Evaluating the Prognostic Value of the MELD 3.0 Score in Predicting Mortality in Patients With Cirrhosis With Acute Variceal Bleeding

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INTRODUCTION: **Acute variceal bleeding (AVB) is a severe complication of cirrhosis, with a 6-week mortality rate of up to 15%–20%. Early risk prediction is essential for guiding management. Model for End-Stage Liver Disease (MELD) 3.0, a refined version of the original MELD score, incorporates additional variables (sex, sodium, albumin, capped creatinine) to improve short-term mortality prediction. This study assessed MELD 3.0's use in predicting 6-week mortality in cirrhotic patients with AVB, in comparison with MELD, Glasgow-Blatchford Score (GBS), and Albumin, INR, Mental status, Systolic blood pressure, Age ≥ 65 (AIMS65).**

METHODS: **A prospective cohort of cirrhotic patients with AVB admitted to Cho Ray Hospital (November 2023–May 2024) was studied. The primary outcome was 6-week mortality; in-hospital mortality was secondary. The predictive performance of MELD 3.0, MELD, GBS, and AIMS65 was evaluated using area under the receiver operating characteristic (AUROC).**

RESULTS: **Among 212 patients, in-hospital and 6-week mortality rates were 4.7% and 19.8%, respectively. For in-hospital mortality, MELD 3.0 showed the highest AUROC (0.88), followed by MELD (0.80), AIMS65 (0.74), and GBS (0.59). For 6-week mortality, MELD 3.0 again outperformed others (AUROC: 0.81), vs MELD (0.75), AIMS65 (0.66), and GBS (0.61) (all $P < 0.05$). A MELD 3.0 cutoff ≥ 20 predicted >25% 6-week mortality (sensitivity 69.1%, specificity 83.5%).**

DISCUSSION: **MELD 3.0 is a strong predictor of early mortality in cirrhotic patients with AVB. A cutoff ≥20 may help identify high-risk patients requiring prompt intensive care.**

KEYWORDS: MELD 3.0 score; variceal bleeding; liver cirrhosis; 6-week mortality

ABBREVIATIONS: 95% CI, 95% confidence intervals; AUC, area under the curve; AUCROC, area under the receiver operating characteristic; AVB, acute variceal bleeding; BCLC, Barcelona Clinic Liver Cancer; ESLD, end-stage liver disease; EVL, endoscopic band ligation; GBS, Glasgow-Blatchford score; HCC, hepatocellular carcinoma; HVPG, hepatic venous pressure gradient; IQR, interquartile ranges; LR, likelihood ratio; PARTO, plug-assisted retrograde transvenous obliteration; ROC, receiver operating characteristic; RR, relative risk; TIPS, transjugular intrahepatic portosystemic shunt; UGIB, upper gastrointestinal bleeding

SUPPLEMENTARY MATERIAL accompanies this paper at http://links.lww.com/CTG/B367, http://links.lww.com/CTG/B368

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INTRODUCTION

Cirrhosis is a chronic liver disease characterized by liver cell necrosis, fibrosis, and the formation of regenerative nodules, ultimately leading to impaired liver function and portal hypertension. Annually, cirrhosis causes approximately 1.3 million deaths worldwide, making it one of the top 10 causes of mortality (1,2). As the disease advances to end-stage liver disease, patients become increasingly vulnerable to decompensating events and life-threatening complications.

Acute variceal bleeding (AVB) is one of the most severe complications of cirrhosis, occurring in roughly one-third of affected patients (3). Despite advancements in diagnosis and treatment, the

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6-week mortality rate remains high at 15%–20%, with mortality varying significantly based on the extent of liver damage (4). In-hospital mortality may exceed 20% in patients with poor hepatic reserve or severe clinical presentation (5). Prognosis is influenced by multiple factors, including the degree of hepatic dysfunction, renal impairment, hemodynamic instability, and coexisting infection (6).

In addition, patients with end-stage liver disease frequently experience other serious complications—such as hepatic encephalopathy, spontaneous bacterial peritonitis, ascites, and hepatorenal syndrome—that both signal advanced disease and further increase short-term mortality (7,8). Reliable risk stratification is therefore essential to guide treatment intensity, allocate resources, and improve outcomes.

Predicting early mortality risk following AVB in cirrhotic patients is crucial for optimizing treatment and guiding clinical decision-making The Model for End-Stage Liver Disease (MELD) score has been used for this purpose. MELD score is currently the most used severity scoring system (4,9). To further improve prognostic accuracy and address sex-based disparities in liver disease assessment, the MELD 3.0 score was recently introduced as an updated version of the original MELD model. It incorporates additional variables such as sex, serum sodium, and albumin, and caps creatinine at 3.0 mg/dL, providing a more accurate short-term mortality prediction and enhancing gender equity in liver transplant allocation (10).

