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Value of Non-Invasive Scores and Modalities in Predicting the Presence of Esophageal Varices in Patients with Liver Cirrhosis

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ABSTRACT

Background: Esophageal varices (EVs) represent the main complication of portal hypertension and carry a significant risk of morbidity and mortality. Esophagogastroduodenoscopy (EGD) is the gold standard test for screening of esophageal varices in patients with cirrhosis, but many studies explored noninvasive modalities in order to overcome its cost and invasiveness.

Objective: The aim of the current work was to assess the potential role of five non-invasive scoring systems/modalities (AST to platelet ratio index {APRI} score, ALT/AST ratio {AAR}, fibrosis – 4 {FIB-4} index, King's score, and platelet count/ spleen diameter {PC/SD ratio}) in detection of esophageal varices in patients with liver cirrhosis.

Patients and Methods: This prospective cohort study included a total of 120 cirrhotic patients, attending at Hepatology Outpatient Clinic, Endoscopy Unit and Radiodiagnosis Department, El-Demerdash Hospital, Ain Shams University. Patients were classified according to presence of esophageal varices (EVs) detected by esophagogastroduodenoscopy (EGD) into two groups; **Group 1** consisted of 9 patients with no EVs, and **Group 2** consisted of 111 patients with EVs. group II were further subdivided according to the grade of esophageal varices (EVs) into three subgroups. The following noninvasive scores and indices were calculated for all patients: APRI score, AAR, FIB-4 index, King's score, and PC/SD ratio.**Results**: Among the five scores studied, AAR at a cut off value >0.88 showed the greatest sensitivity (86.49%) and accuracy (92.8 %), followed by PC/SD ratio at a cut off value <668.97 with an 86.49% sensitivity and 90.1% accuracy and FIB-4 index at a cut off value >5.1 with an 83.78% sensitivity and 90.1% accuracy. While the least sensitive scores were APRI and King's score with a 70.27% and 67.57% sensitivity respectively.

Conclusion: It could be concluded that AAR and PC/SD ratio are the most sensitive scores that can predict the presence of esophageal varices (EVs) in cirrhotic patients with acceptable accuracy. Being cheap and applicable they could be used as an initial screening tests to detect esophageal varices in patients with liver cirrhosis.

Keywords: Liver cirrhosis, Esophageal varices, Non-invasive scores, Non-invasive modalities.

INTRODUCTION

Cirrhosis is the end stage of chronic liver disease, it results in distortion of liver architecture, and nodule formation leading to portal hypertension [(1)]. Clinically significant portal hypertension (CSPH) refers to increase in the pressure of the portal venous system causing a hepatic venous pressure gradient (HVPG) greater than 10 mmHg [(2)].

Esophageal varices (EVs), the main complication of portal hypertension, are present in approximately 50% of cirrhotic patients at time of diagnosis and carry a significant risk of morbidity and mortality [(1,3)]. Esophageal varices are estimated to be present in about 70% of Child-Pugh B or C patients, and only in approximately 40% of Child-Pugh A patients [(4)].

Esophagogastroduodenoscopy (EGD) remains the gold standard test for screening of esophageal varices in patients with cirrhosis, but owing to its invasiveness, cost and patient discomfort, multiple non-invasive modalities for detection of esophageal varices are being explored to potentially overcome these obstacles [(5)].

Thus, the objective of the study was to assess the potential role of five non-invasive scoring systems/modalities (APRI score, AAR, FIB-4 index, King's score, and PC/SD ratio) in detection of esophageal varices in patients with liver cirrhosis.

PATIENTS AND METHODS

This prospective cohort study included a total of One hundred and twenty cirrhotic patients, attending at Hepatology Outpatient Clinic, Endoscopy Unit and Radiodiagnosis Department, El-Demerdash Hospital, Ain Shams university. This study was conducted from November 2020 to November 2021.

Patients were classified according to presence of esophageal varices (EVs) detected by esophagogastroduodenoscopy (EGD) into two groups; **Group 1** consisted of nine patients (7.5%) with no EVs, and **Group 2** consisted of one hundred and eleven patients (92.5%) with EVs. group II were further subdivided according to the grade of esophageal varices (EVs) into three subgroups: **small EVs** (48 patients), **medium EVs** (45 patients), and **large EVs** (18 patients).

