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Original Article

Admission Albumin-Bilirubin Score Is Inferior to MELD, MELD-Na$^+$ and Child-Turcotte-Pugh Score in Predicting Survival in Indian Patients with Alcohol-associated Liver Disease

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Abstract

Background and objectives: Prognostic scores are valuable tools for predicting survival in patients with chronic liver disease. Recently, the albumin-bilirubin (ALBI) score has emerged as a potential prognostic indicator in liver-related conditions. This study aimed to compare the prognostic efficacy of the ALBI score with the Model for End-stage Liver Disease (MELD), MELD-Na$^+$, and Child-Turcotte-Pugh (CTP) scores in predicting survival among patients with alcohol-associated liver disease (ALD).

Methods: This study included consecutive ALD patients admitted to the Medicine and Gastroenterology wards of MKCG Medical College and Hospital, Berhampur, Odisha, India, between November 2019 and November 2022. Upon hospitalization, baseline characteristics, clinical and laboratory parameters, ALBI, MELD, MELD-Na$^+$, and CTP scores were recorded. The accuracy of these scores in predicting survival up to three years was compared.

Results: A total of 490 ALD patients were included. Higher ALBI scores were observed in patients who died during hospitalization ($p < 0.001$), at 28 days ($p < 0.001$), 90 days ($p < 0.001$), six months ($p < 0.001$), one year ($p < 0.001$), two years ($p < 0.001$), and three years ($p < 0.001$), compared to those who survived. However, the area under the receiver operating characteristic (AUROC) curves showed that the ALBI score was inferior to MELD, MELD-Na$^+$, and CTP scores in predicting survival at admission [AUROC: ALBI (0.719), MELD-Na$^+$ (0.823), MELD (0.817), CTP (0.770)] and at three years [AUROC: ALBI (0.755), MELD-Na$^+$ (0.787), MELD (0.758), CTP (0.784)]. Furthermore, Cox regression analysis revealed that components used in the MELD, MELD-Na$^+$, and CTP scores—such as serum creatinine, serum sodium, and hepatic encephalopathy—were independent predictors of mortality, whereas the components of the ALBI score (serum albumin and serum bilirubin) were not.

Conclusions: All hospitalized ALD patients had a grade 3 ALBI score, with significantly higher scores observed among non-survivors compared to survivors. However, MELD, MELD-Na$^+$, and CTP scores were superior to the ALBI score in predicting survival both during hospitalization and over a three-year follow-up period.

Introduction

Reliable prognostic scores are highly valuable in the management of chronic liver disease. For decades, the Child–Turcotte–Pugh (CTP) score has been used to assess liver function and predict patient outcomes. This score was originally developed to assess the outcomes of patients with cirrhosis undergoing surgery for portal hypertension.[1,2] Similarly, the Model for End-stage Liver Disease (MELD) score was initially designed to predict survival in patients undergoing transjugular intrahepatic portosystemic shunt (TIPS) procedures but has since been widely adopted for prioritizing candidates for liver transplantation.[3–5] Over time, MELD has also demonstrated utility in predicting survival in patients with alcoholic hepatitis, variceal bleeding, and hepatorenal syndrome.[6–8] The introduction of the MELD-Na$^+$ score, which incorporates serum

Keywords: Alcohol-associated liver disease; Albumin-bilirubin score; Model for End-stage Liver Disease; Model for End-stage Liver Disease Na$^+$; Child–Turcotte–Pugh; Prognostic score.

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sodium levels, reflects the critical role of hyponatremia in predicting mortality in cirrhosis.[9–11]

