Prognostic values of MESO index in patients with decompensated cirrhosis

Nguyen Thi Thuan[1], Nguyen Manh Huy[1], Nguyen Duc Thao[1], Tran Van Huy[2*]

(1) Department of Gastroenterology, Danang Hospital

(2) Department of Internal Medicine, University of Medicine and Pharmacy, Hue University

Abstract

Background: The models for end-stage liver disease (MELD) and serum sodium (SNa) are common prognostic markers in cirrhosis. A novel score, MELD to SNa ratio (MESO), was developed to amplify the opposing effect of MELD and SNa on outcome prediction. The aims of this study were to evaluate the prognostic value of MELD score for complications (acute variceal bleeding, spontaneous bacterial peritonitis, hepatic encephalopathy, hepatorenal syndrome and mortality) in decompensated cirrhotic patients 6 months after hospitalization. **Patients and methods:** 123 patients with decompensated cirrhotic, admitted to Da Nang between February 2021 and May 2022, were included. Each patient's MESO score was calculated at the time of admission. All patients were followed up for 6 months to assess the following events:acute variceal bleeding, spontaneous bacterial peritonitis, hepatic encephalopathy, hepatorenal syndrome and mortality. **Results:** The mean MESO score for all patients was 1.3 ± 0.4; it was 1.0 ± 0 for patients in group Child-Pugh A; 1.04 ± 0.1 for Child-Pugh B; and 1.5 ± 0.5 for Child-Pugh C. MESO score to predict mortality for 6 months after hospitalization (with a cut-off 1.25; AUC 0.74; sensitivity and specificity are 65.1% and 75%) and to predict hepatorenal syndrome (with a cut-off 1.85; AUC 0.75; sensitivity and specificity are 60.0% and 89.4%), and to predict hepatic encephalopathy (with a cut-off 1.55; AUC 0.69; sensitivity and specificity are 42.9% and 91.4%). The MESO score had no prognostic value for acute variceal bleeding and spontaneous bacteremia peritonitis 6 months after hospitalization in this study. **Conclusions:** MESO score is a valuable prognostic tool of mortality, hepatorenal syndrome, and hepatic encephalopathy in decompensated cirrhotic patients six months after hospitalization.

Keywords: *cirrhosis, MELD score, MESO score.*

1. INTRODUCTION

Cirrhosis is a common disease and a major cause of death. Globally, mortality cases of cirrhosis increased by 47.15% [1]. The common causes of death in cirrhosis are the complications of decompensated cirrhosis, especially refractory ascites, hepatorenal syndrome, and hepatic encephalopathy.

Hyponatremia is one of the independent prognostic factors of mortality in patients with decompensated cirrhosis and thus sodium-based scores, including MELD-Na, IMELD… have been shown to have prognostic values in cirrhotic patients [2], [3].

Recently, MESO (MELD to sodium ratio), by amplyfing the opposite effect of MELD and serum sodium, have been shown by some studies a good prognostic value in patients with decompensated cirrhosis. Data about prognostic value of the MESO score in Vietnamese patients of cirrhosis is still limited. We conducted this study to survey the MESO score in patients with decompensated cirrhosis and to assess the value of the MESO score in predicting some complications and mortality in this group of patients.

2. PATIENTS AND METHODS

2.1. Research subjects

Criteria for choosing a patient

Patients diagnosed with decompensated cirrhosis treated at the Department of Gastroenterology, Da Nang Hospital, from February 2021 to May 2022.

Diagnostic criteria for decompensated cirrhosis

Clinically, it is based on two syndromes: hepatocellular insufficiency syndrome and portal hypertension syndrome.

Cirrhosis is decompensated when there is one of the following manifestations: ascites, variceal bleeding, jaundice, and hepatic encephalopathy, hepatorenal syndrome, spontaneous bacterial peritonitis, and hyponatremia in patients with ascites [4].

Patient exclusion criteria

Cirrhotic patients with an abdominal CT scan or abdominal ultrasound suspect hepatocellular carcinoma. Cirrhotic patients with comas suspected of other causes: stroke, poisoning. The patients did not have enough tests to be classified according to MESO, Child-Pugh. Cirrhotic patients with pre-existing kidney disease.