Diagnosis of liver cirrhosis:

All patients met the diagnostic criteria for cirrhosis, which was based on the presence of two or all three of the following [(6)].

(1) Clinical features (spider naevi, gynecomastia, hepatic encephalopathy, palmar erythema,

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clubbing, distended abdominal veins, female pubic hair pattern, splenomegaly or ascites),
(2) Impaired laboratory tests consistent with cirrhosis (high international normalization ratio {INR}, high total bilirubin and low serum albumin)
(3) Abdominal US signs of cirrhosis (shrunken or enlarged nodular liver with distorted architecture, splenomegaly or ascites).

The exclusion criteria were as follows:

(1) Patients on primary prophylactic treatment for variceal bleeding like B-blockers.
(2) Prior band ligation or sclerotherapy for esophageal varices.
(3) Prior trans-jugular intrahepatic portosystemic shunt (TIBS).
(4) Patients with portal vein thrombosis (PVT).
(5) Existence of other factors that might affect the platelet count and spleen size like splenectomy.
(6) Patients who receive oral anticoagulants.
(7) Patients with contraindication to do EGD like clinically unstable patient, severe heart or lung disease, hematological disorders.
(8) Patients with previous diagnosis of bleeding peptic ulcer.
(9) Refusal of consent, refusal to undergo EGD.

All patients were subjected to full history and clinical data were obtained. Five different noninvasive scoring systems/models were calculated. Esophagogastroduodenoscopy (EGD) and abdominal ultrasound scan with portal vein duplex were performed.

Laboratory testing including alanine aminotransferase (ALT), aspartate aminotransferase (AST), complete blood count (CBC) involving platelet count, prothrombin time (PT), international normalization ratio (INR), and partial thromboplastin time (PTT).

The cause of liver cirrhosis was determined by testing for HBsAg and anti-HCV Ab. Viral etiology of cirrhosis was considered when one of these serological tests of HBV (HBsAg) or HCV (HCV Ab) was positive.

Child Pugh score as well as the following five non-invasive scores/ modalities were calculated from data available one day prior to the upper endoscopy:

1. Child Pugh score (CPS), each measure is scored 1-3, with 3 indicating most severe disorder [(7)].
2. AST / ALT ratio (AAR) by Sheth's formula [(8)].
3. AST to Platelet Ratio Index (APRI) by Wai's formula [(9)]

(AST / ULN of AST) / ((platelet count$\times 10^9$ /L) × 100).

4. FIB-4 index by Sterling's formula [(10)]

(Age in years × AST) / (platelet count $\times 10^9$/L) × √ALT).

5. King's score by Cross's formula [(11)]**:** (Age x AST x INR) / (platelet count$\times 10^9$ /L).
6. PC/SD ratio: platelet count / Spleen Diameter by Giannini's formula [(12)]**.**

Upper gastrointestinal (UGI) Endoscopic evaluation for EV:

Our competent gastroenterologists performed all of the upper endoscopies under propofol sedation. Prior to EGD, routine informed written consent was obtained. EGD was performed as a first screening endoscopy of all included patients, for the diagnosis of presence or absence of esophageal varices (EVs) and their grade. Based on the endoscopic results, patients were categorized as having no EV (F0), small varices (F1), medium varices (F2), and large varices (F3) according to Japanese classification [(13)]**.**

Abdominal ultrasound (US) and portal vein duplex:

About radiological parameters, they were performed for all subjects after an overnight fasting. Abdominal US with comment on hepatic and splenic size and texture, and presence of ascites, and if present amount of ascites was recorded. Then portal vein duplex to detect portal vein diameter (PVD).

***Ethical Consideration*:**

All procedures performed in this study were accepted from Ain Shams University Research Committee (Ethics committee's reference number: 000017585) and with the 1964 Helsinki declaration and its later amendments. Informed written consent was obtained from each participant before enrollment in the study.

