ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 10, Issue – 6, December – 2025, Page No. : 40 – 50

To Evaluate The Role of Congestive Index, Splenoportal Index and Liver Vascular Index Using Doppler Ultrasound in Clinically Suspected Cases of Portal Hypertension

[1]Dr.(Mrs.) Lovely Kaushal, Professor and HOD, Department of Radiodiagnosis, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

[2]Dr. Swati Goyal, Associate Professor, Department of Radiodiagnosis, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

[3]Dr. Lavanya Vullakulla, Junior Resident, Department of Radiodiagnosis, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

[4]Dr. Shubham Lekhwani, Junior Resident, Department of Radiodiagnosis, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

[5]Dr. Nitin Chouhan, Junior Resident, Department of Radiodiagnosis, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

Corresponding Author: Dr. Lavanya Vullakulla, Junior Resident, Department of Radiodiagnosis, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

Citation this Article: Dr.(Mrs.) Lovely Kaushal, Dr. Swati Goyal, Dr. Lavanya Vullakulla, Dr. Shubham Lekhwani, Dr. Nitin Chouhan, "To Evaluate The Role of Congestive Index, Splenoportal Index and Liver Vascular Index Using Doppler Ultrasound in Clinically Suspected Cases of Portal Hypertension", IJMSIR - December – 2025, Vol – 10, Issue - 6, P. No. 40 – 50.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Objectives: Portal hypertension is a major complication of chronic liver disease, associated with ascites, variceal bleeding, and hepatic encephalopathy. Although hepatic venous pressure gradient (HVPG) measurement is the gold standard for diagnosis, its invasive nature limits widespread use. This study evaluates the diagnostic utility of non-invasive Doppler ultrasound-derived indices—Congestive Index (CI), Splenoportal Index (SPI), and Liver Vascular Index (LVI)—in detecting portal hypertension.

Methods: A comparative cross-sectional study was conducted on 100 patients with clinically suspected portal hypertension and 100 matched healthy controls at Gandhi Medical College and Hamidia Hospital, Bhopal, between May 2023 and November 2024. Doppler ultrasound assessed portal, splenic, and hepatic vascular parameters. Pearson/Spearman correlation, Mann–Whitney U test, and ROC analysis were used. Data were analysed using SPSS v23.0; significance was set at $p < 0.05$.

Results: No significant association was found between age, gender, and portal hypertension ($p = 1.000$); 13% had haematemesis or varices. Portal vein parameters were significantly altered: diameter (1.52 vs. 1.13 cm), velocity (14.41 vs. 15.35

cm/s), PI (0.33 vs. 0.42), CI (0.13 vs. 0.07); hepatofugal and pulsatile flow were more frequent (all significant). Splenic vein diameter, index, velocity, and SPI were elevated ($p < 0.001$); 5% had pulsatile flow ($p = 0.024$). Hepatic artery PI was higher (1.47 vs. 0.64) and LVI lower (9.83 vs. 24.20) ($p < 0.001$). CI, SPI, LVI correlated strongly ($r \approx \pm 0.866$); cut-offs yielded ≥97.5% accuracy.

Conclusion: The high diagnostic accuracy of these Doppler-derived indices, especially LVI, highlights their value as accessible, cost-effective tools for non-invasive evaluation of portal hypertension.

Keywords: Portal Hypertension, Doppler Ultrasonography, Congestive Index, Splenoportal Index, Liver Vascular Index.

Introduction

Portal hypertension is a major clinical consequence of chronic liver disease, leading to life-threatening complications like variceal bleeding, ascites and hepatic encephalopathy [1,2]. It is characterized by elevated portal venous pressure, typically resulting from increased intrahepatic resistance to blood flow [3].

Several direct techniques for measuring portal pressure—such as intrasplenic puncture, umbilical vein catheterization, and transhepatic approaches—are invasive and infrequently used [5]. The hepatic venous pressure gradient (HVPG) is currently regarded as the gold standard for estimating portal pressure [6]. However, HVPG is invasive and not widely available, particularly in resource-limited settings [6,7]. These limitations highlight the need for non-invasive, reproducible, and accessible alternatives [8].

Doppler ultrasonography has emerged as a promising non-invasive modality. It is safe, cost-effective, widely available, and suitable for bedside use [9]. In the context of portal hypertension, it enables assessment of vascular parameters such as portal vein diameter, flow velocity, and direction [11]. However, they often lack specificity and demonstrate variability across different populations [12].

