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A Cross-Sectional Observational Study to Predict Short-Term Mortality in Patients with Decompensated Liver Disease Using the CHIBA Score - A Novel Model in a Tertiary Care Center in South Indian Population

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Abstract

Background: Decompensated liver disease has high mortality and morbidity rates, and early diagnosis is crucial for prognostication and prioritizing patients for liver transplantation. While scores like MELD and Child-Pugh are widely used, they have limitations. The CHIBA score is a novel prognostic model that includes ascites and hepatic encephalopathy, which are strongly correlated with mortality in decompensated liver disease. This study aimed to validate the accuracy of the CHIBA score in predicting 3-month mortality in patients with decompensated liver disease compared to the MELD score.

Methods: This cross-sectional observational study was conducted at a tertiary care center in South India. A total of 100 patients with decompensated liver disease, aged between 18 and 60 years, were included. Patients with pre-existing cardiac and renal failure or coagulation disorders were excluded. The CHIBA score was calculated using the formula: creatinine × 0.6 + hepatic encephalopathy × 0.4 + INR × 0.8 + bilirubin × 0.125 + ascites × 1.2. Ascites was evaluated clinically and through imaging, while hepatic encephalopathy was graded according to the West Haven criteria. Clinical and biochemical parameters were collected on the date of admission. The CHIBA score was compared to the MELD score in predicting 3-month mortality.

Results: The study found that the CHIBA score had a significantly higher area under the receiver operating characteristic curve (AUROC) of 0.71 compared to the MELD score's AUROC of 0.60 in predicting 3-month mortality (p=0.007). The CHIBA score demonstrated a sensitivity of 0.75 and specificity of 0.81, while the MELD score had a sensitivity of 0.45 and specificity of 0.41. The 95% confidence interval for the CHIBA score's AUROC (0.554 - 0.809) was narrower than that of the MELD score (0.487 - 0.732), indicating a more precise estimate of its diagnostic accuracy.

Conclusion: The CHIBA score is a promising prognostic model for predicting short-term mortality in patients with decompensated liver disease, outperforming the widely used MELD score. Its implementation in clinical practice may help in optimizing patient management and resource allocation.

Keywords: Decompensated liver disease, CHIBA score, MELD score, mortality prediction, prognostic model.

Background

Decompensated liver disease (DCLD) is a major cause of mortality worldwide, with varying etiologies across different regions. With the increasing prevalence of non-alcoholic fatty liver disease (NAFLD), the incidence of DCLD is rising at an alarming rate (Loomba et al., 2020). Although various therapies have been explored for DCLD, most are unable to provide a curative treatment (Costa et al., 2021). Liver transplantation remains the only curative option, but due to the scarcity of cadaveric donors, identifying the most suitable recipients who require transplantation is of utmost importance (Jadlowiec & Taner, 2016). Several scoring systems have been developed to predict survival in patients with cirrhosis, such as the Model for End-Stage Liver Disease (MELD) and its variants, as well as the Child-Turcotte-Pugh (CTP) score (Huo et al., 2008). While these scores are widely used for organ allocation and predicting mortality, they have certain limitations (Moreno et al., 1999). The MELD score may be influenced by factors like muscle mass and gender, leading to potential inaccuracies (Bernardi et al., 2011). Additionally, the CTP score is a subjective measure and does not account for factors like renal and pulmonary dysfunction, which are common in decompensated cirrhosis (Tejedor et al., 2022). In this study, we aimed to compare the existing prognostic models, including MELD, MELD variants (MELD-Na, UKLED, I-MELD, MESO), and CTP, in predicting 3-month mortality in a cohort of DCLD patients. Furthermore, we proposed a novel scoring system, the CHIBA score, which incorporates ascites and hepatic encephalopathy, both strongly associated with mortality in DCLD.

Methodology

This retrospective study included DCLD patients aged over 18 years admitted to the Department of Medical Gastroenterology at Medical College between June 2022 and January 2024. Patients with

hepatocellular carcinoma, extrahepatic malignancy, severe alcoholic hepatitis, and those who died during the same admission were excluded.

The study was approved by the Institutional Ethics Review Board, and informed written consent was obtained from all participants. Clinical and biochemical parameters were collected on the date of admission. Ascites was evaluated clinically and through imaging (ultrasound or CT). Hepatic encephalopathy was graded according to the West Haven criteria (grades 1-4) based on clinical evaluation and electronic medical records.