Corresponding Author: Tran Van Huy

Email: tvanhuy@hueuni.edu.vn; tvhuy@huemed-univ.edu.vn

DOI: 10.34071/jmp.2024.6.18

Received: 19/9/2024; Accepted: 14/11/2024; Published: 25/12/2024

2.2. Method of proceeding

Select patients with cirrhosis according to the selection criteria.

Data recorded: age, gender, occupation, and history of liver disease. Symptoms: anorexia, fatigue, palmar erythema, spider nevus, ascites, hepatomegaly, jaundice, edema of the lower extremities, and splenomegaly. Determine the cause of cirrhosis due to alcohol, HBV, HCV, alcohol and viral causes. Platelets, prothrombin time, INR, ALT, AST, albumin, bilirubin, creatinine, serum sodium, and upper gastrointestinal endoscopy with or without esophageal varices were all measured.

MELD index = 3.8 x ln(serum bilirubin [mg/dL) + 11.2 x ln(INR) + 9.6 x ln(serum creatinine [mg/dL) + 6.4 [5].

MESO index = (MELD/serum Na mEq/l) x 10 [12].

Child-Pugh scale divided into levels: Child-Pugh A: 5-6 points, Child-Pugh B: 7-9 points, Child-Pugh C: 10-15 points.

Follow-up within 6 months of the time of admission should be done by direct examination and interviewing patients or relatives by phone at least once a month for the following events: gastrointestinal bleeding, hepatic encephalopathy, spontaneous bacterial peritonitis, hepatorenal syndrome, and death.

Table 1. Child-Pugh classification [6]

Clinical and Lab Criteria	1 point	2 points	3 points
Ascites	None	Mild to moderate	Severe
Hepatic Encephalopathy	Grade 0	Grade 1 or 2	Grade 3 or 4
Albumin (g/l)	> 35	28 - 35	< 28
Bilirubin (umol/l)	< 35	35 - 50	> 50
Prothrombin time ratio (%)	54 - 100	44 - 54	< 44

2.3. Study Design: a cross-sectional descriptive study.

2.4. Data analysis method: according to the medical statistics method and SPSS 26.0 software.

3. RESULTS

From February 2021 to May 2022, there were 123 patients at the Department of Gastroenterology, Da Nang Hospital, who met the selection criteria. All patients were followed for a period of six months. Of the 80 patients who survived, 43 died; 75 (61%) patients had gastrointestinal bleeding; 42 (34.1%) patients had hepatic encephalopathy; 13 (10.6%) patients had spontaneous bacterial peritonitis; and 10 (8.1%) patients had hepatorenal syndrome.

3.1. MESO score in patients with decompensated cirrhosis

Table 2. General characteristics of research subjects

Characteristic		
	Male/female, %	82.9/17.1
	Mean age	54.7 ± 10.4
	Etiology: alcohol/alcohol and virus/HBV/HCV/other (%)	61/17.1/10.6/1.6/9.8
MESO score	Median (Min : Max)	1.1 (1 - 1.4)
	Mean	1.3 ± 0.4
Mean MELD score	Male/female	1.3 ± 0.4 /1.4 ± 0.4
	Child- Pugh A/B/C	1 ± 0/1.04 ± 0.1/1.5 ± 0.5

Males were predominated. Alcohol was the most common cause. The mean MESO score was 1.3 ± 0.4, with a statistically significant difference between the group of Child-Pugh.

Table 3. Factors related to the MESO score

Events	Status	MESO	p
Gastrointestinal bleeding	Yes	1.2 ± 0.3	<0.001
	No	1.5 ± 0.5	
Spontaneous Bacterial Peritonitis (SBP)	Yes	1.4 ± 0.4	0.297
	No	1.3 ± 0.5	

Hepatic Encephalopathy (HE)	Yes	1.6 ± 0.6	≤0.001
	No	1.2 ± 0.3	
Hepatorenal Syndrome (HRS)	Yes	1.8 ± 0.7	0.006
	No	1.3 ± 0.4	
Death	Yes	1.6 ± 0.6	<0.001
	No	1.2 ± 0.3	

A statistically significant difference in MESO scores was between groups of patients with GI bleeding, hepatic encephalopathy, hepatorenal syndrome, and death.