Statistical analysis:

Data were collected, reviewed, coded, and entered into the Statistical Package for Social Science (Released 2015) for statistical analysis. IBM SPSS Statistics for Windows, Version 23.0 (IBM Corporation, Armonk, New York). Statistical presentation and analysis of the present study was conducted, using the mean, standard deviation, student t- test, Chi-square, Linear Correlation Coefficient and Analysis of variance [ANOVA] tests by SPSS V20. When data was determined to be non-parametric, it was given as median, interquartile range (IQR), and qualitative variables were provided as numbers and percentages. The Chi-square test was used to compare two groups with qualitative data, whereas the Unpaired Student T-test was used to compare two groups with quantitative data and non-parametric distribution. The confidence interval was set at 95 percent, while the margin of error accepted was set at 5 percent. So, the p-value was considered significant at the p-value < 0.05. Linear Correlation coefficient was used for detection of correlation between two quantitative variables in one group. ANOVA test was used for comparison among different times in the same group in quantitative data. Level of significance of p- value was detected with p >0.05 being of non-significant (NS) value, and $p \leq 0.05$ of significant (S) value, and $p < 0.01$ of highly significant value.

RESULTS

One hundred and twenty patients with liver cirrhosis were included in the present study. Table (1) shows the basic laboratory parameters of the cirrhotic patients and abdominal ultrasound and portal vein duplex findings of the subjects.

Table (1): Basic laboratory data and radiological findings of the patients

Parameters		Mean	±	SD
AST (U/L)		76.300	±	4.944
ALT (U/L)		55.775	±	7.843
T. Bilirubin (mg/dL)		1.598	±	0.168
Albumin (g/dL)		2.878	±	0.466
INR		1.353	±	0.192
TLC		4.860	±	0.967
HB (g/dL)		11.983	±	1.697
Platelet (10^3/uL)		80.450	±	18.839
		N		**%**
Detection of ascites	**No**	15		12.50
	Yes	105		87.50
Amount of ascites	**Mild**	45		42.86
	Moderate	27		25.71
	Tense	33		31.43
Spleen size (cm)	**Range**	12.5	-	18.5
	Mean ±SD	15.738	±	1.519
PVD (mm)	**Range**	11.5	-	16
	Mean ±SD	14.413	±	1.034

Child Pugh score as well as the following five non-invasive scores/modalities were studied, our results showed that: Based on **Child-Pugh Classification** which detect the severity of liver disease, our findings showed that 18 (15%) patients were classified as class A, and 102 (85%) patients were classified as class B, with no class C verified within the patients. **Child Pugh score** was calculated for all the subjects and the mean was 7.67 ± 1.25 points. The mean (± SD) of the five non-invasive scores/modalities was as follow: **APRI score** was 2.84 ± 0.70, **AAR** was 1.64 ± 0.95, **FIB-4 index** was 7.74 ± 1.53, **King's score** was 74.70 ± 17.440, and **PC/SD ratio** was 524.22 ± 124.20 (Table 2).

Table (2): Non-invasive scoring system/ modalities among studied patients

		N		%
Child Pugh classification	**Child A**	18		15.00
	Child B	102		85.00
Child Pugh score	**Range**	5	-	9
	Mean ±SD	7.675	±	1.258
APRI score	**Range**	0.6	-	8.18
	Mean ±SD	2.849	±	0.706
AAR	**Range**	0.7	-	6.46
	Mean ±SD	1.642	±	0.950
FIB-4 index	**Range**	1.48	-	15.33
	Mean ±SD	7.740	±	1.533
King's score	**Range**	10.83	-	180.19
	Mean ±SD	74.705	±	17.440
PC/SD ratio	**Range**	248.48	-	940.74
	Mean ±SD	524.228	±	124.207

The study subjects were categorized according to presence of esophageal varices (EVs) by esophagogastroduodenoscopy (EGD) into two major groups. Group I included nine (7.5%) patients who had no esophageal varies (EVs), whereas group II included one hundred and eleven (92.5%) patients with EVs (Figure 1).