The albumin-bilirubin (ALBI) score was developed as a measure of liver function in patients with hepatocellular carcinoma.[12] It has been incorporated into the Barcelona Clinic Liver Cancer staging system and has demonstrated superior performance compared to the CTP score.[13] A multivariate model analysis showed that the prognostic value of the CTP score could be largely explained by albumin and bilirubin levels alone, as captured by the ALBI formula.[12] These two parameters are readily available for most patients with cirrhosis, making the ALBI score simple and convenient to use. The ALBI score has been evaluated for its role in assessing liver dysfunction and prognosis in various conditions, including hepatocellular carcinoma,[12] primary biliary cholangitis,[14] variceal bleeding,[15] hepatitis B virus-related liver disease,[16] and post-hepatectomy liver failure.[17] Chen *et al*.[18] demonstrated that the ALBI score significantly outperformed the CTP and MELD scores in predicting long-term survival in patients with hepatitis B virus-related cirrhosis. However, to the best of our knowledge, there are no studies assessing the utility of the ALBI score in prognostication and mortality prediction in patients with alcohol-associated liver disease (ALD). Therefore, we aimed to compare the prognostic accuracy of the ALBI score, MELD, MELD-Na^+, and CTP scores in predicting survival in patients with ALD.

Material and methods

Study design and participants

This was a prospective observational study conducted on consecutive patients with ALD who were hospitalized in the Medicine and Gastroenterology wards of MKCG Medical College and Hospital, Berhampur, Odisha, India, between November 2019 and November 2022. The manuscript was prepared in accordance with the Standards for Reporting of Diagnostic Accuracy Studies 2015 guidelines.

Test methods

Patients with ALD were diagnosed based on a history of significant alcohol consumption—defined as more than one standard drink (14 g of pure alcohol) per day for women and more than two standard drinks per day for men along with corroborative clinical findings, laboratory investigations, endoscopic findings, and radiologic imaging.[19] Baseline characteristics and clinical and laboratory data including age, sex, liver disease status, and other biochemical variables were recorded for all patients. Survival during the hospital stay was noted, and additional follow-up data on survival status were collected at 28 days, 90 days, six months, 12 months, 24 months, and 36 months following the index admission, through outpatient records and monthly telephonic follow-ups. The CTP, MELD, MELD-Na^+, and ALBI scores were calculated for each patient at the time of first presentation. Patients were stratified into three groups based on their ALBI scores: grade 1 (≤ −2.60), grade 2 (–2.60 to −1.39), and grade 3 (> −1.39).[11]

Patients with underlying liver diseases of other etiologies, such as hepatitis B, hepatitis C, autoimmune liver disease, Wilson disease, hepatocellular carcinoma, other active malignancies, serious systemic illnesses, or pregnancy, were excluded from the study.

Inpatient survival and survival at 28 days, 90 days, six months, one year, two years, and three years were recorded. The prognostic accuracy of the ALBI score was compared with other prognostic models, including MELD, MELD-Na^+, and CTP scores.

Ethical approval

The study was performed in accordance with the Helsinki Declaration as revised in 2024. Ethical clearance for this study was obtained from the Institutional Ethics Committee, M.K.C.G. Medical College, Berhampur-760004, Odisha [No. 795 - Chairman, IEC, M.K.C.G. Medical College, Berhampur-4]. Written informed consent was obtained from all patients.

Statistical analysis

Statistical analyses were performed using IBM SPSS version 25.0. Normality of distribution for continuous variables was assessed using the Kolmogorov–Smirnov test. Data were reported as mean ± standard deviation or median with interquartile range, as appropriate. Continuous variables were compared using Student's *t*-test, Mann–Whitney *U* test, or one-way analysis of variance, as appropriate. Receiver operating characteristic (ROC) analysis was performed, and the area under the ROC curve (AUROC) was calculated to assess the prognostic accuracy of the scoring systems. Cox proportional hazards regression analysis was performed to evaluate the impact of independent variables on survival time after adjusting for potential confounders. A p-value < 0.05 was considered statistically significant.

Results

Participants

We studied 490 ALD patients with cirrhosis (486 men [99.2%] and 4 women [0.8%]). All patients had an ALBI grade 3 score, with the mean ALBI score being 3.0.

