

Role of Portal Vein Color Doppler and Splenic Size to Evaluate Portal Hypertension and its correlation with Esophageal Varices

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Abstract

Background: Cirrhosis is the end-stage of all chronic hepatic diseases leading to portal hypertension and its various manifestations. Besides, increase in resistance to portal venous flow, splenomegaly and ascites, portal hypertension is commonly associated with portosystemic collateral formation especially esophageal varices. Gastrointestinal bleeding from the esophagus is the commonest and most dreaded complication that develops over a period and requires endoscopy which is an expensive, invasive procedure. Color Doppler parameters of portal vein and splenic size can be used non-invasively to monitor the cirrhotic patients for development of portal hypertension and esophageal varices.

Materials and methods: Our study included 50 patients above 18 years of age inclusive of both sexes with diagnosis of chronic liver disease or cirrhosis or portal hypertension with gastroesophageal varices. All patients underwent ultrasound and color doppler for evaluating portal venous parameters and splenic size as well as upper gastrointestinal endoscopy for detecting the presence of gastroesophageal varices with its grade. The data thus obtained was statistically analyzed using different tools and methods.

Results: Our study group had a male predominance with 49 males and only one female. More than 60% patients in our study revealed gastroesophageal varices of varying grades on upper gastrointestinal endoscopy. Our study revealed statistically significant, positive correlation between portal hypertension and increasing portal vein diameter, mean portal vein velocity and splenic size without obvious correlation between gastroesophageal varices and type of portal flow.

Conclusions: Color Doppler parameters of portal vein along with spleen size correlate well with severity of portal hypertension and risk of development of the gastroesophageal varices, the latter being the major cause of morbidity and mortality in patients of cirrhosis. Non-invasive nature of ultrasonography and color doppler allows monitoring of development of portal hypertension and its complications thus restricting the use of expensive & invasive, upper gastrointestinal endoscopy in patients requiring treatment of gastroesophageal varices.

Keywords: Portal vein, color doppler, spleen size, portal hypertension, esophageal varices

Introduction

Portal hemodynamic is the key pathophysiology in cirrhosis which is in close relationship with disease severity and the final stage of chronic liver disease of any

etiology [1,2]. The most common complication and cause of death in chronic liver diseases is portal hypertension. Diagnosis of cirrhosis is relatively straightforward during the decompensated stage compared to the compensated stage. Increased resistance to portal blood flow caused by alteration in hepatic architecture mainly in the sinusoids leads to portal vein dilatation, splenomegaly, encephalopathy, hypersplenism, ascites, etc. [3].

The most severe complication of portal hypertension and portosystemic collateral formation especially esophageal & gastric varices is gastrointestinal bleeding. As variceal

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bleeding is one of the most dreaded complication of liver cirrhosis with variceal prevalence of 50-60%, risk of bleeding 5%-15% and mortality rates of at least 20%, esophageal varices are the prognostic indicator [4].

Despite several advantages in endoscopy, it is an unpleasant and expensive, invasive method. There is a risk of bleeding, due to manipulation. Presence of varices and risk of variceal bleeding can be indicated through Color Doppler findings of the portal system and splenic size [5,6]. These imaging tools can be used for diagnosis as well as long-term clinical monitoring of portal hypertension. In view of the conflicting reports related to the non-invasive predictors for the presence of esophageal varices in some studies, in this study we evaluated the correlation of Color Doppler parameters of portal vein in relation to spleen size and presence of gastro-esophageal varices in cirrhosis patients [7].

Aim

To find out the correlation of portal vein color doppler parameters, splenic size with gastro-esophageal varices in diagnosed cases of portal hypertension.

Objectives

1. To evaluate the association between portal vein color doppler findings and portal hypertension.
2. To determine the value of Doppler parameters and Splenic size in predicting gastro-esophageal varices.

Materials and Methods

This hospital-based, cross-sectional, observational study was conducted on 50 admitted patients in our institution over a period of two years following approval from the institutional ethics committee and after obtaining written informed consent using strict criteria.

Inclusion Criteria

1. Patients diagnosed with liver cirrhosis
2. Patients diagnosed with Portal Hypertension and esophageal varices.
3. Both sexes with above 18 years of age.
4. Patients with abnormal LFTs and under suspicion of chronic liver disease.

Exclusion Criteria

1. Recent gastrointestinal bleeders.
2. Patients who had undergone variceal ligation and sclerosant therapy, Transjugular Intrahepatic Porto-Systemic Shunt (TIPSS).
3. Terminally ill patients.