To enhance diagnostic accuracy, Doppler-derived vascular indices have been proposed, including the Congestive Index (CI), Splenoportal Index (SPI), and Liver Vascular Index (LVI) [13,14]. These indices integrate hemodynamic parameters from the portal, splenic, and hepatic circulation, providing a more comprehensive assessment of vascular changes [15]. While some studies have demonstrated their potential clinical utility, there is a paucity of validation studies, and few have employed a uniform methodology for direct comparison [16,17].

The present study seeks to address this gap by evaluating the diagnostic performance of CI, SPI, and LVI in patients with clinically suspected portal hypertension, using a comparative cross-sectional design with matched controls. Additionally, it examines the correlation of these indices with clinical features such as ascites and esophageal varices, which serve as important markers of disease severity [18].

By applying a standardized imaging protocol and consistent statistical framework, this study aims to assess the comparative value of these Doppler indices in the non-invasive diagnosis and risk stratification of portal hypertension. If validated, these indices could minimize the reliance on invasive procedures and enhance early diagnostic capabilities in both routine and high-risk clinical settings [19, 20]

Materials and Methods

This comparative cross-sectional study was conducted after obtaining approval from the Institutional Ethics Committee at our hospital. Written informed consent was obtained from all participants prior to enrolment.

The study was conducted prospectively between May 2023 and November 2024. A total of 100 patients with

clinically suspected portal hypertension and 100 age- and gender-matched healthy controls. Inclusion criteria for cases included clinical suspicion of portal hypertension based on features such as splenomegaly, ascites or upper gastrointestinal bleeding. Controls were selected from patients referred for abdominal ultrasound with no clinical or sonographic evidence of liver, renal, or cardiac disease. Exclusion criteria included prior liver surgery, known hepatic malignancy, congenital vascular anomalies, or inability to undergo Doppler examination due to poor acoustic window or non-cooperation.

All patients were examined following a standardised Doppler ultrasound protocol. Prior to the scan, participants fasted for a minimum of six hours to reduce bowel gas. Scans were performed with the patient in a supine position, head slightly elevated, and the right arm placed behind the head. The lateral decubitus position was used to evaluate the spleen and left hepatic lobe.

Examinations were performed using a low-frequency convex transducer (3.5–6.5 MHz) on a Alpinion E-CUBE 9. The liver was assessed in both longitudinal and transverse planes for signs of cirrhosis, nodularity, and hepatomegaly. Portal vein assessment included diameter (at the porta hepatis), peak systolic velocity, mean flow velocity, direction, phasicity, and pulsatility index. The Congestive Index (CI) was calculated as the ratio of the portal vein cross-sectional area (cm^2) to the flow velocity (cm/s). The splenic vein was evaluated in the longitudinal plane at the hilum. Parameters included diameter, velocity, waveform pattern, and direction of flow. The Splenic Index (SI) was calculated as the product of the spleen's transverse and vertical dimensions. The Splenoportal Index (SPI) was derived as the ratio of SI to mean portal vein velocity.

Hepatic veins were assessed for diameter, direction, and waveform phasicity (triphasic, biphasic, monophasic). The inferior vena cava (IVC) was evaluated for diameter and respiratory variation. The hepatic artery was analysed for resistive and pulsatility indices using spectral Doppler. The Liver Vascular Index (LVI) was computed as the ratio of portal venous velocity to hepatic arterial pulsatility index.

Data were recorded in a structured datasheet and entered into Microsoft Excel. Statistical analysis was conducted using SPSS software version 23.0 (IBM Corp., Armonk, NY). Descriptive statistics were calculated for baseline variables. Group comparisons were performed using the Mann–Whitney U test. Correlation of indices with portal hypertension was assessed using Pearson's and Spearman correlation coefficients. Diagnostic accuracy was evaluated using receiver operating characteristic (ROC) curves. A p-value < 0.05 was considered statistically significant.

Results

The age groups were defined as ≤20 years, 21-40 years, 41-60 years, and ≥61 years with number of cases in each group being 8, 50, 110, 32 respectively, maximum in the age group of 41-60 years. Chi-square test indicated no statistically significant association between age group and the presence of portal hypertension (Chi-square = 0.000, p = 1.000).

