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**Research Article**

# CORRELATION OF FIBROSCAN WITH GRADING OF ESOPHAGEAL VARICES IN COMPENSATED ETHANOL, HBV, HCV AND NAFLD RELATED CIRRHOSIS

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## Abstract

**Background:**
Esophageal varices (EV) are a major complication of cirrhosis, with grading influencing management. This study evaluates the correlation between liver stiffness measurement (LSM) measured by FibroScan and EV severity in compensated ethanol, HBV, HCV and NAFLD related cirrhosis.

**Methods:**
This cross-sectional study at GMKMCH, Salem (Dec 2023–Nov 2024), included 100 compensated cirrhosis patients. EV were graded endoscopically, and LSM was measured using FibroScan. Statistical analysis included Kruskal–Wallis, chi-square, and ROC analysis ($p<0.05$ significant).

**Results:**
The mean age was 55.2 ± 10.4 years, with 73% males. Etiologies for Cirrhosis in the study population were ethanol (55%), HBV (30%), HCV (12%) and NAFLD (3%). EV severity distribution was Grade 1 (40%), Grade 2 (35%), and Grade 3 (25%). LSM values (median, IQR) significantly correlated with EV severity: 18.2 kPa (12.5–22.3) for Grade 1, 25.1 kPa (20.0–30.5) for Grade 2, and 35.6 kPa (30.2–40.5) for Grade 3 ($p<0.001$). Platelet count, albumin, total bilirubin, and prothrombin time also showed significant variation across groups.

**Conclusion:**
FibroScan-based LSM measurement correlates significantly with EV severity in compensated cirrhosis, suggesting its utility as a non-invasive predictor of high-risk varices. LSM values above specific thresholds may help guide endoscopic screening, optimizing resource allocation and early intervention.

**Keywords:**
Liver stiffness measurement, FibroScan, esophageal varices, cirrhosis, portal hypertension, endoscopy.

## INTRODUCTION

Cirrhosis is a common outcome of chronic liver diseases. A major complication is esophageal varices, occurring in up to 90% of cirrhotic patients. Variceal bleeding, a life-threatening event, affects 5% of patients with small varices and up to 15% with large varices, with a mortality rate of 10%-20% per bleeding episode. [1]

The most common etiologies causing cirrhosis in India are ethanol consumption, Chronic Hepatitis B, Chronic Hepatitis C, and NAFLD. Cirrhosis due to ethanol consumption and NAFLD are increasing while Chronic Hepatitis B and Chronic Hepatitis C are decreasing over the last 2 decades. [2] Portal hypertension and esophageal varices (EV) significantly impact prognosis and mortality. Liver cirrhosis, the primary cause of portal hypertension, results from increased intrahepatic vascular resistance due to sinusoidal capillarization and fibrosis. Additionally, vasoconstrictors like endothelins and angiotensin II exacerbate portal hypertension, while intrahepatic vasodilators like nitric oxide are reduced. [3]

EV rupture occurs when the hepatic venous pressure gradient (HVPG) exceeds 12 mmHg, increasing mortality risk. Endoscopy is the gold standard for EV diagnosis but is limited in low-resource settings, necessitating non-invasive diagnostic methods. [4] Transient elastography (TE) using FibroScan provides a reliable alternative for assessing liver stiffness measurement, correlating with portal hypertension and EV presence. [5] Liver stiffness measurement values range from 2.4 to 75 kPa, with 12.5 kPa as the cirrhosis threshold. [6] TE facilitates non-invasive risk stratification, optimizing endoscopic screening, and reducing healthcare costs, especially in resource-limited settings. This study aimed to correlate LSM measured by FibroScan with EV grading in compensated cirrhosis due to ethanol, Chronic Hepatitis B, Chronic Hepatitis C and NAFLD. The portability of Fibroscan permits its use in rural and remote areas where individuals with high LSM values can be identified and directed to specialised centres for confirmatory endoscopic evaluation for esophageal varices.

## MATERIAL AND METHODS

This cross-sectional study was conducted over one year (December 2023 – November 2024) at the Department of Medical Gastroenterology, GMKMCH, Salem, involving 100 liver cirrhosis patients diagnosed through clinical, laboratory, and radiological criteria. This study was conducted after Institutional Ethical Committee clearance.

