

## Original Research Article

# Correlation of portal vein diameter with the presence of oesophageal varices in chronic liver disease: a prospective study

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## ABSTRACT

**Background:** Guidelines recommends upper gastrointestinal endoscopy for all the patients with cirrhosis of liver to rule out portal hypertension. Many patients may not be willing to undergo this unpleasant procedure or resources may not be available. In this study, authors aim to identify the effectiveness of portal vein size as a non-invasive predictor of esophageal varices.

**Methods:** In this prospective observational study of 30 patients, patients with liver cirrhosis without a previous history of upper GI bleeding were included between November 2012 and October 2014. Relevant clinical parameters were assessed which included physical examination, complete hemogram, biochemical workup, upper GI endoscopy and ultrasonographic measurement of portal vein diameter.

**Results:** Out of the study population 70% of the patients had Oesophageal varices. Ultrasonography abdomen showed portal vein dilatation(>13mm) in 66.6% cases. The mean portal vein diameter in our study group was 13.1mm and majority of patients had portal vein between 13-13.9 mm (43.3%). A cut-off point of more than 13 mm had strong significant relationship ( $p < 0.01$ ) with presence of esophageal varices (sensitivity of 100%, specificity of 90% and positive predictive value of 95.24%). Higher grades of esophageal varices exists with larger portal vein size.

**Conclusions:** From present study, authors conclude that portal vein size and its dilatation detected ultrasonographically can determine the presence of esophageal varices and can hence identify the subset of patients who require endoscopy for the prophylactic management of variceal bleeding. Therefore, reduce the burden on the endoscopy units, avoiding unnecessary screening endoscopies. Apart from being non-invasive, portal vein diameter is a relatively inexpensive and easily reproducible parameter.

**Keywords:** Cirrhosis of liver, Esophageal varices, Portal vein diameter, Portal hypertension, Upper gastrointestinal endoscopy

## INTRODUCTION

Portal hypertension is defined as the increase in the hepatic venous pressure gradient (HVPG) to >5 mmHg. It is a result of combination of two simultaneously occurring hemodynamic processes that is increased resistance to the passage of blood flow within the liver due to cirrhosis and regenerative nodules, and splanchnic vasodilation resulting in increased blood flow.

Development of esophageal varices is one of the major complications of portal hypertension.<sup>1</sup>

60-80% of patients with cirrhosis of liver are associated with esophageal varices and 25-30% of them have got risk of bleeding. Every year incidence of esophageal varices increases by 5% and 5-10% of patients with small varices progresses to large varices. As the size of varices increases there will be increase in variceal-wall tension

and when it reaches to critical level varices can rupture and cause life-threatening bleeding. Even with optimal treatment in hospital 20% of the patients with variceal bleeding will have mortality.<sup>2</sup>

In 1996, The American Association for the study of liver disease stated that all cirrhotic patients should be screened for the presence of oesophageal varices when portal hypertension is diagnosed.<sup>3</sup> Recent guidelines according to the Baveno VI expanding consensus in portal hypertension recommended that all cirrhotic patients who are compensated with no varices in screening endoscopy should undergo surveillance endoscopy once in 2 years if there is ongoing liver injury otherwise once in 3 years.

Also, the patients with compensated cirrhosis with small varices at screening endoscopy should undergo surveillance endoscopy every year if there is ongoing liver injury otherwise once in 2 years.<sup>4</sup>

However, this approach has two major limitations. Endoscopy is an invasive procedure and secondly the cost effectiveness of this approach is also questionable.<sup>5</sup> Despite the advantages of endoscopy, it is still an unpleasant and expensive invasive method. It also carries the risk of bleeding due to manipulation.<sup>6</sup>

Only 30-40% of patients with compensated cirrhosis are found to have gastrooesophageal varices on screening endoscopy.<sup>7</sup> It may therefore be more cost effective and noninvasive method to routinely screen patients at high risk for the presence of varices, so as to reduce the increasing burden and procedure costs of endoscopy units.