Table 1: Descriptive Statistics and Comparison of Portal Doppler Parameters Between Groups

Parameter	Group	N	Mean	Median	IQR	Mann- Whitney U	p-value
PV Diameter(cms)	Cases	100	1.52	1.375	0.35	49.5	<0.001
	Controls	100	1.13	1.105	0.16		

PV Peak systolic velocity(cms/sec)	Cases	100	14.41	14.645	3.16	4070	0.023
	Controls	100	15.35	14.645	2.59		
PV Pulsatility index	Cases	100	0.33	0.345	0.19	2561	<0.001
	Controls	100	0.42	0.415	0.14		
PV Congestive index	Cases	100	0.13	0.11	0.07	12	<0.001
	Controls	100	0.07	0.055	0.03		

Table 1 presents a comparison of Doppler parameters between cases (patients with portal hypertension) and controls, including the mean, median, interquartile range (IQR), Mann-Whitney U statistic, and associated p-value for each parameter. The median diameter, median peak systolic velocity, median pulsatility index of the portal vein showed a statistically significant difference between the groups (Mann-Whitney U = 49.5, $p < 0.001$), (Mann-Whitney U = 4070, $p = 0.023$), (Mann-Whitney U =2561, $p < 0.001$) respectively. Finally, the median congestive index of the portal vein also demonstrated a highly statistically significant difference between the groups (Mann-Whitney U = 12, $p < 0.001$).

Table 2: Descriptive Statistics and Comparison of Splenic vein Doppler Parameters Between Groups

Parameter	Group	N	Mean	Std. Deviation	Mean rank	Sum of ranks	Mann- Whitney U	p-value
Diameter of splenic vein(cms)	Cases	100	1.34	0.277	149.40	14939.50	49.5	<0.001
	Controls	100	0.680	0.129	51.61	5160.50		
Splenic Index	Cases	100	31.81	8.09	150.14	15014.00	4070	0.023
	Controls	100	14.95	2.63	50.86	5086.00		
Splenic vein velocity (cms/sec)	Cases	100	15.92	2.39	132.71	13270.50	2561	<0.001
	Controls	100	14.05	1.49	68.30	6829.50		
Splenoportal Index	Cases	100	2.22	0.54	150.50	15050.00	12	<0.001
	Controls	100	0.98	0.06	50.50	5050.00		

Table 2 presents the Mann-Whitney U test results comparing splenic vein parameters between cases and controls. The mean rank for the diameter of the splenic vein, the splenic index, splenic vein velocity and splenoportal index showed a statistically significant difference between the groups (Mann-Whitney U = 49.5, $p < 0.001$), (Mann-Whitney U = 4070, $p = 0.023$), (Mann-Whitney U = 2561, $p < 0.001$) and (Mann-Whitney U = 12, $p < 0.001$) respectively.

Table 3: Mann-Whitney U Test Results for Pulsatility Index of Hepatic Artery and Liver Vascular Index

Parameter	Group	N	Mean	Std. Deviation	Mean rank	Sum of ranks	Mann- Whitney U	p-value
Pulsatility Index of hepatic artery	Cases	100	1.47	0.32	150.48	15048.00	2.000	<0.001
	Controls	100	0.64	0.06	50.52	5052.00		
Liver Vascular Index	Cases	100	9.83	1.85	50.53	5053.00	3.000	<0.001
	Controls	100	24.20	4.18	150.47	15047.00		

Table 3 presents the Mann-Whitney U test results comparing the pulsatility index of the hepatic artery and the liver vascular index between cases and controls. The mean rank for the pulsatility index of the hepatic artery was 150.48 in cases and 50.52 in controls, indicating a highly statistically significant difference between the groups (Mann-Whitney U = 2.000, p < 0.001). Similarly, the mean rank for the liver vascular index was 50.53 in cases and 150.47 in controls, also revealing a highly significant difference (Mann-Whitney U = 3.000, p < 0.001).

Table 4: Spearman Correlations between Doppler Parameters and Group

	Group	Congestive index in Portal Vein	Splenoportal index	Liver vascular index
Group	1	-0.866**	-0.867**	0.866**
		<0.001	<0.001	<0.001
Congestive index in Portal Vein	-0.866**	1	0.791**	-0.805**
	<0.001		<0.001	<0.001
Splenoportal index	-0.867**	0.791*	1	-0.771**
	<0.001	<0.001		<0.001
Liver vascular index	0.866**	-0.805**	-0.771**	1
	<0.001	<0.001	<0.001	