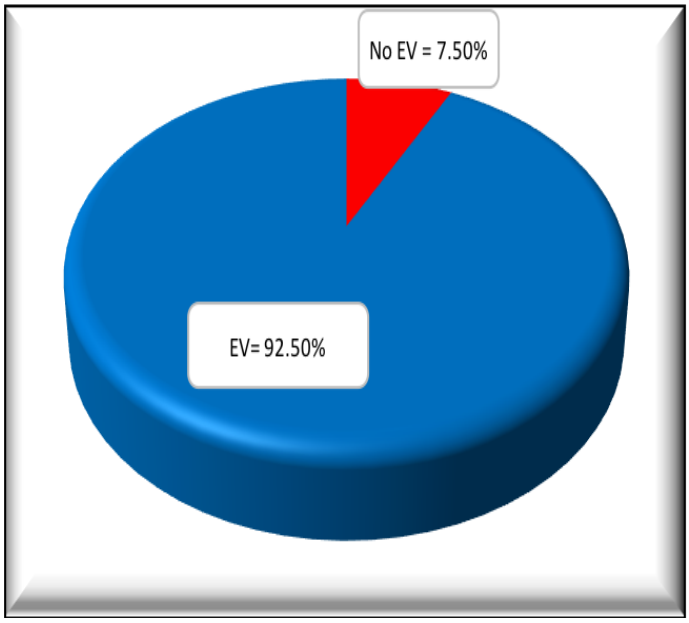

Figure (1): Detection of esophageal varices among all studied patients.

Then, group II were further subdivided according to the grade of esophageal varices (EVs) into three subgroups. Forty-eight (43.24%) patients with small varices, forty-five (40.54%) patients with medium varices, and eighteen (16.22%) patients with large varices (Figure 2).

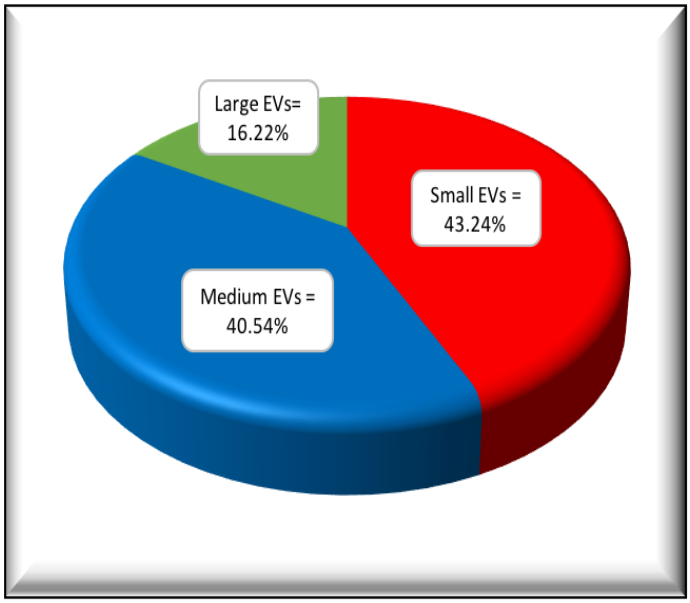

Figure (2): EV grading within group II (patients with EV).

Comparative Data between group I (patients without EV) and group II (patients with EV)

Upon comparing between group I (patients without EV) and group II (patients with EV), The current study showed significant statistical differences among them regarding gender, different laboratory tests as alanine aminotransferase (ALT), total bilirubin, serum albumin, international normalization ratio (INR), total leucocytic count (TLC), and platelets count (Tables 3 & 4).

Also, the two main groups showed statistically significant differences regarding ultrasonographic and porta vein duplex findings linked to the amount of ascites detected, spleen size, and portal vein diameter (PVD) (Tables 3 & 4).

When comparing Child Pugh score and the five noninvasive scoring systems/modalities between the two main groups, there were statistically significant differences regarding Child Pugh score, AAR, FIB-4 index, King's scores as well as platelet count/ spleen diameter ratio (PC/SD). However, there was no significant difference between the studied groups regarding APRI (Table 4).

