

ALBI-Platelets Score and Transient Elastography Combination as Predictor Factor of High-Risk Varices in Egyptian Patients with Compensated Hepatocellular Carcinoma

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Background and study aim:

Hepatocellular carcinoma (HCC) is associated with increased portal pressure; however, variceal screening guidelines are based on cirrhotic patients without HCC, underscoring the need for HCC-specific strategies. Our study aims to evaluate the combination of albumin-bilirubin grade and platelet count (ALBI-PLT score) with Transient Elastography in predicting the presence of high-risk varices (HRVs) in compensated HCC patients.

Patients and Methods: The study prospectively enrolled 220 participants: 160 patients with newly diagnosed hepatocellular carcinoma (HCC) and compensated liver cirrhosis (Child-Pugh A, score 5–6), and 60 control patients with compensated cirrhosis (Child-Pugh A, score 5–6) without HCC. Participants were recruited from the HCC and outpatient clinics at the National Liver Institute, Menoufia University.

Results: There was a significant difference between patients with HRVs and those without HRVs regarding the albumin/bilirubin-platelet (ALBI-PLT) score. An ALBI-PLT score of 2 showed a sensitivity of 97.9% and specificity of 40.5%, while a score of 3 had a sensitivity of 74.5% and specificity of 35%, and a score of 4 showed a sensitivity of 72% and specificity of 74%, all with significant predictive value for HRV. Additionally, Liver stiffness measurement (LSM) demonstrated a sensitivity of 70% and specificity of 62% for predicting HRV. Using an LSM cut-off of 25 kPa combined with the ALBI-PLT score resulted in a sensitivity of 95% and specificity of 52.4%, also significantly predicting HRV.

Conclusion: Combining the ALBI-PLT score with LSM provides a sensitive, non-invasive method to predict high-risk varices in compensated HCC patients, potentially limiting unnecessary endoscopy.

INTRODUCTION

Globally, hepatocellular carcinoma (HCC) ranks as the sixth most frequently diagnosed cancer and represents the third most common cause of death from cancer [1].

HCC has a well-established association with portal hypertension (PHT). The development of PHT is driven by the tumor's formation of arteriovenous shunts and the subsequent alteration of the liver's normal structure, which collectively increase pressure within the portal venous system[2].

To assess clinically significant portal hypertension (CSPH) and identify high-risk varices (HRVs) for hemorrhage prevention, endoscopic screening for esophageal varices is a critical diagnostic procedure. Current guidelines, such as those from the Baveno V consensus, recommend that all patients diagnosed with cirrhosis undergo this endoscopic evaluation. However, a significant knowledge gap exists, as the foundational evidence for these guidelines is derived predominantly from studies on general cirrhotic populations without focal liver lesions [3].

It remains critically unclear whether this evidence fully applies to patients with HCC, in whom the unique hemodynamic effects of the tumor can independently alter portal pressure and bleeding risk [2].

The clinical assessment of advanced chronic liver disease has been augmented by the development of various non-invasive diagnostic methods. In response to these advancements, the Baveno VI guidelines proposed utilizing criteria that combine transient elastography measurements of liver stiffness with platelet count. This algorithm helps to identify individuals with compensated disease for whom endoscopic screening for varices may be safely omitted [3].

Focal liver lesions, elevated bilirubin, and necro-inflammation can confound LSM readings, potentially leading to overestimation of portal hypertension risk and reducing the specificity of the Baveno VI criteria in this subgroup [4].

Initially introduced as a robust prognostic tool, the albumin-bilirubin (ALBI) grade effectively evaluates hepatic functional reserve and predicts outcomes in individuals with hepatocellular carcinoma. Furthermore, the utility and accuracy of this scoring system have been extensively confirmed across diverse global populations and through its application to a wide range of therapeutic interventions [5,6].

Beyond its stand-alone utility, the ALBI grade has been integrated with platelet count to form the ALBI-PLT score. This composite tool was developed to estimate the prevalence and identify risk factors for high-risk varices (HRV) in compensated HCC patients. A key clinical application of this score is to identify a subset of patients for whom endoscopic screening for esophageal varices may be unnecessary [5].