Relative efficacy

ROC curves were established to evaluate the relative efficacy of the CTP, MELD, MELD-Na+, and ALBI scores for predicting both short-term and long-term mortality (Fig. 1). The AUROC values for survival during index hospitalization were 0.823 for the MELD-Na^+ score, 0.817 for the MELD score, 0.770 for the CTP score, and 0.719 for the ALBI score. For 28-day survival, the AUROC values were 0.810 for the MELD-Na^+ score, 0.804 for the MELD score, 0.789 for the CTP score, and 0.746 for the ALBI score. For 90 days-day survival, the AUROC values were 0.771 for the MELD-Na^+ score, 0.759 for the MELD score, 0.755 for the CTP score, and 0.701 for the ALBI score. For six-month survival, the AUROC values were 0.782 for the MELD-Na^+ score, 0.771 for the MELD score, 0.767 for the CTP score, and 0.727 for the ALBI score. For one-year survival, the AUROC values were 0.792 for the MELD-Na^+ score, 0.778 for the MELD score, 0.774 for the CTP score, and 0.743 for the ALBI score. For two-year survival, the AUROC values were 0.783 for the MELD-Na^+ score, 0.757 for the MELD score, 0.783 for the CTP score, and 0.739 for the ALBI score. For three-year survival, the AUROC values were 0.787 for the MELD-Na^+ score, 0.758 for the MELD score, 0.784 for the CTP score, and 0.755 for the ALBI score (Fig. 1, Table 1). The performance of the ALBI score in discriminating between survivors and non-survivors was not found to be superior in predicting either short-term or long-term survival compared to the CTP, MELD, and MELD-Na^+ scores (Fig. 1, Table 1).

Risk prognostication

All ALD patients were divided into non-survivor and survivor groups, and survival rates during hospitalization, at 28 days, 90 days, six months, one year, two years, and three years were determined. A comparison of baseline parameters between patients for