3.2. Prognostic value of the MESO score for 6-month events in patients with decompensated cirrhosis

Table 4. The area under the ROC curve and the cut-off value of the MESO score in the prognosis of death, spontaneous bacterial peritonitis (SBP), hepatic encephalopathy (HE), hepatorenal syndrome (HRS) occurring within 6 months of the time of admission

Events	AUC	85% CI	Cut-off	Sensitivity	Specificity	p
Death	0.74	0.65 - 0.84	≥1.25	65.1 (56.7 - 73.5)	75 (67.4 - 82.6)	<0.001
HE	0.69	0.59 - 0.80	≥1.55	42.9 (34.2 - 51.6)	91.4 (86.5 - 96.3)	0.001
SBP	0.59	0.43 - 0.74	≥1.15	61.5 (52.9 - 70.1)	57.3 (48.6 - 66)	0.32
HRS	0.75	0.57 - 0.93	≥1.85	60 (51.4 - 68.6)	89.4 (84 - 94.8)	0.009

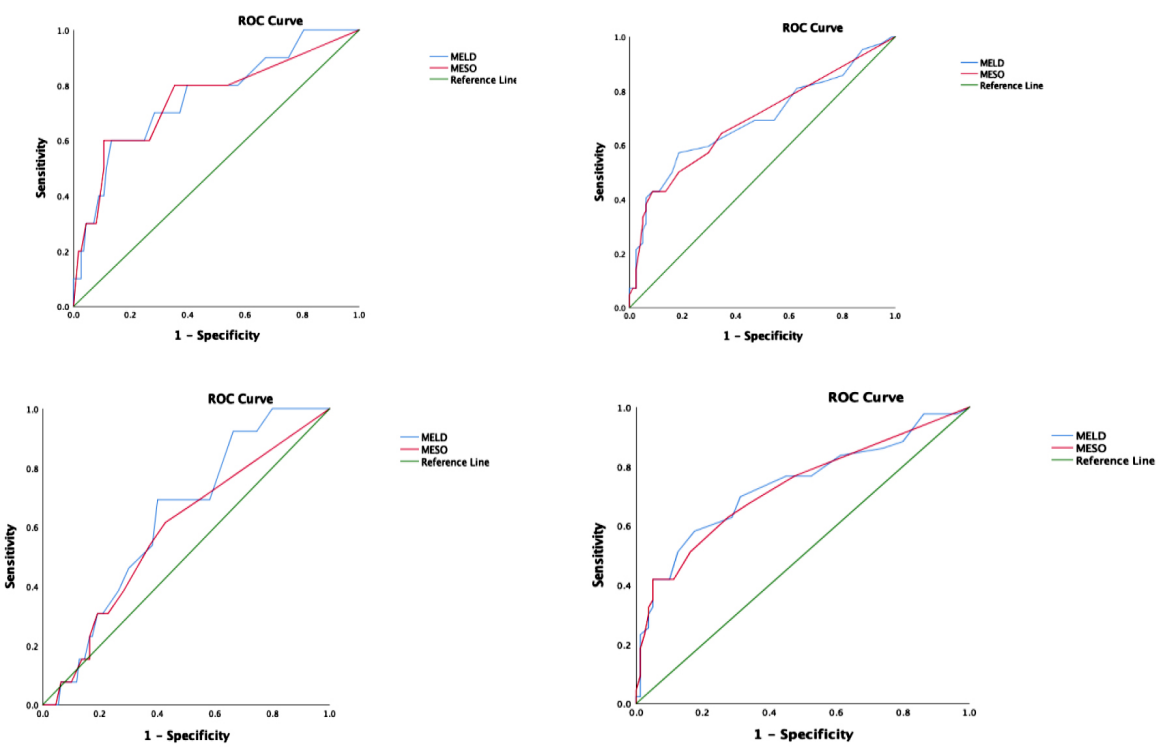

Figure 1. ROC curves of MESO and MELD score for events occurring in 6 months from the time of admission

Table 5. Relationship between MESO and some complications in study subjects

	Crude HR (95% CI)	p
All complications	0.99 (0.6 - 1.6)	0.981
Death	4.2 (2.5 - 7.1)	<0.001
SBP	1.4 (0.5 - 4.1)	0.570
HE	3.3 (1.9 - 5.6)	<0.001
HRS	5.1 (2.0 - 13.1)	0.001

There was a statistically significant relationship between the change in MESO score and hepatic encephalopathy, hepatorenal syndrome, and mortality.