In brief, while non-invasive tools like the Baveno VI criteria have transformed risk stratification in general cirrhosis, their performance specifically in HCC cohorts remains inadequately explored and potentially compromised. The ALBI grade, reflecting synthetic liver function, may capture a dimension of portal hypertensive pathophysiology distinct from the purely structural and hemodynamic factors measured

by LSM. Critically, there is a scarcity of head-to-head comparisons evaluating integrated models that combine functional scores like ALBI with standard tools like LSM for HRV prediction in HCC. This gap leaves clinicians without clear guidance on the optimal non-invasive strategy for this large and distinct patient population, in whom both the tumor and liver function concurrently dictate clinical outcomes [7].

The aim of this study was to assess the utility of the combination of albumin-bilirubin grade and platelet count (ALBI-PLT score) in association with Transient Elastography to predict the prevalence and risk factors of HRV in compensated patients with HCC.

PATIENTS AND METHODS

Sample size estimation: based on the literature that the rate of HRV in HCC-compensated patients was 16.9%, and the sensitivity, specificity, PPV, and NPV of the ALBI-PLT score to predict HRV in compensated patients with HCC were 96.0%, 27.1%, 21.1%, and 97.1% [8]. The minimum required number of compensated patients with HCC is estimated to be 105, provided that α err prob = 0.05 & Power ($1-\beta$ err prob) = 0.8 [9].

Study population and design:

The study prospectively enrolled 220 participants aged ≥ 18 years: 160 patients with newly diagnosed hepatocellular carcinoma (HCC) according to the American Association for the Study of Liver Diseases (AASLD) criteria [10], who had compensated liver cirrhosis, exclusively defined as Child-Pugh class A (with a score of 5 or 6), and 60 control patients with compensated cirrhosis (Child-Pugh A, score 5–6) without HCC. Participants were recruited from the HCC and outpatient clinics at the National Liver Institute, Menoufia University. Study participants were divided into four cohorts. HCC patients ($n=160$) were categorized into three groups based on BCLC stage and treatment eligibility: Group 1: 50 patients (BCLC stages 0, A, or B) eligible for locoregional therapies (e.g., resection, ablation). Group 2: 53 patients (BCLC stages B or C without vascular invasion) who were candidates for transarterial chemoembolization (TACE) or other

intervention, targeted or immunotherapy. Group 3: 57 patients (BCLC stage C with vascular invasion) who were candidates for targeted or immunotherapy. Additionally, a control group (Group 4, n=60) consisted of patients with compensated cirrhosis and no HCC.

Patients with Child B or C cirrhosis or BCLC stage D were excluded from the study.

After obtaining an informed written consent, all patients were subjected to a comprehensive clinical assessment (demographics, smoking, cirrhosis etiology, HCC history, and comorbidities).

Laboratory and radiological assessment:

All patients underwent laboratory testing (complete blood count, liver/renal function, International Normalized Ratio (INR), Alpha-Fetoprotein (AFP), viral serology), and radiological evaluation (multiphasic CT/MRI to assess tumor features, vascular invasion, metastasis, and HCC confirmation per AASLD criteria). Additional assessments at HCC diagnosis included upper endoscopy, transient elastography measured liver stiffness in kilopascal (kPa) using the Fibroscan 504® machine, Echosens, France.

HCC was diagnosed radiologically for focal lesions >1 cm exhibiting characteristic arterial hyperenhancement with washout on venous/delayed phases via multiphasic MDCT or dynamic MRI, per AASLD criteria.

Endoscopic evaluation assessed high-risk varices (HRV) according to the Baveno VII consensus: esophageal varices (large, tortuous, or with red signs requiring band ligation) and gastric varices (large, with signs or soft areas, requiring cyanoacrylate sclerotherapy) were documented [11,12].