Recent research, including a 2023 study by Buckholz et al, (11) has indicated that the MELD 3.0 score is a more accurate predictor of 6-week mortality in patients with AVB. However, the study also reported calibration limitations at higher MELD 3.0 values and emphasized the need for further validation across diverse clinical settings (11). Similarly, other real-world studies have shown that AVB patients with elevated MELD scores or requiring blood transfusion experience significantly higher mortality rates (5,12), reinforcing the importance of reassessing prognostic models such as MELD 3.0 in varied clinical contexts. Notably, although Buckholz et al demonstrated the use of MELD 3.0 in predicting 6-week mortality, their study did not assess in-hospital outcomes and was based on a retrospective design. By contrast, the present study uses a prospective design and evaluates both in-hospital and 6-week mortality, aiming to complement and expand on the existing evidence regarding the prognostic performance of MELD 3.0 in cirrhotic patients with AVB.

METHOD

Patient selection

From November 2023 to May 2024, data were collected prospectively at the Gastroenterology Department of Cho Ray Hospital in Ho Chi Minh City, Vietnam. As the largest and a central-level hospital in the South of Vietnam, Cho Ray Hospital served as the setting for this study.

Inclusion criteria. Patients were eligible for inclusion if they met all of the following:

1. Age 18 years and older.
2. Hospitalized with clinical evidence of upper gastrointestinal bleeding (UGIB), including: hematemesis, melena, hematochezia, or blood detected using a nasogastric tube.
3. Diagnosis of cirrhosis based on a combination of medical history, physical examination, laboratory tests, and imaging consistent with liver cirrhosis.
4. Endoscopic confirmation of variceal bleeding due to portal hypertension, based on the Sarin criteria (13), defined as one or more of the following:
   - Direct visualization of blood (spurting or oozing) arising from an esophageal or gastric varix.
   - Presence of gastroesophageal varix with signs of recent bleed (stigmata) such as white nipple sign or overlying clot.
   - Presence of varix with red signs plus presence of blood in the stomach in the absence of another source of bleeding.
   - Presence of varix with red and clinical signs of UGIB, without blood in the stomach.

Exclusion criteria.

1. Hepatocellular carcinoma stage D according to the Barcelona Clinic Liver Cancer classification due to the high mortality rate (over 60%) and the common practice of withholding aggressive therapy for these patients (14).
2. History of variceal UGIB due to portal hypertension within the previous 6 weeks.
3. UGIB due to nonvariceal causes.
4. Refusal to provide informed consent.

Therapeutic interventions

Patients were treated according to the standard of care outlined by the Baveno VII consensus and the American Association for the Study of Liver Diseases (AASLD) guidelines (4,15): Patients received a combination of vasoactive drugs (octreotide or terlipressin) on admission, endoscopic band ligation, and antibiotic prophylaxis with ceftriaxone. Rescue therapies, such as Sengstaken–Blakemore balloon tamponade were used as needed, especially in cases of rebleeding or failure to control the bleeding. On day 5, combined secondary prophylaxis, including beta-blockers and variceal ligation at 2–4 weeks intervals, was initiated when applicable. The time of hospital admission was designated as time zero for the follow-up evaluation.

METHODS

The primary end point of this study was 6-week mortality, the secondary end point was in-hospital mortality. Demographic, clinical, and laboratory data were collected from clinical records. MELD 3.0 scores were calculated using information obtained at the initial presentation. 6-week mortality was defined as death from any cause occurring either in-hospital or out-of-hospital within 6 weeks after the bleeding episode. In-hospital mortality was determined if the patient died during hospitalization or was discharged in critical condition. Out-of-hospital mortality was defined as death occurring after discharge and was confirmed either by hospital readmission records (documented proof) or by verbal confirmation obtained through a structured telephone interview with the patient's family (for deaths occurring at home). The MELD 3.0 score was calculated based on a published formula involving sex, bilirubin, INR, creatinine, sodium, and albumin levels (10). Details of the formula and constraints are provided in Supplementary Digital Content (see Appendix A, http://links.lww.com/CTG/B367).

Statistical analysis

All data analyses were conducted using Stata version 17.0 (StataCorp LLC, College Station, TX). Comparisons between categorical variables were performed using the χ^2 test or Fisher exact test, as appropriate. For numerical variables, either the Mann–Whitney *U* test or the independent-samples *t*-test was used, depending on the results of the normality test. Normality was assessed using the Shapiro–Wilk test. Continuous data were presented as mean ± SD for normally distributed variables, or as median with interquartile range (IQR; 25th–75th percentiles) for non-normally distributed variables. Categorical data were presented as frequencies and percentages.

The ability of the scoring systems to predict 6-week mortality was evaluated using receiver operating characteristic curve analysis with 95% confidence intervals (CI). Area under the receiver operating characteristic (AUCROC) values ranging from 0.9 to 1.0 were considered excellent, from 0.8 to 0.9 as good, and from 0.7 to 0.8 as acceptable for predictive power. A *P* value of less than 0.05 was considered statistically significant. The predictive performance of the MELD 3.0 score was assessed through sensitivity and specificity. The optimal cutoff value was determined using the Youden index.