Table (3): Comparison between group I (cirrhotic patients without EVs) and group II (cirrhotic patients with EVs) as regards gender, ascites, and Child Pugh classification

		Groups				Chi-Square	
		Group I (No EVs)		Group II (with EVs)			
		N	%	N	%	X^2	P-value
Gender	**Male**	0	0.00	48	43.24	6.486	**0.011***
	Female	9	100.00	63	56.76		
Detection of ascites by US	**No**	0	0.00	15	13.51	1.390	0.238
	Yes	9	100.00	96	86.49		
Amount of ascites	**Mild**	9	100.00	36	37.50	13.125	**0.001***
	Moderate	0	0.00	27	28.13		
	Tense	0	0.00	33	34.38		
Child Pugh classification	**Child A**	3	33.33	15	13.51	2.565	0.109
	Child B	6	66.67	96	86.49		

Table (4): Comparison between group I (cirrhotic patients without EVs) and group II (cirrhotic patients with EVs) as regards age, laboratory parameters, spleen size and PVD, as well as non-invasive scoring systems/modalities

	Groups						Test	
	Group I (No EVs)			Group II (with EVs)				
	Mean	±	SD	Mean	±	SD	T-Test	P-value
Age (years)	52.333	±	24.439	56.270	±	9.750	-1.000	0.319
AST (U/L)	69.667	±	2.179	76.838	±	4.619	-0.480	0.632
ALT (U/L)	87.333	±	9.539	53.216	±	8.139	2.667	**0.009***
T. Bilirubin (mg/dL)	0.600	±	0.173	1.679	±	0.151	-3.781	**<0.001***
Albumin (g/dL)	3.433	±	0.050	2.832	±	0.456	3.937	**<0.001***
INR	1.167	±	0.050	1.368	±	0.192	-3.126	**0.002***
TLC	6.433	±	1.513	4.732	±	0.949	2.552	**0.012***
HB (g/dL)	12.033	±	1.262	11.978	±	1.732	0.093	0.926
Platelet (10^3/uL)	104.000	±	5.196	78.541	±	8.246	4.158	**<0.001***
Spleen size (cm)	14.000	±	0.433	15.878	±	1.488	-3.760	**<0.001***
PV diameter (mm)	13.667	±	0.661	14.473	±	1.038	-2.289	**0.024***
Child Pugh score	6.667	±	0.500	7.757	±	1.266	-2.558	**0.012***
APRI score	1.917	±	0.074	2.925	±	1.753	-1.719	0.088
AAR	0.803	±	0.075	1.709	±	0.956	-2.831	**0.005***
FIB-4 index	3.737	±	0.705	8.065	±	3.446	-3.720	**<0.001***
King's score	40.117	±	17.668	77.509	±	44.810	-2.480	**0.015***
PC/SD ratio	744.510	±	60.180	506.367	±	156.891	4.512	**<0.001***

Comparative Data between the three subgroups of group II (patients with small, medium, and large EVs)

Our findings showed significant statistical differences among the three subgroups of group II (patients with small, medium, and large EVs) regarding Child Pugh classification, and different laboratory tests as serum albumin, international normalization ratio (INR), hemoglobin level (Hb), and platelet count. Patients with large EVs had significantly lower mean values of albumin (2.53 ± 0.35), hemoglobin level (10.88 ± 0.92) and platelet count (58.50 ± 9.06), as well as significantly higher mean values of INR (1.47 ± 0.22) than those with small and medium EVs (Tables 5 & 6).

Also, there were statistically significant differences among the three subgroups of group II (patients with small, medium, and large EVs) regarding ultrasonographic and duplex findings linked to detection of ascites, the amount of ascites detected, spleen size, and portal vein diameter (PVD) (Tables 5 & 6). When comparing Child Pugh score and the five noninvasive scoring systems/modalities among the three subgroups of group II (patients with small, medium, and large EVs), there were statistically significant differences regarding Child Pugh score, APRI score, FIB-4 index, King's scores as well as PC/SD ratio. However, there wasn't a significant difference among the three subgroups as regard AAR (Table 6).