Certain biochemical, clinical and ultrasonographic parameters alone or together have good predictive power for non-invasively assessing the risk of bleeding from varices.

Ultrasound findings in portal system (portal vein size) could predict both the presence of varices and risk of variceal bleeding. It can be used for diagnosis as well as long-term clinical monitoring of patients with portal hypertension.

Many recent studies indicate that ultrasound findings in portal system could predict both the presence of varices and risk of variceal bleeding. Prihatini et al concluded in their study that portal vein size 1.2-cm on ultrasound gives the evidence of presence of oesophageal varices.<sup>8</sup>

Plestina et al concluded in their study that portal vein size on ultrasound is independently associated with bleeding oesophageal varices.<sup>9</sup>

Hence the present study is done with the objectives to find the correlation of portal vein size with presence of oesophageal varices in patients with cirrhosis of liver and

to assess the ability of this parameter as a noninvasive tool to predict the presence of esophageal varices.

## METHODS

This is Descriptive Observational Clinical study. All the patients admitted in the department of General medicine and attending outpatient department of General medicine and department of Medical Gastroenterology of Vydehi institute of medical sciences and research centre, Bengaluru during the period of November 2012 to October 2014, who are fitting into the inclusion criteria were included in the study.

### Inclusion Criteria

All patients >18yrs presenting to General medicine department diagnosed with chronic liver disease based on clinical, biochemical and ultrasonographic findings.

### Exclusion Criteria

- Patients with History of upper gastrointestinal bleeding
- Bleeding disorders apart from secondary to liver disease
- Congestive gastropathy
- Patients who have already received endoscopic or surgical intervention for portal hypertension previously
- Patients with evidence of hepatocellular carcinoma on ultrasonography, or previous or current treatment with beta-blockers, nitrates and diuretics.

### Procedure

Thirty patients with Cirrhosis of liver, attending the medical wards and outpatient Medical and Gastroenterology departments of Vydehi Institute of Medical Sciences & Research Centre, Bengaluru between the months of November 2012 to October 2014 were selected, based on inclusion and exclusion criteria.

All patients in the study underwent a full clinical evaluation. Clinical history and physical examination findings were recorded with particular attention to present or previous haematemesis, malena, bleeding per rectum, bleeding tendencies, alcoholism, blood transfusion, Tuberculosis, intake of hepatotoxic drugs, exposure to sexually transmitted diseases, intravenous drug abuse, jaundice, anaemia, edema, stigmata of chronic liver disease, dilated abdominal veins, ascites, splenomegaly and encephalopathy.

All patients underwent biochemical tests, like liver function tests, complete blood counts, renal function tests, prothrombin time, ultrasonography of the abdomen to confirm the presence of cirrhosis and to record portal vein diameter, its dilatation, presence of ascites, splenic enlargement presence of collaterals.

Upper Gastrointestinal endoscopy was done in all patients to confirm the presence of varices and also to grade them. All endoscopies were performed in a single endoscopy unit using a video endoscope.

Portal vein diameter was recorded ultrasonographically and >13mm was considered dilatation irrespective of sex and was compared between two groups with and without esophageal varices confirmed endoscopically.

#### Statistical analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean  $\pm$  SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The following assumptions on the data were made:

- Dependent variables should be normally distributed,
- Samples drawn from the population should be random, Cases of the samples should be independent.

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous

scale between two groups Inter group analysis) on metric parameters. Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

#### Significant figures

- +Suggestive significance (p value:  $0.05 < p < 0.10$ )
- \*Moderately significant (p value:  $0.01 < p \leq 0.05$ )
- \*\*Strongly significant (P value:  $p \leq 0.01$ )

#### Statistical software

The statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

## RESULTS

In this study predominant age group of distribution was between 30-40 years, youngest being 23 years and the eldest being 63 years. Among them 90% were males and 10% were females.