### Inclusion Criteria:

1) Age ≥ 18 years
2) Individuals with ultrasound abdomen showing shrunken liver with surface nodularity, irregular margins with no or minimal ascites i.e., the features of compensated liver cirrhosis

3) Liver cirrhosis due to etiologies of Ethanol, Chronic Hepatitis B, Chronic Hepatitis C, and NAFLD
4) BMI <35

**Exclusion Criteria:**

1) Individuals with ultrasound abdomen showing normal liver, portal vein thrombosis, features of decompensated cirrhosis like moderate/massive ascites
2) Individuals with history of GI bleeding or hepatocellular carcinoma

**Patient Classification**

Grading followed the **Japanese Research Society for Portal Hypertension** criteria. **Grade 1 (small varices)** are flat and minimally elevated, with a low risk of rupture. **Grade 2 (medium-sized varices)** are more prominent and protrude moderately into the esophageal lumen, carrying a higher risk of bleeding, particularly if red wale markings are present. **Grade 3 (large varices)** are significantly enlarged and occupy a large portion of the esophageal lumen, posing a high risk of rupture and requiring immediate medical intervention such as endoscopic band ligation or sclerotherapy.

**Clinical and Medical Assessment:**

**History & Examination:** Detailed history-taking including the history of risk factors like ethanol consumption, metabolic disorders such as Diabetes Mellitus, and physical examination to assess BMI, liver disease, portal hypertension signs were done.
**Laboratory Tests:** CBC, Liver Function Tests, Renal Function tests, Prothrombin Time, HBsAg, Anti-HCV antibodies and fasting Lipid Profile were evaluated.

**Radiological & Endoscopic Assessments:**

- **Ultrasound:** Evaluated liver cirrhosis, portal hypertension signs, and ascites.
- **Endoscopy:** Upper gastrointestinal endoscopy was performed using **Olympus GIFH170** to assess and grade esophageal varices.
- **Liver Stiffness Measurement (FibroScan):** Hepatic fibrosis severity was assessed using **Echosens FibroScan Mini+430**.

**Statistical analysis**:

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 21.0. A p-value <0.05 was considered significant. Normality was tested with Kolmogorov–Smirnov test for Quantitative variables and Kruskal–Wallis test for Qualitative variables and chisquare tests analyzed nonparametric, categorical data and ROC analysis.

## RESULTS

The study analyzed the general characteristics of 100 individuals with cirrhosis (Table 1). The mean age of the study population was 55.2 ± 10.4 years, with a male predominance (76% male, 24% female). The most common etiology of cirrhosis was ethanol-related (55%), followed by HBV (30%), HCV (12%), and NAFLD (3%). The majority of the study population belonged to Child-Pugh class A (73%), while 27% were in class B. Biochemical parameters revealed a median ALT of 51 U/L (IQR 26–123), AST of 46 U/L (IQR 27–103), total bilirubin of 17.4 µmol/L (IQR 13.2–24.4), and albumin of 42.6 g/L (IQR 38.8–45.9). The median platelet count was 136 × $10^9$/L (IQR 99–173.5), prothrombin time was 13.6 seconds (IQR 12.8–14.6).

When analyzing the characteristics of gastroesophageal varices (Table 2), individuals were grouped into Grade 1 (n=40), Grade 2 (n=35), and Grade 3 (n=25) based on the Japanese Research Society for Portal Hypertension criteria. Total bilirubin levels were significantly higher in Grade 3 (24 µmol/L, IQR 18–29) compared to Grade 1 (15.8 µmol/L, IQR 12.5– 21), $p < 0.05$. Albumin levels significantly decreased from Grade 1 (44.2 g/L, IQR 40–47) to Grade 3 (36 g/L, IQR 32–40), $p < 0.01$. Platelet count showed a marked decline (Grade 1: 145 × $10^9$/L, IQR 110–180; Grade 2: 110 × $10^9$/L, IQR 90–140; Grade 3: 85 × $10^9$/L, IQR 60–115, $p < 0.001$). Similarly, prothrombin time was significantly prolonged in Grade 3 (15 s, IQR 14–17) compared to Grade 1 (13.2 s, IQR 12.5–14), $p < 0.05$. Liver function markers showed a progressive worsening with increasing variceal severity.

The Table 3, Figure 1 and 2 show a significant correlation between Fibroscan liver stiffness measurement (LSM) and esophageal variceal severity ($p < 0.001$). Fibroscan LSM values rise progressively with increasing variceal grade (Median LSM: 18.2 kPa in Grade 1, 25.1 kPa in Grade 2, 35.6 kPa in Grade 3), reflecting increased liver fibrosis and portal hypertension. These findings highlight Fibroscan as a valuable non-invasive tool for predicting variceal severity, enabling early risk assessment and timely intervention to prevent complications like variceal bleeding.