Prognostic scores calculation:

Prognostic scores were calculated: ALBI grade categorized into grades 1:3 based on the calculated score $[-0.085 \times \text{albumin (g/L)} + 0.66 \times \log(\text{bilirubin } \mu\text{mol/L})]$, given that, Grade 1 (score < -2.60), Grade 2 (score > -

2.60 and < or equal to -1.39), Grade 3 (score > -1.39), with ALBI-PLT score calculated by adding 1 or 2 points to the ALBI grade depending on the platelet count ($\leq 150,000/\text{mm}^3 = 2$ points) and ($< 150,000/\text{mm}^3 = 1$ point), thus the ALBI-PLT score ranges from 2 to 5 [5]; Model for End-Stage Liver Disease (MELD score) was calculated using the formula $[9.57 \times \ln(\text{creatinine}) + 3.78 \times \ln(\text{bilirubin}) + 11.2 \times \ln(\text{INR})]$. It ranges from 6 to 40, with higher scores indicating more severe liver disease and higher short-term mortality. A MELD score <10 suggests low risk (<2%), 10–19 indicates moderate risk (6–20%), 20–29 reflects high risk (20–75%), 30–39 indicates very high risk (52–80%), and scores ≥ 40 are associated with critical risk and >90% three-month mortality [13]; and Child-Pugh score was calculated based on bilirubin, albumin, INR, ascites, and encephalopathy classifying liver disease severity into three classes, Class A (5–6 points) indicates well-compensated disease, Class B (7–9 points) reflects significant functional compromise, and Class C (10–15 points) denotes decompensated liver disease with the poorest prognosis. Three-month mortality increases from ~10% in Class A to ~40% in Class B and up to ~80% in Class C [14]. Also, BCLC staging was applied [15] to classify disease progression. The ALBI-PLT score was correlated with endoscopic findings and elastography to identify compensated cirrhosis/HCC patients requiring HRV screening.

Statistical Analysis

Data were analyzed using SPSS (v. 20). Descriptive statistics included mean $\pm$ SD (quantitative) and frequencies/percentages (qualitative). Inferential analyses utilized: Chi-square/Fisher's exact tests (categorical associations); t-test/Mann-Whitney (two-group comparisons); ANOVA/Kruskal-Wallis (multi-group comparisons); Pearson's/Spearman's correlations. ROC curves determined diagnostic cutoffs, with sensitivity, specificity, PPV/NPV reported. Significance threshold: $p < 0.05$.

RESULTS

Baseline patient characteristics, virological history, and previous HCC management

According to demographic data mean age of the studied participants was 61.30 ± 9.08 years. 67.27% of patients were males and 32.73% were females, 29.54% of patients had diabetes mellitus (DM), 27.27% had hypertension (HTN) (Table 1).

Table 1. Distribution of demographic data among the studied patients.

	Studied patients (N=220)	Studied patients (N=220)
	Mean	$\pm$ SD
Age (years)	61.30	9.08
Gender	N	%
Male	148	67.27%
Female	72	32.73%
Comorbidities		
DM	65	29.54%
HTN	60	27.27%
Others	11	5%

Abbreviations: DM, diabetes mellitus; HTN, hypertension

According to virological history, 88.18% of patients had HCV, and 86.8% of patients had Sofosbuvir/Daclatasvir treatment. Regarding previous interventions for HCC, most patients had immunotherapy, radio frequency ablation

(RFA), and trans-arterial chemoembolization (TACE) (45%, 19.54% and 14.09%), respectively, while 6.3% underwent surgical intervention (table 2).

Table 2. Virological history, anti-viral treatment, and previous interventions for HCC.

	Studied patients (N=220)	Studied patients (N=220)
Viral History	N	%
Negative virology	22	10%

HCV Ab positivity	194	88.18%
HB s Ag positivity	4	1.81%
Anti-viral TTT	Anti-viral TTT	Anti-viral TTT
Sofosbuvir-Daclatasvir	191	86.8%
Interferon	2	0.90%
Entecavir	3	1.36%
Tenofovir disoproxil fumarate (TDF)	1	0.45%
	Mean	±SD
Period between anti-viral treatment and HCC development in years	4.55	0.82
Previous intervention for HCC		
Non anatomical resection	11	4.5%
partial hepatectomy	1	0.45%
Right hepatectomy	2	0.9%
Lt lateral segmentectomy	1	0.45%
Trans-arterial Chemoembolization (TACE)	31	14.09%
Immunotherapy	99	45%
Radio frequency ablation (RFA)	43	19.54%
Sorafenib	1	0.45%
Microwave Ablation (MWA)	1	0.45%
Ethanol injection	1	0.45%

