Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2024.282261.3327 Volume 30, Issue 4, July 2024
Manuscript ID ZUMJ-2404-3327
DOI 10.21608/ZUMJ.2024.282261.3327

ORIGINAL ARTICLE

Comparing Prognostic Scores of the Mortality of Patients with Decompensated Liver Cirrhosis Admitted to the Medical Intensive Care Unit

Monkez Motieh Yousif[1], Osama Abdel Aziz Mahmoud[2], Mohamed Khalid Lotfy Magahed[1]*, Ghada Mohamed Samir[1]
[1]Internal Medicine Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt.
[2]Biochemistry Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt.

***Corresponding author:** Mohamed Khalid Lotfy Magahed

Email: mohamed.khaled.7528610@gmail.com

Submit Date 2024-04-08
Revise Date 2024-04-10
Accept Date 2024-04-12

ABSTRACT

Background: For mortality prediction models of decompensated liver cirrhosis to be valid, re-evaluations of score performances are needed. This study aimed to assess the prognostic scores performance in the prediction of mortality among decompensated cirrhotic patients admitted to the ICU, involving Acute Physiology and Chronic Health Evaluation II (APACHE II), sequential organ failure assessment (SOFA), Chronic Liver Failure Consortium acute-on-chronic liver failure (CLIF-C ACLF), Child-Turcotte-Pugh (CTP), Model for End-Stage Liver Disease (MELD), MELD Sodium (MELD-Na), MELD lactate, Glasgow Coma scale (GCS).

Methods: In an observational descriptive cohort study, we recruited 80 patients with decompensated liver cirrhosis who were critically ill and admitted to the ICU. Scores of the APACHE II, Child-Pugh, MELD, MELD-Na, and MELD-lactate were used to evaluate the severity of the disease.

Results: Statistically significant differences were revealed between ICU outcomes and different prognostic scores; as the median of CTP score, MELD, MELD Na, MELD Lactate (MELD.L), S. Lactate, SOFA, APACHE II & CLIF-C ACLF were higher among deceased patients, while the median of GCS & MAP was lower among deceased patients. By Multivariate regression analysis, low GCS (Odd Ratio:0.4), high CTP (OR: 2.37), and high APACHE II (OR: 2.44) were independent predictors of mortality ($p<0.001$), whereas serum sodium, albumin, platelets, hemoglobin, and blood urea were not.

Conclusions: When compared to previous models, SOFA and APACHE scores were superior in predicting the overall mortality among patients at the ICU with decompensated liver cirrhosis.

Keywords: Prognostic Scores; Mortality; Decompensated Liver Cirrhosis; Intensive Care Unit.

INTRODUCTION

Roughly 1.16 million people die every year due to end-stage liver disease, the most common causes of which are alcoholic liver disease, non-alcoholic steatohepatitis, and hepatitis B and C [1]. Over several years, compensated cirrhosis typically progresses to decompensated cirrhosis, that is characterized by acute decompensation (AD) along with ascites, variceal haemorrhage (VH), and hepatic encephalopathy (HE) [2].

In the later stages of cirrhosis, when bacterial infections typically cause acute kidney injury (AKI) and hepatorenal failure, in addition to acute-on-chronic liver failure (ACLF), the patient often experiences recurrent ascites, hepatorenal

dysfunction, and persistent jaundice [3]. Complications requiring intensive care unit hospitalization are common throughout the normal course of liver cirrhosis [4].

A poor prognosis was previously documented for critically ill cirrhotic patients [5]. Still, new data imply improvements due to greater knowledge of the pathophysiology of cirrhosis and substantial advancements in the management of general in-ICU patients [6]. Critically ill individuals with cirrhosis have their fates predicted using a variety of ICU and liver-specific criteria, and futility rules have been established to determine when to withdraw intensive care [7].

The Sequential Organ Failure Assessment (SOFA) scores and Acute Physiology and Chronic Health Evaluation (APACHE) II and III are the most used in intensive care units [8]. On the other hand, Child-Turcotte-Pugh (CTP) and Model for End-Stage Liver Disease (MELD) scores are commonly used to assess patients with cirrhosis. Several studies aimed to predict the likelihood of death in cirrhotic individuals after surgery and the implantation of a transjugular intrahepatic portosystemic shunt (TIPS). Currently, MELD is used to predict and prioritize liver transplantation and CTP, which is used in clinical practice to evaluate the disease severity [9].

To better predict outcomes, included in the updated MELD are measures of serum sodium (MELD-Na) and the ratio of MELD to serum sodium (MESO index), in addition to the age and integrated-MELD (iMELD) to measure serum sodium [10]. Because it assesses organ failure more accurately, ICU scores frequently outperform CTP and MELD scores when predicting mortality [5].

Organ failure, advanced chronic liver disease, and a 28-day death rate of more than 15% constitute the Chronic Liver Failure Consortium (CLIF-C) syndrome. One new prognostic score, CLIF-C AD, is suggested for patients with AD of cirrhosis who do not have ACLF and another, CLIF-C ACLF, is offered for patients with ACLF. [11].

Limited research has been conducted to compare ICU prognostic scores with liver failure scores. The optimal prognostic scoring system for predicting overall mortality in ICU admitted patients remains uncertain.

We aimed in this study to assess the efficacy of various prognostic scores in the prediction of mortality among decompensated cirrhotic patients who were admitted to the ICU, including APACHE II, SOFA, CLIF-C ACLF, CTP, MELD, MELD-Na, MELD lactate, and GCS.

