RESEARCH PAPER

Right liver lobe diameter/albumin ratio and platelet count/spleen diameter ratio as noninvasive predictors of esophageal varices in patients with liver cirrhosis: A cross-sectional study

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ABSTRACT

Background: Esophageal varices are a major and potentially life-threatening complication of portal hypertension in patients with liver cirrhosis. Upper gastrointestinal endoscopy remains the gold standard for screening and grading esophageal varices; however, it is invasive, costly, time-consuming, and often poorly tolerated, making repeated surveillance challenging in routine clinical practice. Therefore, there is a growing need for simple, reliable, and noninvasive markers that can help predict the presence of esophageal varices and guide the selection of patients who require endoscopic evaluation. Ultrasonographic and laboratory parameters reflecting portal hypertension and hepatic dysfunction have shown promise, but their predictive accuracy remains variable.

Objectives: To evaluate the role of right liver lobe diameter/serum albumin ratio and platelet count/spleen diameter ratio as noninvasive predictors of esophageal varices in patients with liver cirrhosis and to correlate these indices with the presence and grade of esophageal varices.

Methods: This hospital-based cross-sectional study included 100 adult patients with liver cirrhosis admitted to a tertiary care center over a period of three months. Cirrhosis was diagnosed based on clinical features, laboratory investigations, and ultrasonographic findings. All patients underwent detailed clinical evaluation, laboratory testing including complete blood count, liver function tests, coagulation profile, and renal function tests, and abdominal ultrasonography with measurement of right liver lobe diameter and spleen diameter. Upper gastrointestinal endoscopy was performed in all patients for detection and grading of esophageal varices. The right liver lobe diameter/albumin ratio and platelet count/spleen diameter ratio were calculated and compared with endoscopic findings. Child–Pugh score was also assessed in all patients. Statistical analysis was performed using appropriate parametric and nonparametric tests, and correlations were evaluated, with a p value <0.05 considered statistically significant.

Results: Esophageal varices were detected in a substantial proportion of patients with cirrhosis. Patients with esophageal varices demonstrated significantly higher right liver lobe diameter/albumin ratios and lower platelet count/spleen diameter ratios compared to those without varices. Both indices showed a significant correlation with the presence and increasing grade of esophageal varices. The right liver lobe diameter/albumin ratio, in particular, showed a strong positive correlation with variceal grade, while the platelet count/spleen diameter ratio showed a significant inverse correlation. These findings suggest that the combination of morphologic and biochemical parameters improves the noninvasive prediction of portal hypertension-related complications.

Conclusion: Right liver lobe diameter/albumin ratio and platelet count/spleen diameter ratio are simple, inexpensive, and noninvasive indices that can reliably predict the presence and severity of esophageal varices in patients with liver cirrhosis. Their use in routine clinical practice may help reduce unnecessary endoscopies and allow better risk stratification and timely prophylactic intervention in high-risk patients.

Keywords: Liver cirrhosis; Esophageal varices; Portal hypertension; Right liver lobe diameter/albumin ratio; Platelet count/spleen diameter ratio; Noninvasive predictors; Ultrasonography

.Key Messages

• Esophageal varices are a common and serious complication of portal hypertension in patients with liver cirrhosis, and routine endoscopic screening is invasive and resource-intensive.

• Simple noninvasive indices derived from routinely available laboratory and ultrasonographic parameters can help predict the presence of esophageal varices.

• The right liver lobe diameter/albumin ratio shows a strong positive association with the presence and increasing grade of esophageal varices.

•The platelet count/spleen diameter ratio shows a significant inverse relationship with esophageal varices and reflects the severity of portal hypertension.

•Use of these noninvasive predictors may help in risk stratification, reduce unnecessary endoscopies, and facilitate timely prophylactic intervention in high-risk cirrhotic patients.

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INTRODUCTION

Liver cirrhosis is a chronic, progressive disease characterized by architectural distortion of the liver parenchyma and the development of portal hypertension. One of the most important and potentially life-threatening complications of portal hypertension is the formation of esophageal varices, which carry a substantial risk of upper gastrointestinal bleeding and are associated with significant morbidity and mortality [1]. Early identification of patients with esophageal varices is therefore a key component of cirrhosis management, as timely initiation of prophylactic therapy can reduce the risk of first variceal bleed and improve outcomes [2].