Abbreviations: TDF, Tenofovir disoproxil fumarate; HCC, Hepatocellular carcinoma; TACE, Trans-arterial Chemoembolization; RFA, Radio frequency ablation; MWA, Microwave Ablation

Upper Endoscopy Findings

Among the studied group, 47 patients were found to have high-risk varices (HRVs) while 173 patients had no HRVs (Table 3).

Table (3): Distribution of High-Risk Varices (HRVs) among the studied groups

	Group 1 (N=50)	Group 2 (N=53)	Group 3 (N=57)	Group 4 (N=60)	P-Value
High-Risk Varices (HRVs)	10 (20%)	11 (20.75%)	12 (21.05%)	14 (23.3%)	0.87

Abbreviations: HRVs, High-Risk Varices

Correlation Between High-Risk Varices (HRVs) in Upper Endoscopy and Both ALBI-PLT Score and Liver Stiffness Measurement (LSM)

Patients with an ALBI-PLT score >2 showed a significantly higher rate of HRV

(97.9%) compared to those with a score ≤2 (2.1%), with a P value of 0.001. The mean LSM was also higher in HRV patients (36.58 ± 18.27 kPa) versus non-HRV (28.53 ± 15.85 kPa), with a P value of 0.050 (Table 4).

Table 4. Correlation Between High-Risk Varices (HRVs) and Both ALBI-PLT Score and Liver Stiffness Measurement (LSM)

	HRV N=47	No HRV N=173	p-value
ALBI-PLT score			
≤2	1(2.1%)	70(40.5%)	0.001*
>2	46(97.9%)	103(59.5%)	0.001*
LSM in Kilopascal (kPa)	36.58±18.27	28.53±15.85	0.050*

Abbreviations: ALBI-PLT, Albumin-Bilirubin-Platelet; HRV, High risk varices; LSM, liver stiffness measurement; kPa, Kilopascal

ALBI-PLT score, Liver stiffness measurement (LSM), and Combination of LSM and ALBI-PLT score for prediction of HRVs

ALBI-PLT score at 2 had a sensitivity of 97.9% and specificity of 40.5% with positive predictive value (PPV) of 30% and negative predictive value (NPV) of 98%, while ALBI-PLT score at 3 had a

sensitivity of 74.5% and specificity of 35% with PPV of 23% and NPV of 83%. ALBI-PLT score at 4 had a sensitivity of 72% and specificity of 74% with PPV of 43% and NPV of 90%, also the cut-off value of 4 showed the best diagnostic performance with an area under the curve (AUC) of 0.735 (Table 5, Figure 1). Liver stiffness measurement (LSM) at a cut-off value of 25 kPa had a sensitivity of 70%

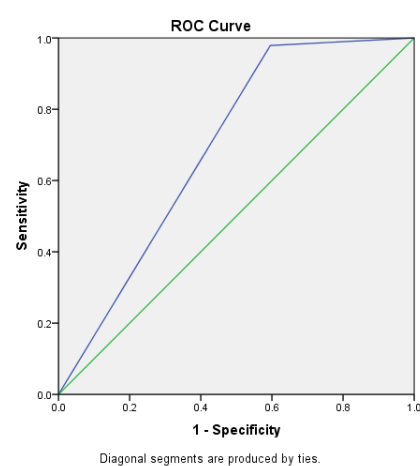
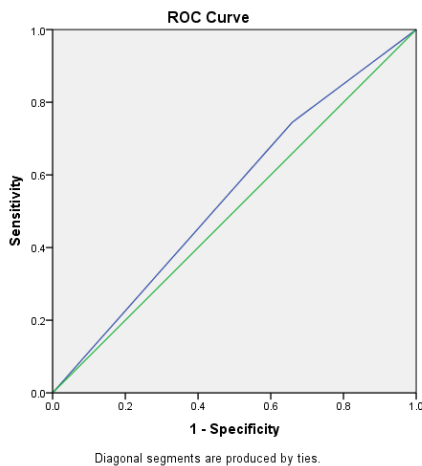
and specificity of 62% with a PPV of 10%, NPV of 70% and AUC of 0.661 (Table 5, Figure 2). Combination of LSM at cutoff value 25 kPa and ALBI-PLT