Data completeness was verified before analysis. As only patients with complete records (n = 212) were included in the final Data set, no missing values were present, and thus no imputation techniques were applied.

Ethics

The study protocol was approved by the Board of Ethics in Biomedical Research at the University of Medicine and Pharmacy in Ho Chi Minh City (ID number: 749/DHYD-HD, signed on August 17, 2023).

RESULTS

Patient characteristics

From November 2023 to May 2024, 220 patients were enrolled in the study. However, 8 patients lost to follow-up evaluation were excluded. Therefore, only 212 of the 220 patients had complete records available for analysis. The baseline characteristics of the patients on admission are detailed in Table 1. In this study of 212 patients, the average age was 56.7 years, with a predominance of men (75.0%). The leading cause of cirrhosis was alcoholic hepatitis, followed by viral hepatitis. A significant portion of the

Table 1. Clinical and demographic characteristics for all patients and comparison between those who survived and those who died within 6 weeks

Characteristics	Total (n = 212)	Dead (n = 42)	Survived (n = 170)	*P* value
Age, y[a]	56.7 ± 12.0	55.3 ± 12.3	57.0 ± 12.0	0.4179[a]
Female sex, n (%)	53 (25.0%)	4 (9.5%)	49 (28.8%)	**0.01**[b]
Etiology of cirrhosis, n (%)				0.656[b]
Alcoholic	102 (48.1%)	18 (42.8%)	84 (49.4%)	
Hepatitis B	61 (28.7%)	12 (28.6%)	49 (28.8%)	
Hepatitis C	26 (12.3%)	6 (14.3%)	20 (11.8%)	
Alcoholic and hepatitis B/C	17 (8.0%)	4 (9.5%)	13 (7.6%)	
Other[a]	6 (2.9%)	2 (4.8%)	4 (2.4%)	
Previous episodes of variceal bleeding, n (%)	141 (66.5%)	31 (73.8%)	110 (64.7%)	0.263[b]
HCC, n (%)	30 (14.2%)	7 (16.7%)	23 (13.5%)	0.624[b]
Encephalopathy, n (%)	33 (15.6%)	12 (28.6%)	11 (6.5%)	<**0.001**[c]
Ascites, n (%)	74 (34.9%)	15 (35.7%)	59 (34.7%)	0.769[b]
Systolic arterial pressure <90 mm Hg, n (%)	22 (10.4%)	8 (19.0%)	14 (8.2%)	**0.04**[c]
Tachycardia (heart rate ≥100 bpm), n (%)	80 (37.7%)	14 (33.3%)	66 (38.8%)	0.215[b]
Score components				
Bilirubin (mg/dL)[f]	1.5 (1.0–2.8)	2.9 (1.2–5.6)	1.4 (1.0–2.5)	**0.0001**[d]
Creatinine (mg/dL)[f]	0.8 (0.7–1.1)	0.9 (0.7–1.3)	0.8 (0.7–1.0)	0.109[d]
Albumin (g/dL)[e]	2.8 ± 0.5	2.5 ± 0.5	2.9 ± 0.5	<**0.001**[a]
Sodium (mEq/L)[f]	135 (132–138)	133 (129–135)	135 (133–138)	**0.0001**[d]
INR[f]	1.5 (1.3–1.6)	1.6 (1.4–2.1)	1.3 (1.2–1.6)	**0.0001**[d]

HCC, hepatocellular carcinoma; INR, International normalized ratio.
Bold values indicate statistical significance ($P < 0.05$).
[a]Independent Samples T-test.
[b]χ^2 test.
[c]Fisher exact test.
[d]Mann-Whitney *U* Test.
[e]Mean ± SD.
[f]Median (interquartile range).

Table 2. Characteristics and endoscopic treatment of acute variceal bleeding episodes for all patients and comparison between those who survived and those who died within 6 weeks

Characteristics	Total (n = 212)	Dead (n = 42)	Survived (n = 170)	*P* value
Symptom, n (%)				
Hematemesis	172 (81.1%)	35 (83.3%)	137 (80.6%)	0.684[b]
Melena	152 (71.7%)	29 (69.0%)	123 (72.4%)	0.670[b]
Hematochezia	24 (11.3%)	11 (26.2%)	13 (7.6%)	**0.01**[c]
Endoscopic finding, n (%)				
Esophageal varices	187 (88.2%)	38 (90.5%)	149 (87.6%)	0.611[b]
Gastric varices	25 (11.8%)	4 (9.5%)	21 (12.4%)	0.611[b]
Treatment, n (%)				
Variceal ligation	144 (67.9%)	32 (76.2%)	112 (52.8%)	0.200[b]
Sengstaken tube placement	4 (1.9%)	1 (2.4%)	3 (1.8%)	0.793[c]
PARTO	2 (0.9%)	0 (0%)	2 (1.2%)	0.480[c]
Blood transfusion	128 (60.4%)	35 (83.3%)	93 (54.7%)	**0.001**[b]
Vasoactive drugs, n (%)	202 (95.3%)	39 (92.9%)	163 (95.9%)	0.408[b]
Hospital stays (d)[d]	4 (3–5)	4 (3–5)	4 (3–5)	0.548[a]

