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RESEARCH ARTICLE

Value Of Different Models For End-Stage Liver Disease In Predicting Mortality In Cirrhotic Patients

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Abstract

Serum sodium (Na) has been suggested for incorporation into the Model for End-Stage Liver Disease (MELD) to enhance its prognostic ability for patients with cirrhosis. Three Na-containing models (the Model for End-Stage Liver Disease with the incorporation of serum sodium (MELD-Na), the integrated Model for End-Stage Liver Disease (iMELD), and the Model for End-Stage Liver Disease to sodium (MESO) index) were independently proposed for this purpose. This study investigated the accuracy of these 3 MELD-based models for outcome prediction. **Patients & Methods:** Operational research was conducted on 151 patients with decompansated cirrhosis (child B & C). They were evaluated, and their medical and laboratory profiles were prospectively analyzed for one year. The outcome was assessed at the 3- and 6- and 12 month for complication and mortality. **Results:** We found that Na-based MELD scores had a better prognostic power than the standard MELD score in prediction of mortality in decompansated cirrhotic patients. The iMELD and MESO index gave the highest AUC (90%), sensitivity (97.4% & 94.5% respectively), NPV (98.8% & 96.9% respectively), and diagnostic accuracy (77.5% & 78.8% respectively). MELD score gave the highest specificity (79.5%) and PPV (75%). As regard association of major complications of cirrhosis and the MELD-based scores, there were statistical significance differences between cases had hepatic encephalopathy and refractory ascities and those hadn't in all MELD scores. Regarding SBP the differences founded in MELD-Na and iMELD only. Finally no differences were found between cases had variceal bleeding and cases hadn't in any of MELD scores except iMELD. **Conclusion:** the incorporation of Na into the MELD may enhance its prognostic accuracy, and both iMELD and MESO index are better prognostic models in prediction of outcome and complications in patients with decompensated cirrhosis.

INTRODUCTION

The Model for End-Stage Liver Disease (MELD), which is calculated from 3 biochemical variables (serum bilirubin, prothrombin time, and creatinine), has been shown to be more accurate in predicting survival than the Child-Turcotte-Pugh (CTP) classification for patients with cirrhosis a waiting liver transplantation in the United States. **[1]**

Although MELD score is useful, it has some important limitations: Hepatic encephalopathy, esophageal variceal bleeding and spontaneous bacterial peritonitis are common complications with cirrhosis, which had been considered one of the allocation policies of liver providing. But, there is no parameter correlated with these complications in MELD**[2]**. Modification of MELD score was developed to predict mortality in patients with cirrhosis of different etiologies and severities of liver disease**.** The incorporation of Na into the MELD may enhance its prognostic accuracy**. [3]**

Hyponatremia is a common event in liver cirrhosis. It develops primarily as a result of free water retention, which is positively correlated with the severity of portal hypertension **[4].** Consequently, the serum sodium (SNa) level may inversely reflect the severity of portal hypertension. Those with low MELD scores who have persistent ascites and low SNa are at a disadvantage. This group of patients has a higher mortality than that predicted by the MELD score alone. **[5]**

Many studies have proposed serum sodium can be used to exactly evaluate the prognosis and mortality of patients with cirrhosis, which is objective, quantitative, and reproducible. The incorporation of Na into the MELD may enhance prognostic accuracy **[6].** Also, there were studies had shown that serum Na was correlated inversely with complications and severity of liver cirrhosis **[7].** On the other hand **Montasser et al. [8]** concluded that there is no value of adding serum sodium to the MELD scoring system.

This study, was designed to evaluate the predictive value of the standard MELD and its alternatives in detecting complications of liver cirrhosis and its possible use in early prediction of survival.

Patients and methods

This Operational research has been carried out in Internal Medicine Department, Gastroenterology and Hepatology Unit, Faculty of Medicine, Zagazig University Hospital between March 2013 to March 2015

The study included 151 patients of decompansated cirrhosis (child B & C) taken from outpatient clinic and after discharging from hospital. They were evaluated, and their medical and laboratory profiles were prospectively analyzed for one year with calculation of the MELD based scores and child-pugh score from the first day they enter in the study and re-evulated at 3- 6- 12 month interval, and the end point was at the end of the one year from starting the follow up of every one of the patients or death.