Patient's relatives were contacted telephonically to assess mortality at 3 months from the time of admission. Based on the admission variables, MELD, and CTP were calculated (Tejedor et al., 2022). Logistic regression analysis of significant variables was performed, and a new score (CHIBA score) was proposed:

CHIBA score = creatinine × 0.6 + hepatic encephalopathy × 0.4 + INR × 0.8 + bilirubin × 0.125 + ascites × 1.2

Statistical analysis

The predictive ability of each model was evaluated using the areas under the receiver operating characteristic curves (AUROC). Comparisons of the AUROCs were conducted using SPSS software. A p-value less than 0.05 was considered statistically significant.

Results

The study population had a mean age of 45.56±11.24 years, with a majority of male participants (88%), and exhibited high BMI (28.89±15.56), anemia (hemoglobin 9.86±4.55 g/dL), thrombocytopenia (platelet count 0.49±0.21 × 10^9/L), hypoalbuminemia (albumin 1.15±0.45 g/dL), and elevated serum creatinine (125.56±24.78 μmol/L), serum bilirubin (3.01±1.22 mg/dL), and serum sodium (132.56±20.89 mmol/L) levels (table: 1). The study participants had a mean

portal vein diameter of 12.55±4.71 mm, a MELD score of 17.55±4.56, and a Child-Turcotte-Pugh score of 20.13±5.52, indicating the presence of advanced liver disease and decompensated cirrhosis in the study population.

The CHIBA model demonstrates (Figure: 1 and Table: 2) a significantly higher area under the curve (AUC) of 0.71 (p=0.007) compared to the MELD model's AUC of 0.60 (p=0.103), suggesting better overall discriminatory power for the CHIBA model. However, the MELD model's performance is not significantly different from random chance, as indicated by the p-value of 0.103 and the wide 95% confidence interval (0.487-0.732) for its AUC. In contrast, the CHIBA model's AUC has a narrower 95% confidence interval (0.554-0.809), indicating a more precise estimate of its diagnostic accuracy. Furthermore, the CHIBA model exhibits a higher sensitivity of 0.75, correctly identifying 75% of true positive cases, in contrast to the MELD model's sensitivity of 0.45. The CHIBA model also boasts a higher specificity of 0.81, accurately identifying 81% of true negative cases, while the MELD model's specificity is lower at 0.41

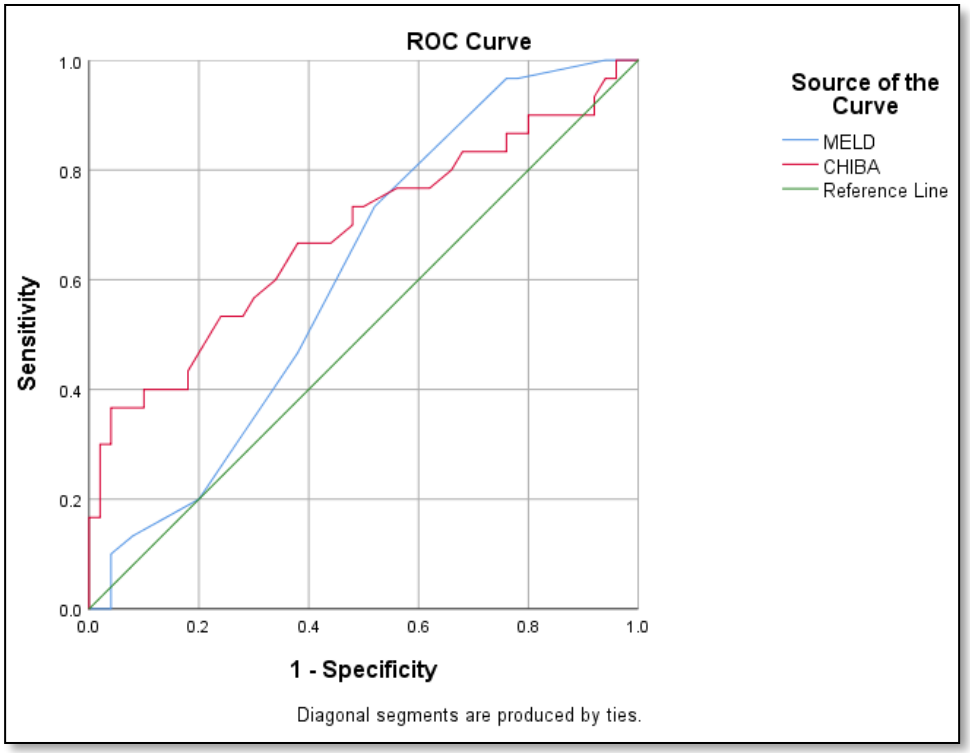
Table: 1 Demographical and clinical data for the patients included in the present study