PARTO, plug-assisted retrograde transvenous obliteration.
Bold values indicate statistical significance ($P < 0.05$).
[a]Mann-Whitney *U* Test.
[b]χ^2 test.
[c]Fisher exact test.
[d]Median (interquartile range).

patients had a history of variceal bleeding (66.5%) and hepatocellular carcinoma was present in 14.2% of the cohort. Low systolic arterial pressure (below 90 mm Hg) was found in 10.4% of the patients, whereas 37.7% exhibited tachycardia, defined as a heart rate of 100 bpm or higher. Common symptoms included hematemesis (81.1%) and melena (71.7%). Endoscopy frequently revealed esophageal varices (88.2%). Treatments varied, with 67.9% undergoing variceal ligation and 60.4% receiving blood transfusions. Most patients (95.3%) were administered vasoactive drugs. The average hospital stay was 4 days. Detailed characteristics and endoscopic treatment are presented in Table 2.

Outcome

During the 6-week follow-up period, the in-hospital mortality rate was 10/212 (4.7%), whereas the mortality rate at 6 weeks was 42/212 (19.8%). Figure 1 illustrates the timing of deaths over the 42-day follow-up period.

In-hospital mortality was associated with a higher MELD 3.0 score. Patients who did not survive in-hospital had a median MELD 3.0 score of 24.5 (IQR, 21–34), which was higher than the median score of 15 (IQR, 12–19) observed in survivors (*P* value < 0.001). The MELD 3.0 score showed good predictive accuracy for in-hospital mortality, with an AUCROC of 0.88

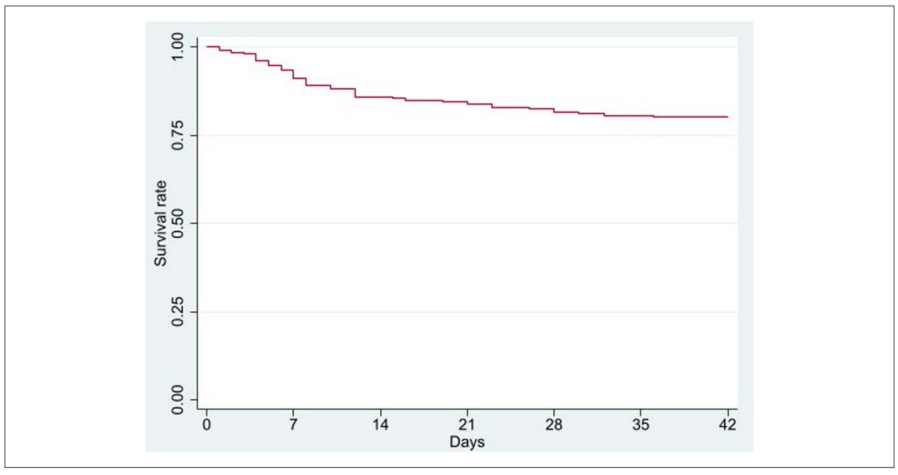

Figure 1. Kaplan-Meier survival curve detailing the time to death in days.

(95% CI: 0.78–0.98) (results are presented in Supporting information, see Supplementary Table S1, http://links.lww.com/CTG/B368). Its performance was significantly better than MELD (0.80), GBS (0.59), and Albumin, INR, Mental status, Systolic blood pressure, Age ≥ 65 (AIMS65) (0.74), with statistically significant differences (P value < 0.05) (see Supplementary Table S2, http://links.lww.com/CTG/B368). A MELD 3.0 score cutoff of ≥ 20 demonstrated a sensitivity of 90%, specificity of 76.2%, positive likelihood ratio (LR+) of 3.8, and negative likelihood ratio (LR−) of 0.1, indicating that this cutoff is effective in predicting in-hospital mortality.

Similarly, the relationship between MELD 3.0 scores and 6-week mortality was strong, with nonsurvivors having a median MELD 3.0 score of 22 (IQR, 18–28) compared with 15 (IQR, 12–18) in survivors (P value < 0.001) (Figure 2). In Figure 3, the AUCROC for predicting 6-week mortality was 0.81 (95% CI: 0.72–0.89), indicating good predictive capability and outperforming the MELD, GBS, and AIMS65 scores, which had AUCROCs of 0.75, 0.61, and 0.66, respectively (see Supplementary Table S3, http://links.lww.com/CTG/B368). All differences were statistically significant (P value < 0.05). A MELD 3.0 score cutoff of ≥ 20 for 6-week mortality yielded a sensitivity of 69.1%, specificity of 83.5%, LR+ of 4.2, and LR− of 0.4. These parameters suggest that the MELD 3.0 score is a reliable indicator for assessing the risk of 6-week mortality (see Supplementary Table S4, http://links.lww.com/CTG/B368). We also observed that patients with a MELD 3.0 score of ≤12 had a mortality rate of <5%, whereas those with a score of ≥20 had a mortality rate of >25% (Figure 4). At elevated MELD 3.0 scores, the observed mortality rates showed significant skewing.

