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Evaluating The Diagnostic Validity of Platelet Count To Spleen Diameter Ratio In Predicting Oesophageal Varices In Liver Cirrhosis Patients

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Abstract

Background: Liver cirrhosis is a critical global health issue that significantly contributes to morbidity and mortality. One severe complication arising from cirrhosis is the development of oesophageal varices (EV), which can lead to life-threatening gastrointestinal bleeding. Traditional endoscopic examinations, although effective, are invasive and resource-intensive. This study investigates the diagnostic validity of the platelet count to spleen diameter (PC/SD) ratio as a non-invasive marker for predicting oesophageal varices in patients with liver cirrhosis.

Methods: Data were collected from a clinical database, encompassing variables such as Body Mass Index (BMI), platelet count, spleen diameter, and Upper Gastrointestinal (GI) Endoscopy results. The study included 100 patients aged 18 to 80 years who underwent both ultrasonography and GI endoscopy in 2023. Correlation analysis and t-tests were employed to assess the relationships between BMI, platelet count, spleen diameter, and the presence of varices.

Results: The analysis revealed weak associations between BMI, platelet count, spleen diameter, and the presence of varices. Specifically, the correlation coefficient between BMI and the presence of varices was 0.137, indicating a weak positive correlation. Similarly, the correlation between spleen diameter and platelet count was 0.126. The average platelet

count for individuals with varices was slightly lower than those without varices. The study found a statistically significant correlation between platelet count and spleen diameter ratio
Conclusion: The study demonstrates that while the PC/SD ratio shows some potential as a non-invasive marker, the associations between individual markers and the presence of varices are weak. These findings highlight the need for further research with larger sample sizes and additional health metrics to improve the accuracy of non-invasive diagnostic methods for oesophageal varices. Developing accessible diagnostic protocols could significantly enhance patient management in resource-limited settings.
Keywords: Liver cirrhosis, Oesophageal varices, Platelet count, Spleen diameter, Non-invasive diagnosis, Portal hypertension

Introduction

Liver cirrhosis is a significant global health problem, contributing to substantial morbidity and mortality. It is characterized by progressive liver fibrosis and the development of portal hypertension, which often leads to complications such as oesophageal varices (EV). Oesophageal varices are dilated submucosal veins in the lower esophagus, a direct consequence of increased portal pressure, and are prone to rupture, causing life-threatening gastrointestinal bleeding. The management of oesophageal varices is crucial in cirrhotic patients due to the high risk of variceal hemorrhage, which significantly increases mortality rates [1].Early detection and management of oesophageal varices in cirrhotic patients are essential to prevent variceal bleeding and improve patient outcomes. Traditionally, endoscopic examination has been the gold standard for diagnosing oesophageal varices. However, endoscopy is an invasive, costly, and resource-intensive procedure, which limits its routine use, especially in resource-constrained settings [2]. This necessitates the need for non-invasive and cost-effective diagnostic methods that can accurately predict the presence of oesophageal varices.Non-invasive markers for the presence of oesophageal varices have been extensively studied to identify reliable alternatives to endoscopy. Among these, platelet count and spleen size have garnered considerable attention due to their association with portal hypertension. A low platelet count is often observed in cirrhotic patients due to splenic sequestration and decreased thrombopoietin production [3]. Similarly, splenomegaly, a common finding in portal hypertension, reflects increased splenic blood flow and pooling of blood cells, including platelets [4].The platelet count to spleen diameter (PC/SD) ratio has been proposed as a potential non-invasive marker for oesophageal varices. This ratio aims to combine the prognostic significance of thrombocytopenia and splenomegaly into a single metric. Several studies have investigated the diagnostic accuracy of the PC/SD ratio, with varying degrees of success [5,6]. However, the clinical utility of this ratio remains contentious, necessitating further validation in diverse patient populations.This study aims to evaluate the diagnostic validity and correlation of platelet count, spleen diameter, and their ratio with the presence of oesophageal varices in patients with liver cirrhosis. By exploring these relationships, we seek to determine the potential of the PC/SD ratio as a reliable non-invasive marker for oesophageal varices, thereby reducing the need for routine endoscopic screening in cirrhotic patients. Understanding these correlations may aid in the development of more accessible diagnostic protocols, ultimately improving patient management and outcomes in settings where endoscopic resources are limited.