Table (5): Comparison between the three subgroups of group II (patients with small, medium, and large EVs) as regards gender, ascites, and Child Pugh classification

		Group II (with EVs)						Chi-Square	
		Small EV (48 patients)		Medium EV (45 patients)		Large EV (18 patients)			
		N	%	N	%	N	%	X^2	P-value
Gender	**Male**	21	43.75	18	40.00	9	50.00	0.533	0.766
	Female	27	56.25	27	60.00	9	50.00		
Detection of ascites by US	**No**	15	31.25	0	0.00	0	0.00	22.764	**<0.001***
	Yes	33	68.75	45	100.00	18	100.00		
Amount of ascites	**Mild**	27	81.82	9	20.00	0	0.00	48.259	**<0.001***
	Moderate	6	18.18	15	33.33	6	33.33		
	Tense	0	0.00	21	46.67	12	66.67		
Child Pugh classification	**Child A**	15	31.25	0	0.00	0	0.00	22.764	**<0.001***
	Child B	33	68.75	45	100.00	18	100.00		

Table (6): Comparison between the three subgroups of group II (patients with small, medium, and large EVs) as regards age, laboratory parameters, spleen size and PVD, as well as non-invasive scoring systems/modalities

	Group II (with EVs)			ANOVA		TUKEY'S Test		
	Small EV (48 patients)	Medium EV (45 patients)	Large EV (18 patients)					
	Mean ± SD	Mean ± SD	Mean ± SD	F	P-value	S&M	S&L	M&L
Age (years)	57.875 ± 9.586	55.000 ± 9.378	55.167 ± 10.977	1.151	0.320			
AST (U/L)	73.438 ± 5.351	83.733 ± 9.697	68.667 ± 5.831	0.978	0.379			
ALT (U/L)	48.250 ± 3.730	62.933 ± 6.997	42.167 ± 2.514	2.704	0.071			
T. Bilirubin (mg/dL)	1.757 ± 0.168	1.731 ± 0.141	1.340 ± 0.148	1.734	0.181			
Albumin (g/dL)	3.150 ± 0.339	2.613 ± 0.392	2.533 ± 0.350	32.628	**<0.001***	<0.001*	<0.001*	0.710
INR	1.302 ± 0.175	1.394 ± 0.172	1.478 ± 0.224	6.912	**0.001***	0.043*	0.002*	0.226
TLC	4.706 ± 1.041	5.013 ± 0.701	4.100 ± 0.437	1.430	0.244			
HB (g/dL)	12.875 ± 1.594	11.460 ± 1.677	10.883 ± 0.921	15.147	**<0.001***	<0.001*	<0.001*	0.377
Platelet (10^3/uL)	92.938 ± 15.490	71.200 ± 9.938	58.500 ± 9.064	62.201	**<0.001***	<0.001*	<0.001*	0.001*
Spleen size (cm)	14.688 ± 1.335	16.567 ± 0.735	17.333 ± 0.707	59.294	**<0.001***	<0.001*	<0.001*	0.025*
PV diameter (mm)	13.719 ± 1.086	15.033 ± 0.537	15.083 ± 0.354	36.990	**<0.001***	<0.001*	<0.001*	0.973
Child Pugh score	6.688 ± 1.114	8.600 ± 0.618	8.500 ± 0.514	65.672	**<0.001***	<0.001*	<0.001*	0.908
APRI score	2.381 ± 1.825	3.347 ± 1.581	3.320 ± 1.652	4.314	**0.016***	0.020*	0.118	0.998
AAR	1.748 ± 1.294	1.705 ± 0.655	1.618 ± 0.407	0.120	0.887			
FIB-4 index	6.914 ± 3.704	8.567 ± 2.343	9.877 ± 4.104	6.169	**0.003***	0.045*	0.004*	0.331
King's score	63.883 ± 46.910	84.973 ± 32.861	95.183 ± 55.780	4.515	**0.013***	0.055	0.028*	0.677
PC/SD	639.774 ± 132.098	431.597 ± 70.948	337.542 ± 52.635	80.295	**<0.001***	<0.001*	<0.001*	0.003*

Prediction of esophageal varices (EVs)

To predict the presence of EVs, the current study showed that AAR at a cut off value >0.88 (with 92.8% accuracy) as well as PC/SD ratio at a cut off value ≤668.97 (with 90.1% accuracy) were the most sensitive scores (with 86.49% sensitivity in both score), followed by FIB-4 index at a cut off value >5.1(with 83.78 sensitivity, and 90.1% accuracy), then APRI score at a cut off value >1.98 (with 70.27% sensitivity, and 72.5% accuracy), while King's score had the least sensitivity of 67.57% at a cut off value >53.33 (with 76.6% accuracy), and APRI score gave the least diagnostic accuracy. However, the five score had the same specificity of 100% (Table 7).