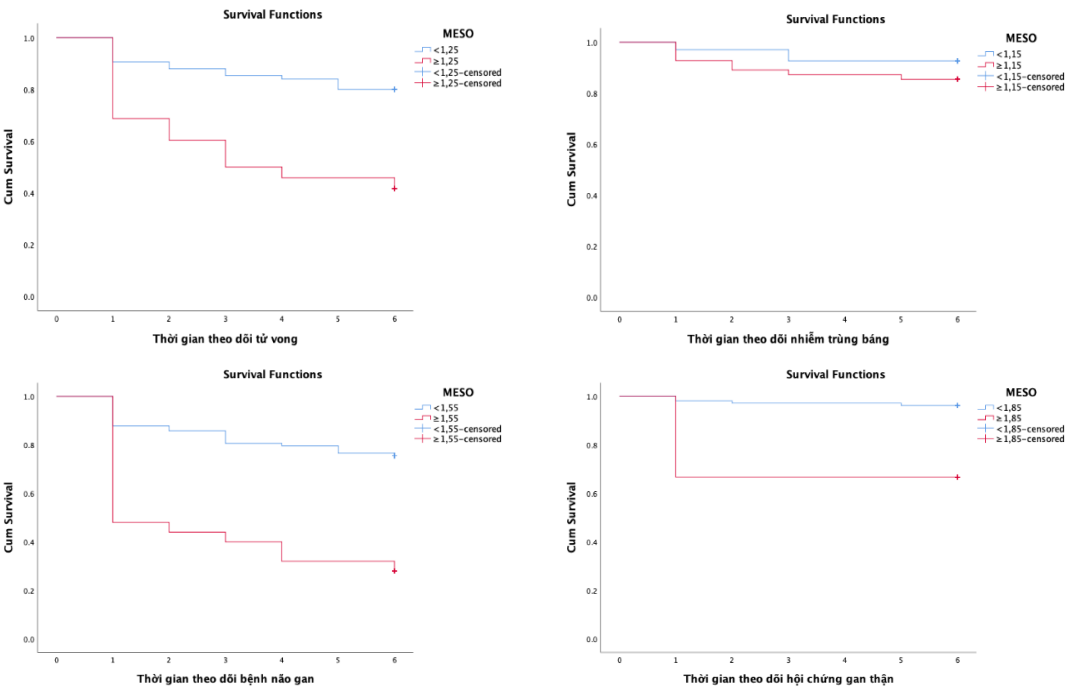

Figure 2. MESO's probability of not occurring events over time

4. DICUSSION

The MELD scoring system has been widely applied in recent years and shown to predict mortality across a broad spectrum of liver diseases in most studies [7], [8], [9], [10]. The utilization of the MELD has been demonstrated to have an equal or better ability in short term or medium term outcome prediction in comparison with the CTP system [11], [12], [13]. In addition, the application of the MELD system has been shown to be a useful model in predicting the outcome of patients with cirrhosis undergoing surgical procedures for hepatocellular carcinoma or non–hepatocellular carcinoma conditions [14], [15].

Hyponatremia often indicates a state of hepatic decompensation in patients with liver cirrhosis and is strongly associated with the risk of mortality [16], Many studies have also proposed Na-containing MELD-based prognostic models, MELD- Na has been extensively studied and demonstrated to be valuable in mortality prognosis [17], [18], [19], [20]. Recently, Huo et al presented a study on the MESO score, created intuitively in patients undergoing portal hemodynamic measurements [18].