**Table 1:General characteristics of study population**

| Variable | Value (n=100) |
|---|---|
| **Age (years), Mean ± SD** | 55.2 ± 10.4 |
| **Gender, n (%)** | |
| - Male | 76 (76%) |
| - Female | 24 (24%) |
| **Aetiology of Cirrhosis, n (%)** | |
| - Ethanol | 55 (55%) |
| - HBV | 30 (30%) |
| - HCV | 12 (12%) |
| - NAFLD | 3 (3%) |
| **Child Category, n (%)** | |
| - A | 73 (73%) |
| - B | 27 (27%) |
| **Biochemical Parameters (Median, IQR)** | |
| ALT (U/L) | 51 (26–123) |
| AST (U/L) | 46 (27–103) |

| | |
|---|---|
| TBIL (μmol/L) | 17.4 (13.2–24.4) |
| ALB (g/L) | 42.6 (38.8–45.9) |
| PLT (×10⁹/L) | 136 (99–173.5) |
| PT (s) | 13.6 (12.8–14.6) |

**Table 2: Characteristics of Gastroesophageal Varices of Different Severities** (Based on **Japanese Research Society for Portal Hypertension Criteria**)

| Variable | Grade 1 (n=40) | Grade 2 (n=35) | Grade 3 (n=25) | p-value |
|---|---|---|---|---|
| **Child Category(A/B)** | 38/2 | 25/10 | 10/15 | <0.01 |
| **ALT(U/L), Median (IQR)** | 48 (25–115) | 50 (26–123) | 55 (30–130) | 0.07 |
| **AST (U/L), Median (IQR)** | 44 (26–100) | 50 (27–103) | 55 (32–115) | 0.05 |
| **TBIL (μmol/L), Median (IQR)** | 15.8 (12.5–21) | 20 (14–26) | 24 (18–29) | <0.05 |
| **ALB(g/L), Median (IQR)** | 44.2 (40–47) | 39 (35–43) | 36 (32–40) | <0.01 |
| **PLT(×10⁹/L), Median (IQR)** | 145 (110–180) | 110 (90–140) | 85 (60–115) | <0.001 |
| **PT (s), Median (IQR)** | 13.2 (12.5–14) | 14 (13–15) | 15 (14–17) | <0.05 |

**Table 3: Correlation of Fibroscan (LSM) with Grading of Esophageal Varices**
*(Based on Japanese Research Society for Portal Hypertension Criteria)*

| Variable | Grade 1 (n=40) | Grade 2 (n=35) | Grade 3 (n=25) | p-value |
|---|---|---|---|---|
| **Aetiology of Cirrhosis, n (%)** | | | | |
| - Ethanol | 20 (50%) | 19 (54.3%) | 16 (64%) | |
| - HBV | 12 (30%) | 10 (28.6%) | 8 (32%) | |
| - HCV | 6 (15%) | 4 (11.4%) | 2 (8%) | |
| - NAFLD | 2 (5%) | 1 (2.9%) | 0 (0%) | |
| **Fibroscan (LSM, kPa) Median (IQR)** | 18.2 (12.5–22.3) | 25.1 (20.0–30.5) | 35.6 (30.2–40.5) | <0.001** |

