

SONOGRAPHIC CORRELATION BETWEEN PORTAL AND SPLENIC VEIN DIAMETERS IN CIRRHOTIC PATIENTS

PORTAL AND SPLENIC VEIN DIAMETER IN CIRRHOTIC PATIENTS

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Abstract

Background: Cirrhosis results from chronic liver injury and is a major cause of morbidity and mortality worldwide. Non-invasive imaging modalities, particularly ultrasonography, play an important role in the assessment and monitoring of liver cirrhosis.

Objective: To determine the ultrasonographic correlation between portal vein diameter (PVD) and splenic vein diameter (SVD) in patients with cirrhosis.

Methodology: A Toshiba Aplio ultrasound system with a curvilinear probe was used for gray-scale and Doppler examinations. The study was conducted at District Headquarter Hospital, Ehsaas Hospital, and Umer Lab & Diagnostic Center, Kot Addu. Portal and splenic vein diameters were measured in 100 participants, comprising 50 patients with cirrhosis and 50 non-cirrhosis controls. The relationship between PVD and SVD was assessed statistically.

Results: A total of 100 participants were included; 64% were female and 36% were male, with ages ranging from 20 to 98 years. A strong positive correlation was observed between PVD and SVD in the overall sample ($r = 0.8681$, $p < 0.0001$). The correlation was also significant in non-cirrhosis participants ($r = 0.7629$, $p < 0.0001$) and cirrhosis participants ($r = 0.5207$, $p = 0.0001$). The porto-splenic vein diameter ratio differed among compensated cirrhosis, decompensated cirrhosis and non-cirrhosis groups ($p = 0.000008$).

Conclusion: Portal and splenic vein diameters demonstrated a statistically significant positive relationship. An increase in portal vein diameter was associated with an increase in splenic vein diameter in the studied population.

These measurements may provide complementary sonographic information in the assessment of portal venous changes associated with cirrhosis.

INTRODUCTION:

The portal vein is the principal vessel of the portal venous system and plays a crucial role in hepatic circulation.[1] It transports nutrient-rich blood from the gastrointestinal tract, spleen, pancreas and gallbladder to the liver for metabolism, detoxification and storage. Anatomically, the portal vein is formed by the confluence of the splenic vein and superior mesenteric vein posterior to the neck of the pancreas. In healthy adults, portal vein diameter is commonly reported within a range of approximately 7–15 mm,[2] while portal venous pressure is normally low. Alterations in portal vein diameter and hemodynamics may indicate underlying hepatic pathology, particularly portal hypertension. [3-6]

The splenic vein drains blood from the spleen and portions of the stomach and pancreas and contributes directly to formation of the portal vein. [7-9] Because of this anatomical and physiological relationship, changes in portal venous pressure may influence splenic venous dimensions. In chronic liver disease, progressive fibrosis increases intrahepatic vascular resistance, resulting in elevated portal venous pressure. This may contribute to dilation of the portal vein and its tributaries, splenomegaly and collateral circulation. [10,11]

Several studies have reported increased portal vein diameter in patients with portal hypertension. [12] However, isolated measurement of portal vein diameter may not accurately reflect the severity of portal hypertension [13-15] because measurements can be affected by age, sex, body habitus, and respiratory phase. Evaluation of additional parameters, including splenic vein diameter and the porto-splenic vein diameter ratio, may therefore provide complementary information regarding portal venous hemodynamics.

MATERIALS AND METHODS:

This analytical correlational study was conducted in the radiology departments of District Headquarter Hospital, Ehsaas Hospital, and Umer

Lab & Diagnostic Center, Kot Addu following approval by the institutional review board. A total of 100 participants were included, comprising 50 patients with cirrhosis and 50 non-cirrhotic controls. Written informed consent was obtained from all participants after explanation of the study objectives and procedures. Participants were informed of their right to withdraw from the study at any time.

Participants were aged 20-80 years or older and had fasted for a minimum of 6–8 hours before ultrasound examination. Hepatitis patients and Drug addict patients were included. Pregnant females and Heart patients were excluded. Pregnant women and patients with fatty liver disease or known cardiac disease were excluded.

Participants were categorized as cirrhotic or non-cirrhotic according to the characteristic findings of liver. On ultrasound cirrhosis is nodular liver surface, round edge, and hypoechoic nodules in liver parenchyma which represent regenerative nodules of cirrhotic liver. Detection of hypoechoic nodule more than 10 mm is important in the early diagnosis of hepatocellular carcinoma. Compensated cirrhosis was considered as a milder form that often doesn't cause noticeable symptoms. While Decompensated cirrhosis is a more advanced form characterized by symptoms of end stage liver failure, such as jaundice or abdominal swelling.