DISCUSSION

Reducing mortality within the critical 6-week period following variceal bleeding in cirrhotic patients is a primary focus of current treatment guidelines (4). However, clinicians face challenges in managing AVB, especially in lowering the mortality risk. Most interventions are applied systematically to all patients; however, developing risk classifications to predict mortality risk and prioritize care for high-risk patients has been underexplored. Our study is the first to prospectively assess the prognostic significance of the MELD 3.0 score in predicting both in-hospital and 6-week mortality among cirrhotic patients with variceal bleeding in Vietnam. Previous research has shown that the MELD 3.0 score is promising for predicting outcomes in acute variceal hemorrhage (11). It suggests that this score can help identify high-risk patients and guide specific treatments to improve their outcomes.

In our study, the in-hospital mortality rate was recorded at 4.7%, which is significantly lower than the 10.6% and 13.9% reported by Tantai (16) and Robertson (17), as well as the 13% reported by Motola (18). However, the 6-week posthemorrhage mortality rate in our study was 19.8%, slightly higher than those reported by Reverter (16%) (19) and Buckholz (17.2%) (11), but lower than the 26% reported in a U.S. multicenter study by Fortune (20). Our study's mortality rate is comparable with that of study Amitrano and Matei (21,22). These differences in mortality may be explained by variations in patient characteristics, baseline disease severity, clinical practices, and adherence to management guidelines across centers.

In our study, the MELD 3.0 score demonstrated excellent predictive accuracy for both in-hospital and 6-week mortality, with AUC values of 0.88 and 0.81, respectively. Compared with traditional scoring systems—including MELD, AIMS65, and GBS—MELD 3.0 consistently showed superior performance in both outcomes. These results are notable when compared with findings from previous studies. For in-hospital mortality, previous research reported AUCs for the original MELD score ranging from 0.788 to 0.828, whereas AIMS65 performed similarly, with AUCs between 0.793 and 0.817. GBS consistently showed lower performance (AUC around 0.749) (18,23). For 6-week mortality, the original MELD score has shown AUCs ranging from 0.74 to 0.79 across several studies, including those by Reverter, Fortune, and Aluizio (19,20,24). AIMS65 showed modest discriminatory ability, with AUCs around 0.67–0.77, whereas GBS had limited use for this outcome, with AUCs as low as 0.60 (24). These comparisons highlight the strong performance of MELD 3.0 in predicting both in-hospital and 6-week mortality, suggesting that it may offer improved risk stratification in acute settings, particularly in cirrhotic patients presenting with variceal bleeding.

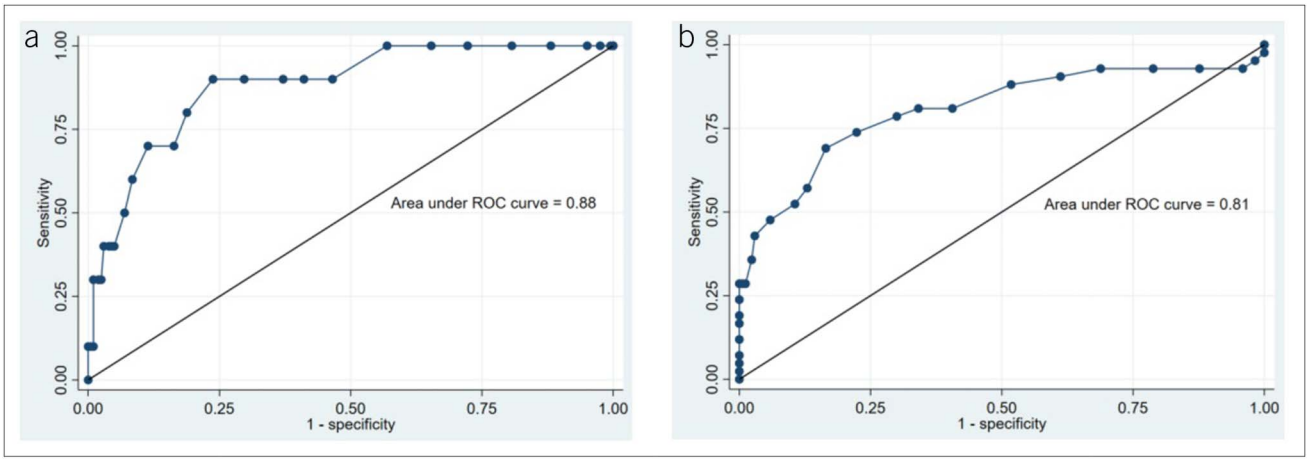

Figure 2. Area under receiver-operating characteristic curves (AUCROC) of Model for End-Stage Liver Disease 3.0 score for predicting mortality in acute variceal bleeding: (**a**) AUCROC for in-hospital mortality, (**b**) AUCROC for 6-week mortality.

