Transient Elastography (Fibroscan) for the Prediction of Esophageal Varices in Egyptian Cirrhotic Patients

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Authors' contributions

This work was carried out in collaboration among all authors. Author RME designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author AAK designed the study and revised the paper and author HHS managed the analyses of the study and revised the paper. Author RAS designed the study and revised the paper. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Background: Esophageal varices (EVs) are atypically dilated submucosal veins, which occurs consequently to portal hypertension. Liver stiffness measurement (LSM), obtained by transient elastography (Fibroscan), strongly correlates with portal hypertension.
Aim: Is to predict the presence and grading of esophageal varices in Egyptian patients with liver cirrhosis using Fibroscan and other noninvasive tests.
Methods: A 101 cirrhotic patients indicated for upper endoscopy were enrolled consecutively and subdivided according to endoscopic findings into: Group I (70 patients with EVs) and Group II (31

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patients without EVs). Upper endoscopy, ultrasonography, routine lab. and Fibroscan assessment were done to all patients.

Results: LSM correlated directly and significantly with the presence (p <0.001), and grading of EVs (p = 0.001). A LSM cut off value of 18.55 kPa had an AUC of 0.726, sensitivity of 74.3%, specificity of 54.8%, PPV of 78.79%, and a NPV of 48.57% for predicting the presence of EVs. Platelet count/spleen diameter ratio (PSR) inversely correlated with the EVs presence (p = 0.002), and grading (p <0.001). PSR had a cut off value of 742.17, an AUC of 0.695, sensitivity of 71% and a specificity of 58.6% (PPV of 82%, NPV of 43.14%) for EVs presence. Right lobe diameter/Albumin ratio (RLAR) correlated directly with EVs presence (p = 0.001), and grading (p =0.012). RLAR cut off value of 3.62 had AUC, sensitivity, specificity, PPV, and NPV of 0.7, 64.3%, 67.7%, 81.8%, and 45.7%, respectively for the prediction of EVs presence.

Conclusion: LSM, PSR, RLAR as noninvasive methods for predicting the presence and grading of EVs are of moderate accuracy.

ABBREVIATIONS

EVs   : Esophageal varices
PH   : Portal hypertension
PSR   : Platelet count / Spleen diameter ratio
RLAR : Right liver lobe diameter / Albumin ratio
LSM   : Liver stiffness measurement
TE   : Transient elastography

1. INTRODUCTION

Liver cirrhosis is the diffuse scarring of the liver parenchyma with formation of regenerating nodules. Cirrhosis is considered the final phase of various liver diseases. Portal hypertension (PH) is the rise of portal venous pressure > 10 mmHg or hepatic venous pressure gradient (HVPG) > 5 mmHg [1,2].

Esophageal varices are aberrantly dilated submucosal veins that occur as a consequence of PH at a HVPG of > 10 mmHg with annual progress rate of 10 – 12% from small to large varices, while bleeding esophageal varices occur at a HVPG of > 12 mmHg with annual risk of variceal hemorrhage of 5% and 15% for small and large varices, respectively [3,4].

Patients at higher risk of variceal bleeding are identified by variceal size, red wale marks on EVs and decompensated liver disease. Without endoscopic intervention, the risk of rebleeding reaches 60% and mortality rate near 33% [5].

The Baveno V consensus graded EVs into small (minimally elevated EVs), medium (EVs occupying less than one third of esophageal lumen) and large (EVs occupy > one third of esophageal lumen) [6]. Also, The Japanese Research Society for Portal Hypertension classification graded EVs based on variceal location, form, color, presence of red color signs (red wale marks, Cherry red spots), bleeding signs, and mucosal findings [7].

Esophagogastroduodenoscopy (EGD) remains the gold standard for diagnosing, screening and treatment of EVs. Owing to the invasive nature and expenses of EGD, the search for noninvasive predictors for detecting EVs were sought [8,9].

Transient elastography (TE; Fibroscan) is an ultrasonic based imaging technique that measures the liver stiffness (LSM), which is a representative of liver fibrosis. LSM was found to have a high diagnostic accuracy for presence of cirrhosis. Also, LSM can predict the presence of PH in cirrhotic patients. Therefore, this study aimed at evaluating the role of Fibroscan and other noninvasive tests for prediction of the presence and grading of EVs [10,11].