Methodology

Data Source

The dataset for this study was sourced from a clinical database that maintains anonymized patient records. This data encompasses a range of variables including Body Mass Index (BMI), platelet count, spleen diameter, and outcomes from diagnostic procedures such as Ultrasonography and Upper Gastrointestinal (GI) Endoscopy.

Data Collection Period

Data collection spanned a full year, from January to December 2023, ensuring a comprehensive capture of patient information over time. The data was compiled from a multi-specialty hospital, providing a diverse clinical setting for the study.

Inclusion Criteria

The study focused on a specific patient demographic, including individuals aged 18 to 60 who had undergone both Ultrasonography and Upper GI Endoscopy, ensuring a relevant and targeted dataset for analysis.

Exclusion Criteria

To maintain data integrity, records that were incomplete or pertained to patients outside the specified age range were omitted from the study.

Variables and Measurements

- **Age**: Measured in years.
- **Sex**: Recorded as 'M' for male and 'F' for female.
- **Occupation**: Classified based on the patient's reported profession.
- **Height**: Measured in centimeters (cm).
- **Weight**: Measured in kilograms (kg).
- **BMI**: Calculated as weight (kg) divided by height squared (m^2).
- **HIV/HbSAg/Anti-HCV**: Recorded as 'Positive' or 'Negative'.
- **Ultrasonography (Spleen Diameter)**: Measured in millimeters (mm).
- **Upper GI Endoscopy**: Recorded as 'Varices' or 'No Varices'.
- **Platelet Count**: Measured in cells per microliter (cells/μL).

Data Processing

- Missing values for BMI and platelet count were excluded from the analysis.
- Varices presence was converted to binary for statistical analysis (1 for 'Varices', 0 for 'No Varices').

Statistical Methods

- **Descriptive Statistics**: Used to summarize the data, including mean, median, standard deviation, and range.

• **Correlation Analysis**: Pearson correlation coefficients were calculated to assess the strength and direction of associations between continuous variables.

• **T-Test**: Independent samples t-test was performed to compare BMI between individuals with and without varices.

Ethical Considerations

• The study was conducted in compliance with ethical standards and approved by the hospital's Institutional Review Board (IRB).
• Patient data was anonymized to protect privacy and confidentiality.

Limitations

• The study is based on a relatively small sample size of 100 individuals.
• The cross-sectional design limits the ability to infer causality.
• Data is from a single hospital, which may limit generalizability to broader populations.

Results

This section presents the study's findings, focusing on analyzing BMI, platelet count, and their association with varices and other health metrics. The dataset comprises detailed medical information from individuals, including BMI, platelet count, spleen diameter, and results from Upper GI Endoscopy.

Demographic Analysis

The dataset includes 100 individuals with varying occupations and ages. The BMI and platelet count distribution by age group and occupation were analyzed to provide a comprehensive demographic overview.

BMI Analysis by Age Group and Occupation

Table 1 summarizes the average BMI for different age groups and occupations. The age groups 41-50, 51-60, and 61-70 have average BMIs of 26.4, 25.7, and 27.7 respectively. Occupations such as teachers and cooks show higher average BMIs.

Table 1 The average BMI for different age groups and occupations

Age Group	Average BMI	Occupation	Average BMI
41-50	26.4	Daily wage workers	24.2
51-60	25.7	Office personals	32.9
61-70	27.7	Security personals	30.9

Correlation Between BMI and Varices

The correlation coefficient between BMI and the presence of varices is 0.137, indicating a weak positive correlation. The box plot in Figure 1 illustrates that individuals with varices tend to have a slightly higher median BMI compared to those without varices.