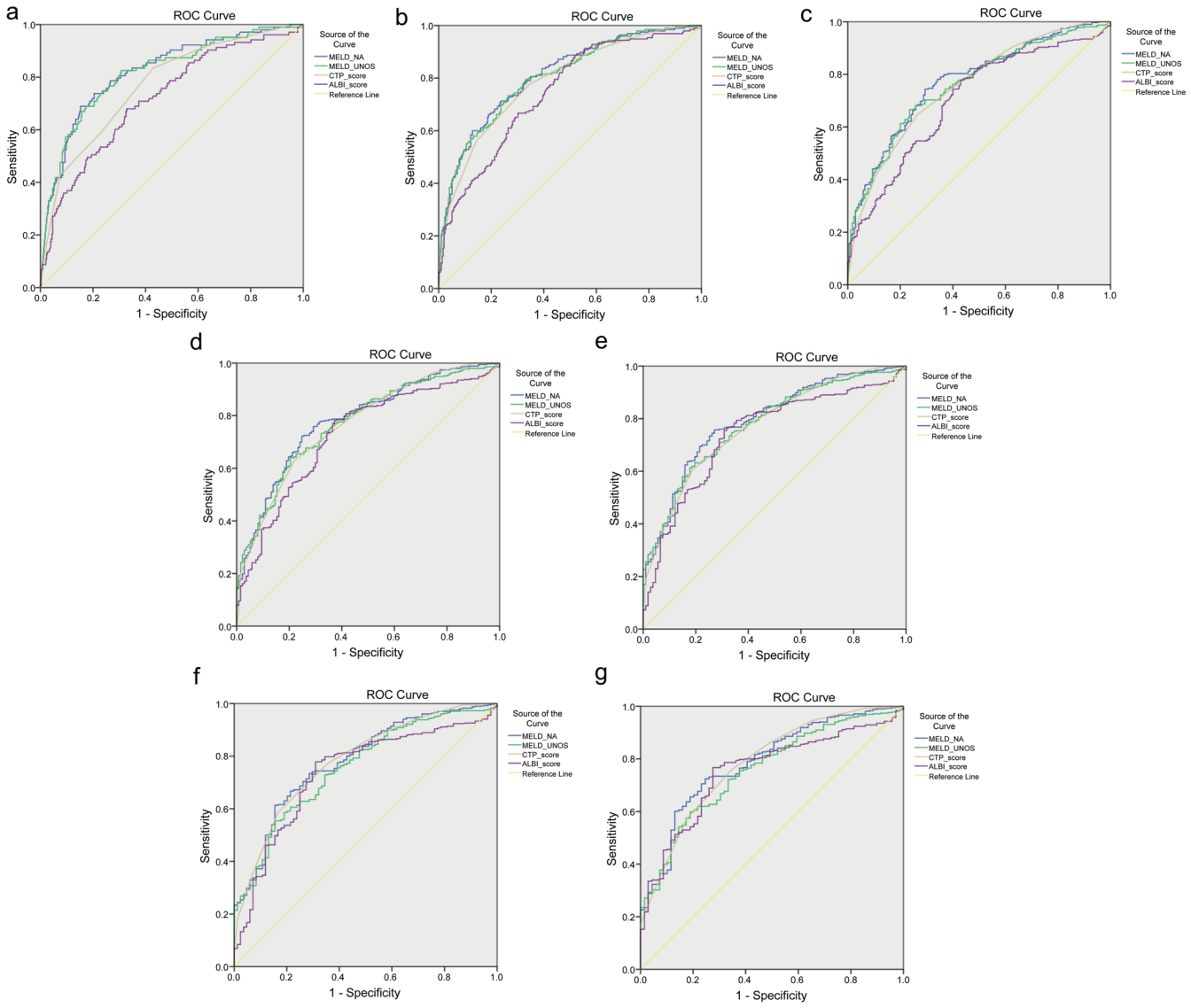

Fig. 1. Area under the receiver operating characteristic curve (AUROC) for MELD, MELD Na+, CTP and ALBI scores for (a) Hospital mortality, (b) 28-day, (c) 90-day, (d) six months, (e) one year, (f) two years, and (g) three years survival. ALBI, albumin-bilirubin score; CTP, Child-Turcotte-Pugh; MELD, Model for End-stage Liver Disease; MELD-Na$^+$, Model for End-stage Liver Disease -Na+.

short-term survival (28 days) and long-term survival (three years) was performed. On comparison of baseline parameters between patients for short-term survival (i.e., patients who survived 28 days and those who died), non-surviving patients had decreased mean arterial pressure (79.82 ± 11.23 mm Hg vs. 84.23 ± 8.61 mm Hg; $p < 0.001$), a higher total leucocyte count per deciliter (dL) (10,800 vs. 8,600; $p < 0.001$), higher serum creatinine (1.80 vs. 1.1 mg/dL; $p < 0.001$), higher serum urea (55 mg/dL vs. 31 mg/dL; $p < 0.001$), higher total bilirubin (7.9 mg/dL vs. 3.4 mg/dL; $p < 0.001$), decreased serum sodium (130.05 ± 7.94 mEq/L vs. 134.90 ± 6.74 mEq/L; $p < 0.001$), decreased total albumin (2.42 ± 0.45 g/dL vs. 2.59 ± 0.46 g/dL; $p < 0.001$), higher international normalized ratio (INR) (2.37 vs. 1.76; $p < 0.001$), higher MELD (29.46 ± 8.41 vs. 19.43 ± 7.73; $p < 0.001$), higher MELD (Na$^+$) (31.59 ± 7.49 vs. 21.72 ± 8.26; $p < 0.001$), higher CTP score (12.57 ± 1.59 vs. 10.60 ± 1.86; $p < 0.001$), and higher ALBI score (0.379 vs. 0.137; $p < 0.001$) (Table 2). On comparison of baseline parameters for long-term survival (i.e., patients who survived three years vs. those who died), patients who died had increased body mass index (22.61 ± 4.32 kg/m^2 vs. 21.68 ± 2.70 kg/m^2; $p = 0.018$), a higher total leucocyte count per deciliter (10,000 vs. 8,000; $p < 0.001$), higher serum creatinine (1.40 vs. 1.1 mg/dL; $p < 0.001$), higher serum urea (41 mg/dL vs. 29 mg/dL; p < 0.001), higher total bilirubin (5.5 mg/dL vs. 2 mg/dL; $p < 0.001$), decreased serum sodium (132.23 ± 7.60 mEq/L vs. 137.49 ± 6.04 mEq/L; $p < 0.001$), decreased total albumin (2.47 ± 0.44 g/dL vs. 2.86 ± 0.49 g/dL; $p < 0.001$), higher INR (2.04 vs. 1.53; $p < 0.001$), higher MELD (24.59 ± 9.24 vs. 16.31 ± 6.82; $p < 0.001$), higher MELD (Na$^+$) (27.0 ± 8.81 vs. 17.40 ± 7.93; $p < 0.001$), higher CTP score (11.69 ± 1.83 vs. 9.51 ± 1.99; $p < 0.001$), and higher ALBI score (0.292 vs. −0.037; $p < 0.001$) (Table 2).

