

COMPARISON OF MODEL FOR END-STAGE LIVER DISEASE-SODIUM SCORE & MODEL FOR END-STAGE LIVER DISEASE SCORE (MELD) IN PREDICTING IN-HOSPITAL MORTALITY IN PATIENTS WITH END-STAGE LIVER DISEASE: AN OBSERVATIONAL STUDY

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Abstract

OBJECTIVES: To assess in-hospital mortality in patients with end-stage liver disease and evaluate its association with mean Model for End-Stage Liver Disease (MELD) and MELD-Na scores.

METHODOLOGY: This prospective cross-sectional study was executed at PUMHSW Nawabshah, comprising a sample of 189 participants aged from 18 to 65 years who were clinically diagnosed with end-stage liver disease. The subjects were monitored until their discharge, and an assessment of in-hospital mortality was conducted utilizing the MELD and MELD-Na scoring systems calculated upon admission. The acquired data underwent rigorous statistical analysis employing SPSS software, version 26, where a threshold level of significance was established at $p \leq 0.05$.

RESULTS : The investigation encompassed a cohort of 189 individuals diagnosed with End-Stage Liver Disease (ESLD) (Mean age 48.86 ± 11.77 years), with 8% identified as male and 19% as female. Non-survivors exhibited significantly elevated Model for End-Stage Liver Disease (MELD) (29.46 ± 8.20) and MELD-Na (31.51 ± 8.17) scores in comparison to their survivor counterparts. Both MELD and MELD-Na scores demonstrated a robust correlation with in-hospital mortality ($p=0.001$ & $p=0.005$, respectively).

CONCLUSION: MELD and MELD-Na scoring systems serve as critical prognostic indicators of in-hospital mortality among individuals afflicted with end-stage liver disease. It was observed that non-survivors exhibited significantly elevated scores in comparison to their survivor counterparts, with MELD-Na demonstrating marginally superior predictive precision. The integration of these scoring systems at the point of hospital admission can facilitate early risk stratification, inform clinical decision-making processes, and enhance patient

outcomes through timely medical interventions and the judicious allocation of healthcare resources.

INTRODUCTION

All the progressive liver diseases of different etiologies have a final common end point which is cirrhosis [1]. The end-stage liver disease (ESLD) is a big killing agent in Pakistan as well as outside Pakistan [2,3]. In the year 2023, liver disease caused 3.760 percent deaths in Pakistan [4]. The natural history of Cirrhosis is due to its aetiology and treatments. In case with viral hepatitis C and B, the rate of decompensation amounts to 4% and 10% per year correspondingly. In continued alcohol consumption, the decompensation of alcoholic liver disease is faster. Irrespective of the aetiology, the morbidity is greater than 85 per cent at the 5-year mark after decompensation [5]. Various scores can foresee the clinical outcome of end-stage liver disease patients. The most frequently used scoring systems are MELD [6], It was created in 2000 by the Mayo Clinic and was used in 2002. to assign transplant priority to liver transplant candidates on the waiting list. It has been modified severally to enhance findings [7,8]. The MELD incorporates three objective biochemical factors which are reproducible and commonly available. These involve serum bilirubin, creatinine and prothrombin time INR. The 3-month post-OLT mortality is very predictable in commencing cirrhotic orthotopic liver transplantation patients using MELD [9]. MELD-Na calculates the likelihood of death of liver transplant patients within 90 days [10,11]. The model has value because it utilizes conveniently accessible and unbiased laboratory information. A recent study proved that the MELD-Na score is a reliable predictor of mortality in the hospitalized population with and without clinical compromises [12]. According to the study conducted by Mukherjee et al [13] 20 (40%) out of 50 patients with end-stage liver disease in the hospital succumbed to complications caused by cirrhosis. The mean MELD and MELD-Na of non-survivor group was significantly higher (28.5 $\pm$ 8.48 and 30.45 $\pm$ 7.22) than that of a survivor group (22.03 $\pm$ 10.75 and 25.67 $\pm$ 9.46). In this research, there was a mortality of 16.360/o in patients with liver cirrhosis. There was increased mortality (88.9%) among patients with MELD scores greater than 20 as opposed to patients with a score of less than 20 (11.1%) [14].

We focus on the comparative analysis of the predictive efficacy of MELD and MELD-Na scores as prognostic indicators of in-hospital mortality among patients suffering from end-stage liver disease. The predominant scoring methodologies utilized for the estimation of mortality risk in individuals with end-stage liver disease are MELD and MELD-Na. A limited number of studies have conducted evaluations aimed at assessing the predictive performance of these scores concerning three-month or one-year mortality in patients with various chronic liver diseases, yielding results that demonstrate their satisfactory performance. However, there exists a notable paucity of scholarly literature addressing the efficacy of these scoring systems in the evaluation of in-hospital mortality in patients with end-stage liver disease. Our study findings will support the risk stratification of patients and this assists in early diagnosis and management of the disease.