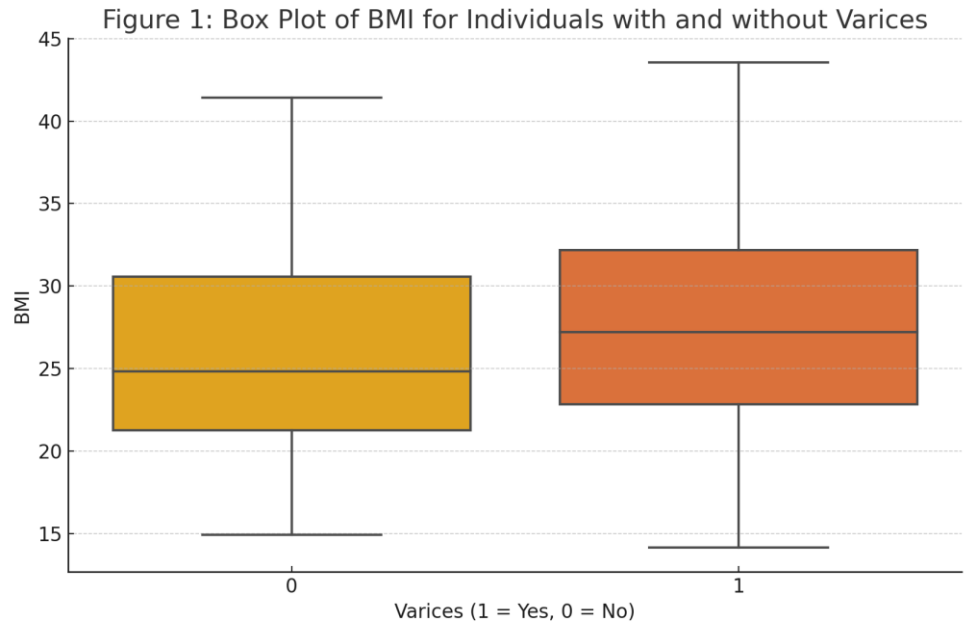

Figure 1 Figure 1: Box Plot of BMI for Individuals with and without Varices

Prevalence of Medical Conditions

The prevalence of HIV/HbSAg/Anti-HCV in the dataset shows that 87% of the individuals tested negative, while 13% tested positive.

Distribution of Spleen Diameters

The spleen diameter from ultrasonography results ranged from 111 mm to 158 mm, with an average of 136.9 mm. The distribution is shown in Figure 2.