Table 2 showed that the mean MESO score of the research group was 1.3 ± 0.4, the highest MESO score was 2.9, and the lowest MESO score was 1. El-Ghannam et al. reported that the mean MESO score was 1.259 ± 0.029 in a study of 777 patients with decompensated cirrhosis [21]. According to Fayad, the mean MESO score was 1.23 ± 0.55 when 123 patients with acute decompensated cirrhosis were studied [22]. According to Lv Xiao, the mean MESO score in cirrhotic patients was 1.1 ± 0.5, the highest MESO was 3.2, and the lowest was 0.4 [23]. Marroni

et al. studied on 558 cirrhotic patients and recorded a mean MESO score of 1.1 ± 0.4 [24].

Table 3 showed the MESO score in patients who eventually died was 1.6 ± 0.6; in the group of survivors, the MESO score was 1.2 ± 0.3. Thus, the mean MESO score in the mortality group was statistically significantly higher than in the surviving group (p<0.001). Our results are consistent with Jiang's: the MESO score in patients who were alive within 3 months was 0.99 ± 0.42, in patients who died, it was 1.59 ± 0.82, and there was a significant difference between the 2 groups with p<0.001 [25]. Silva et al. and Mangla et al. also noted that there was a difference in MESO score in the surviving group and the mortality group (p<0.001) [26], [27].

In our study, the mean MESO score of the group without gastrointestinal bleeding (1.5 ± 0.5) was statistically significantly higher than that of the group with gastrointestinal bleeding (1.2 ± 0. 3) with p<0.001. Huo et al. reported that the mean MESO score of the group with gastrointestinal bleeding was 1.06 ± 0.56, lower than the group without gastrointestinal bleeding complications, with a mean value of 1.14 ± 0.54 [28].

Table 3 also showed that patients with spontaneous bacterial peritonitis, hepatic encephalopathy, and hepatorenal syndrome had higher MESO scores than those without. Huo has also found that patients with hepatic encephalopathy, hepatorenal syndrome, and ascites infection had higher MESO scores than the group without the above events [22].

Table 4 showed that the MESO score cutoff for the best 6-month mortality prognosis was 1.25 with a sensitivity of 65.1%, a specificity of 75%, and an area under the ROC curve (AUC) of 0.74; this was statistically significant (p<0.001) and had a moderate prognostic value. Our findings are consistent with Jiang's, which had a MESO AUC in mortality prognosis of 0.723. According to Fayad, the cut-off value of the MESO score in predicting mortality was 1.3 with a sensitivity of 74% and a specificity of 78%, with an AUC of 0.784 [22]. On the other hand, Huo et al. recorded the highest AUC of MESO in predicting mortality at 0.86 with a sensitivity of 67% and specificity of 84% [28]. Overall, studies have shown that the MESO score had a moderate to high prognostic value in predicting mortality within 3 to 6 months in patients with decompensated cirrhosis. The higher the MESO score, the worse the prognosis and the higher risk of death.

Table 4 showed the optimal cut-off value for predicting hepatic encephalopathy within 6 months of the time of admission was 1.55, weak prognostic value, area under the ROC curve (AUC=0.69), with sensitivity and specificity values of 42.9%, 91.4%, and statistically significant (p = 0.001), respectively. The optimal cut-off value of the MESO score in hepatorenal syndrome was 1.85, the area under the ROC curve (AUC) = 0.74, which had a moderate predictive value with a sensitivity of 60% and a specificity of 89.4%, statistically significant (p=0.009).

According to many authors, the prognostic value of the MESO score for gastrointestinal bleeding was very weak [18] and in our study, the prognostic value of the MESO score for gastrointestinal bleeding and spontaneous bacterial peritonitis was very weak. Probability of no events over time by MESO

Figure 2 showed the survival probability in the group of patients with MESO score ≥1.25 was lower than in the group of patients with MESO score <1.25 (p<0.001). After 6 months, the group of patients with MESO score ≥1.25 only had 41.7% survival, while up to 80% of patients in the group with MESO score < 1.25 were still alive. Hassan et al. found that patients with MESO scores >1.2 had a higher risk of death than patients with MESO scores <1.2 (p < 0.001) [29]. Radisavljevie et al. found that when MESO > 1.85, the risk of death within 3 months increased 4.04 times, with p = 0.008 [30].