Patients were selected according to the following criteria:

Inclusion criteria

1. Age equal or more than 18 years.
2. Both sexes.
3. Patients consent to enter the study.
4. An initial Child-Pugh score of 7 or higher.
5. Decompansated cirrhotic patients (whatever the etiology).
6. A known initial MELD score at the time of evaluation and survival status at follow-up within 1 year.

Exclusion criteria

1. Patients with past or current hepatocellular carcinoma at time of presentation or developing hepatocellular carcinoma during follow up.
2. No comorbidities expecting to affect short term mortality (e.g. cerebrovascular disease, severe kidney disease, diabetes with end organ damage, congestive heart failure, Malignant tumor, metastasis, AIDS).
3. Age < 18.
4. Patients refuse to enter the study.
5. previous liver transplant.

Methods : All subjects of the study were subjected to:

- A detailed medical history and thorough physical examination.
- The diagnosis of liver cirrhosis was based on characteristic findings, including physical stigmata of cirrhosis, decreased serum albumin, ultrasonography findings of a nodular liver surface, coarsened echogenicity of liver parenchyma, an enlarged spleen and/or ascites, and the detection of esophageal varices by endoscopy. **[9]**
    - The presence Variceal bleeding was diagnosed by (1) clinical signs of hematemesis or coffee-ground vomitus and /or melena (2) endoscopic signs of active bleeding or an adherent clot on esophageal or gastric varices. **[2]**

- The diagnosis and treatment of spontaneous bacterial peritonitis (SBP) are in line with the recommendations of the International Ascites Club. SBP was suspected when the clinical signs of peritonitis and infection were present and was diagnosed when (1) the ascites polymorphonuclear leukocyte (PMN) count was ≥250/mm3 with or without positive ascites bacterial culture or (2) the ascites PMN count was ≤250/mm3 but with positive ascites bacterial culture. **[10]**
- The West Haven criteria were used to define the severity of hepatic encephalopathy. **[11]**

● The Presence of ascites (mild, moderate, severe) was assessed by physical examination, or ultrasonography and diagnosed as refractory by diuretic treatment either diuretic resistant ascites or diuretic refractory ascites.

● **Laboratory investigations:**

■ Complete blood count (CBC).

■ Complete liver profile.

■ Renal function tests .

■ Serum electrolytes : Serum sodium (Na) (mEq/L) .

■ Hepatitis markers: (HCV Ab and HBs Ag) and autoimmune markers.

■ Alfa feto protein (αFP).

■ Blood sugar

■ ECG

■ HIV antibody

■ **Abdominal ultrasonography** with special emphasis on**:**

-Criteria that were suggestive of chronic liver disease e.g coarsness, hypertrophied caudate lobe and attenuated hepatic veins.

- Any focal lesions to be excluded from the study.

- Portal vein (patency and its diameter).

- Presence of ascites (mild, moderate, severe).

■ The MELD based scores and child-Turcotte-Pugh (CTP) score were computed according to the original formula for each patient.

● **The MELD equation** was used to calculate the severity score: 9.6 × loge [creatinine (mg/dL)] + 3.8 ×loge [bilirubin (mg/dL)] + 11.2 × loge (INR) + 6.43)**.** Value of creatinine, bilirubin, and INR below 1 are rounded to 1, serum creatinine value above 4 mg/dl are rounded to 4 mg/dl, patient on haemodialysis are given a creatinine value of 4 mg/dl . **[1]**

● **The MELD-Na equation** was based on the MELD and Na: MELD +1.59 × (135 - Na), with maximum and minimum Na values of 135 and 120 mmol/L respectively. **[12]**

● **The iMELD equation** was based on the MELD score, age (years), and Na (mmol/L): MELD + (0.3 × age) - (0.7 + Na) + 100. **[13]**