Study Procedure

The study was performed on Voluson S6 Color Doppler ultrasound scanner using a 3.5–5 MHz convex array probe with patient in supine position. The Doppler parameters of portal vein were measured included portal vein diameter, mean portal venous flow velocity, type of portal venous flow (hepatopetal/ hepatofugal) and splenic vein diameter. The length of the spleen was measured in a coronal view that includes the hilum.

Parameters recorded from upper gastrointestinal endoscopy included presence or absence of varices (gastro-esophageal, gastric, ectopic), variceal grade, grade of portal hypertensive gastropathy and presence of gastric-antral vascular ectasia (GAVE).

The data was analysed using appropriate statistical tools and methods. Confidence intervals were set at 95% and values of $p < 0.05$ were interpreted as statistically significant. Gastro-esophageal varices were divided into two groups of its presence and absence.

Results

In our study, there was male predominance with only one out of fifty being female. It is evident from Table 1 that more than 60% patients in our study had gastroesophageal varices.

Table 2 shows the mean values, standard deviation (SD) and standard error mean of portal hypertension parameters in gastro-esophageal varices and non-varices groups.

Table 3 shows the value of unpaired t test that was applied to compare Portal Vein Diameter (PVD), Portal Vein (PV) velocity and Splenic Size. The results were statistically significant (p -value 0.0001) between variceal and nonvariceal groups for all the parameters.

Table 4 shows lack of statistically significant association between gastroesophageal varices and type of portal venous flow i. e. hepatopetal or hepatofugal.

Table 5 shows logistic regression for all the parameters of portal hypertension to ascertain the effects on gastroesophageal varices on the likelihood of severity in patients diagnosed with portal hypertension. The logistic regression model was statistically significant, $p < 0.05$ for portal vein diameter (PVD), portal vein (PV) velocity, splenic size and PV Flow. The model explained that increased portal vein diameter (PVD), portal vein (PV) velocity, splenic size and PV Flow were associated with an increased likelihood of portal hypertension.

Table 1: Gastro-esophageal varices distribution

Gastro-esophageal varices	Frequency (%)
Present	31 (62)
Absent	19 (38)

Table 2: Mean distribution of portal hypertension parameters

Varices		N	Mean±SD	Std. Error Mean
Portal Vein Diameter (PVD)	Present	31	14.426±1.25	.2260
	Absent	19	9.863±1.78	.4088
Portal Vein (PV) velocity	Present	31	15.19±3.99	.718
	Absent	19	29.37±5.33	1.224
Splenic size	Present	31	15.958±2.84	.5103
	Absent	19	10.537±1.45	.3341

Table 3: Comparison of parameters affected in portal hypertension

Parameters	t-value	df	p-value	Mean Difference	Std. Error Difference	95% Confidence Interval of Difference	
						Lower	Upper
PVD	10.60	48	.0001*	4.5626	.4302	3.6977	5.427
PV velocity	-10.70	48	.0001*	-14.175	1.324	-16.837	-11.51
	-9.990	30.34	.0001*	-14.175	1.419	-17.071	-11.27
Splenic size	7.699	48	.0001*	5.4212	.7042	4.0054	6.837

*Significant

Table 4: Association of gastro-esophageal varices and portal venous flow

Varices		PV Flow		Total	Chi-square	p-value
		Hepatopetal	Hepatofugal			
Present		28	3	31	1.956	.279 (NS)*
	Absent	19	0	19		

Table 5: Binary logistic regression for portal hypertension parameters

Portal Hypertension variables	Beta	S.E.	p-value	Odds ratio	95% C.I.		R square
					Lower	Upper	
PVD	-.236	.301	0.04*	.79	.438	1.42	0.626
PV velocity	-.048	.087	0.03*	.95	.80	1.13	
Splenic size	-.317	.293	0.001*	.728	.410	1.29	
PV Flow	-18.75	23090.7	0.001*	0.74	.00	-	