Figure 2 also showed that the probability of not having spontaneous bacterial peritonitis in the group of patients with MESO score ≥1.15 was lower than in the group of patients with MESO score <1.15, but this difference was not statistically significant with p=0.19. Within 6 months of follow-up, the group of patients with MESO score ≥1.15 and MESO score <1.15 had rates of no spontaneous bacterial peritonitis of 85.5% and 92.6%, respectively. The probability of not having hepatic encephalopathy was lower in the group of patients with MESO score ≥1.55 than in the other group; this was statistically significant (p<0.001). Specifically, within 6 months of follow-up, the group of patients with MESO index ≥1.55 and the group with MESO index <1.55 had rates of no hepatic encephalopathy syndrome of 28% and 75.5%, respectively. Likewise, within 6 months of follow-up, the probability of not having hepatorenal syndrome in the group of patients with MESO index ≥1.85 was lower than that in the group with HRS, this difference was statistically significant with p<0.001. Specifically, the group of patients with MESO index ≥1.85 and MESO <1.85 had rates of no occurrence of hepatorenal syndrome of 66.7% and

96.2%, respectively.

In conclusion, the MESO score has the value to predict survival for patients with cirrhosis in general as well as to predict the possibility of non-occuring of some complications such as hepatic encephalopathy and hepatorenal syndrome in decompensated cirrhotic patients six months after hospitalization

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions

NTT, VHT designed the study, wrote the manuscript. NTT, NMH, NDT collected, analyzed and interpreted the data. NTT and VHT critically reviewed, edited and approved the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest: None

REFERENCES

1. Ye, F., Zhai, M., Long, J., Gong, Y., Ren, C., Zhang, D., Lin, X., & Liu, S. (2022). "The burden of liver cirrhosis in mortality: Results from the global burden of disease study". *Frontiers in Public Health*. https://doi.org/10.3389/fpubh.2022.909455.

2. Brown, C., Aksan, N., & Muir, A. J. (2022). "MELD-Na Accurately Predicts 6-Month Mortality in Patients with Decompensated Cirrhosis: Potential Trigger for Hospice Referral". *Journal of Clinical Gastroenterology*. https://doi.org/10.1097/MCG.0000000000001642.

3. Puentes, J. C. P., Rocha, H., Nicolau, S., & Ferrão, G. (2018). "Effectiveness of the MELD/Na score and the Child-Pugh score for the identification of palliative care needs in patients with cirrhosis of the liver". *Indian Journal of Palliative Care*. https://doi.org/10.4103/IJPC.IJPC_97_18.

4. McCormick, P. A., & Jalan, R. (2018). "Hepatic cirrhosis". *Sherlock's Diseases of the Liver and Biliary System*, p. 107–126.

5. Wedd, J., & Nair, K. (2019). "Predicting Future Complications of Cirrhosis". *Current Hepatology Reports*. https://doi.org/10.1007/s11901-019-00445-5.

6. Durand, F., & Valla, D. (2008). "Assessment of prognosis of cirrhosis". In *Seminars in Liver Disease*. https://doi.org/10.1055/s-2008-1040325.

7. Ahmad, J., Downey, K. K., Akoad, M., & Cacciarelli, T. V. (2007). "Impact of the MELD score on waiting time and disease severity in liver transplantation in United States veterans". *Liver Transplantation*. https://doi.org/10.1002/lt.21262.

8. Al Sibae, M. R., & Cappell, M. S. (2011). "Accuracy of MELD scores in predicting mortality in decompensated cirrhosis from variceal bleeding, hepatorenal syndrome, alcoholic hepatitis, or acute liver failure as well as mortality after non-transplant surgery or tips". In *Digestive Diseases and Sciences*. https://doi.org/10.1007/s10620-010-1390-3.

9. Dunn, W., Jamil, L. H., Brown, L. S., Wiesner, R. H., Kim, W. R., Menon, K. V. N., Malinchoc, M., Kamath, P. S., & Shah, V. (2005). "MELD accurately predicts mortality in patients with alcoholic hepatitis". *Hepatology*. https://doi.org/10.1002/hep.20503.