Table 4 presents the Spearman correlation coefficients between the Doppler parameters and the group classification (cases and controls), where cases are coded as 1. There were strong and statistically significant correlations observed between the group and congestive index in the portal vein (r = -0.866, p < 0.001), splenoportal index (r = -0.867, p < 0.001), and liver vascular index (r = 0.866, p < 0.001). These negative correlations indicate that the congestive index and splenoportal index are higher in the cases group (1) compared to the controls (2), while the positive correlation shows that the liver vascular index is lower in the cases group (1) compared to the controls (2). The congestive index showed a strong positive correlation with the splenoportal index (r = 0.791, p < 0.001) and a strong negative correlation with the liver vascular index (r = -0.805, p < 0.001). The splenoportal index also exhibited a strong negative correlation with the liver vascular index (r = -0.771, p < 0.001). All reported correlations were significant at the 0.01 level.

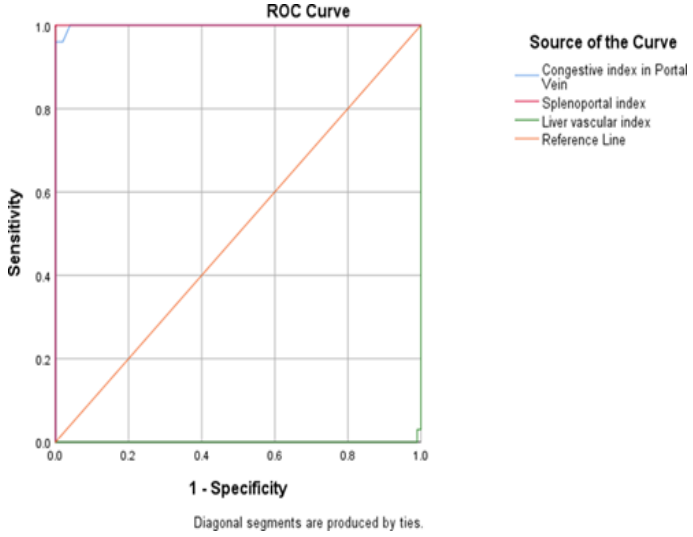

Figure 1: ROC curve analysis of doppler parameters for detecting portal hypertension

Table 5: Diagnostic Accuracy of Doppler Parameters for Portal Hypertension

Parameter	Optimal	Sensitivity	Specificity	Positive Predictive Value (PPV)	Negative Predictive Value (NPV)	Accuracy
	Cut-off	(%)	(%)	(%)	(%)	(%)
Congestive index in Portal Vein	0.082	100	95	95.24	100	97.5
Splenoportal index	1.42	99	100	100	99.01	99.5
Liver vascular index	4.8	100	100	100	100	100

Table 5 summarizes the diagnostic accuracy of the Doppler parameters in identifying portal hypertension.

Table 6: Comparison of mean Congestive Index, Splenoportal Index and Liver vascular index in patients of portal hypertension presenting with or without hematemesis/melena

Variable	Haematemesis/Varices	N	Mean	Std. Deviation	Mann Whitney U	p- value
Congestive Index in Portal Vein	Absent	87	0.12	0.02	295.00	<0.01
	Present	13	0.15	0.04		
Splenoportal Index	Absent	87	2.06	0.36	1.500	<0.001
	Present	13	3.29	0.30		
Liver Vascular Index	Absent	87	9.89	1.83	509.0	0.562
	Present	13	9.44	2.03		

The Mann-Whitney U test revealed significant differences in hemodynamic parameters between patients with and without haematemesis/varices. Specifically, the congestive index in the portal vein was significantly higher in patients with haematemesis/varices (mean=0.15) compared to those without (mean=0.12), with a statistically significant p-value of 0.005 (U=295.00). Similarly, the splenoportal index demonstrated a highly significant increase in the haematemesis/varices group (mean=3.29) compared to the non-haematemesis/varices group (mean=2.06), with a p-value less than 0.001 (U=1.500). However, the liver vascular index did not show a statistically significant difference between the two groups (p=0.562, U=509.0), suggesting that while congestive and splenoportal hemodynamic are altered in the presence of haematemesis/varices, the liver vascular index remains relatively unaffected.