● **The MESO index** was defined as [MELD/Na (mmol/L)] × 10. **[14]**

● **Child-Turcotte-Pugh (CTP) score. [15]**

Statistical analysis:

The collected data were computerized and statistically analyzed using SPSS program (Statistical Package for Social Science) version 18.0 (SPSS Inc., Chicago, Illinois, USA) and MedCalc Statistical Software version 14.8.1

Results:

The baseline demographics of the patients in this study are shown in Table (1). Patients were predominantly males (59.6%), their age ranged from 35 – 76 with mean ± SD 56.77 ± 8.63 y. sixty five were child B (43%) and eighty six were child C (57%). Most of them 98.6% were HCV antibody positive.

Clinical data and complications of the studied group are shown in table (2). The most common complication found among the studied group was hepatic encephalopathy (66.2%) followed by variceal bleeding (60.9%).

Table (3) showed that mortality rate among the studied group was 25.8%. The most common causes of death were variceal bleeding and hepatic encephalopathy (10.59% , 7.28% respectively).

Association of major cirrhosis complications and the MELD-based scores were shawn in table(4). There were statistical significance differences between cases had hepatic encephalopathy and refractory ascities and those hadn't in all MELD scores. Regarding SBP the differences founded in MELD-Na and iMELD only. Finally no differences were found between cases had variceal bleeding and cases hadn't in any of MELD scores except iMELD.

Accuracy of MELD scores in prediction of hepatic encephalopathy is shawn in table(5) and figure(1). the iMELD score gave the highest sensitivity(98%), NPV(94.7%), and accuracy (88.7%). While in prediction of variceal bleeding, the iMELD score gave the highest AUC of (68%) & specificity (81.54%)& sensitivity (73.9)& PPV (86.1%) and the highest diagnostic accuracy (76.8%). table(6) and figure(2)

Accuracy of MELD scores in prediction of Spontaneous bacterial peritonitis (SBP) is shawn in table(7) and figure (3). the iMELD score gave the highest AUC(63%) & accuracy (78.8%)& sensitivity (90.6%) &NPV(91%). While in prediction of refractory ascites, the iMELD score gave the highest AUC(81%) & NPV(97%) &sensitivity(96.8) and MESO index gave the highest accuracy (84.8%)& specificity(78.7%). table(8) and figure(4)

Three month mortality according to MELD score are shawn in table (9)

Accuracy of MELD based scores in prediction of death were seen in table(10) and figure (5) . The iMELD and MESO index gave the highest AUC (90%) and sensitivity (97.4% & 94.5% respectively) and NPV (98.8% & 96.9% respectively)

(Table 1): Demographic data of the studied group:

(n=151)		**Variable**
56.77 ± 8.63 35 – 76		**Age (years):** Mean ± SD Range
%	**No**	**Variable**
59.6 40.4	90 61	**Sex:** Male Female

(Table 2): Clinical data and complications of the studied group

(n=151)		
%	**No**	**Variable**
19.9 80.1	30 121	**Jaundice:** No Yes

13.9 86.1	21 130	**LL edema:** No Yes
43 57	65 86	**Tremors:** No Yes
0.7 99.3	1 150	**Acsities:** No Yes
17.2 82.8	26 125	**Splenomegaly:** No Yes
43 57	65 86	**Child-pugh: B** **C**
33.8 66.2	51 100	**Hepatic encephalopathy:** No Yes
39.1 60.9	59 92	**Variceal bleeding:** No Yes
57.6 42.4	87 64	**SBP:** No Yes
58.9 41.1	89 62	**Refractory ascities:** No Yes

(Table 3): **Number and causes of deaths among the studied group:**

(n=151)		**Variable**
%	**No**	
74.2 25.8	112 39	**Mortality:** Survived Dead
9.27 11.25 5.29	(n=39) 14 17 8	**No. of deathes:** 1st follow up 2nd follow up 3rd follow up
7.28 10.59 3.31 4.63	(n=39) 11 16 5 7	**Cause of death:** Hepatic encephalopathy GIT bleeding SBP+HE Variceal bleeding + HE