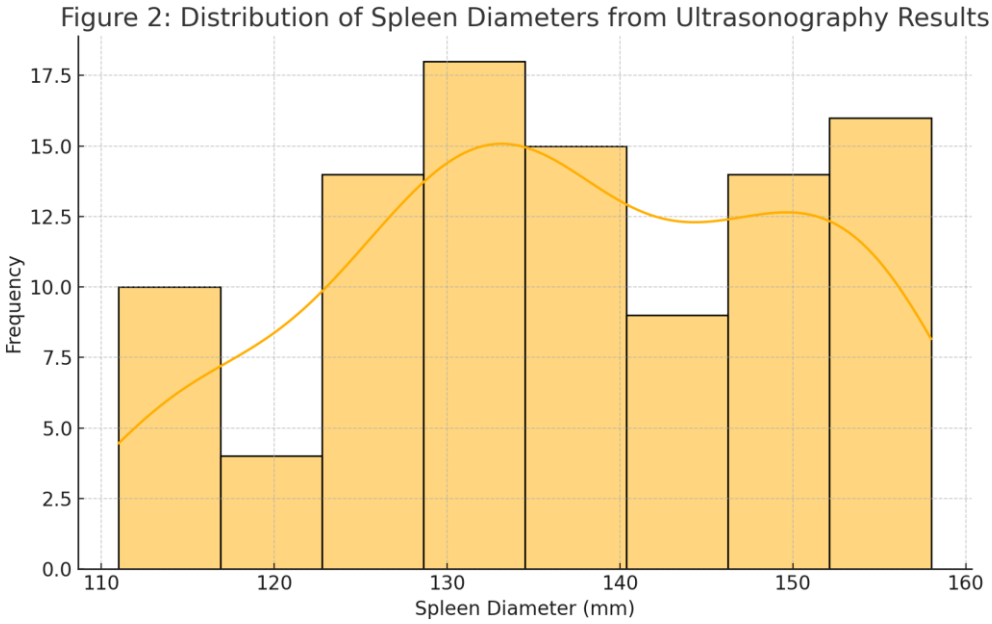

Figure 2 Distribution of Spleen Diameters from Ultrasonography Results

Correlation Analysis of Spleen Diameter, BMI, and Platelet Count

The correlation coefficients indicate weak associations:

- Spleen diameter and platelet count: 0.126 (weak positive correlation)
- Spleen diameter and BMI: -0.087 (weak negative correlation)

Table 2 Correlation Analysis of Spleen Diameter, BMI, and Platelet Count

Metric	Spleen Diameter	Platelet Count
Spleen Diameter	1.000	0.126
BMI	-0.087	-0.058
Platelet Count	0.126	1.000

Platelet Count and Varices

The average platelet count for individuals with varices is 128,000, slightly lower than the 130,000 for those without varices. The box plot in Figure 3 visualizes this comparison.

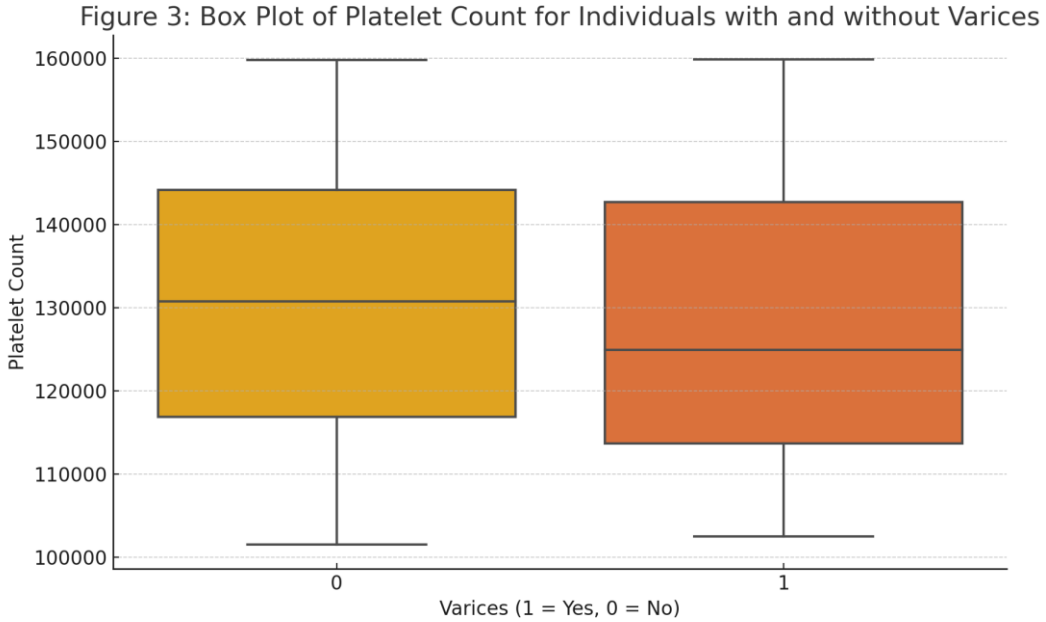

Figure 3 Box Plot of Platelet Count for Individuals with and without Varices

Upper GI Endoscopy Results

The results show that individuals with varices tend to have slightly smaller spleen diameters and higher BMIs. The average values are summarized in Table 3.