Cox regression analysis of baseline parameters was used for assessment of CTP, MELD, MELD-Na$^+$, and ALBI scores to evalu-

Table 1. Comparison of AUROC of MELD-Na$^+$, MELD, CTP Score, and ALBI Score for patient survival

Alive	MELD Na$^+$	MELD	CTP score	ALBI score
Hospital survival (n = 387)	0.823	0.817	0.770	0.719
28 days (n = 295)	0.810	0.804	0.789	0.746
90 days (n = 170)	0.771	0.759	0.755	0.701
6 months (n = 137)	0.782	0.771	0.767	0.727
1 year (n = 107)	0.792	0.778	0.774	0.743
2 years (n = 84)	0.783	0.757	0.783	0.739
3 years (n = 69)	0.787	0.758	0.784	0.755

ALBI, albumin-bilirubin score; AUROC, area under the receiver operating characteristic curve; CTP, Child-Turcotte-Pugh; MELD, Model for End-stage Liver Disease; MELD-Na$^+$, Model for End-stage Liver Disease-Na$^+$.

ate the hazards of mortality. Univariate Cox regression analysis showed significant hazards for mortality with increased admission SCr (hazard ratio [HR], 1.118; 95% confidence interval [CI], 1.057–1.182; $p < 0.001$), decreased serum sodium (HR, 0.979; 95% CI, 0.968–0.991; $p < 0.001$), and encephalopathy (HR, 0.655; 95% CI, 0.536–0.799; $p < 0.001$) at three years. Further, admission SCr (adjusted hazard ratio [AHR], 1.082; 95% CI, 1.020–1.148; $p = 0.008$), serum sodium (AHR, 0.987; 95% CI, 0.976–0.999; $p = 0.041$), and encephalopathy (AHR, 0.705; 95% CI, 0.574–0.865; $p = 0.001$) emerged as independent predictors of decreased survival at three years in multivariate analysis. However, serum bilirubin (HR, 1.006; 95% CI, 0.996–1.016; $p = 0.227$), serum albumin (HR, 0.888; 95% CI, 0.741–1.064; $p = 0.197$), INR (HR, 1.022; 95% CI, 0.966–1.081; $p = 0.448$), and ascites (HR, 1.440; 95% CI, 0.947–2.189; $p = 0.088$) were not significant in predicting mortality at three years (Table 3). These results clearly show that the parameters used for determining ALBI (serum albumin and serum bilirubin) were not efficacious in predicting survival independently. On the contrary, serum creatinine and serum sodium, which are used in the MELD and MELD-Na$^+$ scores, were clearly useful in predicting both short-term and long-term survival.

On comparison of ALBI score levels between survivors and non-survivors, significantly higher ALBI scores were noted in ALD patients who died compared to those who survived during hospitalization (0.464 vs. 0.211; $p < 0.001$), at 28 days (0.379 vs. 0.137; $p < 0.001$), 90 days (0.331 vs. 0.063; $p < 0.001$), six months (0.322 vs. 0.017; $p < 0.001$), one year (0.316 vs. −0.003; $p < 0.001$), two years (0.294 vs. −0.041; $p < 0.001$), and three years (0.287 vs. −0.037; $p < 0.001$) (Table 4).