(Table 4): Relation between MELD scors of the studied group and complication:

		Hepatic encephalopathy		
P	**Z test**	**Yes (n=100)**	**No (n=51)**	**Variable**
<0.001**	**6.36**	19.06 ± 6.73	12.47 ± 4.12	**MELD:** Mean ± SD
<0.001**	**6.17**	24.37 ± 11.44	16.62 ± 11.03	**MELD-Na:** Mean ± SD
<0.001**	**6.1**	42.94 ± 10.31	32.34 ± 7.41	**iMELD:** Mean ± SD
<0.001**	**6.67**	1.5 ± 0.78	0.9 ± 0.3	**MESO index:** Mean ± SD
		Variceal bleeding		
P	**Z test**	**Yes (n=92)**	**No (n=59)**	**Variable**
0.70 NS	0.38	16.71 ± 6.73	17.03 ± 6.8	**MELD:** Mean ± SD
0.12 NS	1.57	21.57 ± 12	22.04 ± 11.72	**MELD-Na:** Mean ± SD
<0.001**	**6.77**	40.65 ± 10.65	28.53 ± 10.65	**iMELD:** Mean ± SD
0.64 NS	0.47	1.3 ± 0.82	1.29 ± 0.54	**MESO index:** Mean ± SD
		SBP		
P	**Z test**	**Yes (n=64)**	**No (n=87)**	**Variable**
0.11 NS	1.61	17.42 ± 6.05	16.4 ± 7.2	**MELD:** Mean ± SD
0.005**	**2.78**	23.36 ± 11.04	20.57 ± 12.34	**MELD-Na:** Mean ± SD
0.009**	**2.62**	41.5 ± 9.41	37.79 ± 11.3	**iMELD:** Mean ± SD

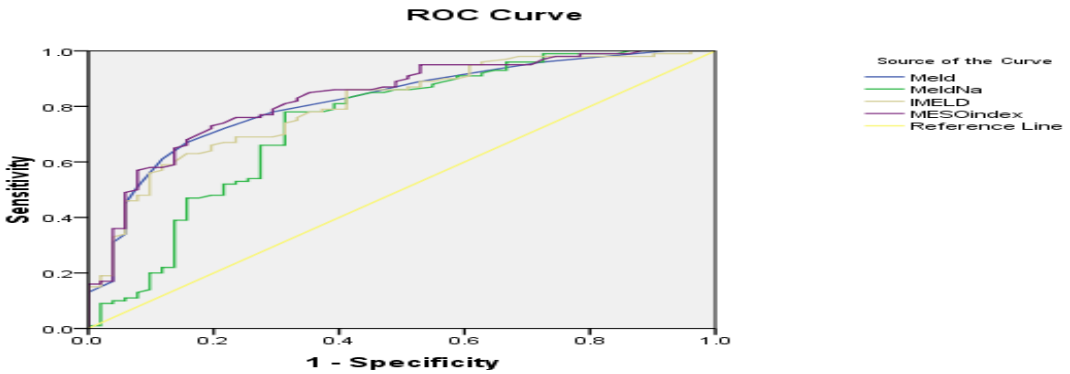
0.09 NS	1.70	1.3 ± 0.48	1.29 ± 0.86	**MESO index:** Mean ± SD
		Refractory ascities		
P	**Z test**	**Yes (n=62)**	**No (n=89)**	**Variable**
<0.001**	**5.39**	20.26 ± 6.92	14.45 ± 5.49	**MELD:** Mean ± SD
<0.001**	**7.12**	27.64 ± 11.9	17.65 ± 9.99	**MELD-Na:** Mean ± SD
<0.001**	**6.53**	45.99 ± 9.97	34.74 ± 8.52	**iMELD:** Mean ± SD
<0.001**	**5.67**	1.56 ± 0.55	1.12 ± 0.77	**MESO index:** Mean ± SD

(Table 5): Accuracy of MELD scores in prediction of hepatic encephalopathy:

p-value	Accuracy	-PV	+PV	Spec.	Sens.	AUC	Cutoff	Score
<0.001**	86.7	87.8	86.4	70.6	95	0.83	25.01	MELD
<0.001**	87.4	90	83.5	70.6	96	0.74	16.4	MELD-Na
<0.001**	88.7	94.7	86.7	70.6	98	0.80	28.45	iMELD
<0.001**	88.1	90.2	87.3	72.5	96	0.82	0.72	MESO index

A p value <0.05 was considered statistically significant(S).