METHODS

Between April 2023 and October 2023, this prospective cohort study was done in the Intensive Care Unit, Internal Medicine Department, Zagazig University Hospitals, on 80 patients with decompensated liver cirrhosis.

The study was authorized by the research ethical council of Zagazig University's Faculty of Medicine, and all participants provided written informed permission. The research followed the guidelines in the Declaration of Helsinki, which is part of the World Medical Association's Code of Ethics for Research Involving Humans. The Institutional Review Board gave authorization (#10634/4-4-2023) before this study could be conducted.

Cases with the following criteria were included: age 18 or older with decompensated liver cirrhosis admitted with Complications of Bleeding O.V., SBP, Hepatic encephalopathy, Hepatorenal syndrome, ACLD, or any other related complications.

Cases with the following characteristics were excluded: cases younger than 18 years and patients with incomplete data or lost follow-up in the medical ICU.

All patients were subjected to Full history taking involving age, name, sex, history of medical diseases, and family history.

Complete general clinical and local abdominal examinations were done to assess signs of Liver cirrhosis and portal hypertension.

Laboratory investigations include complete blood count (CBC), hemoglobin level, white blood cell count, red blood cell count, and platelet count (By system XKX21 from Roche diagnosis). Liver function tests (total and direct bilirubin measured by mg\dl, total protein and albumin in gm\dl, serum Aspartate aminotransferase (AST), and serum Alanine aminotransferase (ALT) measured by (IU\L) By Dimension RXL Auto-analyser from Siemens by Dimension RXL). Coagulation profile (prothrombin time in seconds, prothrombin concentration, and international randomization ratio (INR)). Kidney function tests (blood urea and creatinine By Dimension RXL Auto-analyser from Siemens by Dimension RXL), Sedimentation rate, Blood chemistry tests including s.Na+, s.K+, Urine output, Arterial blood gases including PO2, FiO2,

Blood glucose level, Urine output, and measurement of serum lactate [12].

Abdominal ultrasonography and Doppler were done using MyLab20Plus of the portal vein (PV) for the detection of liver cirrhosis and portal hypertension.

Upper gastrointestinal endoscopy (PENTAX VIDEO):

Oesophogastroduodenoscopy was performed on the patients. A trained endoscopist used a PENTAX VIDEO endoscopy unit and a flexible end video endoscope. We documented the grade of OV, and any risky signs.

Scores: All scores were determined independently, and only information gathered at the time of first intensive care unit admission or during the first 24 hours of that admission was considered.

APACHE II:

Twelve admission physiologic characteristics were used to determine the point score, including the patient's age, chronic health status, and the Acute Physiology Score. By restricting the number of possibilities to those that could fit on a single sheet of paper and using integer values, the approach was fine-tuned for human calculation. Scores ranging from 0 to 71 were determined using multiple measures; higher scores imply a more severe illness and a greater risk of mortality [13].

MELD:

MELD was used for assessment of survival. The formula that determined it was as follows [9]: MELD = 3.78×ln [serum bilirubin (mg/dL)] + 11.2×ln[INR] + 9.57×ln[serum creatinine (mg/dL)] + 6.43. The outcome of the previous equation was rounded off because MELD scores were provided as whole numbers.

MELD-Na score:

This was determined by subtracting [0.033 X MELD] from (137-Na), which equals 1.32 times MELD. Sodium values below 125 mmol/L will be recorded as 125, while values beyond 137 mmol were set as 137. [14].

MELD-Lactate score:

The formula we used was 1.68 times the logarithm of lactate plus 0.64 times the initial MELD. [15].

Child-Pugh Score:

This was developed to forecast the risk of death in individuals with cirrhosis, classified patients according to five different clinical and laboratory parameters: ascites, neurological disease, clinical nutrition status, blood albumin, and bilirubin levels. Children A, B, and C scores are 5–6, 7, 9, and 10-15, respectively [9].

The sequential organ failure assessment score (SOFA score)

It was utilized to monitor a patient's condition while hospitalized to ascertain the degree of their organ function or rate of failure [16]. A total of six separate scores—one each for the cardiovascular, hepatic, coagulation, renal, and neurological systems—formed the basis of the score.

CLIF Consortium acute-on-chronic liver failure (CLIF-C ACLF):

The CLIF-C ACLF was calculated using the following formula: CLIF-C ACLF = 10 × (0.33 × CLIF- OFs + 0.04 x Age + 0.63 × ln (WBC count)-2) [9].

While in the MICU, patients were managed and monitored following the protocols established by our unit. Mortality rate and length of intensive care unit stay were short-term indicators of patient outcomes.

Statistical analysis

We used SPSS 23.0 (SPSS, Chicago, IL, USA) to analyze the statistical data. Data was expressed as the mean ± standard deviation to indicate that it was normally distributed, and comparisons were made using independent samples t-tests. When data has an abnormal distribution, it is expressed using the median and the interquartile range (IQR). The nonparametric Mann-Whitney U test was utilized to compare the distributions between groups. Utilizing the Spearman correlation coefficient (r), we evaluated how much PNI was associated with other variables. Shapiro-Walik test was used for assessing normality distribution of data. Logistic regression analysis was used in the prediction of mortality among studied patients based on a set of different independent variables.

RESULTS

This study included 80 patients with decompensated liver cirrhosis who were admitted to the ICU, ranging in age from 22 to 87 years with mean ± SD of 65.5 ± 10.9; most of the patients (72.5%) were males and (27.5%) were females, (70%) were nonsmokers and (30%) were smokers, the most frequent clinical presentation detected was hepatic encephalopathy grade I & II which was detected among (41.3%) of the patients, while (18.8%) of the patients presented with grade III & VI encephalopathy (Table 1).