2. PATIENTS AND METHODS

Our cross-sectional study incorporated 101 adult cirrhotic patients presenting to Tropical Medicine Department's endoscopy unit, Tanta University Hospital from June 2019 to June 2021. The Ethics Committee of the faculty of medicine, Tanta University approved the study protocol in April 2019 with the code 33090/04/19. Our patients underwent upper endoscopy and subdivided into 2 groups according to presence or absence of esophageal varices.

According to Bujang et al., 2016, the estimated minimum sample size required for both screening and diagnostic studies was 52 patients with at least 31 of them had esophageal varices to

detect sensitivity (power = 0.8 , P value <0.05 Ho=0.7 and Ha=0.9) and 78 patients with at least 47 of them had esophageal varices to detect specificity at same previous values, considering the prevalence of esophageal varices 60% in cirrhotic patients as previously reported [12,13]. To improve accuracy, we recruit number of patients more than the minimum required for evaluation of both sensitivity and specificity of the noninvasive tests valuated in our study (101 patients, among them 70 had EVs grouped as group I and 31 had no varices and grouped as group II).

Patients with narrow intercostal space, hepatocellular carcinoma or the presence of severe ascites that preclude TE examination, severe cardiopulmonary diseases, renal failure, patients treated with non-selective beta-blockers, variceal eradication, or with portosystemic shunt and patients with unmeasurable spleen diameter or undergone splenectomy were excluded from our study.

A full history taking, clinical examination, laboratory tests (Complete Blood Count, hepatic functions, kidney functions), Child-Pugh score, ultrasonography, EGD, and LSM using Fibroscan echosens 502 were performed to all the patients.

EVs were classified using the Japanese classification (the Locus, Form, Color, Red Color, bleeding, and mucosal signs) and Baveno classification for grading of EVs into small, medium, and large.

2.1 Statistical Analysis

Data were processed using IBM SPSS version 22 for Microsoft Windows (Armonk, NY). The independent samples T test was employed for mean comparisons. Chi square test was employed for categorical values. Associations between different variables was done with Spearman's rank correlation test. Receiver operating characteristic (ROC) curves identified the cutoffs for variables associated with EVs. Statistical significance was set at P values < 0.05.

3. RESULTS

The mean age of our patients was 58.24 ± 8.54 years in group I, containing 36 (51.4%) males and 34 (48.57%) females. While the mean age in group II was 54.87 ± 10.41 years with 18 (58.06%) males and 13 (41.93%) females. There was no significant difference between the two groups.

Table 1. Patients baseline characteristics

Parameter	Group I (no. = 70)	Group II (no. =31)	P value
Age (years): Mean ± SD.	58.24 ± 8.54	54.87 ± 10.41	0.76
Sex: male no. (%)	36 (51.4)	18 (58.06)	0.537
Etiology of cirrhosis: no. (%)			0.196
HCV	63 (90)	27 (78.1)	
HBV	2 (2.86)	0	
Wilson's disease	1(1.43)	1 (3.2)	
NAFLD	0	2 (6.5)	
others	4 (5.71)	1 (3.2)	
Jaundice: no. (%)	**9 (12.86)**	**2 (6.45)**	**0.341**
Ascites: no. (%)	17 (24.29)	2 (6.45)	0.034*
Lower limb edema: no. (%)	25 (35.71)	6 (19.35)	0.100
Child Class: no. (%)			0.055
A	39 (55.7)	25 (80.6)	
B	27 (38.6)	5 (16.1)	
C	4 (5.7)	1 (3.2)	
History of blood transfusion: no. (%)	34 (48.57)	13 (41.94)	0.537
History of hematemesis and melena: no. (%)	10 (14.29)	5 (16.13)	0.810
History of DAAs: no. (%)	34 (48.57)	18 (58.06)	0.379
History of hepatic encephalopathy: no. (%)	7 (10)	2 (6.45)	0.564

*HCV: Hepatitis C virus, HBV: Hepatitis B virus, NAFLD: non-alcoholic fatty liver disease, DAAs: Direct acting antivirals, * statistically significant at P <0.05*

HCV was the main etiology of cirrhosis in 63 (90%) patients in group I and in 27 (78.1%) patients in group II whereas other etiologies as HBV was found in 2 patients in group I, NAFLD in 1 patient in group I and 1 patient in group II, Wilson's disease in 2 patients in group II, and unknown etiology in 4 patients in group I and 1 patient in group II with no significant difference between the groups (Table 1).

There was no significant difference amongst the groups regarding the clinical data as presence of jaundice and lower limb edema. No significant difference was detected between the two groups regarding the presence of ascites clinically (P = 0.034). Child-Pugh class A, B, and C were found in 39 (55.7%), 27 (38.6%), and 4 (5.7%) patients in group I, respectively. While group II had 25 (80.6%), 5 (16.1%), and 1 (3.2%) patient with classes A, B, and C, respectively with no significant difference between the two groups. (Table 1).