(Figure 1) : Accuracy of MELD scores in prediction of hepatic encephalopathy:

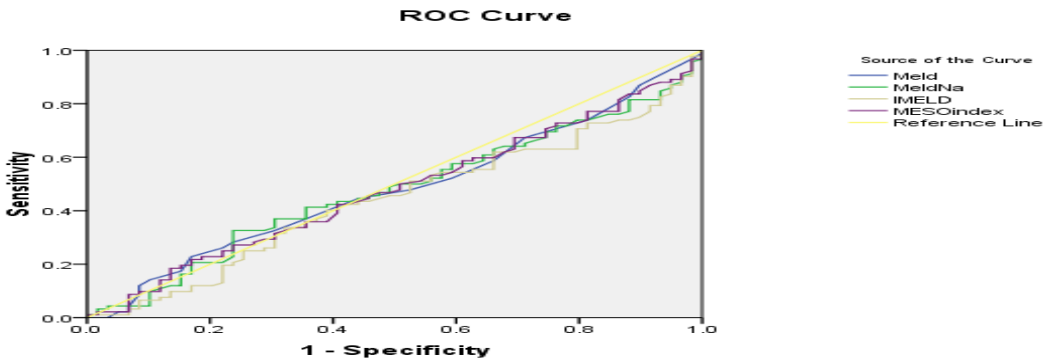


(Table 6): Accuracy of MELD scores in prediction of variceal bleeding:

p-value	Accuracy	-PV	+PV	Spec.	Sens.	AUC	Cutoff	Score
0.23 NS	74.2	63.5	84.4	79.7	70.7	0.44	16.5	MELD
0.64 NS	72.2	62	81.3	74.6	70.7	0.48	22.55	MELD-Na
00.04*	76.8	66.7	86.1	81.4	73.9	0.68	31.65	iMELD
0.62 NS	73.5	63.4	82.5	76.3	71.7	0.48	0.89	MESO index

A p value <0.05 was considered statistically significant(S).

Figure (2): Accuracy of MELD scores in prediction of variceal bleeding:



(Table 7): Accuracy of MELD scores in prediction of SBP:

p-value	Accuracy	-PV	+PV	Spec.	Sens.	AUC	Cutoff	Score
0.09 NS	74.8	83.6	66.7	70.1	81.2	0.58	17.15	MELD
0.03*	76.2	85.9	67.5	70.1	84.4	0.60	34.4	MELD-Na
0.009*	78.8	91	69	70.1	90.6	0.63	30.30	iMELD
0.11 NS	76.8	85.1	68.8	72.4	82.8	0.58	0.9	MESO index

A p value <0.05 was considered statistically significant(S).

Figure (3): Accuracy of MELD scores in prediction of SBP:

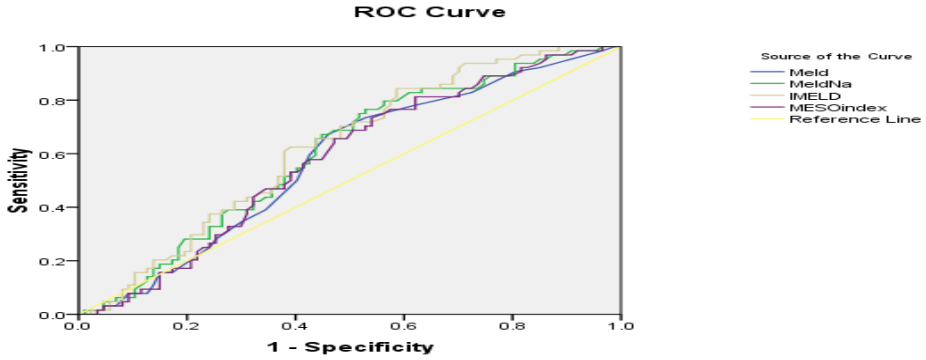


Table (8): Accuracy of MELD scores in prediction of Refractory ascities:

p-value	Accuracy	-PV	+PV	Spec.	Sens.	AUC	Cutoff	Score
<0.001**	78.8	91.3	77.8	70.8	90.3	0.77	10.5	MELD
<0.001**	79.5	92.6	68.7	70.8	91.9	0.76	11.55	MELD-Na
<0.001**	82.8	97	71.4	73	96.8	0.81	29.85	iMELD
<0.001**	84.8	94.6	75.3	78.7	93.5	0.76	0.5	MESO index

A p value <0.05 was considered statistically significant(S).

Figure (4): Accuracy of MELD scores in prediction of Refractory ascities:

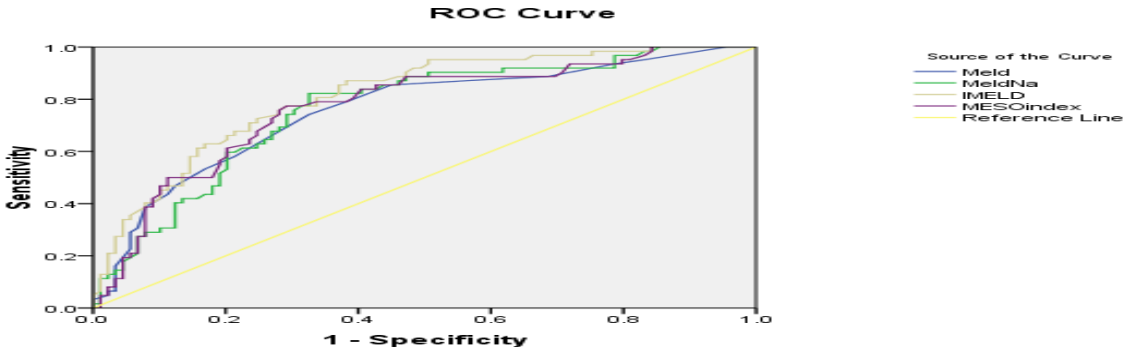


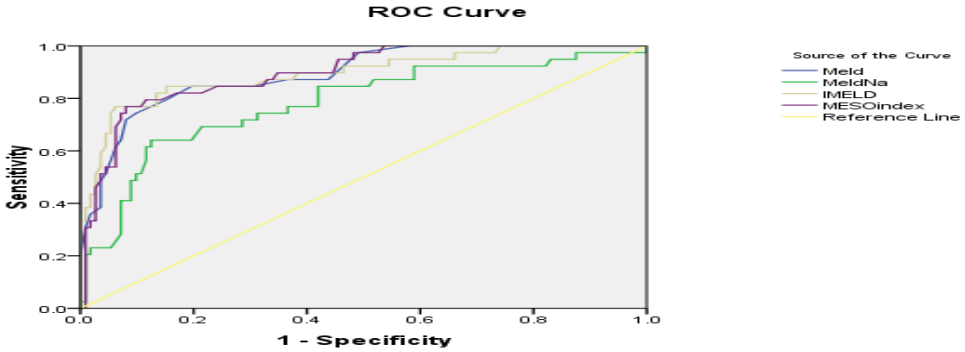
Table (9): Three month mortality according to MELD score

P	Z	Wiesner et al., 2003 %	Our result %	Variable
				MELD score of : at 3 month
0.31 NS	1.005	71.3	75	≥40
<0.001**	3.72	52.6	37.5	30-39
0.06 NS	2	19.6	10.8	20-29
0.01*	2.54	6	1.1	10-19
0.09 NS	1.71	1.9	0	<9