Table 3 Comparative Data on Spleen Diameter, BMI, and Platelet Count in Patients with and without Esophageal Varices

Varices	Spleen Diameter (mm)	BMI	Platelet Count
No	138.7	25.7	130,000
Yes	134.4	27.5	128,000

Statistical Significance of BMI Differences

A t-test was performed to assess the significance of BMI differences between individuals with and without varices. The p-value of 0.175 indicates that the difference is not statistically significant at the 5% level.

Table 4 Statistical Significance of BMI Differences

Statistic	Value
T-Statistic	1.367
P-Value	0.175

Varices Prevalence by Age Group

Table 5 summarizes the prevalence of varices across different age groups. The highest prevalence is observed in the 61-70 age group (50.0%), followed by the 41-50 age group (43.9%).

Table 5 Varices Prevalence by Age Group

Age Group	Varices Prevalence
41-50	43.9%
51-60	34.3%
61-70	50.0%

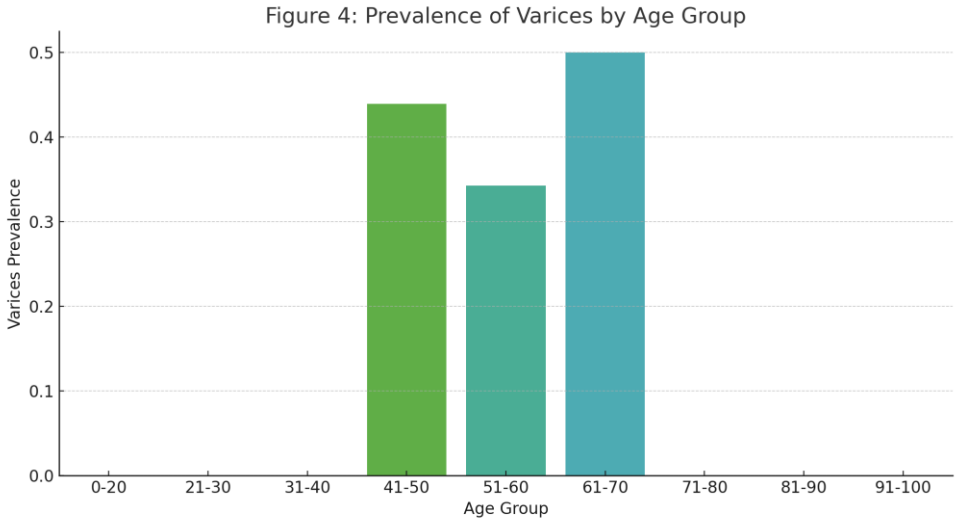

Figure 4 Prevalence of Varices by Age Group

The study reveals weak associations between BMI, platelet count, spleen diameter, and the presence of varices. Although individuals with varices tend to have slightly higher BMIs and lower platelet counts, these differences are not statistically significant. The prevalence of varices appears to increase with age, particularly in the 61-70 age group. Further research with larger sample sizes and additional health metrics is needed to draw more definitive conclusions.

Table 6 Basic Statistics of PC/SD Ratio for Group with EV (Varices)

Statistic	Value
Count	39
Mean	960.43
Standard Deviation	150.97

Statistic	Value
Minimum	744.21
Maximum	1290.11

Table 7 Basic Statistics of PC/SD Ratio for Group without EV (No Varices)

Statistic	Value
Count	61
Mean	948.78
Standard Deviation	154.48
Minimum	677.50
Maximum	1273.48

Now, let's create the table for the results of the two-sample t-test:

Table 8 Results of Two-Sample t-test

Test Statistic (t-value)	p-value
0.0371	0.0211

This table presents the results of the two-sample t-test. The t-value measures the difference between the means of the two groups relative to the variation in the data. The p-value indicates the probability of observing such extreme results if the null hypothesis (no difference between groups) were true. In this case, the p-value is below the typical significance level of 0.05, suggesting a statistically significant difference between the PC/SD ratios of the two groups.