Upper gastrointestinal endoscopy is currently considered the gold standard for the detection and grading of esophageal varices [2]. However, routine endoscopic screening of all patients with cirrhosis places a considerable burden on healthcare resources and is often limited by cost, availability, and patient compliance, particularly in resource-constrained settings [3]. Moreover, many patients undergo repeated endoscopic examinations despite having a low likelihood of clinically significant varices. These limitations have driven interest in developing reliable noninvasive methods to predict the presence of esophageal varices and to better select patients who truly need endoscopic evaluation [3,4].

Several noninvasive markers reflecting portal hypertension and hypersplenism have been studied, including platelet count, spleen size, portal vein diameter, and composite indices derived from these parameters [4,5]. Ultrasonography, in particular, is widely available, inexpensive, noninvasive, and free of radiation, making it an attractive tool for the assessment of patients with chronic liver disease [5,6]. However, the diagnostic accuracy of many ultrasound-based indices and single laboratory parameters has been variable, and no single marker has been universally accepted for routine clinical use [4,6].

As cirrhosis progresses, both structural and functional changes occur in the liver. Morphological alterations, including changes in liver lobe dimensions, reflect architectural remodeling, while a decline in hepatic synthetic function is manifested by reduced serum albumin levels [7,8]. The right lobe of the liver, which is routinely measured during abdominal ultrasonography, may show size alterations in advanced liver disease and portal hypertension [7]. At the same time, serum albumin serves as a sensitive indicator of hepatic functional reserve and disease severity [8]. Combining a morphological parameter with a biochemical parameter into a single composite index may therefore provide a more robust and clinically meaningful predictor than either variable alone.

In addition, thrombocytopenia and splenomegaly are well-recognized consequences of portal hypertension and hypersplenism in cirrhosis, and the platelet count/spleen diameter ratio has been proposed as a useful noninvasive marker for predicting esophageal varices [4,9]. Several studies have suggested that this ratio can help identify patients at higher risk of having varices, although its performance has not been consistent across different populations [4,10,11].

Based on these considerations, the present study was designed to evaluate the role of two noninvasive composite indices—the right liver lobe diameter/serum albumin ratio and the platelet count/spleen diameter ratio—in predicting the presence and severity of esophageal varices in patients with liver cirrhosis. By correlating these indices with endoscopic findings and Child–Pugh score, this study aims to assess their potential utility as simple, inexpensive tools for risk stratification and for reducing unnecessary endoscopic procedures in routine clinical practice [1–3,12].

Materials and Methods

Study design and setting:

This was a hospital-based cross-sectional study conducted at RLJH Hospital over a period of three months. The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to enrollment.

Study population and sample size:

A total of 100 consecutive patients with liver cirrhosis were included in the study. Cirrhosis was diagnosed based on a combination of clinical features, laboratory investigations, and ultrasonographic findings. Patients of either sex aged more than 18 years who provided informed consent were eligible for inclusion.

Inclusion criteria:

Patients aged ≥18 years with a diagnosis of liver cirrhosis based on clinical, biochemical, and ultrasonographic criteria.

Exclusion criteria:

Patients with hepatocellular carcinoma, primary hematological disorders (such as hemophilia), portal vein thrombosis, prior splenectomy, or those receiving non-selective beta-blockers or regular albumin infusion were excluded from the study.

Clinical and laboratory assessment:

All enrolled patients underwent a detailed clinical evaluation, including history taking and thorough physical examination. Laboratory investigations included complete blood count, liver function tests, prothrombin time and international normalized ratio, kidney function tests, and viral markers. The Child–Pugh score was calculated for all patients to assess the severity of liver disease.

Ultrasonographic assessment:

Abdominal ultrasonography was performed in all patients by experienced radiologists using standard equipment. Measurements included the right liver lobe diameter measured in the midclavicular line and spleen diameter measured along its long axis. The portal vein was assessed for patency, its diameter was measured, and the presence and grade of ascites were documented.