**Table 1: Comparison of baseline characteristics of patients studied based on presence and absence of varices.**

	Varices	No varices	Total	p value
Age	39.8 $\pm$ 10.44	36.8 $\pm$ 4.86	38.93 $\pm$ 9.37	0.625
Hb%	9.14 $\pm$ 0.015	10.1 $\pm$ 0.017	10 $\pm$ 0.016	0.69
S. Bilirubin	4.69 $\pm$ 4.7	3.17 $\pm$ 0.76	4.23 $\pm$ 4.09	0.1
PT	24 $\pm$ 4.09	20.5 $\pm$ 1.63	23.02 $\pm$ 3.55	0.09
INR	1.76 $\pm$ 0.24	1.85 $\pm$ 0.44	1.85 $\pm$ 0.325	0.376
ALT(SGPT)	54.7 $\pm$ 37.6	89.3 $\pm$ 27.7	65.13 $\pm$ 39	0.025*
S. albumin	2.11 $\pm$ 0.514	2.26 $\pm$ 0.37	2.26 $\pm$ 0.47	0.19
Platelet count	90590.47 $\pm$ 19178.2	126155.55 $\pm$ 48415	101260 $\pm$ 35500	0.045*
Portal vein diameter	13.86 $\pm$ 1.16	11.24 $\pm$ 0.809	13.1 $\pm$ 1.634	0.000000198**
Ascites	21 cases	7 cases		0.0253*
Splenomegaly	17 cases	4 cases		0.0455*

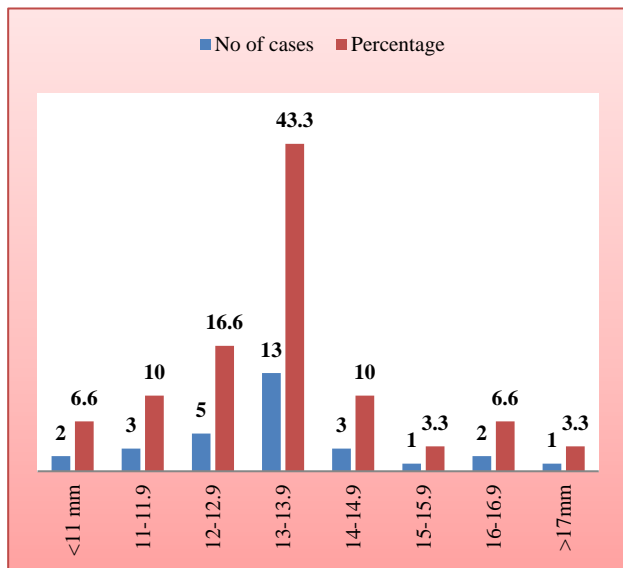
Among the study population majority presented with abdominal distension constituting 90% followed by swelling of lower limbs constituting 80% and jaundice in 76.6%. Symptoms of hepatorenal syndrome (decreased urine output) were present in 3 cases and symptoms of hepatic encephalopathy (altered sleep pattern/lethargy/irritability) present in only one case. Cases with complications were avoided as much as possible.

Among 30 patients studied, cause of cirrhosis was found to be alcoholism in 90% and non-alcoholic in 10%. Among the nonalcoholic patients one patient had hepatitis B positive, one had hepatitis C positive and in

one patient cause could not be detected even after liver biopsy. The clinical signs noted among the patients were most commonly ascites and icterus constituting 90% and pedal edema accounting to about 80%. Majority of the patients had thrombocytopenia with platelet count group between 50,000 and 100,000/mm<sup>3</sup>, accounting to about 66.6%. 30% of patients had platelet count >100000/mm<sup>3</sup>.