Statistically significant differences were revealed between the two groups as regards hepatic encephalopathy, where (37%) of deceased patients

had hepatic encephalopathy grade III - VI, in comparison to only (9.4%) among discharged patients *(P <0.001).*

Also, there is a statistically significant difference between mortality outcomes and baseline total leucocytic count, total bilirubin, aspartate aminotransferase, serum creatinine, serum sodium, and international normalized ratio; as median of TLC, bilirubin, AST, creatinine and INR were higher among deceased patients (P=0.006), (P<0.001), (P=0.03), (P<0.001) and (P=0.004) respectively. (Table 2).

Statistically significant differences were revealed between ICU outcomes and prognostic scales, such as the median CTP score, MELD, and MELD. Na, MELD. L, S. Lactate, SOFA, APACHE II & CLIF-C ACLF were higher among deceased patients *(P<0.001),* while the median of GCS & MAP was lower among deceased patients *(P<0.001).* As regards the Child-Pugh class, most of the deceased patients (85.2%) were class C, while most of the discharged patients (62.3%) were class B *(P<0.001)* (Table 3).

Highly significant positive correlations were revealed between serum lactate and CTP score *(r=0.430, P<0.001),* MELD score *(r=0.372, P<0.001),* and MELD. Na score *(r=0.413, P<0.001),* MELD lactate score *(r=0.791, P<0.001),* SOFA score *(r=0.430, P<0.001),* APACHE II score *(r=0.398, P<0.001)* and CLIF-C ACLF score *(r=0.520, P<0.001).* Furthermore, serum lactate showed a highly significant negative correlation with GCS *(r=-0.487, P<0.001)* and MAP score *(r=-0.362, P<0.001).* Also, highly significant positive correlations were revealed between MELD score and MELD. Na score *(r=0.966, P<0.001),* MELD lactate score *(r=0.783, P<0.001),* SOFA score *(r=0.787, P<0.001),* APACHE II score *(r=0.715, P<0.001)* and CLIF-C ACLF score *(r=0.812, P<0.001)* (Table 4).

Table (5) shows that increased Creatinine levels, lower GCS, increased CTP scores, Child-Pugh C, increased MELD score, serum lactate, SOFA, APACHE, CLIF-C ACLF, and MAP scores are independent predictors for mortality.

When comparing different scores' performance in predicting mortality, SOFA, APACHE II scores, MELD Na, MELD L and CLIF-C ACLF scores showing AUC above 0.9 (Figure 1). Table (6) shows the optimal cut-off point of different prognostic scores for predicting mortality among studied patients.

Table (1): Demographic clinical data, and causes of admission to the ICU among studied patients

Variables	All patients (n=80)
Age *(years)* Mean ± SD Range	 65.5 ± 10.9 (22 – 87)
Sex *(N. %)* – Male – Female	 58 (72.5%) 22 (27.5%)
Occupation *(N. %)* – Employee – Farmer – House wife – Retired	 38 (47.5%) 6 (7.5%) 21 (26.3%) 15 (18.8%)
Smoking status *(N. %)* – Non smoker – Smoker	 56 (70%) 24 (30%)
Comorbidities *(N. %)* – DM – HTN	 35 (43.8%) 27 (33.8%)
Variable *(N. %)*	**All patients (n=80)**

Variables	All patients (n=80)
Hepatic encephalopathy	
– Grade I - II	33 (41.3%)
– Grade III - VI	15 (18.8%)
Hematemesis & Melena	
– Recurrent hematemesis	1 (1.3%)
– Recurrent melena	8 (10%)
– 1st attack of H & M	17 (21.3%)
– Recurrent attack of H&M	13 (16.3%)
Others	
– Hepatic precoma	1 (1.3%)
– Hepatorenal syndrome	6 (7.5%)
– Shock	1 (1.3%)
– Massive right pleural effusion	1 (1.3%)

Table (2): Association between ICU outcome with ICU admission cause, baseline laboratory data, vital signs and ABG findings among the studied patients

Variables	Discharged (n=53)	Died (n=27)	Test	P value
Hepatic encephalopathy				
– Grade I - II	19 (35.8%)	14 (51.9%)		
– Grade III - VI	5 (9.4%)	10 (37%)	F	**<0.001**[1]
Hematemesis & Melena				
– Recurrent hematemesis	0 (0%)	1 (3.7%)		
– Recurrent melena	8 (15.1%)	0 (0%)		
– 1st attack of H & M	13 (24.5%)	4 (14.8%)		
– Recurrent attack of H&M	9 (17%)	4 (14.8%)	F	**0.05**[1]
Others				
– Hepatic precoma	1 (1.9%)	0 (0%)		
– Hepatorenal syndrome	0 (0%)	6 (22.2%)		
– Shock	0 (0%)	1 (3.7%)		
– Massive Rt pleural effusion	0 (0%)	1 (3.7%)	F	**<0.001**[1]
TLC *($10^3/mm^3$)*	7.1 (4.6)	12.4 (8.35)	444	**0.006**[1]
Hematocrit	28 (7)	28 (7.95)	678	0.71[1]
Hb *(g/dL)*	9.1 (2.9)	9.6 (2.7)	78	0.47[2]
PLT *($10^3/mm^3$)*	108 (67)	130 (83.5)	662	0.59[1]
Bilirubin *(mg/dL)*	1.6 (2.1)	5.9 (15)	330	**<0.001**[1]
Albumin *(g/dL)*	2.7 (0.7)	2.4 (0.4)	78	0.16[2]
AST *(U/L)*	41 (80)	92 (104.5)	500	**0.03**[1]
ALT *(U/L)*	25 (25)	30 (48.5)	552	0.09[1]
Creatinine *(mg/dL)*	0.9 (0.6)	2.05 (1.98)	287	**<0.001**[1]
Na *(mEq/L)*	134 (6)	129 (10)	78	**0.001**[2]
Ca+ *(mg/dL)*	8.1 (0.6)	7.9 (0.6)	700	0.87[1]
K *(mmol/L)*	4 (1)	3.7 (0.85)	607	0.27[1]
Mg *(mg/dL)*	1.9 (0.4)	2.1 (0.5)	527	0.054[1]
Ph *(mg/dL)*	3 (0.9)	3.6 (3.3)	562	0.12[1]
INR	1.36 (0.3)	1.6 (0.45)	78	**0.004**[1]
Temperature *(c)*	37.3 (0.3)	38 (0.55)	231	**<0.001**[1]