Discussion

In our study, all patients with ALD had a grade 3 ALBI score, with a mean score of 3.0 at the time of hospitalization. Furthermore, non-survivors had significantly higher ALBI scores compared to survivors during hospitalization and at various time points up to three years, as shown in Table 4. However, the capability of the ALBI score to foretell survival was inferior to that of the CTP, MELD, and MELD-Na$^+$ scores (Fig. 1, Table 1). On multivariable Cox regression analysis, the parameters used to calculate the CTP, MELD, and MELD-Na$^+$ scores—specifically encephalopathy, serum sodium, and serum creatinine—emerged as independent predictors of mortality. In contrast, serum albumin and serum bilirubin,

Table 2. Baseline characteristics and comparison of MELD, MELD-Na$^+$, CTP, and ALBI scores between survivors and non-survivors at 28 days and three years

n = 490	28 days			3 years		
	Alive (n = 295)	Dead (n = 195)	*p*-value	Alive (n = 69)	Dead (n = 421)	*p*-value
Age (years) (Mean ± SD)	45.63 ± 9.90	45.68 ± 10.51	0.965	45.54 ± 9.35	45.67 ± 10.27	0.917
MAP (mmHg) (Mean ± SD)	84.23 ± 8.61	79.82 ± 11.23	<0.001	83.85 ± 7.79	82.25 ± 10.27	0.136
BMI (kg/mt^2) (Mean ± SD)	22.41 ± 4.16	22.58 ± 4.11	0.659	21.68 ± 2.70	22.61 ± 4.32	0.018
Total leucocyte count (10^3 cells/dL) [Median (IQR)]	6,800–11,600 (8,600)	8,000–14,070 (10,800)	<0.001	6,450–9,550 (8,000)	7,245–13,140 (10,000)	<0.001
Serum creatinine (mg/dL) [Median (IQR)]	0.9–1.6 (1.1)	1.20–3.0 (1.80)	<0.001	0.90–1.30 (1.1)	0.90–2.30 (1.40)	<0.001
Serum urea (mg/dL) [Median (IQR)]	21–49 (31)	32–91 (55)	<0.001	22.50–46.50 (29)	24.50–65 (41)	<0.001
Serum sodium (mEq/L) (Mean ± SD)	134.90 ± 6.74	130.05 ± 7.94	<0.001	137.49 ± 6.04	132.23 ± 7.60	<0.001
Serum potassium (mEq/L) (Mean ± SD)	4.14 ± 1.59	4.09 ± 1.03	0.666	4.0 ± 0.77	4.14 ± 1.47	0.238
Serum bilirubin (total in mg/dL) [Median (IQR)]	1.6–6.9 (3.4)	4.3–18.9 (7.9)	<0.001	1.33–4.20 (2)	2.81–12.60 (5.50)	<0.001
Serum albumin (g/dL) (Mean ± SD)	2.59 ± 0.46	2.42 ± 0.45	<0.001	2.86 ± 0.49	2.47 ± 0.44	<0.001
INR [Median (IQR)]	1.46–2.17 (1.76)	1.81–3.15 (2.37)	<0.001	1.29–1.88 (1.53)	1.63–2.60 (2.04)	<0.001
MELD Na$^+$ (Mean ± SD)	21.72 ± 8.26	31.59 ± 7.49	<0.001	17.40 ± 7.93	27.0 ± 8.81	<0.001
MELD (Mean ± SD)	19.43 ± 7.73	29.46 ± 8.41	<0.001	16.31 ± 6.82	24.59 ± 9.24	<0.001
CTP score (Mean ± SD)	10.60 ± 1.86	12.57 ± 1.59	<0.001	9.51 ± 1.99	11.69 ± 1.83	<0.001
ALBI [Median (IQR)]	−0.104–0.350 (0.137)	0.222–0.618 (0.379)	<0.001	−0.181–0.180 (−0.037)	0.084–0.507 (0.292)	<0.001

ALBI, albumin-bilirubin score; BMI, body mass index; CTP, Child-Turcotte-Pugh; INR, international normalized ratio; IQR, interquartile range; MAP, mean arterial pressure; MELD, Model for End-stage Liver Disease; MELD-Na$^+$, Model for End-stage Liver Disease-Na$^+$; SD, standard deviation; TLC, total leukocyte count.