score at score >4 had sensitivity of 95% and specificity of 52.4% with PPV of 32.2%, NPV of 97.8% and AUC of 0.737 (Table 5, Figure 3).

Table 5. ROC analysis of ALBI-PLT score >2, LSM at the cut-off value of 25 kPa, and combination of LSM at cutoff value 25 kPa and ALBI-PLT score at score >4 for prediction of HRV.

Variable	AUC	Sensitivity	Specificity	PPV	NPV	Std. Error	Asymptotic Sig.	Asymptotic 95% Confidence Interval Lower Bound	Asymptotic 95% Confidence Interval Upper Bound
2	0.692	97.9%	40.5%	30%	98%	.037	.000	.619	.764
3	0.543	74.5%	35%	23%	83.3%	.046	.368	.452	.634
4	0.735	72%	74%	43%	90%	.042	.000	.652	.818
LSM (25 kpa)	0.661	70%	62%	10%	70%	0.069	0.025	0.527	0.796
ALBI-PLT score And LSM $\geq$25 kPa	0.737	95%	52.4%	32.2%	97.8%	.053	0.001	0.634	0.840

Abbreviations: ALBI-PLT, Albumin-Bilirubin-Platelet; HRV, High risk varices; AUC, area under curve; PPV, Positive predictive value; NPV, negative predictive value



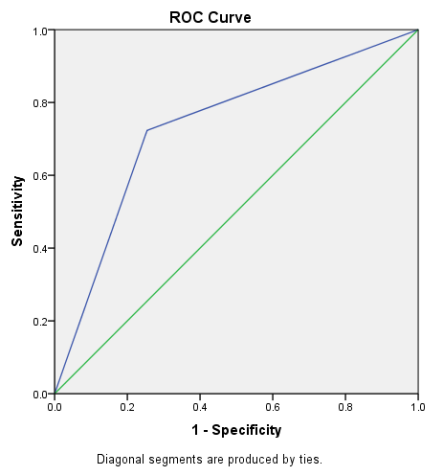


Figure 1. ROC curve analysis of the ALBI-PLT score for predicting HRVs

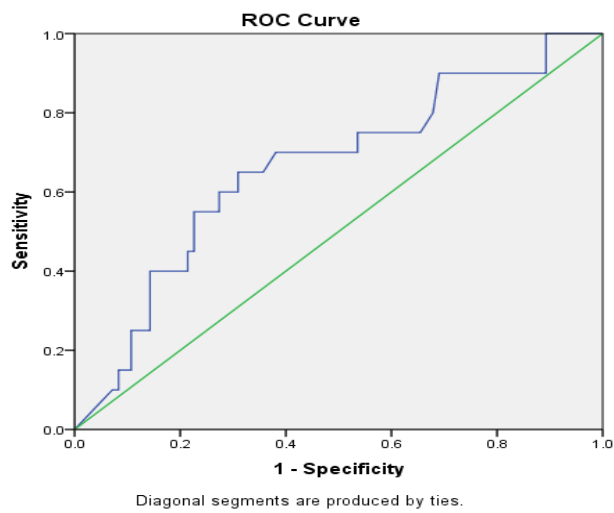


Figure 2. ROC analysis of LSM for prediction of HRV.