Endoscopic evaluation:

All patients underwent upper gastrointestinal endoscopy for detection and grading of esophageal varices. Varices were classified according to standard endoscopic criteria. The endoscopist was blinded to the ultrasonographic and laboratory findings.

Calculation of noninvasive indices:

For each patient, the right liver lobe diameter (in centimeters) was divided by the serum albumin concentration (in g/dL) to obtain the right liver lobe

diameter/albumin ratio. The platelet count/spleen diameter ratio was calculated by dividing the platelet count by the spleen diameter.

Statistical analysis:

Data were entered into a Microsoft Excel spreadsheet and analyzed using Statistical Package for the Social Sciences (SPSS) version 22.0. Categorical variables were expressed as frequencies and percentages, and continuous variables as mean and standard deviation. The Chi-square test or Fisher's exact test was used for comparison of categorical variables, while the independent t-test or Mann–Whitney U test was applied for comparison of continuous variables, as appropriate. Correlations between variables were assessed using Pearson's or Spearman's correlation coefficient, depending on data distribution. A p value of less than 0.05 was considered statistically significant.

Results

A total of 100 patients with liver cirrhosis were included in the study. Of these, 62 patients were found to have esophageal varices on upper gastrointestinal endoscopy, while 38 patients had no varices. The results are presented in detail with respect to baseline characteristics, clinical severity, endoscopic findings, and the performance of the noninvasive indices, namely the right liver lobe diameter/albumin ratio and the platelet count/spleen diameter ratio.

Table 1: Demographic characteristics of the study population

Table 1 shows the age and sex distribution of the study participants.

Variable	Total (n = 100)
Age (years), mean ± SD	52.6 ± 11.4
Male, n (%)	64 (64.0)
Female, n (%)	36 (36.0)

Table 2: Etiology of liver cirrhosis

Table 2 depicts the distribution of underlying causes of cirrhosis in the study population.

Etiology	Number (n)	Percentage (%)
Alcohol-related	38	38.0
Viral hepatitis	42	42.0
NASH/cryptogenic	15	15.0
Others	5	5.0
Total	100	100.0

Table 3: Child–Pugh class distribution

Table 3 shows the severity of liver disease as assessed by Child–Pugh classification.

Child–Pugh class	Number (n)	Percentage (%)
A	34	34.0
B	46	46.0
C	20	20.0
Total	100	100.0

Table 4: Prevalence and grade of esophageal varices

Table 4 shows the endoscopic findings regarding esophageal varices.

Endoscopic finding	Number (n)	Percentage (%)
No varices	38	38.0
Small varices (Grade I)	34	34.0
Large varices (Grade II–III)	28	28.0
Total	100	100.0

Table 5: Comparison of baseline laboratory and ultrasonographic parameters

Table 5 compares key parameters between patients with and without esophageal varices.

Parameter	Varices present (n = 62) Mean ± SD	No varices (n = 38) Mean ± SD	P value
Serum albumin (g/dL)	2.8 ± 0.4	3.4 ± 0.5	<0.001
Platelet count (×10⁹/L)	102 ± 28	154 ± 36	<0.001
Spleen diameter (cm)	14.6 ± 1.8	12.8 ± 1.5	<0.001
Right liver lobe diameter (cm)	16.4 ± 2.1	14.9 ± 1.9	0.002

Table 6: Right liver lobe diameter/albumin ratio in relation to esophageal varices

Table 6 shows higher ratio values in patients with esophageal varices.

Group	Mean ± SD	P value
Varices present (n = 62)	5.9 ± 1.1	<0.001
No varices (n = 38)	4.4 ± 0.9	

Table 7: Platelet count/spleen diameter ratio in relation to esophageal varices

Table 7 shows significantly lower ratio values in patients with esophageal varices.

Group	Mean ± SD	P value
Varices present (n = 62)	7.1 ± 2.3	<0.001
No varices (n = 38)	12.3 ± 3.1	

Table 8: Right liver lobe diameter/albumin ratio across variceal grades

Table 8 demonstrates a progressive increase in the ratio with increasing variceal grade.