(Table 10): **Accuracy of MELD scores in prediction of death:**

p-value	Accuracy	-PV	+PV	Spec.	Sens.	AUC	Cutoff	Score
<0.001**	74.8	92.3	75	79.5	91.2	0.69	19.5	MELD
<0.001**	76.2	96.3	52.3	70.5	92.3	0.78	28.15	MELD-Na
<0.001**	77.5	98.8	53.5	70.5	97.4	0.90	30.6	iMELD
<0.001**	78.8	96.9	54.9	71.4	94.5	0.90	0.8	MESO index

(figure 5): Accuracy of MELD scores in prediction of death



Discussion:

Analysis of the results of our study revealed that hepatic encephalopathy was the most common complication of liver cirrhosis (66.2%) followed by variceal bleeding (60.9%), SBP (42.4%) and lastly, refractory ascites (41.1%). table (2)

As regard hepatic encephalopathy**,** Overt hepatic encephalopathy occurs in approximately 30–45% of cirrhotic patients **Amodio et al. & Romero-Gomez et al. [16,17].** The different results in the previous study could likely be explained by differences among enrolled patients regarding the cause of cirrhosis as most of cases were alcoholic cirrhotic patients, while our patients were HCV positive chronic liver disease. On the other hand in study done by **El-Behery. [18],** hepatic encephalopathy was found to be the most common presentation (54.16%).

As regard variceal bleeding, our results were close to that reported by **El- Kady et al. [19]** who found that esophageal varices develop in about 50-63% of patients with liver cirrhosis and that variceal bleeding was found to be the commonest cause of upper gastrointestinal haemorrhage in Egypt. Also **Jensen [20],** reported that the prevalence of EV in patients with liver cirrhosis ranges from 35% to 70%.

The prevalence of SBP in hospitalized patients with cirrhosis and ascites is between 10% and 30% **Tandon et al. [21]**,while in our study it was 42.2 %. The different result could likely be explained by many of our patients presented in Child's grade C. On other hand the result of our study correlate well with a study conducted by **Iqba et al.** & **Sarwar et al. [22,23],** whose data showed the prevalence of SBP was (38.23% and 38% respectively). Also in study done by **Zedan.A. [24],** the prevalence of SBP in medical ICU was 56.1%.

Ginès et al. [25], showed that refractory ascites occurred in 5% to 10% of cirrhotic ascitic patients and portends a poor prognosis, while it was 41.1% in our study**.** The different result could likely be explained by differences among enrolled patients regarding the cause of cirrhosis as most of cases were alcoholic cirrhotic patients, while our patients were HCV positive chronic liver disease and many of our patients presented in Child's grade C and some had poor compliance to the diuretics

Our study revealed that variceal bleeding was the most common cause of death among studied cases (10.59%) followed by hepatic encephalopathy (7.28%), variceal bleeding and hepatic encephalopathy (4.63%) and lastly S.B.P and hepatic encephalopathy (3.31%)Table (3). **D'Amico et al. [26],** stated that, variceal bleeding was the most severe complication of cirrhosis and was the most common cause of mortality among the patients. Also **Seewald et al. [27]** showed that the mortality rate related to variceal bleeding ranged from 20% - 50%. **Morgan et al. [28],**, stated that hepatic encephalopathy significantly increases mortality risk in patients with chronic liver disease. Numerous studies had shown that ascites was associated with an increased mortality rate in patients with cirrhosis **Mackle et al. & Pathak et al. [29,30].**. Other study concluded that refractory ascites and low serum sodium identified patients with cirrhosis with high mortality risk despite low MELD scores **Heuman et al. [31].**

As regards the role of MELD-based scores in prediction of hepatic encephalopathy in our study the patients with hepatic encephalopathy had higher scores in all 4 models, with iMELD score gave the highest sensitivity(98%), NPV(94.7), and accuracy (88.7), (table 4,5) and (figure 1). These results were similar to that reported by **Huo et al. [2],** who compared 4 models,(iMELD, MELD-Na, MESO and MELD), and they showed that, the patients with hepatic encephalopathy had higher scores in all 4 models, although the statistical significance was established only for the iMELD versus MELD, (P=0.037). Also in prediction of variceal bleeding, the iMELD score gave the highest AUC of (68%) & specificity (81.54%)& sensitivity (73.9)& PPV (86.1%) and the highest diagnostic accuracy (76.8%), table(4,6) and figure(2). This was in concordance with that reported by **Jiang et al. [32],** who showed that the iMELD had a better prognostic power than the standard MELD score in prediction of variceal bleeding.