Variables	Discharged (n=53)	Died (n=27)	Test	P value
HR *(beat/m)*	90 (15)	97 (20)	3.75	**<0.001**[2]
RR *(breath/m)*	17 (2)	24 (4.5)	177	**<0.001**[1]
SpO2	97 (1)	97 (3)	602	0.23[1]
PH	7.39 (0.06)	7.26 (0.08)	176	**<0.001**[1]
Pco2 *(mmhg)*	37 (7)	26 (11.5)	327	**<0.001**[1]
Hco3 *(mEq/L)*	22 (5.4)	15 (6.5)	6.94	**<0.001**[2]
PaO2 *(mmhg)*	96 (4)	92 (11.5)	464	**0.01**[1]
PaO2/FiO2	457 (19)	404 (152.5)	307	**<0.001**[1]
SpO2/FiO2	461 (5)	452 (172)	480	**0.01**[1]

TLC: Total leucocyte count, **HB:** Haemoglobin, **AST:** aspartate aminotransferase, **ALT:** Alanine transaminase, **PLT:** Platelets, **NA:** Sodium, **CS:** Calcium, **MG:** Magnesium, **K:** Potassium, **INR:** International normalised ratio, **HR:** Heart rate, **SPO2:** oxygen saturation, **PCo2:** CO2 saturation, **HCO:** Bicarbonate, **Fio2:** Fractional oxygen saturation.

**[1]Fisher's exact test, [1]Mann-Whitney U test, [2:] Student's T test, Non-significant: P >0.05, Significant: P ≤0.05*

Table (3): Association between ICU outcomes and prognostic scores

Variables	Discharged (n=53)	Deceased (n=27)	Test	P value
GCS	15 (1)	12 (3)	162.5	**<0.001**[1]
CTP score	9 (2)	11 (2)	6.15	**<0.001**[2]
Child Pugh class *(N. %)* – Child A – Child B – Child C	 7 (13.2%) 33 (62.3%) 13 (24.5%)	 1 (3.7%) 3 (11.1%) 23 (85.2%)	 F	 **<0.001**[3]
MELD	14 (7)	26 (9.5)	155.5	**<0.001**[1]
MELD.Na	16 (11)	28 (7.5)	130	**<0.001**[1]
MELD.L	13 (3)	20 (7)	138	**<0.001**[1]
S. Lactate (mmol/l)	2 (1.2)	4.4 (4)	298	**<0.001**[1]
SOFA	3 (3)	9 (2)	72	**<0.001**[1]
APACHE-II	13 (3)	24 (6.5)	22	**<0.001**[1]
CLIF-C ACLF	43 (11)	55 (14.5)	8.13	**<0.001**[2]
MAP	83 (13)	70 (23.5)	358.5	**<0.001**[1]

[1:] Mann-Whitney U test, [2:] Student's T test, [3:] Fisher's exact test, Non-significant: P >0.05, Significant: P ≤0.05

CTP: Child-Turcotte-Pugh, **MELD:** Model for End-Stage Liver Disease, **MELD. NA:** MELD Sodium, **MELD. L:** MELD Lactate, **SOFA:** sequential organ failure assessment, **APACHE-II:** Acute Physiology and Chronic Health Evaluation, **CLIF-C ACLF:** Chronic Liver Failure Consortium acute-on-chronic liver failure, **GCS:** Glascow coma score, **MAP:** Mean arterial Pressure, **S. Lactate:** serum lactate.

Table (4): Correlation of Serum lactate, and MELD score with different prognostic scores.

Variable	Serum lactate	
	r	***P***
GCS	-0.487	**<0.001**[2]
CTP score	0.430	**<0.001**[1]
MELD	0.372	**<0.001**[2]
MELD.Na	0.413	**<0.001**[2]

Variable	Serum lactate	
	r	*r*
MELD.L	0.791	**<0.001**[2]
SOFA	0.406	**<0.001**[2]
APACHE II	0.398	**<0.001**[2]
CLIF-C ACLF	0.520	**<0.001**[1]
MAP	-0.362	**<0.001**[2]
Variable	**MELD**	
	r	*P*
GCS	-0.514	**<0.001**[2]
CTP	0.766	**<0.001**[2]
MELD.Na	0.966	**<0.001**[2]
MELD.L	0.783	**<0.001**[2]
SOFA	0.787	**<0.001**[2]
APACHE II	0.715	**<0.001**[2]
CLIF-C ACLF	0.812	**<0.001**[1]
MAP	-0.359	**0.001**[2]

CTP: Child-Turcotte-Pugh, **MELD:** Model for End-Stage Liver Disease, **MELD. NA:** MELD Sodium, **MELD. L:** MELD Lactate**, SOFA:** sequential organ failure assessment, **APACHI:** Acute Physiology and Chronic Health Evaluation, **CLIF-C ACLF:** Chronic Liver Failure Consortium acute-on-chronic liver failure, **GCS:** Glascow coma score, **MAP:** Mean arterial Pressure, **S. Lactate:** serum lactate.