Discussion

Doppler evaluation of the portal vein revealed that the mean diameter was significantly greater in cases (1.52 cm) than in controls (1.13 cm; $p < 0.001$). Peak systolic velocity was lower in cases (14.41 cm/s) compared to controls (15.35 cm/s; $p = 0.023$), and the pulsatility index was also reduced in cases (0.33 vs. 0.42; $p < 0.001$). The mean congestive index was elevated in the portal hypertension group (0.13 vs. 0.07; $p < 0.001$). Abnormal flow patterns were more prevalent in cases, with hepatofugal flow noted in 7% (vs. 0%; $p = 0.007$) and pulsatile flow in 83% (vs. 0%; $p < 0.001$). In the splenic vein, cases exhibited a significantly larger mean diameter (1.34 cm vs. 0.68 cm; $p < 0.001$), higher splenic index

(31.81 vs. 14.95; p = 0.023), and increased flow velocity (15.92 cm/s vs. 14.05 cm/s; p < 0.001). The splenoportal index was also markedly elevated in cases (2.22 vs. 0.98; p < 0.001). Although hepatofugal flow was detected in 2% of cases (vs. 0%; p = 0.155), pulsatile splenic flow was significantly more common among cases (5% vs. 0%; p = 0.024). Hepatic vein Doppler analysis showed altered waveform phasicity in the portal hypertension group, with more monophasic or biphasic patterns (p = 0.002). The mean diameter of the inferior vena cava (IVC) was slightly but significantly reduced in cases compared to controls (18.25 mm vs. 18.65 mm; p = 0.014). Hepatic artery assessment revealed a significantly higher pulsatility index in cases (1.47 vs. 0.64; p < 0.001), while the liver vascular index (LVI) was significantly lower (9.83 vs. 24.20; p < 0.001). Strong correlations were observed between the presence of portal hypertension and each of the Doppler-derived indices: CI (r = –0.866), SPI (r = –0.867), and LVI (r = 0.866), all with p < 0.001. The optimal diagnostic cut-off values identified were CI ≥ 0.082 (accuracy 97.5%), SPI ≥ 1.42 (accuracy 99.5%), and LVI ≤ 4.8 (accuracy 100%). Subgroup analysis revealed that patients with haematemesis or varices had significantly higher CI (0.15 vs. 0.12; p < 0.01) and SPI (3.29 vs. 2.06; p < 0.001), while LVI did not differ significantly between those with and without hematemesis. (p = 0.562)

Comparison with Previous Studies

Demographic and Clinical Characteristics

Among 200 participants, including 100 cases and 100 age- and gender-matched controls, no statistically significant differences in age group or gender were found (p = 1.000). Males comprised 65% of both groups. All cases presented with splenomegaly and ascites; 13% had haematemesis or varices. These distributions align with prior studies, including Saulat et al. (2019), [21] which reported similar male predominance. However, most earlier reports did not formally assess age or gender associations with portal hypertension.

Portal Vein Doppler Parameters

Portal vein diameter was significantly greater in cases (1.52 ± 0.13 cm) than controls (1.13 ± 0.09 cm; p < 0.001), consistent with Chouhan et al. (2015) and Elatty et al. (2020) [22,23], who found similar associations with varices. Peak systolic velocity was lower in cases (14.41 ± 2.08 cm/s vs. 15.35 ± 2.65 cm/s; p = 0.023), consistent with Katwal et al. (2023)[26], suggesting increased intrahepatic resistance. Congestive index (CI) was markedly elevated in cases (0.13 ± 0.02 vs. 0.07 ± 0.01; p < 0.001), mirroring findings by Katwal et al. and Ogholoh et al [26, 27], supporting its diagnostic utility.

Splenic Vein Doppler Parameters

Splenic vein diameter was higher in cases (1.34 ± 0.28 cm vs. 0.68 ± 0.13 cm; p < 0.001), likely due to venous stasis. Splenic index (31.81 ± 8.09 vs. 14.95 ± 2.63; p = 0.023) also increased, reflecting splenomegaly which closely resembled the finding of increased splenic length/ splenic volume by Elatty et al. (2020) and Romero-Cristóbal et al (2023) [23,24]. Splenic vein velocity and splenoportal index (SPI) were significantly elevated in cases (SPI: 2.22 ± 0.54 vs. 0.98 ± 0.06; p < 0.001). Previous studies, such as Saulat et al. and Jami et al., demonstrated comparable findings and high accuracy for SPI in predicting varices. [21,25]. Our study found a SPI cut-off of 1.42 yielded 99.5% accuracy.