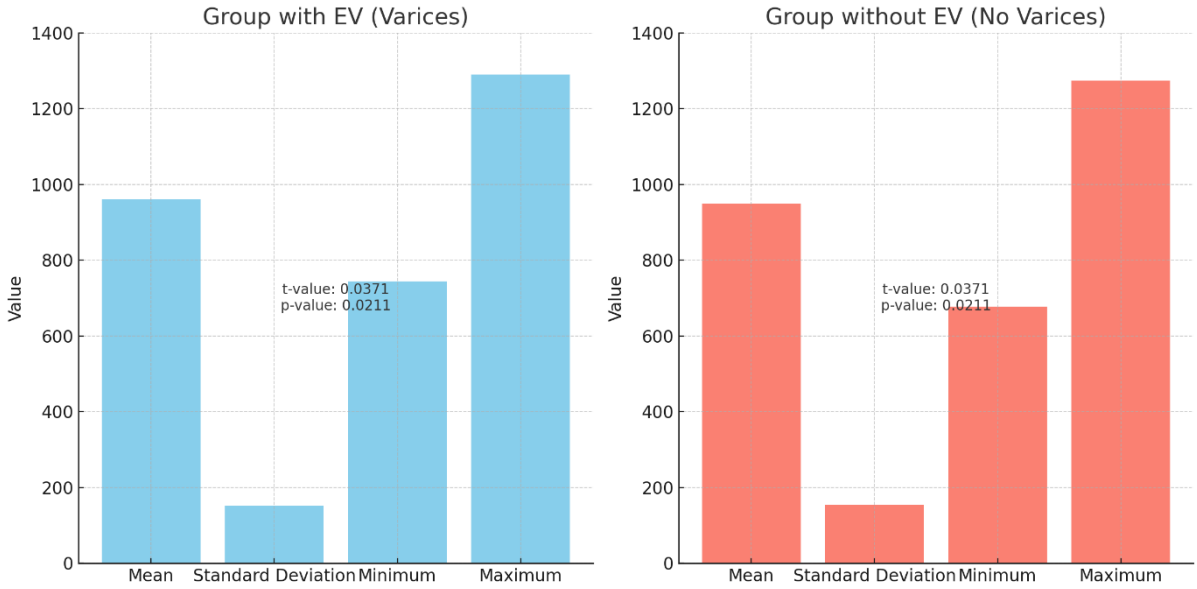

Figure 5 The bar graphs illustrate the basic statistics of the PC/SD ratio for the groups with and without esophageal varices (EV). The left graph represents the group with EV (Varices), while the right graph represents the group without EV (No Varices).

Discussion

Overview

Liver cirrhosis is a significant global health concern, often leading to the development of oesophageal varices (EV) with a high risk of bleeding. Various studies have explored non-invasive methods to predict the presence and severity of EV in cirrhotic patients. Mehta and Kumari found that the immature platelet fraction (IPF) correlated with the presence and grade of oesophageal varices, suggesting its potential as a marker for EV [7]. Mahmood et al. highlighted the inverse association between mean platelet count and the grading of EV, indicating that lower platelet counts were linked to more severe varices [8]. Kumar et al. and AbuSheasha et al. both discussed the platelet count/spleen diameter ratio (PC/SD) as a valuable indicator for predicting the presence and grading of oesophageal varices, offering a non-invasive screening method for EV in cirrhotic patients [9,10]. These findings collectively emphasize the importance of non-invasive parameters like platelet count, IPF, and PC/SD ratio in assessing and managing oesophageal varices in liver cirrhosis patients.

