ORIGINAL ARTICLE

Scoring Systems that Predict Mortality at Admission in End-stage Liver Disease

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Abstract

Background: Various scoring systems have been developed to assess the severity and survival in end-stage liver disease.

Aim of the study: Prospective study to compare and analyze the efficacy of scoring systems in predicting mortality in ESLD patients who present with cirrhosis specific complications to the emergency room.

Materials and methods: This prospective, single point study was conducted over a two year period from September 2014 to August 2016 among 162 ESLD patients seeking admission to the emergency unit of Gleneagles Global Health City, Chennai. Baseline investigations incorporated hemogram, liver biochemical parameters, coagulation parameters (PT/INR), serum creatinine, serum electrolytes and blood gas analysis, to calculate the CTP score, MELD, MELD-Na, MESO, iMELD, Updated MELD, UKELD, SOFA and APACHE II. Comparison of MELD snd non MELD scores were done between survivors and nonsurvivors. The mortality rate for the same admission was calculated.

Results: Of the 162 patients requiring emergency admision, 148 were men (91.4%). The median age of patients was 56 years (range 25–75 years). The cause for liver cirrhosis was alcohol followed by nonalcoholic steatohepatitis and hepatitis B. The indications for emergency admissions were fever, tense ascites, reduced urine output and altered sensorium. Thirty patients (18.5%) expired during the same admission. The predictive accuracy of all scores for predicting mortality by ROC curves was between 0.7 and 0.8 ($p < 0.05$).

Conclusion: Although, all scores appear to be equally good, simple scores like CTP and MELD is all that is required to ascertain the prognosis of patients seeking emergency admission.

Keywords: Cirrhosis, Emergency, Mortality

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Introduction

Cirrhosis of the liver is associated with complications like gastrointestinal bleeding, ascites, hepatic encephalopathy and infections that can influence survival. End-stage liver disease patients coming to emergency room differ in clinical presentation, etiology, age, treatment response and eventual mortality. Risk stratification of these sick patients has an impact on clinical management and outcome.

The severity of liver disease over the years has been assessed using different scoring systems. Most of them have been introduced primarily with an objective to predict the need for a liver transplantation (LT). The Child Turcotte Pugh score was initially used to assess severity of liver disease.[1] However, it was replaced by The Model for End-stage Liver Disease (MELD) score. This scoring system independently predicted the mortality irrespective of the etiology and complications related to portal hypertension.[2] Subsequent studies showed a negative impact of hyponatremia on survival in cirrhosis. In order to incorporate this parameter into MELD, a mathematical equation based on both MELD and Sodium, known as MELD-Na, was developed. This predicts the 6-month mortality in patients with cirrhosis awaiting LT.[3] Subsequently other MELD-based prognostic models, the integrated Model for End-stage Liver Disease (iMELD) score, Model for End-stage Liver Disease to sodium (MESO) index, United Kingdom End-stage Liver Disease score (UKELD), updated MELD and MELD XI were introduced to improve the prognostication in end-stage liver disease.[4–8] Apart from these MELD-based scores, there are 2 other generic scoring systems, APACHE II and SOFA scores that are not specific for liver disease. These are used in an intensive care set up to assess and prognosticate the outcome.[9,10]

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Though there are several scores to assess the prognosis of these patients in an intensive care unt and while awaiting liver transplantation, these scores have seldom been evaluated in emergency room setting. Moreover, many of these scores require numerous biochemical parameters and are difficult to calculate. The utility of these scoring systems to predict survival in ESLD patients seeking emergency admission has not been studied.

The aim of the present study was therefore to compare the predictive validity of various scoring systems in predicting mortality in end-stage liver disease patients who present with cirrhosis related complications to the emergency room (ER).

Objectives

- To compare the predictive validity of various scoring systems in predicting mortality in end-stage liver disease patients who present with cirrhosis related complications to the emergency room.

- To determine how simple scores like CTP and MELD compare with more cumbersome and difficult scoring systems.

Materials and Methods

Study location: Emergency room of Gleneagles Global Health City, Chennai.

Study duration: September 2014 to August 2016

Inclusion criteria: One hundred sixty-two consecutive ESLD patients seeking admission to the emergency unit irrespective of the etiology and indication for admission.

Exclusion criteria: patients below 18 years of age, overseas patients and those with hepatocellular carcinoma in a noncirrhotic liver.

Patient details at entry to the emergency unit included age, gender, duration of illness, etiology and indication for admission. Baseline investigations incorporated hemogram, liver biochemical parameters, coagulation parameters (PT/INR), serum creatinine, serum electrolytes and blood gas analysis. These were used to calculate the CTP score, MELD, MELD-Na, MESO, iMELD, Updated MELD, UKELD, SOFA and APACHE II (Flowchart 1).

Outcomes studied: The duration of hospital stay was noted and outcome at discharge was classified as survivors and nonsurvivors. The latter included terminally ill patients who were discharged against medical advice.

