

ORIGINAL ARTICLE

Role of Portal Vein Doppler Ultrasound for Presence of Esophageal Varices in Patients with Chronic Liver Disease: A Study from GMC Sukkur

Rabia Hafeez^{1*}, Inayatullah Memon¹, Khalil Sanghroo³,
Saleh Muhammad Channa⁴, Rubina Hafeez⁵

¹Assistant Professor, Department of Radiology, SMBBMU/GMC, Sukkur, Sindh-Pakistan

²Associate Professor, Department of Radiology, SMBBMU/GMC, Sukkur, Sindh-Pakistan

³Assistant Professor, Department of Medicine, SMBBMU/GMC, Sukkur, Sindh-Pakistan

⁴Professor, Department of Medicine, SMBBMU/GMC, Sukkur, Sindh-Pakistan

⁵Professor, Department of Gynae & Obs., SMBBMU/GMC, Sukkur, Sindh-Pakistan

Correspondence: Rabiahafeez66@gmail.com

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ABSTRACT

OBJECTIVE: To determine the diagnostic accuracy of Doppler portal vein flow velocity in predicting esophageal varices, taking upper GI endoscopy as the gold standard.

METHODOLOGY: This cross-sectional study was conducted at the Radiology Department of Ghulam Muhammad Mahar Medical College (GMC), Sukkur, from October 2024 to March 2025. A total of 300 consecutive patients aged 25-70 years with chronic liver disease who were referred for ultrasound abdomen and Doppler examination were included. Findings of both modalities were correlated, and the Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of Doppler portal vein flow velocity were calculated.

RESULTS: Of the 300 patients, 186 (62%) were males, and 114 (38%) were females. Endoscopy confirmed the presence of esophageal varices in 230 patients and had positive Doppler ultrasound findings (true positives). A portal vein flow velocity cutoff value of 16 cm/s was used to predict the presence of esophageal varices. The diagnostic accuracy, specificity, sensitivity, negative predictive value, and positive predictive value of Doppler ultrasound were 91.7%, 75.0%, 95.8%, 81.8%, and 93.9%, respectively.

CONCLUSION: Doppler ultrasound is a valid, noninvasive diagnostic tool for screening patients with esophageal varices, supporting early diagnosis and reducing the risk of variceal bleeding and associated morbidity. Given the high burden of chronic liver disease patients in our setting, Doppler ultrasound of the portal vein may also avoid the unnecessary intervention of endoscopy in high-risk patients.

KEYWORDS: Doppler ultrasound, portal vein velocity, diagnostic accuracy, chronic liver disease, esophageal varices, endoscopy.

INTRODUCTION

Bleeding from esophageal varices is a life-threatening complication of portal hypertension in patients with chronic liver disease and is associated with significant morbidity and mortality. Clinically significant portal hypertension, defined as a hepatic venous pressure gradient of ≥ 10 mmHg, underlies the formation of varices. In contrast, the risk of variceal bleeding increases substantially when the pressure gradient exceeds 12 mmHg^{1,2}. Early detection and intervention have shown improved clinical outcomes. However, the gold standard for variceal surveillance is esophagogastroduodenoscopy (EGD), which is invasive, costly, and causes discomfort for patients^{3,4}. The prevalence of esophageal varices in Pakistan is 65%⁵.

Ultrasound, including Doppler and endoscopic ultrasound, provides a noninvasive and readily available method for assessing portal hypertension and risk of variceal bleeding. B-mode ultrasound can identify indirect signs such as splenomegaly, portal vein dilatation, changes in liver morphology, and collateral vessel formation⁶. Doppler ultrasonography further evaluates the hemodynamic changes within the portal venous system by measuring portal vein flow velocity, flow direction, and collateral circulation⁷.

Ultrasound Doppler-measured reductions of portal vein flow and velocity have been associated with the development and progression of varices. Doppler ultrasound is a safe and easily accessible alternative to endoscopy for risk stratification and monitoring in patients with chronic liver disease.