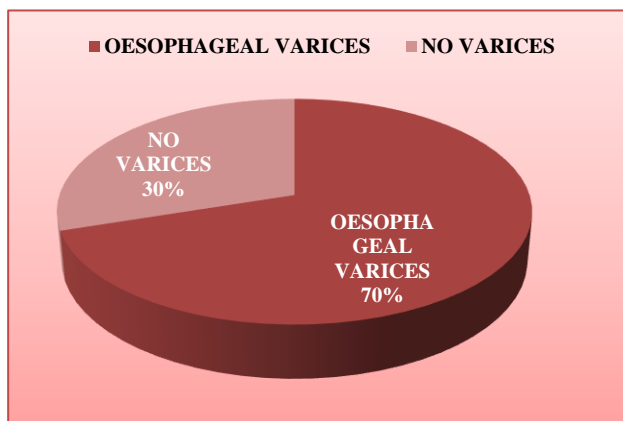
Only 3.3% of patient had severe thrombocytopenia of <50000 mm<sup>3</sup>. USG abdomen showed portal vein dilatation (13mm) in 66.6% cases and majority being ascites in 93.3% patients. Splenomegaly which is also a noninvasive predictor of esophageal varices constituted 76.6% among present cases.

Majority of the patients in ultrasound showed portal vein diameter within 13-13.9 mm constituting 43.3 % of cases and next being between 12-12.9 mm. Maximum portal vein diameter among present cases was 17 mm (Figure 1).



**Figure 1: Portal vein size in ultrasound.**

Out of 30 cases 70% had esophageal varices and 16 cases had other significant endoscopic findings like portal hypertensive gastropathy, erosive gastropathy and red colour sign which were not taken into consideration for grading or significance of varices. 30% cases had no varices (Figure 2).



**Figure 2: Presence of varices in upper GI endoscopy.**

Based on endoscopic grading, the grading of the varices in study population was done. Incidence of grade I was high among variceal cases with 50% followed by grade II and grade III of 10% in each.

Relationship between noninvasive parameters like Age, Serum Bilirubin, Serum albumin, Hemoglobin, Platelet count, Portal Vein Diameter, PT, INR, Alanine Transaminase (ALT), splenomegaly and ascites to

presence of varices was studied. Of these SGPT ( $p < 0.05$ ), platelet count ( $p < 0.05$ ), ascites ( $p < 0.05$ ), splenomegaly ( $p < 0.05$ ) had statistical significance and among all portal vein diameter (PVD) had strongest significance ( $< 0.01$ ) (Table 1).

## DISCUSSION

Portal hypertension is the most common complication and also one of the important causes of death in cirrhosis of the liver and Esophageal variceal bleeding is one of the most serious complications of cirrhosis because of its high mortality. Many studies have mentioned that all the patients diagnosed to have cirrhosis of liver should undergo upper gastrointestinal endoscopy to rule out esophageal varices. Despite the advantages of endoscopy, it is still an unpleasant and expensive invasive method. It also carries the risk of bleeding especially in patients with large varices. Therefore, there is a particular need for a noninvasive predictor for the presence of esophageal varices to ease the medical, social and economic burden of the disease

Many previous studies have documented good predictive value of various non-endoscopic variables for the presence or absence of varices. In present study authors considered only simple, commonly available, reproducible parameter. Monitoring of portal vein size by ultrasonography offers an easy, frequently available, non-invasive yet reliable and cost-effective way to evaluate the patients with cirrhosis for the risk of variceal bleeding. It can be used for diagnosis as well as clinical monitoring of patients with portal hypertension, which is very important for the follow-up of these patients. Prihartini et al and Plestina et al have reported in their study portal vein diameter is an effective noninvasive predictor for esophageal varices. By simple ultrasonography non-invasively these patients should be offered for optimal measures to prevent them from bleeding esophageal varices.<sup>8,9</sup> These patients should be kept under close surveillance and prescribed prophylactically Propranolol and vasodilators to prevent them from bleeding from oesophageal varices.