**[1]Pearson correlation, [2]Spearman rank correlation test, Non-significant: P >0.05, Significant: P ≤0.05*

Table (5): Logistic regression analysis of predictors of mortality

Variables	Mortality		
	P value	**Odds ratio**	**(95% Confidence interval)**
Age	0.19	1.03	(0.98 – 1.08)
Sex	0.82	0.89	(0.39 – 3.22)
Smokers	0.57	1.35	(0.48 – 3.80)
DM	0.93	1.04	(0.41 – 2.65)
HPN	0.96	0.97	(0.36 – 2.59)
Hemoglobin	0.46	1.08	(0.88 -1.32)
Platelets	0.95	1.00	(0.99 – 1.00)
Albumin	0.16	0.53	(0.22 – 1.28)
Creatinine	**0.001**	2.45	(1.44 – 4.29)
ICU stay duration	0.10	1.13	(0.98 – 1.29)
GCS	**<0.001**	0.4	(0.26 – 0.62)
CTP score	**<0.001**	2.37	(1.59 – 3.53)
Child Pugh class			
– Child A	-		-
– Child B	0.71	0.64	(0.06 – 7.05)
– Child C	**0.03**	12.4	(1.4 – 112.1)
MELD	**<0.001**	1.34	(1.18 – 1.52)
MELD. Na	**<0.001**	1.36	(1.18 – 1.58)
MELD. L	**<0.001**	1.71	(1.34 – 2.18)
S. Lactate	**<0.001**	1.98	(1.38 – 2.83)
SOFA	**<0.001**	2.83	(1.81 – 4.45)
APACHE II	**<0.001**	2.44	(1.53 – 3.89)
CLIF-C ACLF	**<0.001**	1.35	(1.16 – 1.56)
MAP	**<0.001**	0.93	(0.89 – 0.97)

CTP: Child-Turcotte-Pugh, **MELD:** Model for End-Stage Liver Disease, **MELD. NA:** MELD Sodium, **MELD. L:** MELD Lactate**, SOFA:** sequential organ failure assessment, **APACHI:** Acute Physiology and Chronic Health Evaluation, **CLIF-C ACLF:** Chronic Liver Failure Consortium acute-on-chronic liver failure, **GCS:** Glascow coma score, **MAP:** Mean arterial Pressure, **S. Lactate:** serum lactate.

Table (6): Performance of different prognostic scores in predicting mortality using the optimal cut-off point.

Variables	Cutoff point	Sensitivity (%)	Specificity (%)	PPV	NPV	AUC
CTP	10	85.19%	75.47%	63.9%	90.91%	0.856
MELD	22	74.1%	90.57%	80%	87.27%	0.891
MELD.Na	23	85.19%	83.02%	71.88%	91.67%	0.909
MELD.L	17	77.78%	86.79%	75%	88.46%	0.904
S. lactate	36	59.26%	92.45%	80%	81.67%	0.790
SOFA	8	77.78%	100%	100%	89.83%	0.950
APACHE II	19	92.59%	96.23%	92.59%	96.23%	0.985
CLIF-C ACLF	54	66.67%	98.11%	94.74%	85.25%	0.915

CTP: Child-Turcotte-Pugh, **MELD:** Model for End-Stage Liver Disease, **MELD. NA:** MELD Sodium, **MELD. L:** MELD Lactate**, SOFA:** sequential organ failure assessment, **APACHI:** Acute Physiology and Chronic Health Evaluation, **CLIF-C ACLF:** Chronic Liver Failure Consortium acute-on-chronic liver failure, **GCS:** Glascow coma score, **MAP:** Mean arterial Pressure, **S. Lactate:** serum lactate.

