

# Role Of Color Doppler Ultrasonography In Assessment Of Portal Hypertension

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## Abstract

**Background :** Chronic alcoholism, obesity, hepatitis C and hepatitis B, are the most common reasons behind continued growing prevalence of chronic liver disease. In cirrhotic patients, portal hypertension and its complications account for the significant morbidity and mortality. Ultrasound doppler is an accurate noninvasive investigation to evaluate the etiology, grading and the complications of portal hypertension. The various spectrum of imaging findings, flow volumetric changes and portosystemic collaterals can be assessed on ultrasonography. The purpose of study is to evaluate the role of colour doppler sonography in assessment of portal hypertension.

**Materials and methods:** A total of 40 patients referred to the Department of Radiodiagnosis, Gayatri vidya parishad institute of health care and medical technology, Visakhapatnam with clinically suspected or diagnosed with portal hypertension in a period from July 2023 to January 2024 were included in the study. The patients were studied using colour doppler and were statistically analysed.

**Result :** Majority (92.50%) of the patients were males and male to female ratio was 12.33:1. The commonest age group was between 51 to 60 years (52.5%) and the mean age was  $45.45 \pm 10.59$  years. The spleen size of more than 13cms was noted in 77.5% patients and ascites in 77.5% of the patients. The portal vein diameter of  $\geq 1.3$  cms was noted in 50% of the patients and the percentage variation with respiration was  $\leq 20\%$  in 80% of the patients. The lumen was anechoic and normal in 75% of patients and flow direction in portal vein was hepatopetal in 67.5% of the patients. The splenorenal collateral formation was seen in 97.5% patients

**Conclusion :** Ultrasound Doppler is an accurate noninvasive investigation of diagnosing and assessing the aetiology, severity and complications of the portal hypertension. The various spectrum of imaging findings, flow metric changes and portosystemic collaterals can be accurately studied with the help of ultrasound

**Keywords:** Portal hypertension, cirrhosis, colour Doppler.

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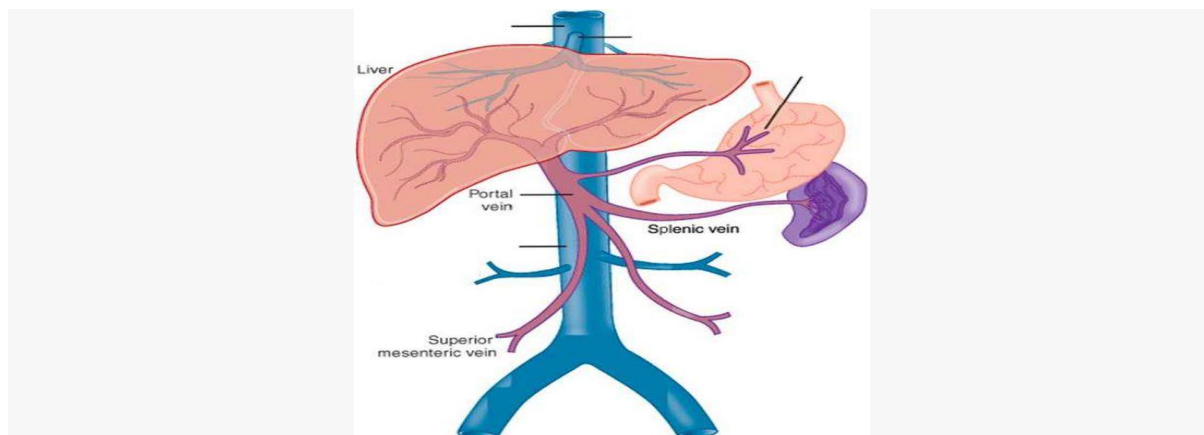
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## I. Introduction

Portal hypertension is defined as the pathologic increase in portal venous pressure greater than 12 mmHg, in which the pressure gradient between the portal vein and inferior vena cava (the portal pressure gradient (PPG) is increased above the upper normal limit of 5mm Hg). Portal hypertension can be sinusoidal, pre sinusoidal and post sinusoidal, exact analysis by imaging methodology can help in brief treatment with cirrhosis being the most common cause. It leads to various complications which include hematemesis, acute or chronic hepatic encephalopathy . Study of portal hypertension using colour doppler holds its importance by aiding the diagnosis of etiology, severity and the possible complications and to decide the therapeutic measures. As direct measurement of portal vein pressure is an invasive procedure and may be associated with the multiple complications. Ultrasound Doppler is a non-invasive, highly reproducible , requiring no radiation, and cost-effective method for the evaluation of portal hemodynamics , hence the purpose of study is to evaluate the role of colour doppler sonography in portal hypertension.



**Fig. 1 : Anatomy of portal venous system**

## **II. Material And Methods**

This is a prospective observational study which was carried in patients of Department of Radio-diagnosis at, Gayatri vidya parishad institute of health care and medical technology ,Visakhapatnam from *July 2023 to January 2024*. A total 40 adult subjects (both male and females) were included in the study.