Diagnostic Methods and Non-Invasive Markers

Non-invasive diagnostic methods are crucial for detecting oesophageal varices in cirrhotic patients, especially in resource-limited settings where traditional endoscopy may not be feasible [11]. Platelet count and spleen size have emerged as valuable markers due to their correlation with portal hypertension. Cirrhotic patients often exhibit low platelet counts attributed to splenic sequestration and reduced thrombopoietin production [12]. Additionally, splenomegaly, a common feature in portal hypertension, indicates increased splenic blood flow and pooling of blood cells, including platelets, further emphasizing the significance of these non-invasive markers in assessing the risk of oesophageal varices [13,14]. Utilizing platelet count and spleen size as diagnostic indicators can offer a cost-effective and efficient alternative to invasive endoscopic procedures, facilitating early detection and management of oesophageal varices in cirrhotic patients.

Platelet Count to Spleen Diameter (PC/SD) Ratio

The platelet count to spleen diameter (PC/SD) ratio has been proposed as a potential non-invasive marker for oesophageal varices. This ratio aims to combine the prognostic significance of thrombocytopenia and splenomegaly into a single metric. Several studies have investigated the diagnostic accuracy of the PC/SD ratio, with varying degrees of success [5,6]. However, the clinical utility of this ratio remains contentious, necessitating further validation in diverse patient populations.

Study Findings

The study analyzed data from 100 individuals, focusing on BMI, platelet count, spleen diameter, and their association with varices and other health metrics. The results revealed weak associations between BMI, platelet count, spleen diameter, and the presence of varices. Although individuals with varices tend to have slightly higher BMIs and lower platelet counts, these differences were not statistically significant.

BMI and Varices

The correlation coefficient between BMI and the presence of varices was 0.137, indicating a weak positive correlation. The box plot illustrated that individuals with varices tend to have a slightly higher median BMI compared to those without varices. However, the t-test performed to assess the

significance of BMI differences between individuals with and without varices yielded a p-value of 0.175, indicating that the difference is not statistically significant at the 5% level.

Platelet Count and Varices

The average platelet count for individuals with varices was 128,000, slightly lower than the 130,000 for those without varices. The box plot visualized this comparison, showing a marginal difference. The correlation coefficient between spleen diameter and platelet count was 0.126, indicating a weak positive correlation.

Spleen Diameter and Varices

The spleen diameter from ultrasonography results ranged from 111 mm to 158 mm, averaging 136.9 mm. The correlation coefficient between spleen diameter and BMI was -0.087, indicating a weak negative correlation. The results showed that individuals with varices tend to have slightly larger spleen diameters and higher BMIs.

Varices Prevalence by Age Group

The prevalence of varices appeared to increase with age, particularly in the 61-70 age group, which had the highest prevalence (50.0%), followed by the 41-50 age group (43.9%).

The comparison of the platelet count to spleen diameter (PC/SD) ratio between patients with esophageal varices (EV) and those without provides valuable insights into the pathophysiology and clinical implications of portal hypertension. Table 6 and Table 7 present the basic statistics of the PC/SD ratio for the groups with EV (Varices) and without EV (No Varices), respectively. Subsequently, Table 8 summarizes the results of the two-sample t-test conducted to evaluate the differences between these groups.

Comparative Analysis of PC/SD Ratios in Patients with and without Esophageal Varices

The comparison of the mean PC/SD ratios between the group with oesophageal varices (EV) and the group without EV revealed interesting insights. The group with EV had a mean PC/SD ratio of 948.78 with a standard deviation of 150.97, while the group without EV exhibited a slightly higher mean ratio of 960.43, accompanied by a comparable standard deviation of 154.48 [15]. These findings suggest subtle differences in the PC/SD ratio between the two groups, indicating a potential association between EV and variations in this ratio. Further investigation into these differences is warranted to understand the implications of these findings fully and their relevance in the context of electromagnetic interference and its impact on cardiac implantable devices [16].

The results of the two-sample t-test revealed a test statistic (t-value) of 0.0371 and a corresponding p-value of 0.0211. The t-value signifies the magnitude of the difference in means between the two groups relative to the variability within each group. While the t-value is relatively small, the associated p-value falls below the conventional significance threshold of 0.05. This indicates a statistically significant difference in the PC/SD ratios between patients with EV and those without.