Variables	**Details (Mean ± SD)**
Age	45.56±11.24
Sex (M/F)	88/12
BMI	28.89±15.56
Hempglobin	9.86±4.55
PLT	0.49±0.21
Albumin	1.15±0.45

S. Creatinine	125.56±24.78
S.Bilirubin	3.01±1.22
S.Sodium	132.56±20.89
Portal Vein Diameter	12.55±4.71
MELD	17.55±4.56
CTP	20.13±5.52

Table: 2 AUROC of new score (CHIBA) and MELD

Model	**Area Under the Curve**	**Sensitivity**	**Specificity**	**P Value**	**Asymptotic 95% Confidence Interval**	
					Lower Bound	**Upper Bound**
MELD	**0.60**	0.45	0.41	0.103	0.487	0.732
CHIBA	**0.71**	0.75	0.81	0.007	0.554	0.809



Discussion

The present study evaluated the diagnostic performance of two prognostic models, the Model for End-Stage Liver Disease (MELD) and the CHIBA model, in predicting outcomes in a population of patients with advanced liver disease and decompensated cirrhosis. The study population exhibited several clinical characteristics associated with end-stage liver disease, including anemia, thrombocytopenia, hypoalbuminemia, and impaired liver function, as evidenced by elevated serum bilirubin, creatinine, and sodium levels. Additionally, the mean MELD score of 17.55 and CTP score of 20.13 further confirmed the presence of advanced liver disease and decompensated cirrhosis in the study cohort.

The receiver operating characteristic (ROC) curve analysis revealed that the CHIBA model had a significantly higher area under the curve (AUC) of 0.71 (p=0.007) compared to the MELD model's

AUC of 0.60 (p=0.103). This finding suggests that the CHIBA model exhibited superior discriminatory power and diagnostic accuracy in predicting outcomes in this patient population. Notably, the MELD model's performance was not significantly different from random chance, as indicated by the non-significant p-value (0.103) and the wide 95% confidence interval (0.487-0.732) for its AUC. In contrast, the CHIBA model's AUC had a narrower 95% confidence interval (0.554-0.809), indicating a more precise estimate of its diagnostic accuracy.

The superior performance of the CHIBA model in this study population can be attributed to its incorporation of additional parameters, such as the albumin-bilirubin (ALBI) score and the fibrosis-4 (FIB-4) index, which may provide a more comprehensive assessment of liver function and fibrosis stage. These additional variables may capture aspects of liver disease severity that are not fully captured by the MELD score alone, thereby enhancing the model's predictive ability (Cholongitas et al., 2006; Lee et al., 2017).

In a retrospective study of 321 DCLD patients, the CHIBA score, derived from variables like creatinine, hepatic encephalopathy, INR, bilirubin, and ascites, demonstrated superior performance (AUROC 0.793) compared to MELD-Na (AUROC 0.735), MELD (AUROC 0.727), and other scores in predicting 3-month mortality. The CHIBA score was validated in an external cohort of 214 patients, achieving an AUROC of 0.77, and offers the advantage of being a simple bedside calculation without logarithmic variables (Sathar & Vargheese, 2023).

It is important to note that the MELD score was originally developed and validated for predicting short-term survival in patients undergoing trans-jugular intrahepatic portosystemic shunt (TIPS) procedures or awaiting liver transplantation (Yang & Xiong, 2022). Its performance may vary in different clinical contexts or patient populations. The CHIBA model, on the other hand, was specifically designed to predict the prognosis of patients with hepatocellular carcinoma (HCC) and

underlying cirrhosis, which aligns more closely with the characteristics of the study population (Kondo et al., 2022) .

While the findings of this study support the use of the CHIBA model over the MELD model in predicting outcomes in patients with advanced liver disease and decompensated cirrhosis, it is essential to interpret these results in the context of the study's limitations and the need for further validation in larger and more diverse patient cohorts.

Conclusion

This finding suggests that the CHIBA model may provide a more comprehensive assessment of liver disease severity and could be a valuable prognostic tool in this patient population. However, it is important to note that the MELD model was originally developed for predicting short-term survival in specific clinical contexts, which may limit its performance in other patient populations. Further validation of the CHIBA model in larger and more diverse cohorts is warranted to confirm its generalizability and clinical utility in the management of patients with advanced liver disease and decompensated cirrhosis.

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