*Significant

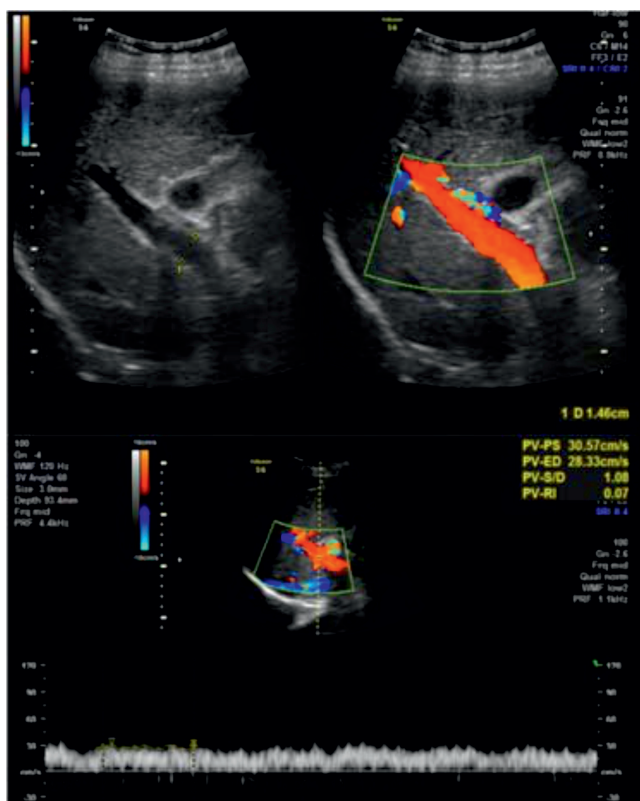


Image 1: USG images showing increase in Portal vein diameter (top left), hepatopetal flow (top right) and increase in Portal vein velocity (lower row).

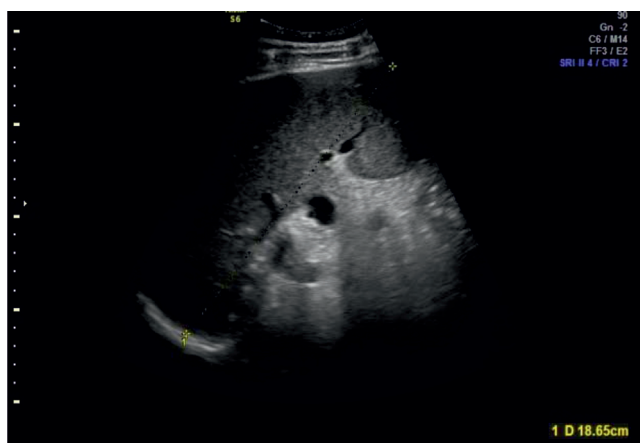


Image 2: USG image shows increase in splenic size

Discussion

Out of 50 patients in our study, 62% (n=31) had gastro-esophageal varices whereas in the rest 38% (n=19) there were no gastro-esophageal varices. In our study, there has been a highly significant increase in the PV diameter in mm in patients in variceal group (p value < 0.001). This is in agreement with a study by Sarwar et al that revealed patients with PV diameter greater than 11 mm are more likely to have high-grade varices [7]. Also, Nicolau et al found an association between an increase in portal venous diameter with liver cirrhosis and portal hypertension [8]. Hagen-

Ansert and Schepis et al. reported that a measurement threshold of PV diameter greater than 13 mm is a predictor of portal hypertension in patients with cirrhosis [9,10]. A PVD of 13mm and 15mm was found to be predictive for variceal detection in patients with cirrhosis by Cherian et al. and Prihatini et al. respectively [11,12]. The development of gastroesophageal varices was 13.5 mm according to Thomopoulos et al. [13].

In contrast, Jaheen found that PV dilatation is a specific but insensitive indicator of portal hypertension as it may also occur in the absence of portal hypertension (e.g. in response to massive splenomegaly or acute PV thrombosis) [14].

The diagnostic feature of portal hypertension is velocity <16cm/sec in addition to increased diameter of the main portal vein. The normal range of mean systolic velocity (MVP) in the portal vein is 20 cm/sec and 40cm/sec [15]. Our study revealed a significant decrease in the PV flow velocity (cm/s) in patients compared with varices (p < 0.001).

Our results are similar to Liu et al. who reported decrease in mean PV velocity correlated with the severity of portal hypertension and the risk of esophageal varix bleeding [16].

Splenomegaly is indicated when the maximum measurement exceeds 13cms [17]. In our study, patients without varices had mean spleen size 10.537 cm and those with varices had 15.958cm which was statistically significant (p<0.001). For the cut-off value of spleen size >13.5cm, Shanker et al. reported 90% sensitivity and 80% specificity for prediction of the presence of esophageal varices, which is consistent with our results [4].

Furthermore, Mandal et al. in their studies described a direct correlation between PVD and spleen size consistent with our study results [3].

Conclusion

In cirrhotic patients with portal hypertension as portal vein diameter increases, there is increased risk of development of gastro-esophageal varices. The decrease in the mean PV velocity can be correlated with the severity of portal hypertension and the risk of esophageal varix bleeding. Size of spleen can also be correlated with increasing risk of development of varices. Hence, measurement of portal vein doppler indices and spleen size by ultrasonography can be used as a non-invasive imaging tool for predicting gastroesophageal varices in portal hypertension.

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Ethics:	There is no ethical violation as it is based on voluntary anonymous interviews
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