Full blood count demonstrated no significant differences between the two groups concerning the hemoglobin level (P =0.081) and the white blood cells (P =0.241). The platelet count was significantly lower in group I than group II (P = 0.007) (Table 2).

Serum bilirubin, ALT, and AST demonstrated no significant difference among the studied groups (P >0.05). Serum albumin was significantly lower in group I than group II (P = 0.001). A significant difference between the two groups was demonstrated concerning the prothrombin activity (P =0.006) and INR (P =0.037) (Table 2).

No significant difference was detected among the studied groups concerning serum urea, creatinine (P =0.924) and fasting blood sugar (P =0.061) (Table 2).

Platelet count / spleen diameter ratio (PSR) was significantly reduced in group I than group II (P =0.005). Right lobe/ albumin ratio (RLAR) was significantly elevated in group I than in group II (P =0.001) (Table 3).

The Fibroscan results detected that LSM median was significantly higher in group I than in group II (P <0.001). The controlled attenuation parameter (CAP) median demonstrated no significant difference amongst the groups (P =0.880) (Table 3).

The endoscopic findings demonstrated that EVs was identified in 70 (96.3%) of our patients (small EVs in 28 (40%) patients, medium sized varices in 24 (34.3%) patients, and large EVs in 18 (25.7%) patients) (Table 3).

The hemoglobin level showed a significant inverse correlation with EVs grading (p = 0.032). The white blood cells showed insignificant correlation with the presence and grading of EVs. The platelet count had a significant correlation with the presence (p = 0.004), and grading of EVs (p <0.001) (Table 4). A platelet cut off value of $122.5 \times 10^3/mm^3$ had an AUC of 0.679, sensitivity of 64.5%, specificity of 60%, a PPV of 79.25% and a NPV of 41.67% for detecting the presence of EVs (Table 5) (Fig. 1).

Table 2. Laboratory findings

Parameter	Group I (no. = 70)	Group II (no. =31)	P value
Hb (gm/dl): Mean ± SD.	10.13 ± 2.00	10.91 ± 2.04	0.081
WBCs × 10^3 /(mm3): Mean ± SD.	4.92 ± 2.19	5.54 ± 2.52	0.241
Platelets × 10^3 /(mm3): Mean ± SD.	117.37 ± 49.26	146.81 ± 49.02	0.007*
T. Bilirubin (mg/dl): Mean ± SD.	1.42 ± 1.03	1.24 ± 0.68	0.311
AST (U/L): Mean ± SD.	50.2 ± 22.89	44.56 ± 18.41	0.193
ALT (U/L): Mean ± SD.	36.11 ± 18.39	33.7 ± 11.01	0.417
S. Albumin (gm/dl): Mean ± SD.	3.21 ± 0.61	3.64 ± 0.54	0.001*
Prothrombin activity (%): Mean ± SD.	74.7 ± 17.3	85.05 ± 16.68	0.006*
INR: Mean ± SD.	1.36 ± 0.29	1.23 ± 0.28	0.037*
S. Creatinine (mg/dl): Mean ± SD.	0.94 ± 0.42	0.93 ± 0.3	0.924
Fating blood sugar (mg/dl): Mean ± SD.	142.68 ± 60.26	119.68 ± 45.56	0.061

*Hb: hemoglobin, WBCs: white blood cells, AST: aspartate aminotransferase, ALT: alanine aminotransferase, INR: international normalized ratio, * statistically significant at P <0.05*

Table 3. Radiological and endoscopic findings

Parameter	Group I (no. = 70)	Group II (no. =31)	P value
Ultrasonographic findings: Mean ±	12.52 ± 1.29	12.19 ± 1.28	0.239
SD.	16.4 ± 2.48	15.36 ± 2.21	0.038*
Right lobe diameter (cm)	19 (27.14)	3 (9.68)	0.0498*
Spleen diameter (cm)			
Ascites: no. (%)			
PSR: Mean ± SD.	749.21 ± 380.2	988.46 ± 375.39	0.005*
RLAR: Mean ± SD.	4.04 ± 0.897	3.44 ± 0.712	0.001*
LSM med. (kPa): Mean ± SD.	29.26 ± 14.8	19.46 ± 4.84	<0.001*
CAP med. (dB/m): Mean ± SD.	200.21 ± 69.55	202.77 ± 81.46	0.880
Grading of EVs: no. (%)	28 (40)		
Small	24 (34.3)		
Medium	18 (25.7)		
Large			
PHG: no. (%)	36 (51.4)	15 (48.6)	0.778