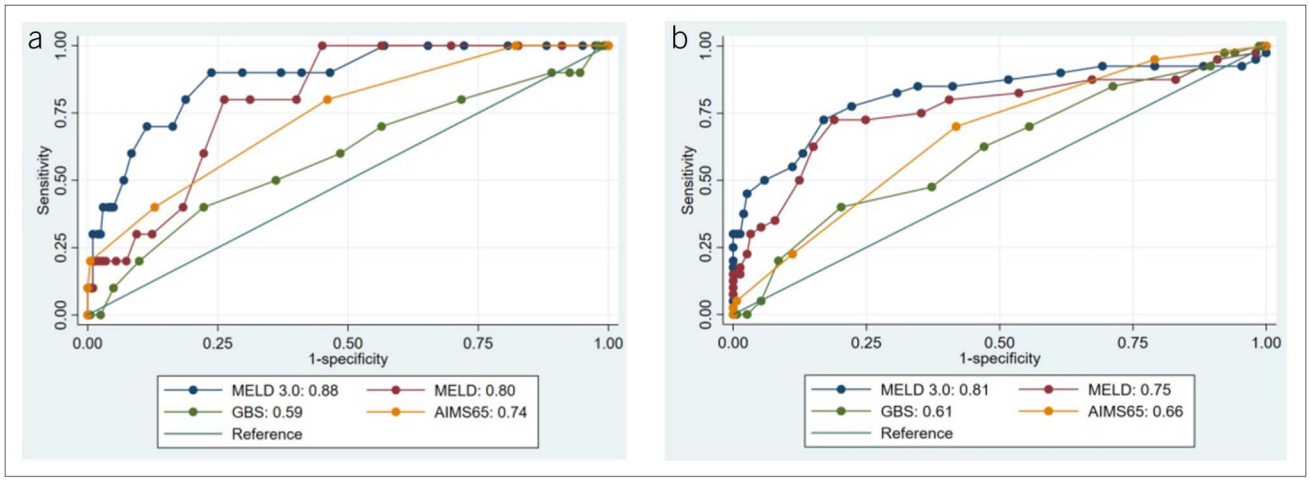

Figure 3. ROC curves comparing the predictive performance of MELD 3.0, MELD, GBS, and AIMS65: (**a**) AUCROC for in-hospital mortality, (**b**) AUCROC for 6-week mortality. AUCROC, area under the receiver operating characteristic; GBS, Glasgow-Blatchford score; MELD, Model for End-Stage Liver Disease; ROC, receiver operating characteristic.

Our results are consistent with the Buckholz multicenter retrospective study in the United States on 354 cirrhotic patients with UGIB. Both studies found a link between the MELD 3.0 score and 6-week mortality. The Buckholz study had an AUC of 0.77 for predicting 6-week mortality, lower than our AUC of 0.81 (11). Our study demonstrated that the MELD 3.0 score was effective in predicting both in-hospital and 6-week mortality, outperforming the MELD, GBS, and AIMS65 scores. Similarly, the Buckholz study yielded comparable results, showing that the predictive accuracy of MELD 3.0 exceeded that of the MELD score, with AUCROCs of 0.77 and 0.76, respectively.

Our study selected a cutoff score of 20 with the highest Youden index for the MELD 3.0 score in predicting in-hospital mortality and 6-week mortality following UGIB due to portal hypertension. Notably, a MELD 3.0 score of ≥20 increases the risk of 6-week mortality following bleeding by 6.1 times compared with patients with a MELD 3.0 score of <20. This finding is supported by a χ^2 test ($\chi^2 = 47.4$; P value < 0.001; relative risk = 6.1 [95% CI: 3.4–10.8]). At this cutoff point, the sensitivity and specificity for in-hospital mortality were 90.0% and 76.2%, respectively. For predicting 6-week mortality, the sensitivity was 69.1% and the specificity was 83.5%. The Buckholz study also selected a cutoff score of 20; in the group with a MELD 3.0 score of >20, the 6-week mortality rate was over 20%, whereas in the group with a MELD 3.0 score of ≤12, the mortality rate was less than 5% (11). In our study, patients with a MELD 3.0 score of ≤12 also had a mortality rate of less than 5%. However, when the score was ≥20, the mortality rate exceeded 25%, which is higher than the mortality rate reported in the Buckholz study. This may be due to a small portion of patients in our study not following the proper protocol, whereas the Buckholz study only included patients who received interventions according to AASLD guidelines (11). As a result, patients in our study had a higher risk of mortality. A deeper analysis of the components of the MELD 3.0 score revealed significant differences in sex, levels of bilirubin, albumin, sodium, and International normalized ratio between the 6-week mortality group and the nonmortality group (with P value < 0.05), all of which are components of the MELD 3.0 score. In addition, other parameters that showed substantial