Ultrasonographic examinations were performed using a Toshiba Aplio 500 ultrasound machine equipped with a 2–5 MHz curvilinear probe. Participants were examined in the supine position with a slight left lateral tilt to optimize visualization of the portal and splenic veins. Portal vein diameter was measured in the longitudinal plane at the level of the hepatic hilum. Splenic vein diameter was measured near the splenic hilum and at its junction with the superior mesenteric vein. Doppler ultrasound was used to assess blood-flow direction and to identify hepatopetal or hepatofugal flow patterns.

Statistical Analysis

Data were analyzed using statistical software. Quantitative variables were expressed as mean $\pm$ standard deviation and categorical variables were presented as frequencies and percentages. Pearson's correlation coefficient was used to assess the relationship between portal vein diameter and splenic vein diameter. An independent-samples t-test was used to compare mean values between cirrhotic and non-cirrhotic groups. The Kruskal-Wallis test was used to assess differences in the porto-splenic vein diameter ratio among compensated cirrhotic, decompensated cirrhotic

and non-cirrhotic groups. A p-value < 0.05 was considered statistically significant.

RESULTS:

A total of 100 participants were included. Of these, 64 (64.0%) were female and 36 (36.0%) were male. The participants ranged in age from 20 to 98 years. The mean age was 39.31 ± 15.83 years, with a median age of 36.5 years.

A strong positive correlation was found between portal and splenic vein diameters in the overall sample ($r = 0.8681$, $p < 0.0001$). The 95% confidence interval for the correlation coefficient was 0.8098-0.9095.

Table 1. Correlation between portal and splenic vein diameters

Measure	Value
Sample size	100
Correlation coefficient (r)	0.8681
p-value	<0.0001
95% CI for r	0.8098-0.9095

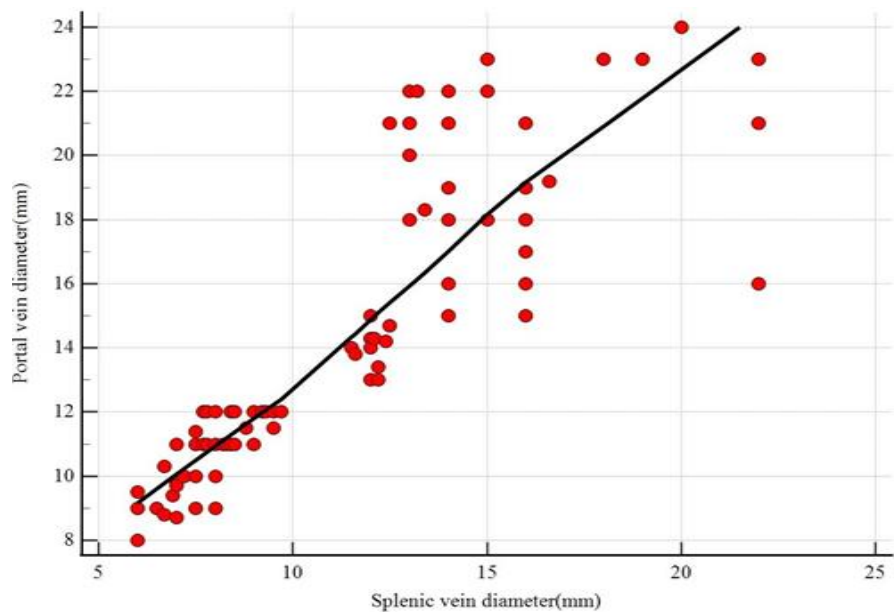


Figure 1. Scatterplot of portal and splenic vein diameters in the overall sample.

Analysis of liver size shows a statistically significant result ($p < 0.0001$); The two groups had mean values of 11.98 and 12.90, respectively.