*LSM: liver stiffness measurement, CAP: controlled attenuation parameter, EVs: esophageal varices, PSR: platelet count/spleen diameter ratio, RLAR: right liver lobe diameter/albumin ratio, * statistically significant at P <0.05*

Table 4. Correlations between the laboratory, radiologic, and endoscopic findings and EVs presence and grading

	EVs presence		EVs grading	
	r	P value	r	P value
Hb	-0.159	0.112	-0.213	0.032*
WBCs	-0.109	0.279	-0.091	0.363
Platelets	-0.286	0.004*	-0.369	<0.001*
T. Bilirubin	0.022	0.826	0.086	0.390
AST	0.097	0.331	0.038	0.706
ALT	-0.008	0.936	-0.087	0.385
S. Albumin	-0.311	0.002*	-0.245	0.014*
Prothrombin time	0.269	0.0067*	0.295	0.0029*
Prothrombin activity	-0.287	0.0037*	-0.275	0.0054*
INR	0.264	0.0078*	0.250	0.0117*
Child class	0.221	0.027*	0.279	0.0048*
Child score	0.286	0.0039*	0.259	0.009*
Ultrasonographic findings				
Right lobe diameter	0.0810	0.420	0.0122	0.904
Spleen diameter	0.172	0.085	0.210	0.035*
Ascites	0.195	0.0506	0.191	0.0563
PSR	-0.311	0.002*	-0.384	<0.001*
RLAR	0.319	0.001*	0.248	0.012*
LSM median	0.361	<0.001*	0.314	0.001*
CAP median	-0.0575	0.567	-0.0289	0.773

*PHG: portal hypertensive gastropathy, Hb: hemoglobin, WBCs: white blood cells, AST: aspartate aminotransferase, ALT: alanine aminotransferase, INR: international normalized ratio, PSR: platelet count/spleen diameter ratio, RLAR: right liver lobe diameter/albumin ratio, LSM: liver stiffness measurement, CAP: controlled attenuation parameter, * statistically significant at P <0.05*

Table 5. Cut off values for detection of EVs presence

	Cut off value	AUC	P value	Sensitivity	Specificity	PPV	NPV	LR+	LR-
Platelets× 10^3/mm^3	122.5	0.679	0.004*	64.5	60	79.25	41.67	1.6125	0.888
Albumin (gm/dl)	3.45	0.694	0.002*	64.5	71.4	81.97	50	2.255	0.497
PSR	742.17	0.659	0.002*	71	58.6	82	43.14	1.715	0.495
RLAR	3.62	0.700	0.001*	64.3	67.7	81.8	45.7	1.99	0.527
LSM (kPa)	18.55	0.726	< 0.001*	74.3	54.8	78.79	48.57	1.644	0.469

*PHG: portal hypertensive gastropathy, PSR: platelet count/spleen diameter ratio, RLAR: right liver lobe diameter/albumin ratio, AUC: area under the curve, PPV: positive predictive value, NPV: negative predictive value, LR: likelihood ratio, * statistically significant at P <0.05*
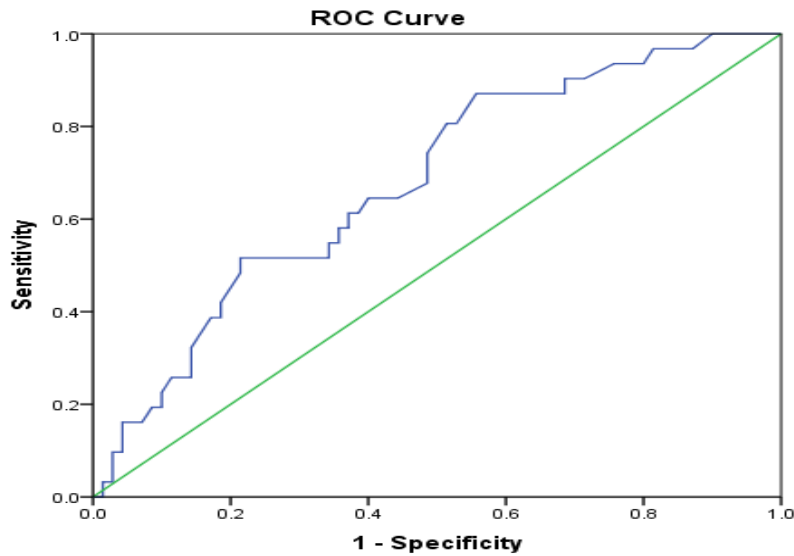
Fig. 1. ROC curve of platelet count for detection of EVs presence (AUC= 0.679, p= 0.004, 95% CI (0.570 - 0.789))