This study aimed to determine the diagnostic accuracy of portal vein Doppler ultrasonography in predicting esophageal varices in patients with chronic liver disease, using upper GI endoscopy as the gold standard.

METHODOLOGY

This cross-sectional study was conducted at the Department of Radiology, Ghulam Muhammad Mahar College (GMMC), Sukkur, from October 2024 to March 2025. A sample size of 300 patients was calculated using a confidence level of 95%, a 5% margin of error, 92% sensitivity, 93% specificity and 65% prevalence of esophageal varices. Included patients had a known diagnosis of chronic liver disease, presented in the liver OPD, and were referred for ultrasound of the abdomen. Patients with thrombosis of the portal vein, hepatoma or prior intervention were excluded.

After informed consent, ultrasound was performed by an experienced and senior radiologist. We used an Aplio 500 ultrasound machine for grayscale and Doppler imaging to measure portal vein flow velocity and the diameter of the portal vein. A velocity cutoff value of 16 cm/s was used. Subsequently, patients were advised to get an upper GI endoscopy by a gastroenterologist who was blinded to the Doppler ultrasound findings.

We correlated and analyzed the ultrasound and endoscopy findings using a 2x2 table to measure the diagnostic accuracy, specificity, sensitivity, negative predictive value, and positive predictive value of Doppler ultrasound of detecting esophageal varices, using endoscopy as the gold standard. Collected data were analyzed using the software SPSS 21.0. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Included patients ranged in age from 25 to 70 years, with a mean age of 47.5 years. Out of 300 patients, 186 were males (62%) and 114 females (38%), with an M: F ratio of 3:1. Doppler ultrasound of the portal vein showed reduced flow velocity in 230 patients and varices were confirmed on endoscopy (true positive). Ten patients had normal Doppler ultrasound, but also varices on endoscopy (false negative). Fifteen patients had positive Doppler findings for varices, but they were not found on endoscopy (false positive). Both Doppler and endoscopy were negative in 45 patients (true negative) (Table I). Overall diagnostic accuracy, specificity, sensitivity, negative predictive value, and positive predictive value of Doppler ultrasonography were 91.7%, 75.0%, 95.8%, 81.8%, and 93.9%, respectively. respectively. **Figure 1**

TABLE I: Cutoff value of portal vein velocity 16cm/sec

	Positive on Doppler*	Negative on Doppler*	Total
Positive on endoscopy	230	10	240
Negative on endoscopy	15	45	60
Total	245	55	300

Cutoff value of portal vein velocity 16cm/sec

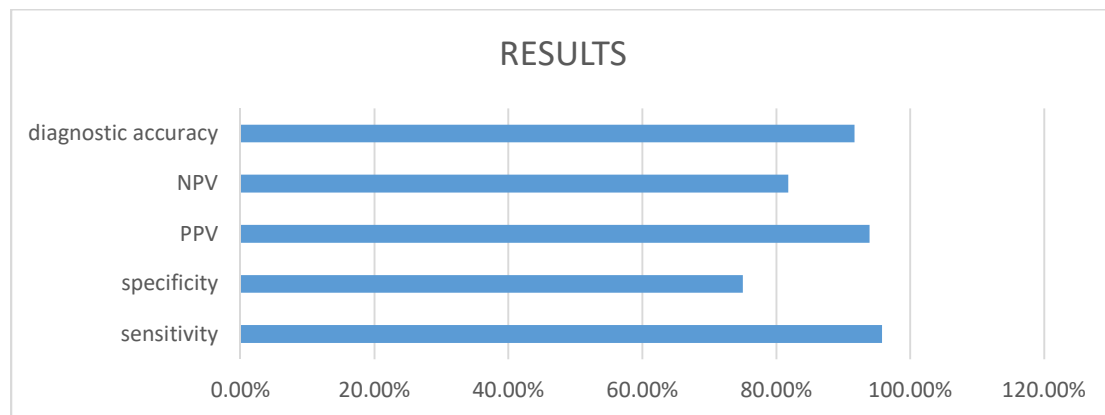


Figure 1: Results of diagnostic accuracy of Doppler Ultrasound of the portal vein.