Table 2. Comparison of the liver-size variable between cirrhotic and non-cirrhotic groups

Statistic	Cirrhotic	Non-cirrhotic
Sample size	50	50
Arithmetic mean	11.98	12.9
95% CI for mean	11.0153-12.9447	12.6826-13.1174
Variance	11.5229	0.5853
Standard deviation	3.3945	0.7651
Standard error of mean	0.4801	0.1082

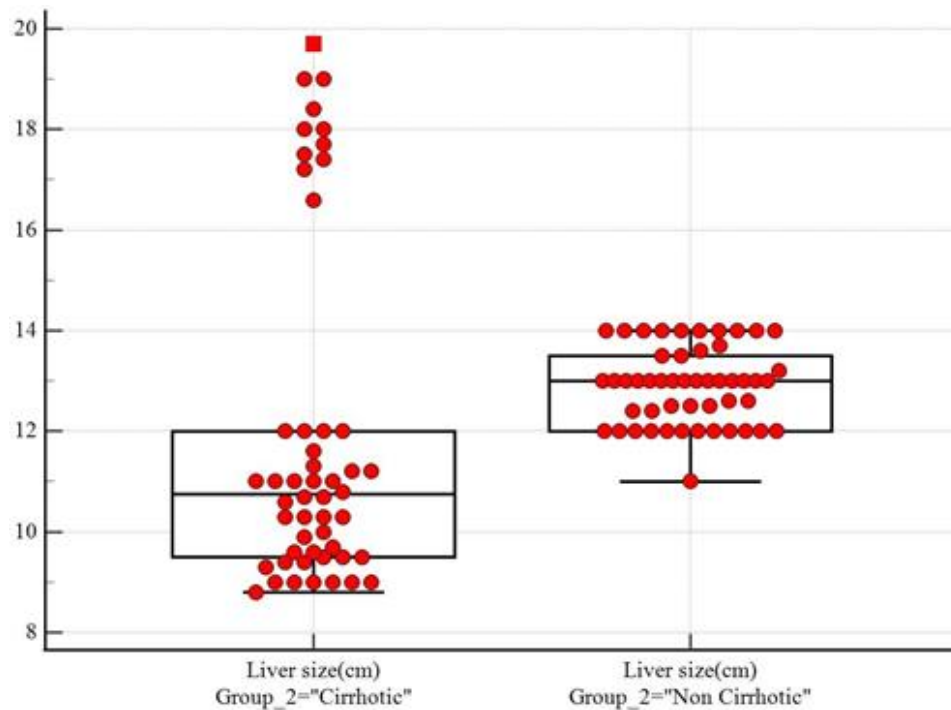


Figure 2. Comparison of the liver-size variable.

Among non-cirrhotic participants, a strong positive correlation was observed between portal

and splenic vein diameters ($r = 0.7629$, $p < 0.0001$; 95% CI 0.6151-0.8588).

Table 3. Correlation between portal and splenic vein diameters in non-cirrhotic participants

Measure	Value
Sample size	50
Correlation coefficient (r)	0.7629
p-value	<0.0001

95% CI for r	0.6151-0.8588
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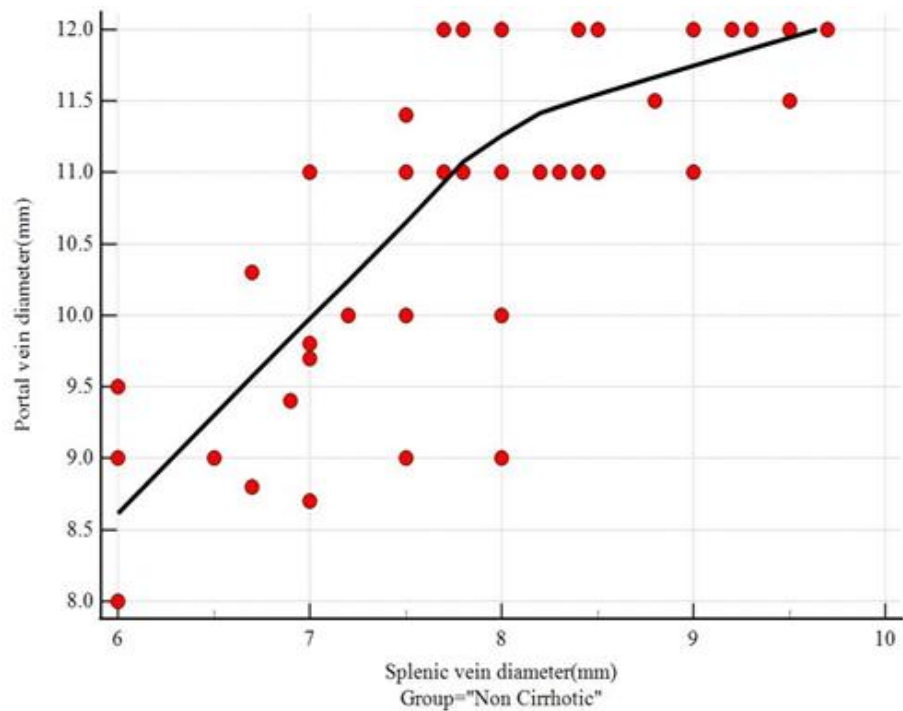


Figure 3. Scatterplot of portal and splenic vein diameters in non-cirrhotic participants.