Hepatic Artery and Liver Vascular Index

Hepatic artery pulsatility index was significantly increased in cases (1.47 ± 0.32 vs. 0.64 ± 0.06; p < 0.001), indicating hepatic microvascular resistance. Liver Vascular Index (LVI) was markedly lower in cases (9.83 ± 1.85 vs. 24.20 ± 4.18; p < 0.001), capturing global hepatic perfusion deficits. Our cut-off of 4.8 yielded

100% diagnostic accuracy for portal hypertension, underscoring LVI's potential as a robust, composite hemodynamic marker.

Correlation and Interrelationships

Spearman analysis confirmed strong associations between portal hypertension and CI ($r = –0.866$), SPI ($r = –0.867$), and LVI ($r = 0.866$), all with $p < 0.001$. CI and SPI were strongly intercorrelated ($r = 0.791$), and both showed negative correlations with LVI, suggesting they reflect distinct but complementary circulatory dynamics.

Diagnostic Accuracy of Doppler Parameters

The optimal cut-offs for CI (0.082), SPI (1.42), and LVI (4.8) yielded sensitivities of 100%, 99%, and 100%, respectively, and specificities of 95%, 100%, and 100%. Compared to liver stiffness and other elastography techniques, our indices—especially LVI—offered equal or superior diagnostic accuracy, with the added advantages of cost-effectiveness, real-time assessment, and wide accessibility.

Subgroup Analysis: Hematemesis/Varices

Patients with haematemesis/varices had higher CI (0.15 ± 0.04 vs. 0.12 ± 0.02; $p < 0.01$) and SPI (3.29 ± 0.30 vs. 2.06 ± 0.36; $p < 0.001$), suggesting a relationship between higher congestion and risk of variceal bleeding. However, LVI did not differ significantly between subgroups ($p = 0.562$), indicating its utility may be more focused on detecting portal hypertension rather than predicting its complications

Despite its strengths, this study has limitations. It was conducted at a single tertiary centre with limited sample size potentially limiting generalisability. The cross-sectional design restricts the ability to assess temporal changes or monitor disease progression, which would be better addressed in longitudinal studies. Patients with pre-existing cardiovascular or renal anomalies were excluded to maintain hemodynamic uniformity; however, these conditions are known to affect portal and systemic circulation and their exclusion may limit real-world applicability. The control group, while matched by age and sex, may differ in unmeasured variables such as nutritional status or subclinical liver dysfunction. Endoscopic confirmation of varices was not performed for all cases, which may have affected subgroup analysis. In addition, the absence of invasive pressure measurement (HVPG) as a reference standard precluded validation against the current gold standard. However, the use of consistent scanning protocols and robust statistical analysis strengthened the internal validity of results.

In conclusion, this study highlights the clinical utility of CI, SPI, and particularly LVI as non-invasive Doppler-based indices for diagnosing portal hypertension. These indices offer an accessible, reproducible, and radiation-free alternative to invasive testing. LVI demonstrated the highest diagnostic performance, suggesting it could be adopted as a reliable screening tool in routine clinical settings. Further multicentric studies with larger cohorts and HVPG correlation are recommended to validate these findings and facilitate their integration into standard practice.

Conclusion

Based on the findings of this study, it can be concluded that significant alterations exist in the Congestive Index, Splenoportal Index, and Liver Vascular Index in patients with clinically suspected portal hypertension compared to controls. The high diagnostic accuracy demonstrated by these non- invasive Doppler-derived indices, particularly the Liver Vascular Index which exhibited 100% accuracy, underscores their potential as valuable tools for the non-invasive assessment of portal hypertension. These results suggest that these indices, can offer a readily accessible, cost-effective, and accurate method for the diagnosis and evaluation of portal hypertension.