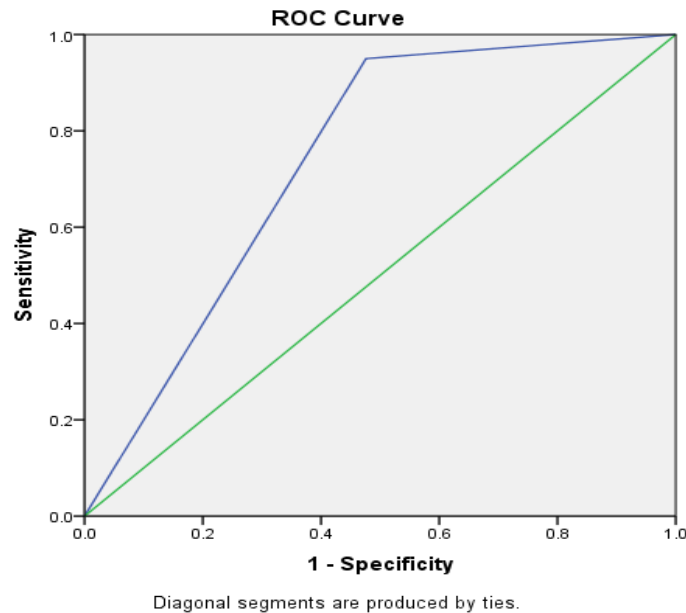


Figure 3. ROC curve of the combined model using LSM and the ALBI-PLT score for predicting HRVs

DISCUSSION

Portal hypertension represents a major sequela of liver cirrhosis, a condition that is often exacerbated by the co-existence of hepatocellular carcinoma (HCC). Following a cirrhosis diagnosis, clinical guidelines recommend periodic endoscopic surveillance for esophageal varices (EV). The recommended interval for this surveillance is typically every two to three years in the absence of varices, and annually or biennially if small varices are detected. Despite this standard of care, the procedure of upper endoscopy is associated with significant financial costs and imposes a considerable burden on patients. These limitations have driven the investigation and proposal of numerous non-invasive surrogate markers for assessing portal hypertension [16].

Our study aimed to evaluate the reliability of a laboratory-based, non-invasive model, which is the albumin-bilirubin-platelets score (ALBI PLT) combined with liver stiffness measurement (LSM) by transient elastography, as a predictive tool for high-risk varices (HRV) presence, avoiding unnecessary invasive endoscopy in

patients having HCC with compensated liver cirrhosis .

There was no statistically significant difference between the studied groups regards gender, occupation, viral history, anti-viral TTT, DM, and HTN. While there was a statistically significant difference between the studied groups, with regard to age and previous intervention for HCC, such as surgical intervention, RFA, TACE, and immunotherapy.

Upper endoscopic findings demonstrated that 47 patients of the studied population had HRVs, while 173 patients had no HRVs, with an observed significant correlation between HRVs and both ALBI-PLT score and LSM. Patients with an ALBI-PLT score >2 had a higher prevalence of HRV (97.9%) compared to those with ≤ 2 (2.1%) ($p=0.001$), confirming its strong predictive value. The mean LSM was also higher in HRV patients (36.58 ± 18.27 kPa) than in non-HRV (28.53 ± 15.85 kPa), with a borderline significance ($p=0.050$), suggesting its role as a supportive marker.

The ROC analysis of the ALBI-PLT score for predicting HRVs identified an optimal diagnostic

threshold. Specifically, a cut-off of 4 demonstrated a balanced profile of high sensitivity (72%) and specificity (74%), suggesting it is the most suitable value for clinical identification of HRV. In contrast, a lower cut-off of 2 offered high sensitivity (97.9%) but substantially lower specificity (40.5%), potentially rendering it more useful as an initial screening tool to rule out HRVs.

These findings are corroborated by a 2018 study that sought to determine the prevalence and risk factors for high-risk varices (HRV) in HCC patients, and to evaluate the predictive capacity of the ALBI-PLT score for identifying compensated patients unlikely to require endoscopic screening [8]. The reported prevalence of HRV was low, at 2.9% in the study cohort and 1.9% in the validation cohort, among compensated patients with an ALBI-PLT score of 2. A univariate analysis further identified a significant correlation between HRV and ALBI Grade. The ALBI-PLT score demonstrated high sensitivity and negative predictive value (NPV) for ruling out HRV; in the study cohort, sensitivity was 96.0% with an NPV of 97.1%, and in the validation cohort, these values were 96.8% and 98.1%, respectively. Crucially, multivariate analysis confirmed that both the ALBI grade and platelet count served as independent predictors for the presence of HRV in compensated HCC patients[8].