METHODOLOGY

This investigation constitutes a descriptive cross-sectional analysis conducted within the Department of General Medicine at the Peoples University of Medical and Health Sciences for Women (PUMHSW) in Nawabshah, sanctioned by the College of Physicians and Surgeons Pakistan (CPSP) and the institutional ethical review board. A non-probability consecutive sampling methodology was employed to recruit all participants aged between 18 and 65 years of either sex who presented with end-stage liver disease (ESLD). ESLD was characterized by the presence of jaundice, fluid retention and abdominal distension, a leg edema or perplexity, accompanied by complications, including ascites, variceal hemorrhage, hepatic encephalopathy or renal impairment. The patients who met the inclusion criteria were selected in the gastroenterology high-dependency unit (HDU) and the intensive care unit (ICU). The exclusion criteria were patients with history of chronic renal failure, malignancy, immunocompromised status, coagulopathy or patients on antiplatelet or anticoagulant agents. All the risks and benefits have been described before

enrolment when informed consent was obtained in written form either by the patient or the attendant in case the patient was incapacitated. Age, gender, place of residence, time span of liver disease, comorbidity conditions (hypertension and diabetes), smoking status, as well as family history of liver failure were obtained at the time of enrollment, taken as baseline demographic and clinical data. This data was captured in a predesigned proforma to avert variations and bias. The standard formulas in the operational definitions were used in calculating the Model for End-Stage Liver Disease (MELD) and MELD-Na scores at the time of admission. The in-hospital mortality was assessed by all enrolled patients till their release. The patients were given routine care according to the hospital procedures during their stay in hospitals. The analysis of data will be conducted with the help of SPSS 26. Continuous variables shall be reported as mean (standard deviation) whilst categorical variables shall be reported as frequencies and percentages. Statistical difference will be determined using the Chi-square test and a p-value of < 0.05 will be taken as being statistically significant.

RESULTS

The research encompassed a sample population of 189 individuals, with a calculated mean age of 48.86 ± 11.77 years (95% Confidence Interval: 47.17–50.55). The average body mass index (BMI) was established at 26.12 ± 3.93 kg/m² (95% Confidence Interval: 25.55–26.68). The serum creatinine levels presented a mean value of 1.59 ± 1.36 mg/dL (95% Confidence Interval: 1.40–1.79), while the total bilirubin concentrations were found to average 8.65 ± 6.73 mg/dL (95% Confidence Interval: 7.68–9.62). The serum albumin levels were documented at 2.20 ± 0.92 g/dL (95% Confidence Interval: 2.06–2.33), and the mean International Normalized Ratio (INR) was 2.41 ± 1.07 (95% Confidence Interval: 2.26–2.57). The average concentration of serum sodium was determined to be 132.71 ± 9.41 mmol/L (95% Confidence Interval: 131.36–134.06), whereas the serum potassium concentration was measured at 3.41 ± 1.38 mmol/L (95% Confidence Interval: 3.21–3.61). The mean serum ammonia concentration was assessed at 149.99 ± 54.89 μ mol/L (95% Confidence Interval: 142.11–157.87). With regard to hepatic enzymes, alanine aminotransferase (ALT) presented

an average of 67.33 ± 28.77 IU/L (95% Confidence Interval: 63.20–71.46), while aspartate aminotransferase (AST) exhibited an average of 83.84 ± 27.67 IU/L (95% Confidence Interval: 79.87–87.81). In terms of demographic distribution by sex, 153 participants (81.0%) were categorized as male, while 36 individuals (19.0%) were classified as female (TABLE I).

Among the cohort comprising 189 patients, individuals classified as non-survivors ($n=37$) exhibited markedly higher severity scores when juxtaposed with their surviving counterparts. The mean MELD score for the patients who unfortunately succumbed was documented at 29.46 ± 8.20 , whereas the survivors manifested a mean score of 22.40 ± 12.13 , thereby yielding a mean differential of 6.9 points (95 % CI 2.90 – 11.21; $p = 0.001$). A similar pattern was observed regarding the sodium-adjusted MELD (MELD-Na): non-survivors revealed an average of 31.51 ± 8.17 , in contrast to the 25.51 ± 12.07 average documented for the surviving patients, ultimately resulting in a mean difference of 6.0 points (95 % CI 1.87 – 10.14; $p = 0.005$). These findings elucidate that both elevated MELD and MELD-Na scores are significantly associated with in-hospital mortality (TABLE II).