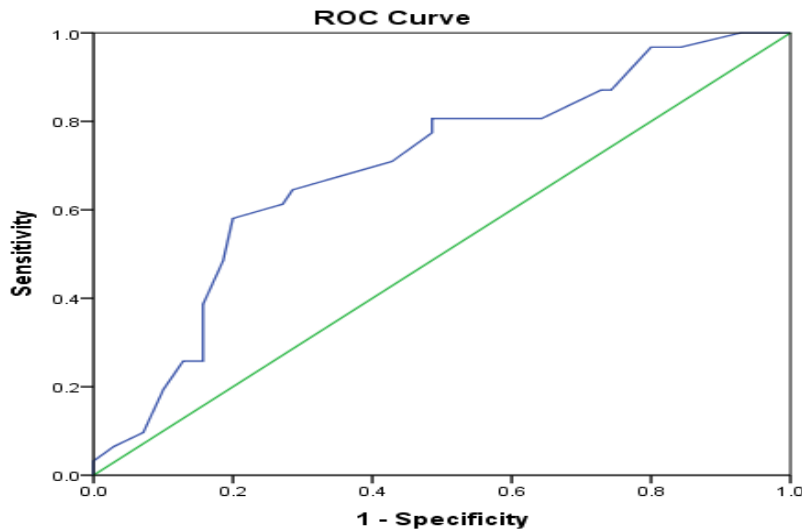*AUC: Area under the curve, EV: esophageal varices, CI: Confidence interval*

Fig. 2. ROC curve of serum albumin for detection of EVs presence EV (AUC= 0.694, p= 0.002, 95% CI (0.583 - 0.806))

AUC: Area under the curve, EV: esophageal varices, CI: Confidence interval

No significant correlation was found between the presence and grading of EV and bilirubin or transaminases. Serum albumin had significant inverse correlations with the presence (p = 0.002) and grading of EVs (p = 0.014) (Table 4). Serum albumin cut off value of 3.45 gm/dl had a sensitivity of 64.5%, specificity of 71.4%, PPV of 81.97%, and a NPV of 50% for detection of the presence of EVs (Table 5) (Fig. 2).

The prothrombin time had direct correlations with the EVs presence (p = 0.0067), and grading (p = 0.0029). The prothrombin activity had inverse correlations with the EVs presence (p = 0.0037), and grading (r = -0.275, p = 0.0054). The INR had direct correlations with EVs presence (p = 0.0078) and grading (p = 0.0117) (Table 4).

The Child-Pugh score showed significant direct correlations with the EVs presence (p = 0.027) and grading (p = 0.0048). The Child-Pugh class showed significant direct correlations with the EVs presence (p = 0.0039) and grading (p = 0.009). The spleen diameter by ultrasound

correlated directly with EVs grading (p = 0.035) but it showed insignificant correlations with the presence of EVs (Table 4).

The PSR had significant inverse correlations with the presence (p = 0.002), and grading of EVs (p <0.001) (Table 4). PSR cut off value of 742.17 had an AUC, sensitivity, specificity, PPV, and NPV of 0.695, 71%, 58.6%, of 82%, and 43.14%, respectively for the presence of EVs. (Table 5) (Fig. 3).
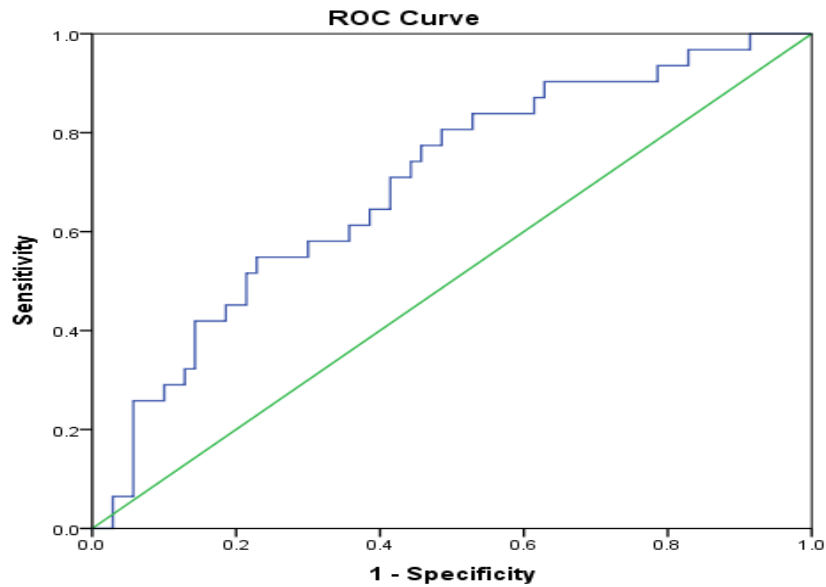