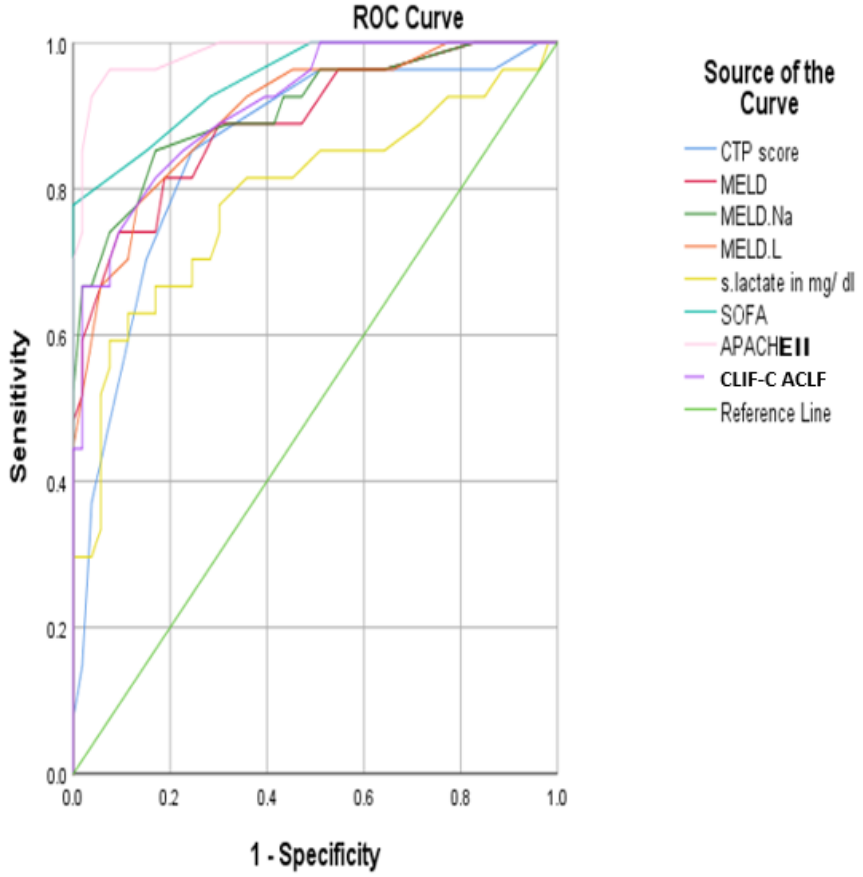

Figure (1): Comparison between different prognostic scores to predict mortality by AUC ROC analysis.

CTP: Child-Turcotte-Pugh, **MELD:** Model for End-Stage Liver Disease, **MELD. NA:** MELD Sodium, **MELD. L:** MELD Lactate, **SOFA:** sequential organ failure assessment, **APACHI:** Acute Physiology and Chronic Health Evaluation, **CLIF-C ACLF:** Chronic Liver Failure Consortium acute-on-chronic liver failure.

DISCUSSION

Stratification of cirrhotic patients still relies heavily on determining prognostic markers. This is useful for determining overall survival rates, determining the best course of treatment, and, ultimately, finding people who can benefit from liver transplants. This led to the development of a plethora of prognostic ratings. The APACHE II score has gained widespread acceptance and is used by several clinicians. The APACHE II served as the basis for developing the APACHE III scale. When deciding on a prognosis, the APACHE II and III consider age, chronic health, and physiology [17].

Our results showed that males comprised three-quarters of the patients and females just one-quarter. The majority of instances were males, according to the data. Approximately two-thirds of the patients were male, as found by Al Kaabi *et al*. [18], which aligns with our results. The fact that alcohol problems affect men at a higher rate than women may account for this observation.

The present study found that the participant's mean age was 65.5 ± 10.9 years. The median of ICU stay was 5 (3.31) days. This is in agreement with Al Kaabi *et al.* [18], who reported that the participants in the study had an average age of 58 ± 13.8 years, and their average hospital stay was 7 days, with an interquartile range of 4-12 days.

The mean ICU stay of 6.53 ± 3.21 days was shown by Abbasy *et al.* [19]. In univariate analysis, hospital length of stay and duration of intensive care unit stay were factors linked to death.

The current findings regarding the cause of ICU admission are in agreement with the results of Al Kaabi *et al.* [18], who illustrated that Within 28 days after the first decompensation, hepatic encephalopathy was responsible for 75% of the deaths, and it was also substantially linked to mortality within 90 days.

The current study found that the mortality rate among patients was 33.8 and this is in accordance with with Al Kaabi *et al.* [18], who stated that the overall mortality rate was approximately 40% within 90 days. Moreover, Abbasy *et al.* [19] illustrated that the mortality rate was 49.5%.

In the current study, we found statistically significant differences between mortality outcomes and baseline total leucocytic count, total bilirubin, aspartate aminotransferase, serum creatinine, serum sodium, and international normalized ratio; as the median of TLC, bilirubin, AST, creatinine and INR were higher among deceased patients and respectively, while the median of serum sodium was lower among deceased patients.

Similar findings were revealed by Bohra *et al.* [20], who stated that there was an inverse correlation between good prognosis and five laboratory variables: elevated serum bilirubin, urea, creatinine, and INR, as well as a low white blood cell count. Patients with liver cirrhosis have a clear link between bilirubin, renal function, and INR, which are extensively used in predictive risk stratification algorithms.

The current study results revealed statistically significant differences between ICU outcomes and different prognostic scales; the median of CTP score, MELD, MELD Na, MELD.L, S. Lactate, SOFA, APACHE II & CLIF CLIF-C ACLF were higher among deceased patients, while the median of GCS & MAP was lower among deceased patients. Regarding the Child-Pugh class, most deceased patients (85.2%) were class C, while most discharged patients (62.3%) were class B.

In accordance with our findings, Chen *et al.* [21] reported that ACLF scores on the APACHE III, CLIFOF, and CLIF-C measures may provide better overall mortality prediction for intensive care unit (ICU) admitted patients with ACLF. On the other hand, CLIF-C ACLF provides an easy and effective substitute for manual data collection and limited costs. With the assumption that 80% of patients would die if their futility scores were higher than the set thresholds, the APACHE III score was set at 125, and the CLIF-C ACLF score at 71. There is an approximate futility cutoff for CLIF-C ACLF scores, with values of 70 or higher linked to futility. These cutoffs could aid clinical decision-making, including when to discontinue treatments or use alternative tactics like rapid OLT assessment.

In the current study, significant positive correlations were revealed between serum lactate and CTP score, MELD score, MELD Na score, MELD lactate score, SOFA score, APACHE II score, and CLIF-C ACLF score. Furthermore, serum lactate showed a highly significant negative correlation with GCS and MAP scores.