DISCUSSION

The late stage of chronic liver damage is characterized by end-stage liver disease (ESLD) and includes refractory hepatic dysfunction and life-threatening symptoms like ascites, hepatic encephalopathy, gastrointestinal bleeding and hepatorenal syndrome. Outpatient patients with ESLD in our study physiologically manifested with signs of jaundice, edema, leg edema, and neurological abnormalities, which are characterized by decompensated cirrhosis based on the international guidelines [19]. As a prognostic tool, the accuracy of the MELD and MELD-Na scores which include objective biochemical markers of in-hospital mortality, can be used to evaluate the prognostic utility of these tools in predicting mortality. The results obtained were that the non-survivors had significantly higher MELD (29.46, 8.20) and MELD-Na (31.51, 8.17) scores than survivors (22.40 12.13 and 25.51 12.07 respectively) with a p-value of 0.001 and 0.005. These findings strengthen clinical significance of these scoring

systems to detect high risks of hospitalized cirrhotic patients.

This finding is in alignment with the previous research. Mukherjee et al. discovered similarity in the predictive potential of MELD and MELD-Na, as in both cases, the scores of non-survivors were significantly higher [13]. Elevated mortality among patients with MELD scores of more than 20 has been also reported by Menena et al. [14]. MELD-Na was developed to further improve the prognostic power of MELD by taking into consideration the serum sodium toxicity which is involved with great ease in the advanced liver condition due to the development of circulatory dysfunction [9,10,11]. A number of studies have established the better prognostic ability of MELD-Na in short-term and waitlist mortality prediction [12,15,17,18]. Tapper and Lok also have highlighted that adoption of MELD-Na into everyday clinical decision making can serve to enhance transplantation triaging, as well as designation of priorities in treatment of patients with liver cirrhosis [16]. In addition, MELD-Na found enormous acceptance in the prognosis and therapeutic planning in decompensated cirrhosis, as recommended by the European Association for the Study of the Liver (EASL) [19].

The strength of this study consists in its prospective character, the use of validated scoring tools, and real-life clinical environment. Internal validity is achieved with the standard use of operational definitions and a broad spectrum of the demographic distribution of samples. Nevertheless, there are a few limitations that have to be cited. The study is a single-center study which means that the findings cannot be applied to all populations. The trial was done with the in-

hospital death being the only outcome ignored or lacked in the study as they could not capture the long-term outcomes and complications afterwards. Also, serum sodium levels can be affected by a number of factors including hydration and diuretic treatment as well as other acute conditions, which may interfere with the reliability of MELD-Na. Comorbidities were documented but not used to assess its relationship with mortality, which was also a waste of opportunities at a deeper risk profiling.

The study demonstrated that, both MELD and MELD-Na scores serve as reliable predictors of in-hospital mortality in patients with end-stage liver disease, with MELD-Na showing a slight predictive advantage. Incorporating these scores into early clinical assessment may improve risk stratification, facilitate timely interventions, and guide decisions regarding escalation of care or palliative planning in high-risk ESLD patients.

CONCLUSION

MELD and MELD-Na scoring systems serve as critical prognostic indicators of in-hospital mortality among individuals afflicted with end-stage liver disease. It was observed that non-survivors exhibited significantly elevated scores in comparison to their survivor counterparts, with MELD-Na demonstrating marginally superior predictive precision. The integration of these scoring systems at the point of hospital admission can facilitate early risk stratification, inform clinical decision-making processes, and enhance patient outcomes through timely medical interventions and the judicious allocation of healthcare resources.

Table I: Demographic and Clinical Characteristics of Study Participants (n=189)

Mean $\pm$ SD	95% CI
Age in years = 48.86 ± 11.77	47.17~50.55
BMI in kg/m^2 = 26.12 ± 3.93	25.55~26.68
Serum Creatinine in mg/dL = 1.59 ± 1.36	1.40~1.79
Total Bilirubin in mg/dL = 8.65 ± 6.73	7.68~9.62
Serum Albumin in g/dL = 2.20 ± 0.92	2.06~2.33
INR Ratio = 2.41 ± 1.07	2.26~2.57
Serum Sodium in mmol/L = 132.71 ± 9.41	131.36~134.06

Serum Potassium in mmol/L = 3.41 ± 1.38		3.21~3.61
Serum Ammonia in $\mu\text{mol/L}$ = 149.99 ± 54.89		142.11~157.87
ALT in IU/L = 67.33 ± 28.77		63.20~71.46
AST in IU/L = 83.84 ± 27.67		79.87~87.81
Frequency (%)		
Gender	Male	153 (81.0)
	Female	36 (19.0)

Table II: Comparison of MELD and MELD Na with Mortality (n=189)				
Score	Mortality		95% C. I	P-Value
	Yes (n=37)	No (n=152)		
MELD	29.46 ± 8.20	22.40 ± 12.13	2.904~11.212	0.001*
MELD (Na)	31.51 ± 8.17	25.51 ± 12.07	1.874~10.140	0.005*

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