Among cirrhotic participants, a statistically significant positive correlation was observed between portal and splenic vein diameters ($r = 0.5207$, $p = 0.0001$; 95% CI 0.2834-0.6979).

Table 4. Correlation between portal and splenic vein diameters in cirrhotic participants

Measure	Value
Sample size	50
Correlation coefficient (r)	0.5207
p-value	0.0001
95% CI for r	0.2834-0.6979

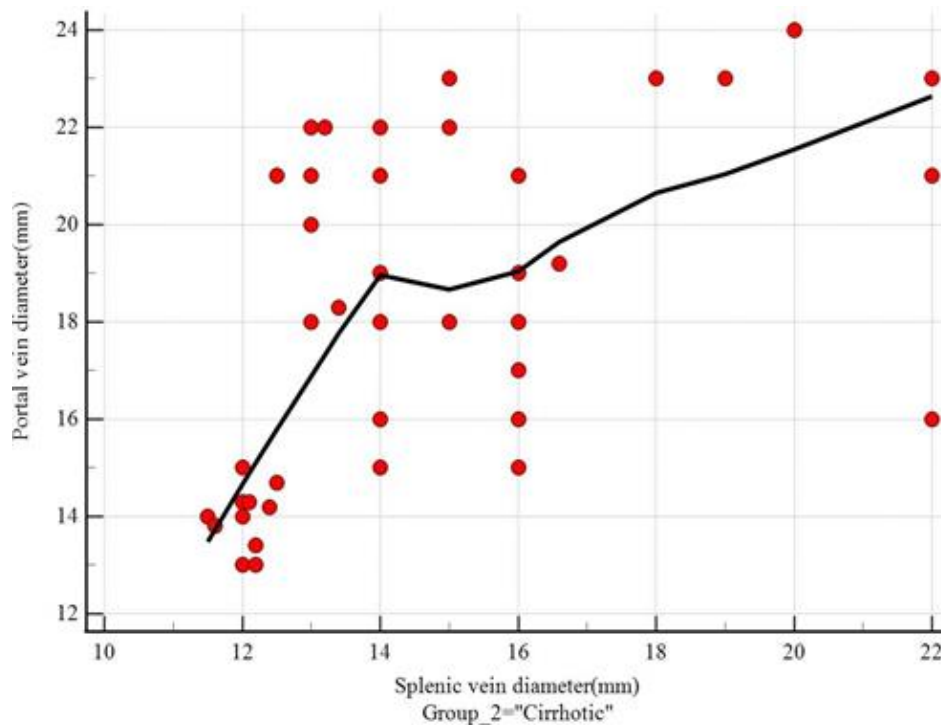


Figure 4. Scatterplot of portal and splenic vein diameters in cirrhotic participants.

The porto-splenic vein diameter ratio differed significantly among the compensated cirrhotic, decompensated cirrhotic and non-cirrhotic groups ($p = 0.000008$).

Table 5. Porto-splenic vein diameter ratio by study group

Group	N	Minimum	25th percentile	Median	75th percentile	Maximum
Compensated cirrhotic	13	1.0	1.1	1.1	1.2	1.2
Decompensated cirrhotic	37	0.7	1.1	1.2	1.425	1.6
Non-cirrhotic	50	1.1	1.3	1.3	1.4	1.5