The strong predictive value of the ALBI-PLT score for varices has been further confirmed in other recent studies. A 2023 investigation by Li et al. also concluded that the ALBI-PLT score was an effective non-invasive tool for predicting esophageal varices in patients with hepatitis B-related cirrhosis, demonstrating a high AUROC that aligns with the diagnostic performance observed in our cohort [17].

Further supporting this approach, a 2022 investigation evaluated the utility of the albumin-bilirubin-platelet (ALBI-PLT) score for ruling out the presence of high-risk varices (HRV) in individuals with cirrhosis [18]. The findings indicated that a low risk of HRV was observed in patients presenting with an ALBI grade of 1 (≤ -2.60) combined with a platelet count exceeding $150 \times 10^9/L$. The study also detailed the distribution of the ALBI-PLT score among the enrolled cohort with compensated cirrhosis, reporting that the proportion of patients with

scores of 2, 3, 4, and 5 was 10%, 26%, 51%, and 0%, respectively[18].

A subsequent 2022 study compared these scores in patients with HCV-related cirrhosis, with and without esophageal varices [16]. The research analyzed two groups: Group A comprised 87 patients with varices, and Group B consisted of 63 patients without varices. The distribution of ALBI-platelet scores differed notably between the groups. In Group A, the percentages of patients with scores of 2, 3, 4, and 5 were 1.15%, 33.34%, 57.47%, and 8.04%, respectively. In contrast, the distribution in Group B was 3.17%, 42.86%, 44.45%, and 9.52% for the same scores. The analysis established an ALBI-platelet score cutoff of >3 as a predictor for the presence of esophageal varices (irrespective of size), with a statistically significant p-value of 0.040. The predictive performance of this cutoff demonstrated a sensitivity of 42.5%, a specificity of 63.5%, a negative predictive value (NPV) of 40%, and a positive predictive value (PPV) of 65%[16].

Similarly, a 2021 study by Wu et al. focused on patients with HBV-related decompensated cirrhosis and found that the ALBI-PLT score not only correlated with the severity of liver disease but also served as a significant independent predictor for the presence of gastro-esophageal varices, reinforcing the broad applicability of this score across different etiologies of liver disease [19].

Significant differences in the ALBI-Platelet score were observed between cirrhotic patients with small versus large esophageal varices, as documented in a prior study [20]. The reported diagnostic performance of the ALBI-PLT score for predicting high-risk varices (HRVs) was notably high, demonstrating a sensitivity of 97.48% and a specificity of 87.76%. This predictive capability was statistically robust, supported by a highly significant p-value of less than 0.001 [20].

Corroborating these findings, a 2020 investigation demonstrated a statistically significant difference in ALBI-PLT scores based on variceal size [21]. The mean score was significantly higher in patients with large esophageal varices (4.18 ± 0.78 , $n=71$) compared to those with small varices (3.89 ± 0.92 , $n=132$), with a p-value of 0.039. This study identified the ALBI-PLT score as an independent predictor for

the presence of esophageal varices. Furthermore, a score cutoff of >3 provided a sensitivity of 77.34% and a specificity of 72.93%, confirming its utility as a predictive tool for varices [21].

Regarding the ROC analysis of LSM, our study revealed that LSM at a cut-off value of 25 had a sensitivity of 70% and specificity of 62% with significance for the prediction of HRV.

The clinical value of liver stiffness measurement (LSM) for assessing portal hypertension is well established in the literature [13]. Historically, numerous non-invasive diagnostic tools have been developed to detect clinically significant portal hypertension or early-stage cirrhosis. However, the utility of many such methods is limited for routine clinical practice due to concerns over reliability and inconsistent performance across studies. A notable exception to this trend is transient elastography, which has consistently demonstrated significant clinical value and robust performance in this setting [13].