References

1. Gunarathne LS, Rajapaksha H, Shackel N, Angus PW, Herath CB. Cirrhotic portal hypertension: From pathophysiology to novel therapeutics. World J Gastroenterol. 2020 Oct 28;26(40):6111–40.
2. Oliver TI, Sharma B, John S. Portal Hypertension. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Nov 27]. Available from: http://www.ncbi.nlm.nih.gov/ books/ NBK507718/
3. Carale J, Azer SA, Mekaroonkamol P. Portal Hypertension: Practice Essentials, Background, Anatomy. Anand B, editor. 2024 Oct 29 [cited 2024 Nov 27]; Available from: https://emedicine. medscape.com/article/182098-overview
4. Nakhleh RE. The pathological differential diagnosis of portal hypertension. Clin Liver Dis (Hoboken). 2017 Sep 29;10(3):57–62.
5. Morales-Ruiz M, Rodríguez-Vita J, Ribera J, Jiménez W. Pathophysiology of Portal Hypertension. PanVascular Medicine. 2015 Jan 23;3631–65.
6. Bandali MF, Mirakhur A, Lee EW, Ferris MC, Sadler DJ, Gray RR, et al. Portal hypertension: Imaging of portosystemic collateral pathways and associated image- guided therapy. World J Gastroenterol. 2017 Mar 14;23(10):1735–46.
7. Iwakiri Y. Pathophysiology of Portal Hypertension. Clin Liver Dis. 2014 May;18(2):281–91.
8. Bleibel W, Al-Osaimi AMS. Hepatic Encephalopathy. Saudi J Gastroenterol. 2012; 18 (5):301–9.
9. Lu Q, Leong S, Lee KA, Patel A, Chua JME, Venkatanarasimha N, et al. Hepatic venous-portal gradient (HVPG) measurement: pearls and pitfalls. Br J Radiol. 2021 Aug 1;94(1124):20210061.
10. Bochnakova T. Hepatic Venous Pressure Gradient. Clin Liver Dis (Hoboken). 2021 Apr 13;17(3):144–8.
11. Parikh S. Hepatic Venous Pressure Gradient: Worth Another Look? Dig Dis Sci. 2009 Jun;54(6):1178–83.
12. Nouh MAEl, Abd-Elmageed MK, Amer AAM, ELhamouly MS. Role of portal color Doppler ultrasonography as noninvasive predictive tool for esophageal varices in cirrhotic patients. Egyptian Journal of Radiology and Nuclear Medicine. 2022 Jan 4;53(1):4.
13. Guidi G, Tortoli P. Doppler Ultrasound: Physics Instrumentation and Signal Processing (2nd Edition): David H. Evans, W. Norman Mc Dicken, Wiley, 2000, ISBN 0-471-97001-8, 427 pp. Ultrasound in Medicine & Biology. 2001 May 1;27:727–8.
14. Lutz HH, Gassler N, Tischendorf FW, Trautwein C, Tischendorf JJW. Doppler ultrasound of hepatic blood flow for noninvasive evaluation of liver fibrosis compared with liver biopsy and transient elastography. Dig Dis Sci. 2012 Aug;57(8):2222–30.
15. Harvey CJ, Lim AKP. Vascular disorders of the liver. In: Clinical Ultrasound [Internet]. Elsevier; 2011 [cited 2024 Nov 27]. p. 179–98. Available from: https://linkinghub.elsevier.com/ retrieve/pii/ B9780702031311000122
16. Maruyama H, Yokosuka O. Ultrasonography for Noninvasive Assessment of Portal Hypertension. Gut Liver. 2017 Jul;11(4):464–73.
17. Moriyasu F, Nishida O, Ban N, Nakamura T, Sakai M, Miyake T, et al. "Congestion index" of the portal vein. American Journal of Roentgenology. 1986 Apr 1;146(4):735–9.
18. Antil N, Sureka B, Mittal MK. Hepatic Venous Waveform, Splenoportal and Damping Index in Liver Cirrhosis: Correlation with Child Pugh's Score

and Oesophageal Varices. JCDR [Internet]. 2016 [cited 2024 Oct 25]; Available from: http:// jcdr. net/article_fulltext.asp?issn=0973-709x&year=2016&volume=10&issue=2&page=TC01&issn=0973-709x&id=7181