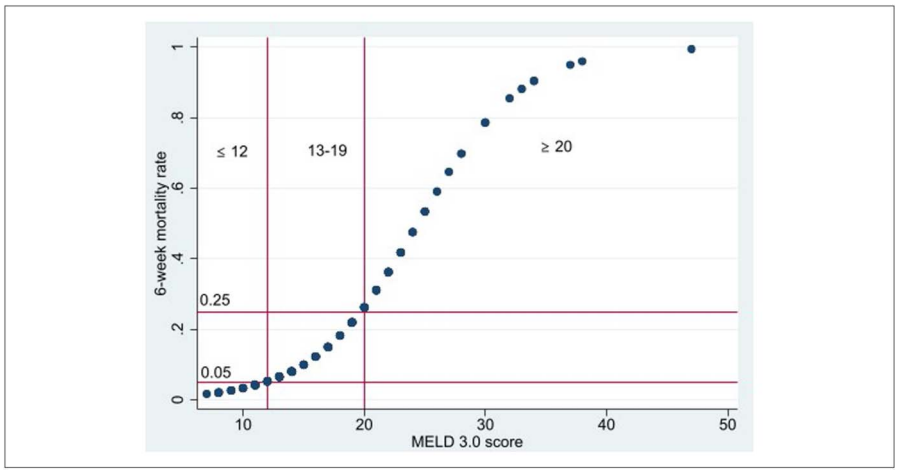

Figure 4. Scatterplot and identifying thresholds for Model for End-Stage Liver Disease (MELD) 3.0 score.

differences between the mortality and survival groups included encephalopathy and systolic arterial pressure < 90 mm Hg on presentation, hematochezia, and the rate of blood transfusion (with P value < 0.05).

A key strength of this study is its prospective design, with complete 6-week follow-up for all patients included in the final analysis. This allowed for accurate assessment of both in-hospital and post discharge mortality. The study also provides real-world clinical data from a cirrhotic population presenting with AVB, which adds to the practical relevance of the findings. However, we acknowledge certain limitations. This was a single-center study, which may limit the generalizability of our results to other healthcare settings. In addition, although the sample size was sufficient to detect significant differences, larger multicenter studies would be helpful to confirm these findings and strengthen external validity.

The MELD 3.0 score demonstrated strong predictive value for both in-hospital and 6-week mortality in cirrhotic patients with variceal bleeding due to portal hypertension. Given its simplicity and reliable performance, MELD 3.0 should be considered for early risk stratification in clinical practice. Patients with MELD 3.0 ≥ 20 had significantly higher short-term mortality and may benefit from closer monitoring or more intensive treatment strategies. Early identification of such high-risk patients could facilitate timely clinical decision-making, including intensive care unit admission or individualized care pathways. Although current guidelines primarily rely on the Child–Pugh classification and hepatic venous pressure gradient to guide pre-emptive transjugular intrahepatic portosystemic shunt (4), the MELD 3.0 score—owing to its simplicity and strong prognostic performance—may warrant further investigation as a practical tool to support early risk stratification and treatment decisions. This could be particularly relevant in resource-limited settings where hepatic venous pressure gradient measurements or timely endoscopy are not readily available.

CONFLICTS OF INTEREST

Guarantor of the article: Tram Que Nguyen Pham, MD, Thong Duy Vo, MD, PhD.

Specific author contributions: T.Q.N.P. and T.D.V.: designed the study; T.Q.N.P. and T.D.V.: participated in the acquisition, analysis, and interpretation of the data, and drafted the initial manuscript; T.Q.N.P. and T.D.V.: examined and revised the manuscript; T.D.V.: revised the article critically for important intellectual content. All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Potential competing interests: None to report.

Data transparency statement: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Study Highlights

WHAT IS KNOWN

- ✓ MELD 3.0 improves short-term mortality prediction in cirrhosis.
- ✓ Acute variceal bleeding has high 6-week mortality.
- ✓ Existing scores (MELD, Glasgow-Blatchford score, AIMS65) have limitations.

WHAT IS NEW HERE

- ✓ MELD 3.0 outperforms MELD, Glasgow-Blatchford score, and AIMS65 in predicting mortality.
- ✓ A MELD 3.0 score ≥20 indicates high mortality risk.
- ✓ Prospective validation confirms MELD 3.0's clinical use.