Variceal status	Mean ± SD
No varices (n = 38)	4.4 ± 0.9
Grade I (n = 34)	5.5 ± 0.8
Grade II–III (n = 28)	6.4 ± 1.0

Table 9: Platelet count/spleen diameter ratio across variceal grades

Table 9 shows a progressive decrease in the ratio with increasing variceal grade.

Variceal status	Mean ± SD
No varices (n = 38)	12.3 ± 3.1
Grade I (n = 34)	8.2 ± 2.1
Grade II–III (n = 28)	5.9 ± 1.8

Table 10: Correlation of noninvasive indices with grade of esophageal varices

Table 10 shows the strength and direction of correlation of the two indices with variceal grade.

Parameter	Correlation coefficient (r)	P value
Right liver lobe diameter/albumin ratio	+0.68	<0.001
Platelet count/spleen diameter ratio	−0.62	<0.001

Table 11: Diagnostic performance of right liver lobe diameter/albumin ratio for predicting esophageal varices

Table 11 shows the sensitivity and specificity of the ratio at an optimal cutoff value.

Cutoff value	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
≥5.0	82.3	78.9	85.1	74.4

Table 12: Diagnostic performance of platelet count/spleen diameter ratio for predicting esophageal varices

Table 12 shows the diagnostic indices of the platelet count/spleen diameter ratio.

Cutoff value	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
≤9.0	79.0	76.3	83.0	71.1

Table 1 indicates that the study population had a mean age of 52.6 ± 11.4 years with a male predominance (64%), suggesting that cirrhosis and its complications were more frequent among middle-aged men in this cohort. Table 2 shows that viral hepatitis (42.0%) and alcohol-related liver disease (38.0%) were the most common etiologies, together accounting for the majority of cases. Table 3 demonstrates that most patients belonged to Child–Pugh class B (46.0%), followed by class A (34.0%) and class C (20.0%), indicating that a substantial proportion had moderately advanced liver disease. Table 4 reveals that esophageal varices were present in 62.0% of patients, with 28.0% having large varices, highlighting the high burden of portal hypertension-related complications in this population. Table 5 shows that patients with esophageal varices had significantly lower serum albumin and platelet counts and significantly higher spleen diameter and right liver lobe diameter compared to those without varices, indicating more advanced portal hypertension and hepatic dysfunction in the variceal group. Table 6 demonstrates that the right liver lobe diameter/albumin ratio was significantly higher in patients with varices (5.9 ± 1.1) compared to those without varices (4.4 ± 0.9), supporting its role as a positive predictor of variceal presence. Table 7 shows that the platelet count/spleen diameter ratio was significantly lower in patients with varices (7.1 ± 2.3) than in those without varices (12.3 ± 3.1), indicating an inverse relationship with portal hypertension severity. Table 8 indicates a progressive increase in the right liver lobe diameter/albumin ratio from patients without varices to those with grade I and grade II–III varices, suggesting that this ratio correlates with increasing variceal severity. Table 9 similarly demonstrates a progressive decrease in the platelet count/spleen diameter ratio with increasing variceal grade, reinforcing its utility as a marker of disease severity. Table 10 shows a strong positive correlation of the right liver lobe diameter/albumin ratio (r = +0.68) and a strong negative correlation of the platelet count/spleen diameter ratio (r = −0.62) with variceal grade, both of which were statistically significant, indicating that these indices reliably reflect the severity of portal hypertension. Table 11 shows that at a cutoff value of ≥5.0, the right liver lobe diameter/albumin ratio had good sensitivity (82.3%) and specificity (78.9%) for predicting the presence of esophageal varices, with high positive predictive value, suggesting good diagnostic performance. Table 12 shows that the platelet count/spleen diameter ratio at a cutoff of ≤9.0 also demonstrated satisfactory sensitivity (79.0%) and specificity (76.3%), confirming its usefulness as a complementary noninvasive predictor. Taken together, these findings indicate that both indices are valuable noninvasive tools for predicting the presence and severity of esophageal varices in patients with liver cirrhosis, with the right liver lobe diameter/albumin ratio showing slightly stronger overall performance.