Fig. 3. ROC curve of PSR for detection of EVs presence (AUC= 0.695, p= 0.002, 95% CI (0.585 - 0.804))

PSR: Platelet count/ spleen diameter ratio, AUC: Area under the curve, EV: esophageal varices, CI: Confidence interval
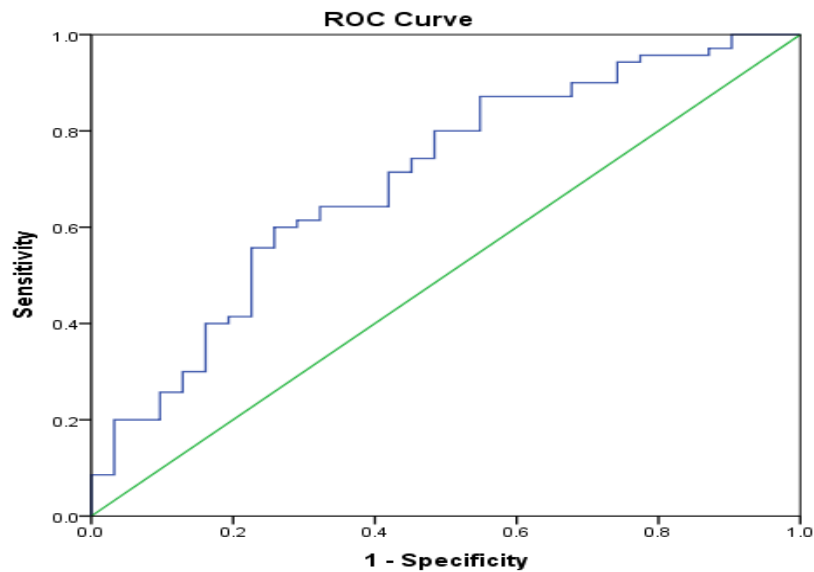

Fig. 4. ROC curve of RLAR for detection of EVs presence (AUC= 0.700, p= 0.001, 95% CI (0.587 - 0.812))

RLAR: Right liver lobe/Albumin ratio, AUC: Area under the curve, EV: esophageal varices, CI: Confidence interval
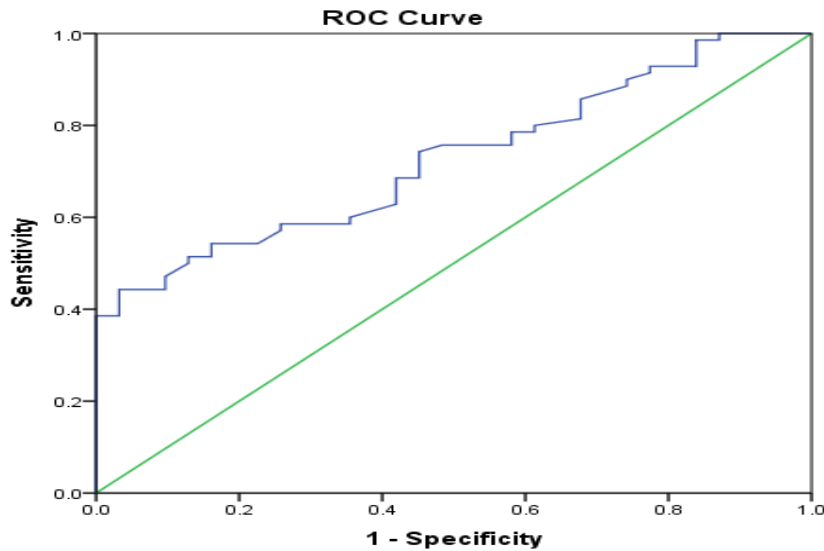
Fig. 5. ROC curve of LSM for detection of EVs presence (AUC= 0.726, p< 0.001, 95% CI (0.628 - 0.823))

AUC: Area under the curve, EV: esophageal varices, CI: Confidence interval

The RLAR had significant direct correlations with the presence (p = 0.001), and grading of EVs (p =0.012) (Table 4). RLAR had a sensitivity, specificity, PPV, NPV, and AUC of 64.3%, 67.7%, 81.8, 45.7%, and 0.700, respectively for a cut off value of 3.62 to detect the presence of esophageal varices. (Table 5) (Fig. 4).