10. Wiesner, R. H., McDiarmid, S. V., Kamath, P. S., Edwards, E. B., Malinchoc, M., Kremers, W. K., Krom, R. A. F., & Kim, W. R. (2001). "Meld and Peld: Application of survival models to liver allocation". *Liver Transplantation*, *7*(7), p. 567–580. https://doi.org/10.1053/jlts.2001.25879.

11. Huo, T.-I., Wu, J.-C., Lin, H.-C., Lee, F.-Y., Hou, M.-C., Lee, P.-C., Chang, F.-Y., & Lee, S.-D. (2005). "Evaluation of the increase in model for end-stage liver disease (ΔMELD) score over time as a prognostic predictor in patients with advanced cirrhosis: risk factor analysis and comparison with initial MELD and Child–Turcotte–Pugh score". *Journal of Hepatology*, *42*(6), p. 826–832.

12. Schepke, M. (2003). "Comparison of MELD, Child-Pugh, and Emory model for the prediction of survival in patients undergoing transjugular intrahepatic portosystemic shunting". *The American Journal of Gastroenterology*. https://doi.org/10.1016/s0002-9270(03)00295-8.

13. Wiesner, R., Edwards, E., Freeman, R., Harper, A., Kim, R., Kamath, P., Kremers, W., Lake, J., Howard, T., Merion, R. M., Wolfe, R. A., Krom, R., Colombani, P. M., Cottingham, P. C., Dunn, S. P., Fung, J. J., Hanto, D. W., McDiarmid, S. V., Rabkin, J. M., … Wegman, L. R. (2003). "Model for end-stage liver disease (MELD) and allocation of donor livers". *Gastroenterology*, *124*(1), p. 91–96. https://doi.org/10.1053/gast.2003.50016.

14. Befeler, A. S., Palmer, D. E., Hoffman, M., Longo, W., Solomon, H., & Di Bisceglie, A. M. (2005). "The safety of intra-abdominal surgery in patients with cirrhosis: Model for end-stage liver disease score is superior to Child-Turcotte-Pugh classification in predicting outcome". *Archives of Surgery*. https://doi.org/10.1001/archsurg.140.7.650.

15. Cucchetti, A., Ercolani, G., Vivarelli, M., Cescon, M., Ravaioll, M., La Barba, G., Zanello, M., Grazi, G. L., & Pinna, A. D. (2006). "Impact of model for end-stage liver disease (MELD) score on prognosis after hepatectomy for hepatocellular carcinoma on cirrhosis". *Liver Transplantation*. https://doi.org/10.1002/lt.20761.

16. Alukal, J. J., John, S., & Thuluvath, P. J. (2020). "Hyponatremia in Cirrhosis: An Update". In *American Journal of Gastroenterology*. https://doi.org/10.14309/ajg.0000000000000786.

17. Annamalai, A., Harada, M. Y., Chen, M., Tran, T., Ko, A., Ley, E. J., Nuno, M., Klein, A., Nissen, N., & Noureddin, M. (2017). "Predictors of Mortality in the Critically Ill Cirrhotic Patient: Is the Model for End-Stage Liver Disease Enough?". *Journal of the American College of Surgeons*. https://doi.org/10.1016/j.jamcollsurg.2016.11.005.

18. Huo, T. I., Wang, Y. W., Yang, Y. Y., Lin, H. C., Lee,

P. C., Hou, M. C., Lee, F. Y., & Lee, S. D. (2007). "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 International*. https://doi.org/10.1111/j.1478-3231.2007.01445.x.

19. Luca, A., Angermayr, B., Bertolini, G., Koenig, F., Vizzini, G., Ploner, M., Peck-Radosavljevic, M., Gridelli, B., & Bosch, J. (2007). "An integrated MELD model including serum sodium and age improves the prediction of early mortality in patients with cirrhosis". *Liver Transplantation*. https://doi.org/10.1002/lt.21197.

