
| Creatinine | Acute renal failure\textsuperscript{21,22}  
             Hepatorenal syndrome  
             Other causes: shock, hypovolemia, drug-induced nephropathy, and medication-induced nephropathy |
| INR | Anticoagulant therapy: warfarin  
             Hemodilution\textsuperscript{23}  
             Bleeding-induced coagulopathy\textsuperscript{24}  
             Disseminated intravascular coagulopathy\textsuperscript{25}  
             Malnutrition |

INR- International Normalized Ratio

Table 2 Components of ICU-specific prognosis scores

<table>
<thead>
<tr>
<th>Organ system</th>
<th>ICU-specific prognosis scores</th>
</tr>
</thead>
</table>
| Cardiovascular system         | SAPS II, APACHE II  
                                  SAPS II, APACHE II, SOFA |
| Heart rate                    | APACHE II  
                                  SAPS II, APACHE II, SOFA |
| Respiratory system            | APACHE II (acute renal failure)  
                                  SOFA, APACHE II  
                                  SAPS II  
                                  SAPS II, SOFA |
| Renal function                | APACHE II (cirrhosis)  
                                  SAPS II, SOFA |
| Liver function                | SAPS II, APACHE II  
                                  SOFA |
| Hematologic findings          | SAPS II, APACHE II  
                                  SOFA |
| Neurologic function           | SAPS II, APACHE II, SOFA |

SAPS- Simplified Acute Physiology Score; APACHE- Acute Physiology and Chronic Health Evaluation;  
SOFA-Sequential Organ Failure Assessment
Gastroenterol Res Pract


The Southwest Respiratory and Critical Care Chronicles 2016;4(16)

REFERENCES


**DETAILS**

2. Accepted-9/23/2016
3. Reviewer-Thomas Kerr MD
4. Author affiliation-Supannee Rassameehiran was a resident in Internal Medicine at Texas Tech University Health Sciences Center in Lubbock, TX. Tinsay A. Woreta was a transplant hepatologist working at TTUHSC in Lubbock, TX.
5. Corresponding author-Supannee Rassameehiran at s.rassameehiran@gmail.com
6. Conflicts-none