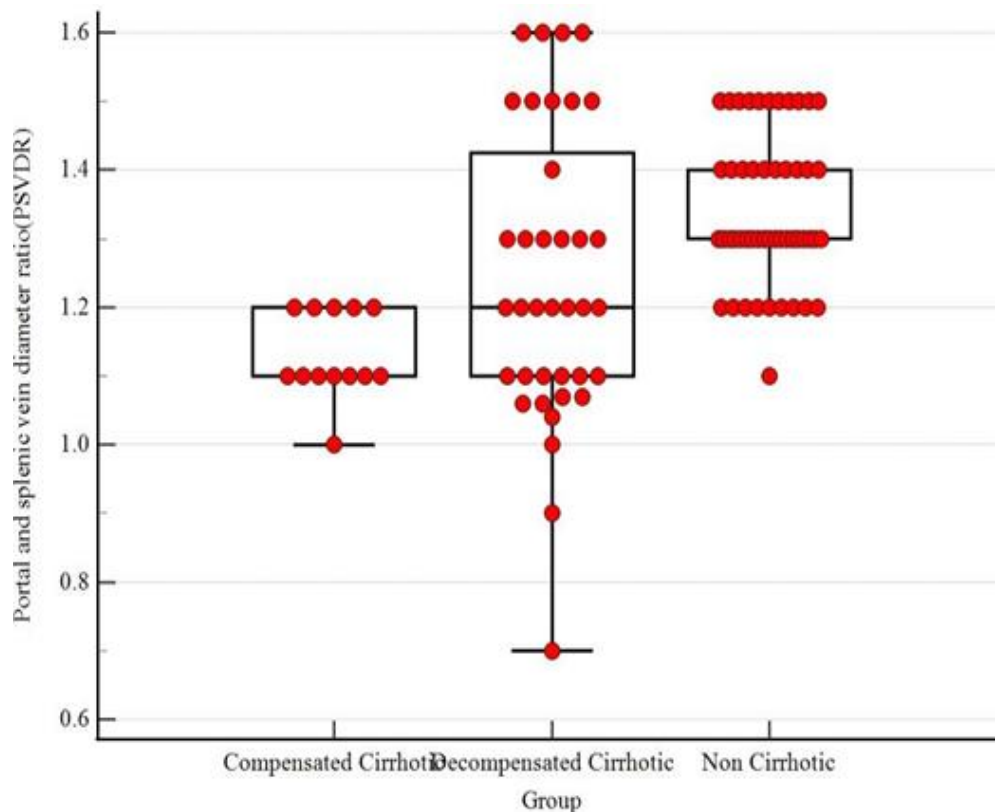


Figure 5. Distribution of the porto-splenic vein diameter ratio among compensated cirrhotic, decompensated cirrhotic, and non-cirrhotic participants.

DISCUSSION:

Real-time ultrasonography is a widely used, non-invasive method for assessing the portal venous system. Measurement of portal and splenic vein diameters can provide useful structural information in patients with chronic liver disease. [16,17] Portal vein diameter is influenced by several physiological and technical factors, including respiratory phase, body habitus, and measurement technique; therefore, it should be interpreted together with other sonographic and clinical findings. [18,19]

In the present study, 100 participants aged 20–98 years were included. Females represented 64% of the study population and males 36%. The mean age was 39.31 ± 15.83 years. The observed age distribution was broadly comparable with the previously reported findings done by Shah Zaman et al 2013.[20] and Sibgha Aqeel et al 2022 [21]

Bhattarai et al. studied patients with chronic liver parenchymal disease and reported larger mean portal vein diameters among patients with gastroesophageal varices than among those without varices.[17] The present study similarly demonstrated a significant relationship between portal and splenic vein diameters in both cirrhotic and non-cirrhotic participants.

O'Donohue et al. evaluated patients with chronic liver parenchymal disease and healthy individuals and reported reference values for portal venous measurements. Their findings support the use of Doppler assessment of hepatic and portal vessels as part of the sonographic evaluation of chronic liver disease.[14]

The present findings are also consistent with studies, reporting portal vein dilatation in cirrhosis and portal hypertension. [22-25] In addition, the current analysis examined the porto-splenic vein diameter ratio across compensated,

decompensated, and non-cirrhotic groups. The significant Kruskal-Wallis result suggests that the ratio may differ according to disease status.

The strong positive correlation between portal and splenic vein diameters supports the anatomical and hemodynamic relationship between these vessels. Nevertheless, correlation does not establish that an increase in portal vein diameter independently predicts an increase in splenic vein diameter.

CONCLUSION:

A statistically significant positive correlation was found between portal and splenic vein diameters in the studied population, including both cirrhotic and non-cirrhotic participants. The porto-splenic vein diameter ratio also differed significantly among compensated cirrhotic, decompensated cirrhotic, and non-cirrhotic groups. Portal and splenic vein measurements may therefore provide complementary sonographic information in the assessment of portal venous changes associated with cirrhosis.

RECOMMENDATION:

- Further studies using standardized measurement protocols and multivariable analysis are recommended to determine the independent diagnostic or predictive value of these parameters.

LIMITATIONS:

- The study included a relatively small sample of 100 participants recruited from selected centers; therefore, the findings may not be generalizable to the wider Pakistani population.
- Portal and splenic vein measurements may be influenced by respiratory phase, patient position, fasting status, body habitus, and the exact site and technique of measurement. Interobserver and intraobserver measurement reliability was not reported.
- The diagnosis and classification of compensated and decompensated cirrhosis were based on the clinical and sonographic characteristics. Detailed laboratory, endoscopic, or histopathological criteria were not provided due to lack of resources.

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