Statistical Analysis

The sample size was calculated to be 150 and eventually 162 patients were recruited.The mortality rate for the same admission was calculated. The scores were divided into two groups for further interpretation—MELD based scores and other scores. Age, gender, duration of hospital stay and all the severity scores were compared between survivors and nonsurvivors. All the quantitative variables were assessed for compliance with normal distribution using visul inspection of histograms, normality Q-Q plots. *P* values of Shapiro–Wilk test and Kolmogorov–Smirnov test were also assessed. Considering the non-normal distribution, quantitative variables were compared by median and interquartile range, using Mann–Whitney U-test. Predictive validity of different scoring systems in predicting mortality, was assessed by receiver-operating characteristic (ROC) aanalysis. C-statistic equivalent to the area under the curve (AUC) along with its 95% CI and *p* value was presented. A *p* value <0.05 was considered as statistically significant. All statistical analysis was done using IBM SPSS for Windows version 22.0 (IBM corp Armonk, NY; 2013).

Results

Of the 162 patients seeking admission in ER, 91.4% (148) were men. The median age of patients was 56 years (range 25–75 years). The cause for liver cirrhosis was alcohol in 48.9% (79 patients) followed by nonalcoholic steatohepatitis (28; 17.0%), hepatitis B infection (25; 15.9%), cryptogenic cirrhosis (13; 8%), autoimmune hepatitis (6; 2.3%) and others in 2 (1.2%). Three patients (1.9%) had more than one etiology. Fifty percent (81 patients) of emergency admissions were for fever, for tense ascites with breathlessness in 32 (19.8%), significant reduction in urine output in 30 (18.5%), altered sensorium in 26 (16.0%) and gastrointestinal bleeding in 15 (9.2%) patients.

By Child Turcotte Pugh score, 89 patients belonged to CTP class C status (89, 54.9%), followed by class B(60, 37.0%) and class A (13, 8%). The median duration of in-hospital stay was 6 days (range 1–50 days). Thirty patients (18.5%) expired during the same admission.

Median duration of hospital stay was slightly higher in non-survivors (median 6.00 IQR 4–9), compare to survivors (Median 7.00 IQR 3.75–10.25). Table 1 shows the differences in MELD and

Table 1: Comparison of scores between survivors and nonsurvivors

Parameters	*Alive (132) (Median (IQR))*	*Expired (30) (Median (IQR))*	*p value*
Hospital stay in days	6.00 (4–9)	7.00 (3.75–10.25)	<0.001
MELD-based scores			
MELD score	18.50 (13.00–25.00)	26.00 (22.00-38.00)	<0.001
MELD Na score	22.40 (15.70–33.05)	37 (26.80-47.12)	<0.001
I MELD score	42.70 (34.55–49.20)	52.60 (45.65-63.60)	<0.001
UKELD score	54.00 (49.80–60.57)	62.45 (56.97-66.75)	<0.001
Updated MELD score	4.00 (3.30–4.90)	5.10 (4.37- 6.32)	<0.001
MELD Na A score	22.80 (16.70–28.97)	29.65 (26.80-37.00)	<0.001
Non-MELD scores			
CTP score	9 (8.0-11.0)	11.0 (10.0-13.0)	<0.001
MESO	14.05 (10.00-18.87)	20.90 (17.77-27.02)	<0.001
APACHE	13.00 (11.0-16.0)	19.50 (13.0-22.0)	<0.001
SOFA	5.0 (3.0 – 5.0)	7.0 (4.0-8.25)	<0.001

Flowchart 1: Flowchart of the study

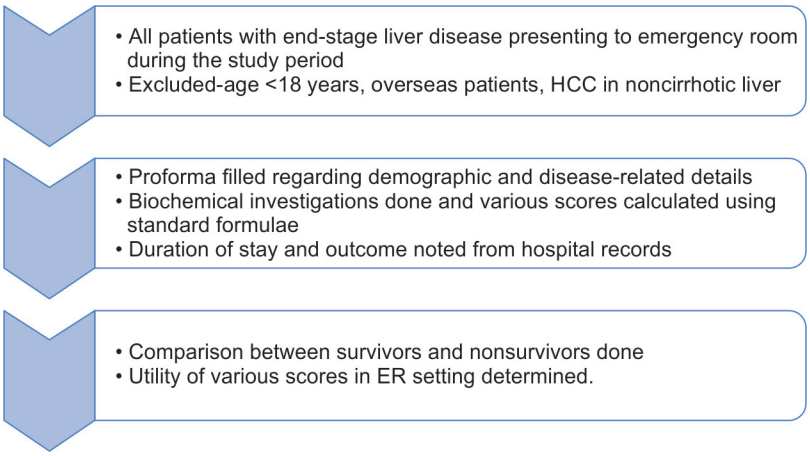


Table 2: Predictive validity of MELD and non-MELD scoring systems in predicting mortality

		95% confidence interval of AUC		
Score	*AUROC*	*Lower bound*	*Upper bound*	*p value*
MELD score	0.788	0.701	0.875	<0.001
MELD-NA score	0.765	0.673	0.856	<0.001
MELD-NA_A score	0.783	0.694	0.871	<0.001
IMELD score	0.758	0.663	0.854	<0.001
UKELD	0.754	0.661	0.847	<0.001
Updated MELD	0.766	0.677	0.855	<0.001
CTP score	0.722	0.610	0.833	<0.001
MESO	0.788	0.698	0.879	<0.001
APACHE-II score	0.733	0.606	0.860	<0.001
SOFA score	0.751	0.640	0.861	<0.001

non-MELD scores at admission in the 2 groups. All scores were significantly high amongst nonsurvivors.