The Baveno VI consensus established non-invasive thresholds to identify patients with a very low risk of high-risk varices (HRV), who can safely avoid endoscopic screening. The original criteria (LSM <20 kPa & platelets $>150,000/\mu\text{L}$) target a $<5\%$ risk, while the Expanded Baveno VI criteria (LSM <25 kPa & platelets $>110,000/\mu\text{L}$) increase applicability by accepting a slightly higher risk (5-10%) [22]. Subsequent validation studies have confirmed the clinical utility of this approach. A 2018 study demonstrated that applying the Baveno VI criteria could prevent 21% of endoscopies while maintaining a missed HRV rate below 5% [23]. A 2023 study further affirmed the moderate performance of these criteria, showing the original version offers a sensitivity of 76% and specificity of 55%, while the expanded version trades higher specificity (69%) for lower sensitivity (67%) [24]. The more recent Baveno VII consensus (2022) built upon this foundation, formally defining LSM ≥ 25 kPa as diagnostic for clinically significant portal hypertension (CSPH) and LSM <15 kPa with platelets $>150,000$ as sufficient to exclude it [12].

In our study, we combined the use of ALBI-PLT score and transient elastography, hoping to create the most appropriate non-invasive tool for the prediction of HRV in patients with HCC and with compensated liver cirrhosis, as this strategy may save costs and avoid unnecessary invasive endoscopy for these selected patients.

Our results showed that the combination of LSM and ALBI-PLT score had a sensitivity of 91% and specificity of 70% with significance for the prediction of HRV. Also, LSM at a cutoff value of 25 combined with ALBI-PLT score at **score >4** had a sensitivity of 95% and a specificity of 52.4% with significance for the prediction of HRV.

The promising results of combining LSM with the ALBI-PLT score in our study find support in the literature. A 2022 analysis by Chen et al. also explored a combined model and reported that integrating LSM with serum-based scores significantly improved the accuracy for predicting high-risk varices compared to using either method alone, which is consistent with our findings of enhanced sensitivity through combination [25].

CONCLUSION

Our study assessed the utility of a combination of albumin-bilirubin grade and platelet count (ALBI-PLT score) in association with Transient Elastography to predict the prevalence and risk factors of HRV in compensated patients with HCC. We concluded that the integration of ALBI-PLT score and LSM offers a highly sensitive, non-invasive, and practical approach to identify patients at risk for HRV, potentially reducing the need for routine endoscopy in low-risk compensated cirrhotic HCC patients.

Ethics approval and consent to participate

After the research questions and goals were established, everyone who participated was made aware of the purpose of the study and was requested to give their written permission before taking part. The National Liver Institute

Menoufia University Ethics Committee, Egypt, approved the study (IRB: NLI 00600/2024), and the study was carried out following the Helsinki Declaration.

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Authors' contributions: All authors made significant contributions to the work presented, whether in the areas of ideation, study design, implementation, data collection, analysis, and interpretation, or all of these. Additionally, they agreed to take responsibility for all aspects of

the work, helped write, revise, or evaluate the article carefully, approved the final version to be published, and selected the journal to which it was submitted.

Abbreviations

HCC:Hepatocellular carcinoma

HRV:High risk varices

EV:Esophageal varices

ALBI-PLT:Albumin-bilirubin-platelet

LSM:Liver stiffness measurement

PHT:Portal hypertension

CSPH:Clinically significant portal hypertension

AASLD:American association for the study of liver diseases

BCLC:Barcelona clinic liver cancer

TACE:Trans-arterial chemoembolization

MELD: Model for end-stage liver disease

CTP:Child turcotte pugh

RFA:Radio frequency ablation

MWA:Microwave ablation

HIGHLIGHTS

- The ALBI-Platelets score combined with transient elastography improves the prediction of high-risk varices in compensated HCC patients.
- The combination offers a simple, non-invasive alternative to routine endoscopy for risk stratification.
- The findings support the integration of the ALBI-Platelets score and elastography into clinical decisions for Egyptian HCC patients.

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