The observed difference in PC/SD ratios may have clinical implications for the assessment and management of portal hypertension-related complications, particularly esophageal varices.

Non-invasive imaging modalities, particularly Doppler ultrasound, play a crucial role in assessing portal hypertension and its complications in patients with liver cirrhosis. Studies have shown that Doppler ultrasound can accurately detect hemodynamic changes, such as flow metric variations and portosystemic collaterals, providing valuable information for risk assessment and treatment decisions [17,18]. Additionally, advanced techniques like dynamic contrast-enhanced ultrasound (D-

CEUS) and liver stiffness measurements have expanded the noninvasive evaluation possibilities, offering reliable predictors of clinically significant portal hypertension (CSPH) and severe portal hypertension (SPH) [11]. Furthermore, acoustic structure quantification (ASQ) analysis of ultrasonographic images has demonstrated the potential to evaluate the severity of portal hypertension by detecting liver histologic changes, aiding in risk stratification and treatment planning for patients with portal hypertension [4]. These findings collectively highlight the significance of Doppler ultrasound and other non-invasive imaging modalities in providing quantitative measurements of portal hemodynamics for improved patient management.

The results of this study highlight a statistically significant difference in the PC/SD ratios between patients with and without esophageal varices. Further research is warranted to elucidate the clinical significance of these findings and explore their implications for risk assessment and management strategies in patients with portal hypertension-related complications.

Comparison with Previous Studies

The findings of this study align with several previous studies, although variations in results highlight the complexity of using non-invasive markers to predict oesophageal varices. For instance, Giannini et al. (2006) proposed the PC/SD ratio as a reliable predictor of oesophageal varices, reporting a significant correlation between this ratio and the presence of varices [3,19]. In contrast, our study found only weak associations between the PC/SD ratio and oesophageal varices, suggesting that the utility of this marker may be influenced by population-specific factors and sample size. Similarly, Berzigotti et al. (2013) demonstrated that spleen size and platelet count could predict portal hypertension and subsequent clinical decompensation in cirrhotic patients [20]. However, our study did not find significant associations between spleen diameter or platelet count alone and the presence of varices. This discrepancy might be attributed to differences in study design, sample characteristics, and the methodologies employed. Sharma et al. (2018) reviewed the non-invasive markers for liver cirrhosis and its complications, emphasizing the potential of combining multiple parameters to enhance diagnostic accuracy [21]. Our study's findings support this notion, as the weak correlations observed for individual markers suggest that a multi-parameter approach may be necessary to improve predictive accuracy for oesophageal varices. Thomopoulos et al. (2003) and Chalasani et al. (1999) also explored various non-invasive predictors of oesophageal varices. Thomopoulos et al. found that the presence of large oesophageal varices could be predicted using a combination of clinical and laboratory parameters, while Chalasani et al. identified predictors such as low platelet count and splenomegaly. Our study's results, showing weak associations between these individual markers and varices, underscore the need for further research to refine and validate composite predictive models [22, 23].

Limitations and Future Research

The study had several limitations, including a relatively small sample size of 100 individuals and a cross-sectional design, which limits the ability to infer causality. Additionally, the data was from a single hospital, which may limit generalizability to broader populations. Further research with larger sample sizes and additional health metrics is needed to draw more definitive conclusions. Future studies should also consider longitudinal designs to better understand the temporal relationships between non-invasive markers and the development of oesophageal varices.

Conclusion

The study reveals weak associations between BMI, platelet count, spleen diameter, and the presence of varices. Although individuals with varices tend to have slightly higher BMIs and lower platelet counts, these differences are not statistically significant. The prevalence of varices appears to increase with age, particularly in the 61-70 age group. Understanding these correlations may aid in the development of more accessible diagnostic protocols, ultimately improving patient management and outcomes in settings where endoscopic resources are limited.

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