20. Ruf, A., Dirchwolf, M., & Freeman, R. B. (2022). "From Child-Pugh to MELD score and beyond: Taking a walk down memory lane". In *Annals of Hepatology*. https://doi.org/10.1016/j.aohep.2021.100535.

21. El-Ghannam, M. T., Hassanien, M. H., El-Talkawy, M. D., Saleem, A. A. A., Sabry, A. I., & Abu Taleb, H. M. (2017). "Performance of disease-specific scoring models in intensive care patients with severe liver diseases". *Journal of Clinical and Diagnostic Research*, *11*(6), p. OC12–OC16. https://doi.org/10.7860/JCDR/2017/24543.9980.

22. Fayad, L., Narciso-Schiavon, J. L., Lazzarotto, C., Ronsoni, M. F., Wildner, L. M., Bazzo, M. L., Schiavon, L. de L., & Dantas-Corrêa, E. B. (2015). "The performance of prognostic models as predictors of mortality in patients with acute decompensation of cirrhosis". *Annals of Hepatology*. https://doi.org/10.1016/s1665-2681(19)30804-x.

23. Lv, X. H., Liu, H. B., Wang, Y., Wang, B. Y., Song, M., & Sun, M. J. (2009). "Validation of model for end-stage liver disease score to serum sodium ratio index as a prognostic predictor in patients with cirrhosis". *Journal of Gastroenterology and Hepatology (Australia)*. https://doi.org/10.1111/j.1440-1746.2009.05913.x.

24. Marroni, C. P., De Mello Brandao, A. B., Hennigen, A. W., Marroni, C., Zanotelli, M. L., Cantisani, G., & Fuchs, S. C. (2012). "MELD scores with incorporation of serum sodium and death prediction in cirrhotic patients on the waiting list for liver transplantation: A single center experience in southern brazil". *Clinical Transplantation*. https://doi.org/10.1111/j.1399-0012.2012.01688.x.

25. Jiang, M., Liu, F., Xiong, W. J., Zhong, L., & Chen, X. M. (2008). "Comparison of four models for end-stage liver disease in evaluating the prognosis of cirrhosis". *World Journal of Gastroenterology*. https://doi.org/10.3748/wjg.14.6546.

26. Costa E Silva, P. P., Codes, L., Rios, F. F., Esteve, C. P., Valverde Filho, M. T., Lima, D. O. C., De Almeida Filho, G. F., Morais, M. C. A., Lima, B. C., Chagas, P. B. D. O., Boa-Sorte, N., & Bittencourt, P. L. (2021). "Comparison of General and Liver-Specific Prognostic Scores in Their Ability to Predict Mortality in Cirrhotic Patients Admitted to the Intensive Care Unit". *Canadian Journal of Gastroenterology and Hepatology*. https://doi.org/10.1155/2021/9953106.

27. Mangla, N., Bokarvadia, R., Jain, M., Varghese, J., & Venkataraman, J. (2019). "Scoring systems that predict mortality at admission in end-stage liver disease". *Indian Journal of Critical Care Medicine*, *23*(10), p. 445–448. https://doi.org/10.5005/jp-journals-10071-23261.

28. Huo, T. I., Lin, H. C., Huo, S. C., Lee, P. C., Wu, J. C., Lee, F. Y., Hou, M. C., & Lee, S. D. (2008). "Comparison of four model for end-stage liver disease-based prognostic systems for cirrhosis". *Liver Transplantation*. https://doi.org/10.1002/lt.21439.

29. Hassan, E. A., & Abd El-Rehim, A. S. E. D. (2013). "A revised scope in different prognostic models in cirrhotic patients: Current and future perspectives, an Egyptian experience". *Arab Journal of Gastroenterology*. https://doi.org/10.1016/j.ajg.2013.08.007.

30. Radisavljevic, M., Bjelakovic, G., Jovic, J., Radovanovic-Dinic, B., Benedeto-Stojanov, D., Brzacki, V., & Markovic-Zivkovic, B. (2017). "Creatinine-modified Child-Turcotte-Pugh score is a good predictor of a short-term survival in patients with bleeding from esophageal varices". *Vojnosanitetski Pregled*, *74*(1), p. 13–18. https://doi.org/10.2298/vsp150717147r.