DISCUSSION

Esophageal varices constitute the predominant part of gastroesophageal varices and are observed in approximately 50-60% of patients with compensated cirrhosis, increasing to 80% in those with decompensation⁸. Variceal bleeding accounts for 70% of upper gastrointestinal bleeding in patients with cirrhosis and portal hypertension. The annual incidence of bleeding due to varices is around 5-15%, while each bleeding episode carries a six-week mortality risk of approximately 15-25%⁹.

Esophageal varices develop as a consequence of increased portal venous pressure, which results in the formation of collateral circulation due to increased intrahepatic vascular resistance. Although upper gastrointestinal endoscopy is the standard method for screening of varices, it is invasive and not widely available. To reduce unnecessary endoscopic procedures, researchers have investigated several noninvasive laboratory and imaging markers¹⁰.

Currently, several noninvasive diagnostic approaches are being investigated for the prediction and detection of gastroesophageal varices in patients with compensated cirrhosis^{11,12}.

Doppler ultrasonography is a noninvasive Imaging modality that has been widely investigated as a potential tool to evaluate the relationship between portal hypertension and the presence of esophageal varices¹³⁻¹⁵.

A study by Mansoor A 2019¹⁶ reported high diagnostic accuracy of Doppler ultrasound for detecting esophageal varices, with diagnostic accuracy (89.00%), specificity (89.04%), sensitivity (88.98%), negative predictive value (82.28%), and positive predictive value (93.00%). Our study results are consistent with those reported by Mansoor A 2019¹⁶. In our study, the diagnostic accuracy, specificity, sensitivity, negative predictive value, and positive predictive value of Doppler ultrasound were 91.7%, 75.0%, 95.8%, 81.8%, and 93.9%, respectively.

A study conducted by Shastri M 2014¹⁷ shows that portal vein velocity could be used as a noninvasive screening test before endoscopy referral. They reported a sensitivity of 84% at a cutoff of 16 cm/s, but with a smaller sample size than our study.

A recent local study by Khan WH 2023¹⁸ reported much higher diagnostic accuracy (93.43%), specificity (92.86%), sensitivity (93.83%), negative predictive value (91.23%) and positive predictive value (95%), at a cutoff of 18 cm/s.

Another recent international study by Elkenawy YN 2020¹⁹ reported 97% sensitivity using a cutoff velocity of the portal vein of ≥ 19 cm/s.

Our results showed that portal vein flow velocity is reduced in patients with chronic liver disease and is strongly associated with the development of esophageal varices confirmed on endoscopy.

Along with various clinical and laboratory tests, esophageal varices can be detected without intervention by using Doppler Ultrasound. It will help in early diagnosis and reduction of mortality associated with variceal bleeding in cirrhotic patients²⁰.

Esophageal varices can be predicted by four radiological indices, with the portal vein velocity considered the most sensitive parameter, followed by the congestion index, splenic index and portal vein diameter²¹.

Recent advanced literature shows that computed tomography of the abdomen can serve as a supplemental, reliable investigation to assess the grading of esophageal varices. Quantitative parameters from computed tomography of liver lobe volume can predict the severity of varices and hemorrhage risk in patients with liver cirrhosis^{22,23}.

CONCLUSION

This study concluded that Doppler ultrasound of the portal vein has high diagnostic accuracy in predicting esophageal varices and should be considered a noninvasive imaging modality for screening of cirrhotic patients in daily practice. This may support early referral and reduce the unjustified burden and cost to the endoscopy suite.

Ethical Permission: Ghulam Muhammad Mahar Medical College, Sukkur, Pakistan, ERC approval letter No. 813/25.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Hafeez R: Literature search & study design
Memon I: Data collection & interpretation
Sanghroo K: Data collection & analysis
Channa SM: Data collection & analysis
Hafeez R: Data collection & analysis

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