LSM correlated directly and significantly with EVs presence (p <0.001), and grading (p = 0.001) (Table 4). A LSM cut off value of 18.55 kPa had a sensitivity, specificity, PPV, NPV, and AUC of 74.3%, 54.8%, 78.79%, 48.57%, and 0.726, respectively for the prediction of the presence of EVs (Table 5) (Fig. 5).

4. DISCUSSION

Esophageal varices pose an important health sequel of portal hypertension giving the risks of morbidity and mortality associated with variceal hemorrhage having 15 – 25% six weeks mortality rate. Owing to the expenses and invasiveness of endoscopy, several noninvasive predictors of EVs were proposed [14].

Transient Elastography is a technique that uses ultrasonic shear waves to measure liver stiffness as a substitute of liver fibrosis. The Baveno VII consensus set criteria of LSM ≥20 kPa and platelet count ≤150,000/mm^3 to predict the presence of EVs and the need for endoscopic variceal screening [15]. The aim of our study was to evaluate the accuracy of TE and other

markers for the non-invasive prediction of EVs in Egyptian cirrhotic patients.

Concerning the hematological tests, The Hb level and the WBC count showed no significant difference between the studied groups. The platelet count showed significant difference between the two groups agreeing with Tag-Adeen et al. and Kumar et al. [16,17].

The serum bilirubin, ALT and AST showed no significant difference between the studied groups while the serum albumin was significantly lower in group I than group II agreeing with Kumar et al. 2020 but disagreeing with Rahmani et al. 2021 who found no significant difference regarding serum albumin [17,18].

Prothrombin activity and INR showed significant difference between the studied groups (P = 0.006 and P = 0.037) in agreement with Alsebaey et al. and Rahmani et al. [18,19]. This could be explained by progression of portal hypertension and cirrhosis with deterioration of liver synthetic functions.

The ultrasonographic examination demonstrated insignificant difference between the two groups regarding the right liver lobe diameter disagreeing with Kumar et al. [17]. However, spleen diameter and presence of ascites showed significant differences between the two groups (P = 0.038, P =0.0498) agreeing with Kumar et al. and Alsebaey et al. [17,19].

PSR was significantly lower in group I than in group II (P =0.005). RLAR was significantly elevated in group I than in group II (P =0.001). These results were in agreement with Jamil et al. Salem et al. and Elbasiony et al. [20-22].

LSM was significantly elevated in patients with EVs than in patients without (P <0.001) agreeing with Paternostro et al. Alsebaey et al. and Fofiu et al. [19,23,24].

Concerning the correlations of EVs with the hematological tests, an inverse relationship was detected between Hb level and grading of EVs (P 0.032). As the risk of EVs bleeding is about 25 – 35% and larger esophageal varices is associated with increase in esophageal wall tension which increase the risk of bleeding.

The platelet count showed a significant inverse correlation with the presence (P = 0.004) and grading of EVs (P <0.001). Our data was in harmony with Alsebaey et al. Elbasiony, et al. As both low platelet count and large EVs tend to occur in advanced liver disease [19,21].

A platelet count cut off value of $122.5 \times 10^3/mm^3$ had a sensitivity, specificity, PPV, and NPV of 64.5%, 60%, 79.25%, and 41.67% respectively for the detection of the presence of EVs. Baveno VII consensus stated that a platelet count of > $150 \times 10^3/mm^3$, LSM < 20 kPa could be used for ruling out the presence of high risk EVs [15].

Colli et al. in a systematic review stated that a platelet count cut off value of around $150 \times 10^3/mm^3$ from 10 studies had a sensitivity and a specificity of 71% and 80% respectively for the detection of varices of any size. Elbasiony et al. found that a cut off value of platelet count of ≥ $112.5 \times 10^3/mm^3$ had a sensitivity and a specificity of 84% and 87% for ruling out the presence of EVs [21,25].

The correlations between the liver function tests and the presence and grading of EVs demonstrated insignificant association with serum bilirubin, ALT and AST. However, serum albumin was significantly inversely associated with the presence of EVs (P = 0.002) and grading (P 0.014). These results agreed with Kumar et al. As both large EVs and low serum albumin are associated with advanced liver disease [17].