Table 3. Predictors of mortality in patients with ALD at three years (univariate and multivariate Cox regression analysis)

Parameters at admission	*p*-value	HR (95% CI)
Three-year survival (univariate Cox regression analysis)		
Serum bilirubin	0.227	1.006 (0.996–1.016)
Serum albumin	0.197	0.888 (0.741–1.064)
INR	0.448	1.022 (0.966–1.081)
Serum creatinine	<0.001	1.118 (1.057–1.182)
Serum sodium	<0.001	0.979 (0.968–0.991)
Ascites	0.088	1.440 (0.947–2.189)
Encephalopathy	<0.001	0.655 (0.536–0.799)
Three-year survival (multivariate Cox regression analysis)		
Serum creatinine	0.008	1.082 (1.020–1.148)
Serum sodium	0.041	0.987 (0.976–0.999)
Encephalopathy	0.001	0.705 (0.574–0.865)

ALD, alcohol-associated liver disease; CI, confidence interval; INR, international normalized ratio.

which are the parameters used to calculate the ALBI score, were not independent predictors. Of note, serum creatinine—known to adversely affect survival in patients with chronic liver disease—is included in the MELD and MELD-Na^+ scores.[20–24] Our findings indicate that the MELD and MELD-Na^+ scores are superior to the ALBI score in predicting mortality in ALD patients (Fig. 1). This aligns with the findings of Ronald *et al*.,[11] who demonstrated that while the ALBI score significantly predicted survival after TIPS, the MELD score remained a superior prognostic tool for short-term, long-term, and overall mortality due to hepatic failure, reaffirming its utility in guiding decisions regarding TIPS candidacy.[11]

Furthermore, encephalopathy, used in the calculation of the CTP score, is a known negative predictor of survival.[25–27] Hence, in our study, the CTP score also proved to be a better predictor of mortality than the ALBI score (Fig. 1).

Ironically, we were able to conduct this real-world study on outcomes and mortality due to the lack of local liver transplantation facilities and the inability of our patients to afford treatment at other centers. Paradoxically, the absence of access to transplantation enabled us to document the natural course and outcomes of these patients.

To our knowledge, no other study on ALD has reported similar findings. A major limitation of our study is its single-center design. A larger multicenter study is needed to validate these results. Additionally, the small number of female participants limits the generalizability of our findings, particularly to female patients.

Conclusions

All ALD patients in our study had high ALBI scores, corresponding to grade 3 at the time of hospitalization. Non-survivors had significantly higher ALBI scores compared to survivors. However, the CTP, MELD, and MELD-Na^+ scores were found to be superior predictors of survival during hospitalization and up to three years post-admission, compared to the ALBI score. Validation of our findings requires larger multicenter studies with better representation of female patients. It may also be worthwhile to evaluate whether combining the ALBI score with alcohol-specific biomarkers improves prognostication.

Acknowledgments

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Table 4. Comparison of ALBI scores between survivors and non-survivors

Total patients (n = 490)	Alive	Dead	*p*-value
Hospital mortality alive (n = 387)	−0.051–0.395 (0.211)	0.238–0.699 (0.464)	<0.001
28 days alive (n = 295)	−0.104–0.350 (0.137)	0.222–0.618 (0.379)	<0.001
90 days alive (n = 170)	−0.145–0.305 (0.063)	0.137–0.544 (0.331)	<0.001
6 months alive (n = 137)	−0.163–0.275 (0.017)	0.127–0.538 (0.322)	<0.001
1 year alive (n = 107)	−0.164–0.248 (−0.003)	0.121–0.533 (0.316)	<0.001
2 years alive (n = 84)	−0.167–0.219 (−0.041)	0.101–0.507 (0.294)	<0.001
3 years alive (n = 69)	−0.181–0.180 (−0.037)	0.084–0.507 (0.287)	<0.001

ALBI, albumin-bilirubin.

Conflict of interest

The authors declare no conflicts of interest.

Author contributions

Study conception and design, data analysis and interpretation (CRK, SPS), data collection and assembly, statistical analysis (CRK), manuscript writing (CRK, MKP, PA, SPS), and final approval (MKP, PA, SPS). All authors have approved the final version and publication of the manuscript.

Ethical statement

The study was performed in accordance with the Helsinki Declaration as revised in 2024. Ethical clearance for this study was obtained from the Institutional Ethics Committee, M.K.C.G. Medical College, Berhampur-760004, Odisha [No. 795 - Chairman, IEC, M.K.C.G. Medical College, Berhampur-4]. Written informed consent was obtained from all patients.

Data sharing statement

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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