19. Tasu JP, Rocher L, PÉletier G, Kuoch V, Kulh E, Miquel A, et al. Hepatic Venous Pressure Gradients Measured by Duplex Ultrasound. Clinical Radiology. 2002 Aug;57(8):746–52
20. Tank A. PORTAL HYPERTENSION [Internet]. Dr AvinashTank, is a super-specialist (MCh) Laparoscopic Gastro-intestinal Surgeon,. 2023 [cited 2024 Dec 9]. Available from: https://www. dravinashtank.in/service/liver-pancreas-surgery/liver-treatment/portal-hypertension/
21. Saulat Z, Wasim S, Khaliq M, Wasim S, Khaliq M, Altaf B. Diagnostic accuracy of splenoportal index for detection of esophageal varices in patients of liver cirrhosis. Journal of Rawalpindi Medical College. 2019;23(2).
22. Chouhan A, Trikha S, Dhawle S, Nagwanshi J, Chandra S. DOI: 10.14260/jemds/201 5 / 1 0 Original Article J of Evolution of Med and Dent Sci/ eISSN - 2278 - 4802 , pISSN - 2278 - 4748/ Vol . 4 / Issue 01 / Jan 01 , 201 5 Page 59 A Study Of Correlation Of Esophageal Varices In Cirrhotic Patients With Portal Haemodynamics With Special Reference To Portal Vein Diameter, Portal Vein Velocity, Congestion Index, Liver Vascular Index. jemds. 2014 Dec 31;4(01):59–66.
23. Elatty EAA, Elshayeb EI, Badr MH, Mousa WAE, El Mansory MF. Noninvasive parameters for assessment of esophageal varices. Egypt J Intern Med. 2019 Dec;31(4):536–43.
24. Romero-Cristóbal M, Clemente-Sánchez A, Ramón E, Téllez L, Canales E, Ortega- Lobete O, et al. CT-derived liver and spleen volume accurately diagnose clinically significant portal hypertension in patients with hepatocellular carcinoma. JHEP Reports. 2023 Mar;5(3):100645.
25. Jami A, Ahmed MK, Baig MR, Lodhi MS, Khaliq SA, Kashif SM. Splenoportal- Index–A diagnostic Tool for the Non-Invasive Detection of Esophageal Varices. In: Med Forum. 2023.
26. Katwal S, Ansari MA, Suwal S, Rayamajhi S, Ghimire P, Ghimire A. Measurement of portal vein indices and splenic index by ultrasound and their association with gastroesophageal varices in cirrhosis of liver. Annals of Medicine & Surgery. 2023 Dec;85(12):5926–31.
27. Ogholoh OD, Zaccheus AO, Department of Radiology, Lagoon Hospitals, Ikeja, Lagos State, Nigeria, Ikubor JE, Department of Radiology, Delta State University, Abraka and Delta State University Teaching Hospital, Oghara, Delta State, Nigeria, Nwafor NN, et al. Portal vein congestion index in patients with and without chronic liver disease. J Ultrason. 2023 Apr 28;23(93):53–60.

Legend Figure

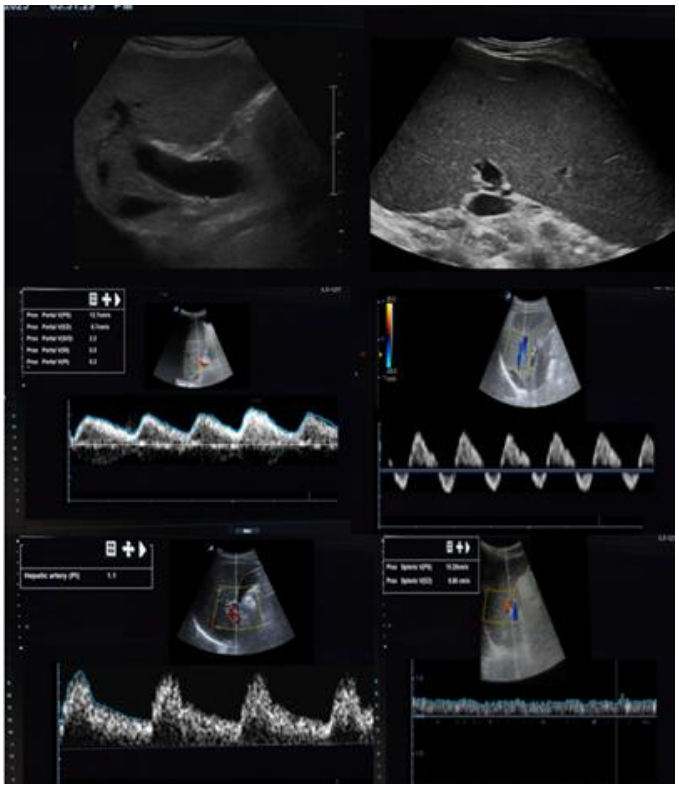

Figure 1: In a clinically suspected case of portal hypertension, doppler ultrasound reveals-

- Portal vein diameter of 1.6cms.
- Splenomegaly with splenic index of 40.67.
- Elevated pulsatility index of hepatic artery=1.1
- Reduced peak systolic velocity of portal vein of 12.7cms/sec.
- Congestive index =0.15 (elevated)
- Splenoportal index computed as ratio of splenic index divided by peak systolic velocity of portal vein =SI/ PSV of PV= 40.67/12.7=3.2
- Liver vascular index calculated as ratio of portal vein velocity to hepatic artery pulsatility index= PSV of PV/ HAPI =12.7/ 1.1= 11.54