This is in agreement with the findings revealed by Lin *et al.* [22], who showed that in a series of

critically ill cirrhotic patients admitted to the intensive care unit, the CLIF-C ACLF lactate score outperformed the CLIF-C ACLF and NACSELD ACLF scores, according to AUROC analysis. Patients with advanced liver disease often have suboptimal lactate clearance, which is linked to worse outcomes. Bedside blood gas analysis provides a rapid and inexpensive way to measure lactate level, which is a strong indicator of disease severity in critically sick patients with liver cirrhosis. The improved AUROC value of CLIF-C ACLF lactate compared to CLIFC ACLF in cirrhotic patients with ACLF may be explained by these results.

In the present study, we found that increased Creatinine levels, lower GCS, increased CTP scores, Child-Pugh C, increased MELD score, serum lactate, SOFA, APACHE, CLIF-C ACLF, and MAP scores are independent predictors for mortality.

This is in agreement with the results revealed by Abbasy *et al*. [19], who found, according to their multivariate analysis, low serum sodium, greater HE grades, and higher MELD, MELD-Na, and CLIF-SOFA scores were independent predictors of mortality. The CLIF SOFA score was the most robust independent predictor of mortality. Pan *et al.* [23] showed that patients with severe cirrhosis admitted to the intensive care unit on the first day of admission had excellent predictive tools like APACHE III and CLIF-SOFA scores.

The current study findings comparing different scores' performance in predicting mortality revealed that SOFA and APACHE scores showed the highest AUC, followed by CLIF-C ACLF, MELD Na, and MELD.L. In contrast, the MAP score showed the lowest AUC.

In accordance with our findings, Chen *et al.* [21] showed that according to time-dependent ROC curve research, APACHE III scores were significantly higher than other models for predicting overall mortality (AUROC: 0.817). Results were comparable when examining patients with chronic hepatitis B-related cirrhosis as a subgroup. Regarding 28-day mortality prediction, statistical significance was found to be more with CLIF-C OFs, CLIF-C ACLF, and APACHE III over Mortality Probability Admission Model (MPM0-III) and Simplified Acute Physiology Score (SAPS III).

Furthermore, Taş *et al.* [24] researched individuals admitted to the intensive care unit with varying degrees of hepatic encephalopathy who had a history of liver cirrhosis. A comparison of CLIF-SOFA, APACHE II, CTP, and MELD scores for mortality prediction showed that CLIF-SOFA was the best score for predicting prognosis in these patients.

Moreover, Dupont *et al.* [25] investigated the correlation between cirrhotic patients' SOFA, MELD, and CTP scores and mortality rates after intensive care unit admission. A total of 25.3% of the population died. SOFA, MELD, and CTP levels were substantially associated with death rates. SOFA, MELD, and CTP all had AUROC values of 0.82, 0.81, and 0.76, correspondingly. The two most reliable predictors of mortality while hospitalized were SOFA and MELD scores.

Costa e Silva *et al.* [26] revealed that CCI, APACHE II), CTP, SOFA, MELD (and its variants), CLIF-SOFA, and CLIF-COF all performed better in this patient group compared to other general ICU and liver-specific scores. A higher SOFA score was formerly linked to improved prognosis, especially when contrasted with lower MELD and CTP scores. Given these results, the CLIF-C team revised the SOFA score to include INR rather than platelet count (CLIFSOFA) to assess organ failure and liver dysfunction in critically sick cirrhotic patients (CLIF-C OF). It should be noted that when predicting death, both scores were more effective than SOFA.

CONCLUSIONS

When compared to previous models, SOFA and APACHE scores were superior in the predicting the overall mortality among patients at the ICU with decompensated liver cirrhosis. The selection of an appropriate prognostic score should be based on clinical judgment, considering each patient's specific needs and characteristics. One benefit of CLIF-SOFA is that it considers the work of several important organs at once. These include the liver (bilirubin and INR), the brain (encephalopathy), the kidneys (creatinine), the heart (mean arterial blood pressure), and the lungs (PaO2, FiO2). However, the usual scores overlook these functions that we think are crucial to examine in critically sick patients admitted to the ICU (MELD and CTP).

Conflict of interest: The authors declared that they have no conflicts of interest with respect to the authorship and publication of this article.

Financial Disclosures: This study was not supported by any source of funding.