Table (7): Application of the cutoffs, sensitivity, specificity, positive predictive value (PPV) and negative predictive values (NPV) and diagnostic accuracies of five noninvasive scoring systems (APRI score, AAR, FIB-4 index, King's score, and PC/SD ratio) for prediction of EVs by in cirrhotic patients

ROC curve in prediction of presence of EV in cirrhotic patients						
	Cutoff	Sens.	Spec.	PPV	NPV	Accuracy
APRI score	>1.98	70.27	**100.0**	100.0	21.4	72.5%
AAR	>0.88	**86.49**	**100.0**	100.0	37.5	92.8%
FIB-4 index	>5.1	83.78	**100.0**	100.0	33.3	90.1%
King's score	>53.33	67.57	**100.0**	100.0	20.0	76.6%
PC/SD ratio	≤668.97	**86.49**	**100.0**	100.0	37.5	90.1%

DISCUSSION

Esophageal variceal bleeding is one of the fatal portal hypertension-related complications in liver cirrhosis [(14)]. The prevalence of esophageal varices (EVs) in patients with cirrhosis ranges from 30% to 80%, while the risk of bleeding from esophageal varices ranges from 30% to 40% and carries significant morbidity and mortality [(15)]. Esophagogastroduodenoscopy (EGD) is the gold method for diagnosis of EVs, and so it is used as a screening method in patients with liver cirrhosis. During EGD, either prophylactic therapy or follow-up can be decided [(16)]. Because of invasiveness of endoscopy, its cost as well as poor adherence of the patients, noninvasive diagnostic methods have been studied [(17)].

The current study found that there was statistically significant difference between group I and II, as well as between the three subgroups of group II (which included small, medium and large esophageal varices) as regard FIB-4 index, with p-value < 0.001. This finding was similar to study of **Shibata *et al.*** [(18)] which revealed that FIB-4 index showed a statistical difference when comparing those with and without esophageal varices, along with comparing between different gradings of EVs.

On the other hand, study by **Galal *et al.*** [(19)] revealed that FIB-4 index showed no statistically significant difference between those with and without esophageal varices, with p-value = 0.801, but showed a significant difference when comparing between different gradings of EVs.

Our study also noted that FIB-4 index at a cut off value >5.1 gave a sensitivity of 83.78%, a specificity of 100%, and an accuracy of 90.1%, which reflects on the importance of FIB-4 in predicting the presence of esophageal varices. While **Shibata *et al.*** [(18)] reported that FIB-4 index at a cut-off value 4.1 had 61.5% sensitivity, 89.5% specificity and 84.8% accuracy. And **Galal *et al.*** [(19)] showed that FIB-4 index at a cut-off value >3.65 had 84% sensitivity, 53% specificity and 62% accuracy for identifying the presence of esophageal varices.

Upon looking at APRI score, the present study showed that there was no statistical significance between patients with esophageal varices and those without EVs. But, it showed a statistical difference when comparing between the three subgroups of group II, with p-value = 0.016. This finding was in line with study of **Galal *et al.*** [(19)] which noted that APRI score showed no statistical difference between patients with esophageal varices and those without EVs, with p-value = 0.64. In contrast to our result, study of **Galal *et al.*** [(19)] noted that APRI score didn't show a statistical difference when comparing between the three subgroups of group II.

However, **Shibata *et al.*** [(18)] revealed that APRI score showed a statistical difference when comparing the patients with and without EVs with p-value was <0.001, as well as when comparing the risky varices and non-risky varices, with p-value was 0.026.

The present study revealed that APRI score at a cut off value >1.98 had 70.27% sensitivity, 100% specificity, and 72.5% accuracy to predict the existence of EVs. While **Shibata *et al.*** [(18)] found that APRI score at a cut off value >1.2 had 59% sensitivity, 84.8% specificity, and 80.4% accuracy.