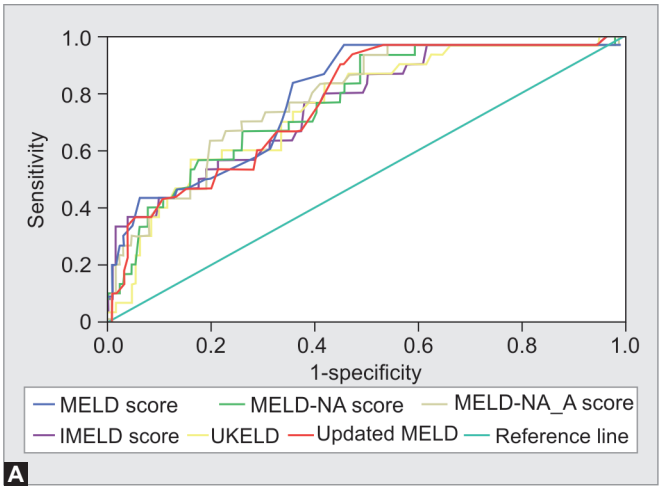
Table 2 shows the validity of MELD and non-MELD scoring systems in predicting mortality. The predictive accuracy of these scores for predicting mortality by ROC curves was between 0.7 and 0.8 for all scoring systems and *p* values were statistically significant (Fig. 1).

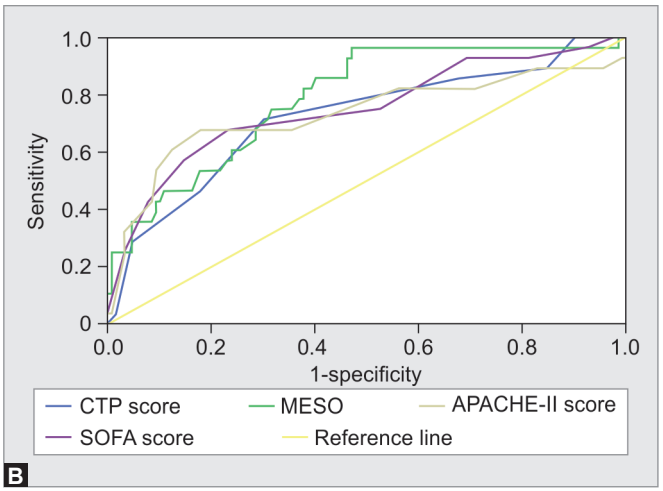
Discussion

Approximatley three-fourths of patients with cirrhosis of liver often require emergency admisions for specific complications related to ESLD. In a retrospective study, by Pant et al., infection was the most frequent concurrent complicating diagnosis leading to admission (20.1%). This was followed by hepatic encephalopathy, variceal bleeding and hepatorenal syndrome in decreasing order.[11] The most common indication in our setting for emergency room visit was fever, followed by tense ascites, renal dysfunction, hepatic encephalopathy and gastrointestinal bleeding. Majority of the patients in our study had advanced liver disease and were registered cases in the liver unit. They belonged to either CTP class B or C. The high mortality of 18.5% in the same admission was therefore not surprising.

All the scores in MELD and non-MELD scores in our series had a high validity in predicting mortality during the same hospital admission. Boone et al.,[12] reported that among medical intensive care unit admission in liver disease patients, MELD + SOFA, MELD, and SOFA, predicted an excellent discrimination for mortality at 28-day and at 1-year. The Acute Kidney injury Network criteria (AKIN), SOFA, and MELD scores also in yet another study have shown discriminative power in predicting in-hospital mortality in critically ill cirrhotic patients.[13] Except for CTP score and MELD scores, calculation using all other scores are cumbersome. These two simple scores, i.e. MELD and CTP scores, in our study were equally effective in predicting outcome in patients seeking and emergency admission for cirrhosis specific complications.

The present study highlights the need to stratify ESLD patients at presentation to the emergency department for detailing the prognosis. In conclusion, although, all scores, both MELD and non-MELD scores are equally good in predicting outcome, simple scores like CTP and MELD is all that may be required to ascertain the prognosis and outcome of patients with cirrhosis related specifc complicaitons seeking emergency admission.





Figs 1A and B: ROC curve showing predictive validity of various (A) MELD scoring systems and (B) non-MELD scoring systems in predicting mortality

The study has few drawbacks. We did not study the impact of duration of illness, etiology and cirrhosis specific complications as factors affecting outcome, as the sample size was inadequate for this analysis and that was not the primary aim of the study.

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