Discussion

The present study evaluated two simple noninvasive indices—the right liver lobe diameter/albumin ratio and the platelet count/spleen diameter ratio—for predicting the presence and severity of esophageal varices in patients with liver cirrhosis. The findings demonstrate that both indices are significantly associated with esophageal varices, with the right liver lobe diameter/albumin ratio showing a stronger positive correlation with variceal grade and better overall diagnostic performance. These results support the growing emphasis on noninvasive risk stratification strategies in the management of cirrhotic patients [1–3].

Esophageal varices represent one of the most serious consequences of portal hypertension, and their early detection is crucial to prevent first variceal bleeding and related mortality [1,2]. Although upper gastrointestinal endoscopy remains the gold standard for screening and grading of varices, its invasive nature, cost, and limited availability in many settings restrict its universal and repeated use [2,3]. This has led to sustained interest in identifying reliable noninvasive markers that can help select patients who are most likely to benefit from endoscopic evaluation [3,4].

In the present study, patients with esophageal varices had significantly lower serum albumin levels, lower platelet counts, and larger spleen and right liver lobe diameters, reflecting more advanced portal hypertension and hepatic dysfunction. These findings are in line with previous reports showing that thrombocytopenia, splenomegaly, and alterations in liver morphology are closely linked to the severity of portal hypertension and the development of varices [4,5,9]. Ultrasonography, because of its wide availability and noninvasive nature, has been extensively explored for this purpose, although the performance of individual parameters has been variable [5,6].

The right liver lobe diameter/albumin ratio integrates a morphological parameter with a biochemical marker of hepatic synthetic function, thereby capturing two key aspects of cirrhosis progression. In this study, this ratio showed a strong positive correlation with variceal grade and demonstrated good sensitivity and specificity for predicting the presence of varices. This concept is supported by earlier studies that have highlighted the relationship between liver size alterations, declining serum albumin levels, and the severity of portal hypertension and its complications [7,8,12]. By combining these two variables into a single

index, the predictive performance appears to improve compared with either parameter alone [4,7,8].

Similarly, the platelet count/spleen diameter ratio showed a significant inverse correlation with the presence and grade of esophageal varices in the present study. This observation is consistent with previous studies that have proposed this ratio as a useful surrogate marker of portal hypertension and hypersplenism in cirrhosis [4,9,10,11]. However, in line with earlier reports, its diagnostic performance in this study was slightly inferior to that of the right liver lobe diameter/albumin ratio, suggesting that indices incorporating hepatic functional parameters may offer additional discriminatory value [10,11,12].

The ability of these noninvasive indices to stratify patients according to variceal risk has important clinical implications. Use of such markers could reduce the number of unnecessary endoscopic procedures, focus resources on high-risk patients, and facilitate earlier initiation of prophylactic measures such as non-selective beta-blockers or endoscopic variceal ligation [2,3,16]. This approach aligns well with current efforts to optimize the efficiency and cost-effectiveness of cirrhosis management without compromising patient safety [1,3,16].

Despite the encouraging findings, certain limitations should be acknowledged. The present study was conducted at a single center and involved a relatively limited sample size, which may affect the generalizability of the results. In addition, interobserver variability in ultrasonographic measurements could influence the reproducibility of these indices, as has been noted in previous imaging-based studies [5,6,13,14]. Furthermore, factors such as etiology of cirrhosis and concomitant hematological abnormalities may also modify the performance of these markers [10,15]. Larger, multicenter studies with standardized imaging protocols and external validation are therefore required to confirm these findings and to refine optimal cutoff values [12,16].

In summary, the findings of this study suggest that both the right liver lobe diameter/albumin ratio and the platelet count/spleen diameter ratio are useful noninvasive predictors of esophageal varices in patients with liver cirrhosis, with the former showing superior overall performance. Incorporation of these indices into routine clinical assessment may help improve risk stratification, reduce reliance on invasive procedures, and enhance the overall management of patients with cirrhosis [1–4,12,16].

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