A cut off value of serum albumin of 3.45 mg/dl had a sensitivity of 64.5%, specificity of 71.4%, PPV of 81.97%, and a NPV of 50% for detecting the presence of EVs. Wong et al. (2021) proposed a criteria of serum albumin > 4mg/dl, serum bilirubin < 2.2 gm/dl, and platelet count > $114 \times 10^3/mm^3$ for the exclusion of high risk EVs [26].

A significant correlation was detected between the coagulation profile and the presence and grading of EVs as follows: a significant negative correlation between the prothrombin activity and presence (P = 0.0037) and grading of EVs (P 0.0054) and a direct correlation between the INR and presence (P = 0.0078) and grading of EVs (P 0.01117). These findings were similar to the findings of Kraja et al. and Alsebaey et al. [19,27].

A significant positive correlation was found between the Child Pugh score and the presence (P = 0.0039) and grading of EVs (P 0.009). Also, a significant correlation was present between the Child Pugh Class and the presence (P = 0.027) and grading of EVs (P 0.0048).These results were in agreement with Bhattarai et al. Kraja et al. and Krige, et al. [27–29].

The ultrasonographic examination in our study demonstrated that the right liver lobe diameter and presence of ascites showed no correlation with EVs presence and grading. Although a significant correlation was found between spleen diameter and EVs grading (P = 0.035). These results agreed with Hassan, et al. and Rahmani, et al. [18,30].

PSR was significantly correlated with the presence (P = 0.002) and grading of EVs (P <0.001). In our study, a cut off value of 742.17 for PSR for detection of EVs presence with AUC, sensitivity, specificity, PPV, and NPV of 0.695, 71%, 58.6%, 82%, and 43.14% respectively.

Jamil et al. set a PSR cut off value of ≤1077.42 for prediction of EVs with AUC, sensitivity, and specificity of 0.9, 88.75%, and 81.43%. Mahfuzzaman, et al. used a cut off value for PSR of 908.5 had a sensitivity, specificity, PPV, and NPV of 100%, 55.6%, 85.4%, and 100% respectively. Rahmani, et al. concluded that a cut off value of <6.95 (µL /cm3) had an AUC, sensitivity, specificity, PPV, and NPV of 0.794, 76.2%, 71.2%, 68.1%, and 78.7% for the prediction of EVs [18,20,31].

RLAR was found to correlate significantly with the presence (P = 0.001) and grading of EVs (P = 0.012). Our data were similar to Salem et al. and Akram et al. A RLAR cut off value of >3.62

had an AUC of 0.7, sensitivity 64.3%, specificity 67.7%, PPV 81.8%, and NPV 45.7% for the prediction of EVs. Nouh, et al., (2019) used a RLAR cut off value 3.7 with sensitivity and specificity of 95% and 76.4%. Awad, et al. set a cut off value of >3.88 with sensitivity and specificity of 86.67 and 73.33. While Kamal, et al. set a cut off value of >2.8 with sensitivity and specificity of 80% and 53% [22,32–35].

Transient elastography (Fibroscan) results showed significant association between LSM and the presence of EVs (P <0.001) and the grading of EVs (P = 0.001). Our results were also similar to Zhu et al. Sarkar et al. Fofiu et al. and Elbasiony et al. [21,24,36,37].

The ROC curve yielded a cut off value of 18.55 kPa for the prediction of EVs with AUC 0.726, sensitivity 74.3%, specificity 54.8%, PPV 78.79%, and NPV 48.57%. Sarkar et al. [37] proposed a cut off value of 18 kPa with a sensitivity and specificity of 88.7% and 75%, respectively for the prediction of EVs. A meta-analysis conducted by Cheng et al. [38] concluded that LSM is useful for the detection of the presence and grading of EVs. However, a single cut off value couldn't be reached. Elbasiony et al. set a cut off value of >23.1 kPa for the prediction of EVs with a sensitivity 94% and specificity 81% [21,37,38].

5. CONCLUSION

Liver stiffness measurement, platelet count/ spleen diameter ratio, right liver lobe diameter/ albumin ratio, serum albumin and platelet counts are noninvasive, cheap, and easy screening modalities for predicting the presence and grading of esophageal varices. However, they have moderate accuracy and cannot replace endoscopy.

ETHICAL APPROVAL AND CONSENT

The ethics committee of the faculty of medicine, Tanta University approved the study in April 2019 with the code 33090/04/19. Written consent had been taken from all participating patients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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