**Figure 1: ROC curve for Fibroscan Liver Stiffness Measurement (LSM) in predicting esophageal varices**

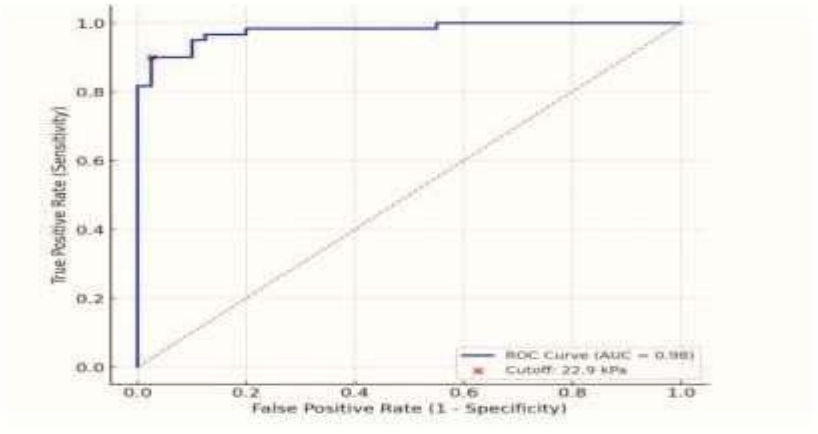
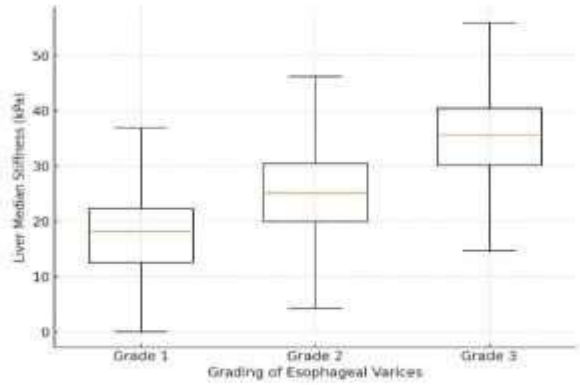



**Figure 2: Correlation of Liver Stiffness Measurement (LSM) in Fibroscan with Grading of Esophageal Varices**




## DISCUSSION

The present study evaluates the correlation between liver stiffness measurements (LSM) obtained via FibroScan and the grading of esophageal varices in individuals with compensated cirrhosis due to ethanol, Chronic Hepatitis B, Chronic Hepatitis C and NAFLD etiologies. Our findings indicate a significant association between higher LSM values and increased severity of esophageal varices.

The present study, median LSM values escalated with variceal grade: 18.2 kPa for Grade 1, 25.1 kPa for Grade 2, and 35.6 kPa for Grade 3, with a p-value of <0.001. These results align with previous research indicating that higher LSM values correlate with the presence and size of esophageal varices. Mahmoud Hassan Al Ghamdi et al., 2016 demonstrated that individuals with esophageal varices had higher mean LSM compared to those without (34.5 kPa vs. 25.8

kPa, p=0.027). [7] Pritchett et al. (2011) found that liver stiffness measurements could predict the presence of large esophageal varices in cirrhotic patients. [8]

Our analysis revealed that individuals with higher-grade varices exhibited elevated total bilirubin levels and prolonged prothrombin time, while albumin levels and platelet counts decreased as variceal grade increased. These findings align with existing literature, which identifies hypoalbuminemia and thrombocytopenia as markers associated with advanced liver disease and increased portal pressure. El Lehleh et al. (2018) observed significant differences in biochemical parameters correlating with variceal grades, underscoring their potential role in non-invasive assessment strategies. [9]

In our study, the diagnostic performance of Fibroscan Liver Stiffness Measurement (LSM) in predicting the presence of esophageal varices was evaluated using receiver operating characteristic (ROC) curve analysis. The ROC curve demonstrated an area under the curve (AUC) of 0.98 indicating high accuracy of LSM for this purpose. The optimal cut off value identified was 22.9 kPa which provided balance between sensitivity and specificity.

The significant correlation between LSM and variceal severity highlights the potential of FibroScan as a non-invasive tool to stratify the risk of esophageal varices in individuals with compensated cirrhosis. Implementing LSM in clinical practice could aid in identifying individuals at higher risk who may benefit from earlier or more frequent endoscopic surveillance, thereby optimizing resource utilization and patient care. This approach aligns with the growing emphasis on personalized medicine, tailoring surveillance and treatment strategies to individual patient risk profiles.

**Study Limitations**

While our study provides valuable insights, certain limitations should be acknowledged. The cross-sectional design precludes assessment of longitudinal changes in LSM and variceal progression. Additionally, factors such as interobserver variability in LSM measurements and potential confounders like concurrent medication use were not controlled for, which could influence the results. Future studies with larger, diverse populations and longitudinal followup are needed to validate our findings and refine the use of LSM in clinical practice.

## CONCLUSION

In conclusion, our study demonstrates a significant association between liver stiffness measurements obtained via FibroScan and the grading of esophageal varices in individuals with compensated cirrhosis due to ethanol, Chronic Hepatitis B, Chronic Hepatitis C, and NAFLD. These findings support the use of FibroScan as a non-invasive modality to predict variceal severity, potentially guiding clinical decision-making and optimizing the management of cirrhotic patients. Further research is warranted to establish standardized LSM thresholds and to explore the impact of cirrhosis etiology on variceal development and progression.

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