In present study group consisting of 30 patients most commonly affected patients were middle-aged males coming from lower socioeconomic class. Average age was 39 years comparable to the study done by Devrajani et al.<sup>10</sup> 90% were males and 10% were females. This pattern of male predominance is comparable to the study done by Sharma and Aggarwal which had 86.1% of male patients.<sup>11</sup> Compared to study done by Devarajini et al proportion of males affected were more in present study because major cause of cirrhosis in present patients was alcohol consumption which is more seen in male patients.<sup>10</sup>

In present study upper gastrointestinal endoscopy showed varices in 70% and no varices in 30% of which grade I was majority accounting for 50%, which is comparable to

study done by Sarwar et al where 64.3% of patients had varices.<sup>12</sup> Chalasani et al in their study found esophageal varices in 70% which is also comparable to present study.<sup>13</sup> High grade varices were seen in 15 patients and 50 patients had low grade varices.

Ultrasonography abdomen showed ascites in 93.3% patients, splenomegaly in 76.6% patients and portal vein dilatation(>13mm) in 66.6% cases. The mean portal vein diameter in present study group was 13.1mm and majority of patients had portal vein between 13-13.9 mm (43.3%).

For numerous studies the cut off portal vein size for prediction has varied. From present study, we can state that portal vein diameter more than 13mm has strong prediction of presence of varices though grading based on portal vein size has been difficult. However, from present study authors can say that larger portal vein sizes are associated with high grade varices.

Comparing various studies available we can see that portal vein size is varying in different study populations conducted all over the world. It may be due to difference in study sample, race and sex distribution (Table 2).

**Table 2: Various studies and their portal vein diameter (PVD) cut-off for presence of varices.**

Study	Portal vein diameter
Devrajani et al	14mm
Prihartini et al	11.5mm
Plestina et al	15mm
Schepis et al	13mm
Lopamudra.et al	11.5mm
Sarwar et al	11mm
Present study	13mm

Lopamudra et al concluded in their study that gastroesophageal varices developed when PV diameter was >11.5 mm and spleen size was >13.1 cm.<sup>14</sup> In the study by Prihartini et al, portal vein diameter 11.5 mm and spleen size of 10.3 cm were predictive factors for oesophageal varices in liver cirrhosis with a sensitivity of 75% and a specificity of 54.5%.<sup>8</sup> From the study done by Devrajani et al at Department of Medicine, Liaquat University of Medical and Health Science Jamshoro, Sindh, Pakistan concluded that the patients who had portal vein size more than 1.4 cm were at a great risk of bleeding from esophageal varices.<sup>10</sup> Schepis et al found a portal vein diameter of 13.82±2.1 mm, among patients with esophageal varices, and 12.33±2.04 mm among patients without esophageal varices. Their results were similar to present study.<sup>15</sup>

On comparison of baseline characteristics of patients studied based on presence and absence of varices relationship of noninvasive parameters like Age, Serum Bilirubin, Serum albumin, Haemoglobin, Platelet count, Portal Vein Diameter, PT, INR, Alanine Transaminase

(SGPT), splenomegaly and ascites to presence of varices was studied. Of these SGPT ( $p<0.05$ ), platelet count ( $p<0.05$ ), ascites ( $p<0.05$ ), splenomegaly ( $p<0.05$ ) had statistical significance and among all Portal Vein Diameter (PVD) had strongest significance ( $<0.01$ ) with sensitivity of 100%, specificity of 90% and positive predictive value of 95.24%.

## CONCLUSION

In conclusion Portal vein diameter measured using simple ultrasonography can be used as a simple tool for assessing bleeding risk in a cirrhotic patient. Monitoring of portal vein size by ultrasonography offers an easy, frequently available, non-invasive yet reliable and cost-effective way to evaluate the patients with cirrhosis for the risk of variceal bleeding. It can be used for diagnosis as well as long-term clinical monitoring of patients with portal hypertension, which is very important for the follow-up of these patients. Portal vein size >13mm in USG abdomen has to alert a physician that patient might be having esophageal varices and prophylactically start him on beta blockers and vasodilator along with proton pump inhibitors to prevent him from impending risk of bleeding and death. He should be offered optimal measures and kept under close surveillance.

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