**Study Design:** Prospective observational study

**Study Location:** This was a tertiary care teaching hospital based study done in Department of Radio-diagnosis at, Gayatri vidya parishad institute of health care and medical technology ,Visakhapatnam.

**Study Duration:** *July 2023 to January 2024*

**Sample size:** 40 patients.

**Sample size calculation:** Patients clinically suspected for portal vein hypertension between *July 2023 to January 2024* undergoing Colour Doppler USG were included in the study.

### **Inclusion criteria:**

- 1)All cases with clinical suspicion of portal hypertension.
- 2)All cases with alter biochemical parameters s/o cirrhosis with portal hypertension.

### **Exclusion criteria:**

- 1)Patients not willing for study .
- 2)Pregnant women.
- 3)Patients presenting with trauma.

### **Procedure methodology:**

After approval of the study protocol by our Institutional research & human ethical committee, patients of age group >18 years with complaints and clinical features suggestive of chronic liver disease and portal hypertension, will be enrolled in the study. All the patients will be explained in detail about the procedure and informed consent will be obtained. Study will be done using Samsung HS 70A, colour Doppler equipment with a curvilinear array low frequency (2-5 MHz) transducer. Ultrasound (USG) of abdomen will be done .If there are features suggesting portal hypertension, then colour Doppler and spectral tracing studies of portal vein and hepatic vein will be done.

### **Statistical analysis:**

The data was expressed in number, percentage, mean and standard deviation. Statistical Package for Social Sciences (SPSS 20.0) was used to calculate the mean and standard deviation. Number and percentage was calculated by using MS Excel 2007.

## **III. Result**

In this study 52.5% of the patients presented with age between 51 to60 years, 22.5% between 61 to 70 years, 12.5% with age between 41 to 50 , and 7.5% with age more than 30-40years.The mean age was

45.45 ± 10.59 years (Table-1). In the present study majority (95%) were males. The male to female ratio was 12.33:1 (Table 2).

**Table-1: Number and percentage of patients based on age**

Age (Years)	Number	Percentage (%)
30-40	2	5.00
41-50	5	12.50
51-60	21	52.50
61-70	9	22.50
Above 70	3	7.50
Total	40	100.00

**Table-2: Number and percentage of patients based on gender**

Gender	Number	Percentage (%)
Male	38	95.00
Female	2	5.00
Total	40	100.00

In the present study 95 % patients had coarse liver echotexture and 5% increased liver echotexture (Table -3). Maximum number of patients (19) had <13 portal vein diameter in quiet respiration, 23 had >13 portal vein diameter in deep respiration (Table -4).

**Table-3: Number and percentage of patients based on liver echo texture**

Liver echotexture	Number	Percentage (%)
Increased	2	5.00
Coarse	38	95.00
Total	40	100.00

**Table-4: Number of patients based on diameter of portal vein on respiration**

Portal vein	<13 mm	>13mm	Could not beevaluated	Total
Portal vein diameter quiet respiration	19	17	4	40
Portal vein diameter deep respiration	13	23	4	40

In this present study majority of patients (67.5%) presented with Hepatopetal flow, (27.5%) to & fro, (2.5%) in Hepatofugal and (27%) no flow in portal vein (Table -5).

**Table-5: Number and percentage of patients based on portal vein flow**

Portal vein flow	Number	Percentage (%)
Hepatofugal	1	2.50
Hepatopetal	27	67.50
To & Fro	1	2.50
No flow	11	27.50
Total	40	100.00

In the present study the spleen size of more than 13cms was noted in 77.5% of the patients. The mean spleen size was found to be 14.57±2.16cms (Table -6 ). Maximum patients (n=17) had >1cm Splenic vein diameter in quiet respiration and also deep respiration. (Table-7).

**Table-6: Number of patients based on size of spleen**

Spleen size	Number	Percentage (%)
<13 cm	9	22.50
>13 cm	31	77.50
Total	40	100.00

**Table-7: Number of patients based on diameter of splenic vein on respiration**

Splenic vein	<1 cm	>1 cm	Total
Splenic vein diameter quiet respiration	13	17	40
Splenic vein diameter deep respiration	13	17	40

In this present study majority of patients (75%) present with normal lumen, (20%) thrombosed (Table-8). Maximum number (n=25) of patients showed alcoholic liver disease compared to other diseases. Portal vein obstruction (n=5) is next commonest condition. (Table -9)

**Table-8: Number and percentage of patients based on lumen of portal vein.**

Lumen of portal vein	Number	Percentage (%)
Normal	30	75.00
Thrombosed	8	20.00
Cavernous transformation	2	5.00
Total	40	100.00

**Table-9: Number and percentage of patients based on diagnosis**

Diagnosis	Number	Percentage (%)
Alcoholic liver disease	25	62.50
Carcinoma of pancreas	1	2.50
Chronic pancreatitis	2	5.00
Portal vein obstruction	5	12.50
Splenic vein thrombosis	1	2.50
Wilson's disease	1	2.50
Others	5	12.50
Total	40	100.00

1 patient showed no collateral. SR was the most common in single collateral. SR+PU is the most common (n=7) in the two collaterals. 27.50% of patients showed PU+GEJ+SR type of collateral (Table -10)