LIVER

REFERENCES

1. Asrani SK, Devarbhavi H, Eaton J, et al. Burden of liver diseases in the world. J Hepatol 2019;70(1):151–71.
2. Vo TD, Bui VTT, Lam HT, et al. High efficacy and safety of direct-acting antivirals for the treatment of chronic hepatitis C: A cohort study conducted in Vietnam. Pharmacol Res Perspect 2024;12(5):e70007.
3. Thong VD, Anh HTV. Prediction of esophageal varices based on serum-ascites albumin gradient in cirrhotic patients. Gastroenterol Insights 2021;12(2):270–7.
4. de Franchis R, Bosch J, Garcia-Tsao G, et al. Baveno VII–renewing consensus in portal hypertension. J Hepatol 2022;76(4):959–74.
5. Mehmood T, Zia MQ, Latif A, et al. Mortality related factors in patients with variceal bleeding with MELD score ≥ 18. J Coll Physicians Surg Pak 2019;29(12):1199–202.
6. Bambha K, Kim WR, Pedersen R, et al. Predictors of early re-bleeding and mortality after acute variceal haemorrhage in patients with cirrhosis. Gut 2008;57(6):814–20.
7. Biggins SW, Angeli P, Garcia-Tsao G, et al. Diagnosis, evaluation, and management of ascites, spontaneous bacterial peritonitis and hepatorenal syndrome: 2021 practice guidance by the American association for the study of liver diseases. Hepatology. 2021;74(2):1014–48.
8. Huynh NC, Vo TD. Validation of a new simple scoring system to predict spontaneous bacterial peritonitis in patients with cirrhosis and ascites. BMC Gastroenterol 2023;23(1):272.
9. Singal AK, Kamath PS. Model for end-stage liver disease. J Clin Exp Hepatol 2013;3(1):50–60.
10. Kim WR, Mannalithara A, Heimbach JK, et al. MELD 3.0: The model for end-stage liver disease updated for the modern era. Gastroenterology 2021;161(6):1887–95.e4.
11. Buckholz A, Wong R, Curry MP, et al. MELD, MELD 3.0, versus Child score to predict mortality after acute variceal hemorrhage: A multicenter US cohort. Hepatol Commun 2023;7(10):e0258.
12. Radadiya D, Devani K, Rockey DC. The impact of red blood cell transfusion practices on inpatient mortality in variceal and non-variceal gastrointestinal bleeding patients: A 20-year US nationwide retrospective analysis. Aliment Pharmacol Ther 2022;56(1):41–55.
13. Sarin SK, Kumar A, Angus PW, et al. Diagnosis and management of acute variceal bleeding: Asian Pacific Association for study of the liver recommendations. Hepatol Int 2011;5(2):607–24.
14. Bruix J, Sherman M, American Association for the Study of Liver Diseases. Management of hepatocellular carcinoma: An update. Hepatology 2011;53(3):1020–2.
15. Kaplan DE, Ripoll C, Thiele M, et al. AASLD Practice Guidance on risk stratification and management of portal hypertension and varices in cirrhosis. Hepatology 2024;79(5):1180–211.
16. Tantai XX, Liu N, Yang LB, et al. Prognostic value of risk scoring systems for cirrhotic patients with variceal bleeding. World J Gastroenterol 2019;25(45):6668–80.
17. Robertson M, Ng J, Abu Shawish W, et al. Risk stratification in acute variceal bleeding: Comparison of the AIMS65 score to established upper gastrointestinal bleeding and liver disease severity risk stratification scoring systems in predicting mortality and rebleeding. Dig Endosc 2020;32(5):761–8.

18. Motola-Kuba M, Escobedo-Arzate A, Tellez-Avila F, et al. Validation of prognostic scores for clinical outcomes in cirrhotic patients with acute variceal bleeding. Ann Hepatol 2016;15(6):895–901.
19. Reverter E, Tandon P, Augustin S, et al. A MELD-based model to determine risk of mortality among patients with acute variceal bleeding. Gastroenterology 2014;146(2):412–9.e3.
20. Fortune BE, Garcia-Tsao G, Ciarleglio M, et al. Child-Turcotte-Pugh class is best at stratifying risk in variceal hemorrhage: Analysis of a US Multicenter Prospective Study. J Clin Gastroenterol 2017;51(5):446–53.
21. Amitrano L, Guardascione MA, Bennato R, et al. MELD score and hepatocellular carcinoma identify patients at different risk of short-term mortality among cirrhotics bleeding from esophageal varices. J Hepatol 2005;42(6):820–5.
22. Matei D, Crisan D, Procopet B, et al. Predictive factors of failure to control bleeding and 6-week mortality after variceal hemorrhage in liver cirrhosis–a tertiary referral center experience. Arch Med Sci 2022;18(1):52–61.
23. Yang L, Sun R, Wei N, et al. Systematic review and meta-analysis of risk scores in prediction for the clinical outcomes in patients with acute variceal bleeding. Ann Med 2021;53(1):1806–15.
24. Aluizio CLdS, Montes CG, Reis G, et al. Risk stratification in acute variceal bleeding: Far from an ideal score. Clinics (Sao Paulo) 2021;76:e2921.