Regarding AST/ALT ratio (AAR), this study revealed that there was no significant difference between group I and group II, while there was a statistical difference between the three subgroups of group II. In agreement with **Galal *et al.*** [(19)] who noted that there was no statistical difference between patients with esophageal varices and those without EVs, with p-value = 0.572. But **Galal *et al.*** [(19)] disagreed with our study in that AAR didn't also show a statistical difference between the three subgroups of group II.

Our study was also in concordance with **Kraja *et al.*** [(20)] who revealed that there was no significant association between esophageal varices and AAR.

Our results reported that AAR at a cut off value >0.88 gave a sensitivity of 86.49%, a specificity of 100% and an accuracy of 92.8% for identifying the presence of esophageal varices. While **Duah *et al.*** [(21)] reported that AAR at a cutoff value ≤2.2 gave a sensitivity of 66.92% and specificity of 78.57%. PPV and an accuracy of 68.02%. As regard PC/SD ratio, the present study showed that there was a statistically significant difference between patients with esophageal varices and those without EVs, and when comparing between the three subgroups of group II. In accordance with those of **Shibata *et al.*** [(18)] who revealed that there was a statistical difference regarding PC/SD ratio when comparing the patients with and without EVs with p-value was <0.001, as well as when comparing the risky varices and non-risky varices, with p-value was 0.003.

In the contrast, **Duah *et al.*** [(21)] reported that there was no difference regarding PC/SD ratio between those with varices and those without, with p-value = 0.291.

The current study found that PC/SD ratio at a cut off value ≤ 668.97 gave a sensitivity of 86.49%, a specificity of 100%, and an accuracy of 90.1%, which reflects on the importance of PC/SD ratio in predicting the existence of esophageal varices. **Abu El Makarem *et al.*** [(22)] found an optimal cutoff value 939.7 for this ratio, which gave a diagnostic accuracy of 96.5%. While **Shibata *et al.*** [(18)] reported that PC/SD ratio at a cut off value 1330 had 76.9% sensitivity, 84.3% specificity, and 83% accuracy. **Duah *et al.*** [(21)] noted that PC/SD ratio at a cut off value ≤ 833.3 gave a sensitivity of 73.48%, a specificity of 64.29%, and an accuracy of 72.62%.

Regarding King's score, it showed a p-value of 0.015 and 0.013 when comparing groups I and II and when comparing the subgroups, respectively. This meant it was significant in this study. This finding was similar to **Ahmed *et al.*** [(23)] who stated that King's score

showed a significant difference between patients with EVs and those without EVs.

In the contrast, **Galal *et al.* [19]** reported that King's score didn't show significant difference between patients with EV and patients without EV, with p-value was 0.681

Our study revealed that King's score at a cut off value >53.33 gave a sensitivity of 67.57%, a specificity of 100%, and an accuracy of 76.6%, to predict the presence of esophageal varices. **Ahmed *et al.* [23]** stated that King's score at a cut off value 12.11 was the most sensitive and specific score in predicting the presence of EVs. While **Galal *et al.* [19]** noted that King's score at a cut off value >26.65 had 77% sensitivity, 52% specificity, and 59% accuracy.

CONCLUSION

It could be concluded that within the five scoring systems, AAR at a cut off value >0.88 and PC/SD ratio at a cut off value ≤668.97 are the most sensitive scores that can predict the presence of esophageal varices (EVs) in cirrhotic patients with acceptable accuracy. So, they could be used as an initial screening tests to detect patients with EVs being cheap and applicable. Thus, they can reduce the burden and cost of the endoscopy on the patient, also screening for varices won't be worrying for the patients. Followed by FIB-4 index at a cut off value >5.1. Whereas King's score had the least sensitivity, and APRI score harbored a poor diagnostic accuracy.

Declarations:

-Consent for publication: Informed written consent to publish patient's data was signed by all participants prior to beginning of the research.

-Availability of data and material: The authors confirm that the data supporting the findings of this study are available within the article.

-Competing interests: There is no conflict of interest.

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