**Table-10: Number and percentage of patients based type of collateral**

Type of collateral	Number	Percentage (%)
Nil	1	2.50
Single		
Spleno-renal (SR)	8	20.00
Double		
Gastroesophageal junction (GEJ) GEJ,SR	5	12.50
SR, Para-umbilical (PU)	7	17.50
Above two		
PU, GEJ, SR,	11	27.50
Peripancreatic (PP), GEJ, SR	1	2.50
GR, PU, GEJ	2	5.00
Periportal, SR, PU,	1	2.50
Gall bladder (GB), PP, SR, PU, GEJ	2	5.00
PP, GEJ, SR, PU, Periportal	1	2.50
GB, PP, SR, PU, GEJ, Periportal	1	2.50
Total	40	100.00

#### IV. Discussion

Portal hypertension is a serious and debilitating condition. It results from various causes, cirrhosis being most frequent of all. Colour Doppler ultrasonography being noninvasive, reliable, widely available and affordable, is the initial tool for evaluation and diagnosis of portal hypertension, finding out etiology and its complications. Splenomegaly and ascites are associated with portal hypertension. Portosystemic collaterals are almost always associated with portal hypertension. Lienorenal and gastro-renal, GEJ and paraumbilical veins were more frequent. Hence colour doppler ultrasonography is best noninvasive investigation tool which shows various spectrum of findings, flow metric changes and collaterals accurately in portal hypertension.

In this study, we studied 40 patients, who were clinically diagnosed as portal hypertensive and confirmed on ultrasound and Doppler study and studied flow patterns in portal vein and collaterals.

### **Age and Sex distribution**

In the present study males outnumbered females that is, 95% of the patients were males and 5% were females with male to female ratio as high as 12:1. In this study more than half of the study population (52.5%) presented with age from 51 to 60 years. The next common age group was 31 to 45 years noted in 35% of the patients. The mean age was noted as  $45.45 \pm 10.59$  years. These findings are consistent with a study to assess the aetiological reasons for portal hypertension in adult patients attending a tertiary care centre in southern India which reported mean age as 46 years.<sup>(1)</sup> Another study by Kim MY et al<sup>(2)</sup> from Korea also reported mean age of 52.8 years.

### **Splenomegaly**

Gibson et al<sup>(3)</sup> found that splenomegaly is an intensive sign of portal hypertension. In this study, 77.5% of the patients had spleen size of  $> 13$  cm and the mean spleen size of the study population was also found to be more than 13 cm ( $14.58 \pm 2.16$ ).



**Fig-2: Splenomegaly**

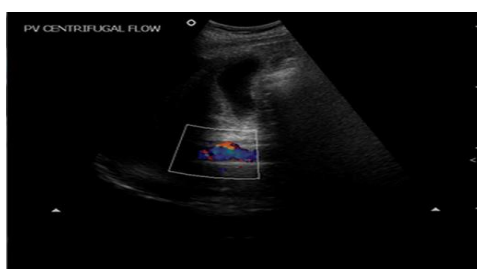
### **Portal vein**

A study by Bolondi et al<sup>(4)</sup> had concluded that portal vein diameter  $> 13$  mm can be considered fairly characteristic sign of portal hypertension. The same was true in this study with almost 50% of the patients having portal vein diameter of  $\geq 13$  mm.

In our study the lumen appeared normal and anechoic in 75% of the patients and the flow was hepato petal in 67.5% of the patients while 2.5% of the patients showed hepatofugal flow. Herbay AV et al<sup>(5)</sup> studied 67 men and 49 women with biopsy proven cirrhosis and showed that the direction of venous flow was hepatopetal in 67.5%, hepatofugal in 2.5% and bidirectional in 2.5%, whereas 11% of patients had thrombosed portal vein.



**Fig-3: Dilated portal vein**



**Fig-4: Centrifugal flow in portal vein**

### **Collaterals**

In this study formation of splenorenal collaterals was commonly noted (97.5%). The next common collateral formation was paraumbilical venous collaterals (62.5%) and gastro-esophageal junction (57.5%) However, few that is, peripancreatic (12.5%), periportal (7.5%), and gallbladder (7.5%) collateral formations were also noted. Subramanyam et al<sup>(6)</sup> reported GEJ collateral among 64% cases out of 40 cases. The increased frequency of splenorenal collaterals may be attributed to their easier detection because of location or small GEJ collaterals which could not be detected or due to more number of cases having thrombosed portal vein and sinistral portal hypertension



**Fig-4:Splenorenal collaterals**

### **Etiology**

In the present study 65% of the patients were diagnosed to have cirrhosis and of which as high as 96.15% had alcoholic liver disease. The other etiologies were portal vein obstruction (12.5%), malignancy (10%) and left sided portal hypertension (7.5%).

### **V. Conclusion**

Color Doppler sonography is a best noninvasive test which not only provides precise information in localizing and characterizing portal vein and to diagnose and to find out etiology of portal hypertension. The various spectrum of imaging findings, flow metric changes and portosystemic collaterals can be accurately studied using ultrasound Doppler.

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