As regard to MELD-based scores in prediction of SBP, iMELD score and MELD-Na were the only significant (table 4,7) and (figure 3). This came in agreement with **Biselli et al. [3]**, who found that only iMELD and MELD-Na had a better prognostic power than the standard MELD score. While in prediction of refractory ascites, in our study the patients with refractory ascites had higher scores in all 4 models. The iMELD score gave the highest AUC(81%) & NPV(97%) &sensitivity (96.8%). MESO index gave the highest accuracy (84.8%) & specificity (78.7%).(table 4,7) and (figure 3). **Heuman et al.[31].** stated that refractory ascites and low serum sodium identify patients with cirrhosis with high mortality risk despite low MELD scores.

In interpretation of MELD score and short term mortality (3 month) (table 9). Our result are close but not similar to that reported by **Wiesner et al**. **[1].** Our mortality was significant at score (10-19) & score (30-39). The difference might be due to large number of cases included in their study**.**

As regard accuracy of MELD based scores in prediction of death. The iMELD and MESO index gave the highest AUC (90%) and sensitivity (97.4% & 94.5% respectively) and NPV (98.8% & 96.9% respectively). MELD score gave the highest specificity (79.5%) and PPV (75%). MESO index gave the highest diagnostic accuracy (78.8 %) among all MELD alternatives. (table 10 and figure 5)

Our results showed that Na-based MELD scores had a better prognostic power than the standard MELD score in prediction of mortality in cirrhotic patient. This was similar to that reported by **Luca et al. [13],** who showed that

iMELD had a better prognostic power than the standard MELD score in cirrhotic patients mortality.Also, **Lv et al. [7].** showed that MESO index had a better prognostic power than the standard MELD.
These results came in agreement with **Jiang et al. [32],**who discovered that the AUCs of MELD-Na, iMELD, MESO were higher for each one than that of MELD in evaluating the short-term and intermediate-term prognosis of decompensated cirrhotic patients. Among the four models, iMELD had the highest AUC at different periods and showed significant differences with MELD. Also, The iMELD was demonstrated to be better prognostic model for prediction of outcome in patients with cirrhosis, which was similar to that reported by **Huo et al. [2]**
Kim et al. [33], showed that the MELD score and the serum sodium concentration were important predictors of survival among candidates for liver transplantation**.** Risk of death across all MELD scores was higher for patients with advanced cirrhosis and for patients with hyponatremia than those without **Ruf et al.[6].** Also , **Zhang et al. [34],** confirmed that hyponatremia was correlated with mortality and complications in decompensated cirrhotic patients and incorporation of Na into the MELD may enhance it's prognostic ability **.**
Study by **LV et al.[7].** had shown that serum Na was correlated inversely with complications and severity of liver cirrhosis. Interestingly, in addition to the MELD and Na, the iMELD also took into account the factor of age. Age was associated with a risk of mortality as a continuous variable, as older patients had worse survival. The association of aging with mortality in cirrhosis has been shown in the past by **Ginés et al. [35]**. It had been suggested that aging may reflect a longer duration of cirrhosis and a more severe liver disease **Jiang et al. [32].**The study done by **Luca et al. [13],** who incorporated both serum sodium and age into the new formula: iMELD revealed that the iMELD was better than original MELD in evaluating the mortality of cirrhotic patients 1 year after transjugular intrahepatic portosystemic shunt (TIPS).
In conclusion, three new models combination with serum sodium (MELD-Na, iMELD, MESO) can all exactly predict the prognosis of patients with decompensated
cirrhosis for short and intermediate period, and may enhance the prognostic accuracy of MELD. The MESO index and iMELD are better prognostic models for outcome prediction in patients with decompensated cirrhosis for both mortaity and complications.

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