REFERENCES

1. Asrani SK, Devarbhavi H, Eaton J, Kamath PS. The burden of liver diseases in the world. J Hepatol. 2019;70(1):151-71.
2. Garcia-Tsao G, Abraldes JG, Berzigotti A, Bosch J. Portal hypertensive bleeding in cirrhosis: Risk stratification, diagnosis, and management: 2016 practice guidance by the American Association for the study of liver diseases [published correction appears in Hepatology. 2017; 66(1):304]. Hepatology. 2017;65(1):310-35.
3. Nadim MK, Durand F, Kellum JA, Levitsky J, O'Leary JG, Karvellas CJ, et al. Management of the critically ill patient with cirrhosis: A multidisciplinary perspective. J Hepatol. 2016; 64(3):717-35.
4. Tsochatzis EA, Bosch J, Burroughs AK. Liver cirrhosis. Lancet. 2014; 383(9930):1749-61.
5. Levesque E, Hoti E, Azoulay D, Ichaï P, Habouchi H, Castaing D, et al. Prospective evaluation of the prognostic scores for cirrhotic patients admitted to an intensive care unit. J Hepatol. 2012; 56(1):95-102.
6. Sauneuf B, Champigneulle B, Soummer A, Mongardon N, Charpentier J, Cariou A, et al. Increased survival of cirrhotic patients with septic shock. Crit care. 2013; 17(2): R78.
7. Michard B, Artzner T, Lebas B, Besch C, Guillot M, Faitot F, et al. Liver transplantation in critically ill patients: Preoperative predictive factors of post-transplant mortality to avoid futility. Clin Transplant. 2017;31(12).
8. Vincent JL, Moreno R. Clinical review: scoring systems in the critically ill. Crit Care. 2010;14(2):207.
9. Kamath PS, Wiesner RH, Malinchoc M, Kremers W, Therneau TM, Kosberg CL, et al. A model to predict survival in patients with end-stage liver disease. Hepatol. 2001; 33(2):464-70.
10. Huo TI, Wang YW, Yang YY, Lin HC, Lee PC, Hou MC, et al. Model for end-stage liver disease score to serum sodium ratio index as a prognostic predictor and its correlation with portal pressure in patients with liver cirrhosis. Liver Int. 2007; 27(4):498-506.
11. Jalan R, Pavesi M, Saliba F, Amorós A, Fernandez J, Holland-Fischer P, et al. The CLIF Consortium Acute Decompensation score (CLIF-C ADs) for prognosis of hospitalised cirrhotic patients without acute-on-chronic liver failure [published correction appears in J Hepatol. 2015;63(1):291]. J Hepatol. 2015;62(4):831-40.
12. Bailey EM, Krakovsky DJ, Rybak MJ. The triazole antifungal agents: a review of itraconazole and fluconazole. Pharmacotherapy. 1990; 10(2): 146-53.
13. Bahtouee M, Eghbali S. S, Maleki N, Rastgou V, Motamed N. Acute Physiology and Chronic Health Evaluation II score for the assessment of mortality prediction in the intensive care unit: a single-centre study from Iran. Nurs. Crit. Care. 2019; 24(6): 375-80.
14. Wong VW, Chim AM, Wong GL, Sung JJ, Chan H.L. Performance of the new MELD-Na score in predicting 3-month and 1-year mortality in Chinese patients with chronic hepatitis B. Liver Transpl. 2007; 13(9): 1228-35.
15. Li X, Gong M, Fu S, Zhang J, Wu S. Establishment of MELD-lactate clearance scoring system in predicting death risk of critically ill cirrhotic patients. BMC Gastroenterol, 2022; 22(1): 280.
16. Ferreira FL, Bota DP, Bross A, Mélot C, Vincent JL. Serial evaluation of the SOFA score to predict outcome in critically ill patients. Jama. 2001; 286(14): 1754-8.
17. Teerasarntipan T, Thanapirom K, Chirapongsathorn S, Suttichaimongkol T, Chamroonkul N, Bunchorntavakul C, et al. Validation of prognostic scores predicting mortality in acute liver decompensation or acute-on-chronic liver failure: A Thailand multicenter study. PLoS One. 2022; 17(11): e0277959.
18. Al Kaabi H, Al Alawi AM, Al Falahi Z, Al-Naamani Z, Al Busafi SA. Clinical Characteristics, Etiology, and Prognostic Scores in Patients with Acute Decompensated Liver Cirrhosis. J Clin Med. 2023; 12(17): 5756.
19. Abbasy M, Zaghla H, Elhelbawy M, Ramadan M, Zakareya T. Predicting in-hospital mortality of cirrhotic patients hospitalized with hepatic encephalopathy. Egypt. Liver J. 2022; 12(1): 1-7.
20. Bohra A, Worland T, Hui S, Terbah R, Farrell A, Robertson M. Prognostic significance of hepatic encephalopathy in patients with cirrhosis treated with current standards of care. WJG. 2020; 26(18): 2221.
21. Chen BH, Tseng HJ, Chen WT, Chen PC, Ho YP, Huang CH, et al. Comparing Eight Prognostic Scores in Predicting Mortality of Patients with Acute-On-Chronic Liver Failure Who Were Admitted to an ICU: A Single-Center Experience. J Clin Med. 2020; 9(5):1540.

22.Lin SH, Chen WT, Tsai MH, Kuo WL, Wang SF, Liu Y, et al. Comparing Three Profoundly Influential Prognostic Scores in Cirrhotic Patients with Acute-on-Chronic-Liver Failure Admitted to the ICU: Prediction of One-Month Mortality-A Retrospective Cohort Study. Diagnostics (Basel). 2023;13(20):3160.
23.Pan HC, Jenq CC, Tsai MH, Fan PC, Chang CH, Chang MY, et al. Scoring systems for 6-month mortality in critically ill cirrhotic patients: a prospective analysis of chronic liver failure–sequential organ failure assessment score (CLIF-SOFA). Aliment pharmacol ther. 2014; 40(9): 1056-65.
24.Taş A, Yalçın MS, Sarıtaş B, Kara B. Comparison of prognostic systems in cirrhotic patients with hepatic encephalopathy. Turk J Med Sci. 2018; 48(3):543-7.
25.Dupont B, Delvincourt M, Koné M, du Cheyron D, Ollivier-Hourmand I, Piquet MA, et al. Retrospective evaluation of prognostic score performances in cirrhotic patients admitted to an intermediate care unit. Dig Liver Dis. 2015; 47(8): 675-81.
26.Costa E Silva PP, Codes L, Rios FF, Esteve CP, Valverde Filho MT, Lima DOC, et al. Comparison of general and liver-specific prognostic scores in their ability to predict mortality in cirrhotic patients admitted to the intensive care unit. Can J Gastroenterol Hepatol. 2021; 2021:9953106.

To Cite:

Yousif, M., Mahmoud, O., Magahed, M., Samir, G. Comparing Prognostic Scores of Mortality among Patients with Decompensated Liver Cirrhosis Admitted to the Medical Intensive Care Unit. *Zagazig University Medical Journal*, 2024; (1519-1530): -. doi: 10.21608/zumj.2024.282261.3327