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Sonographic Comparison of Mean Velocity of Portal Vein in Liver Cirrhosis and Normal Individuals

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Abstract

Background: Liver cirrhosis is a life threatening condition, its consequences ranging from gross financial loss to death. Grayscale ultrasound has been used since long for the diagnosis of liver cirrhosis. Gray scale sonography along with color Doppler is the first-line modality used for evaluating the mean velocity of portal vein in Liver Cirrhosis. Chronic liver parenchymal diseases (CLPD) and liver cirrhosis cause decrease in the flow velocity of portal vein. Doppler ultrasound (US) can determine portal vein (PV) velocity in liver cirrhosis. The mean velocity of portal vein provides a distinguishable value between cirrhotic and normal individuals. Mean portal vein velocity is a reliable parameter in the diagnosis of liver cirrhosis and (CLPD). Objective: To compare mean velocities of portal vein of cirrhotic patients, and normal individuals by Doppler Ultrasound. Methods: A total of 188 individuals were cross-sectionally included in this study. The study was conducted in Gilani Ultrasound Centre, Ferozpur Road, Lahore, while using Toshiba Xario with 3-6 MHz transducer. Results: Mean portal vein velocity in cirrhotic patient was 10.72 ± 1.91 cm/s and in normal individuals was 23.36 ± 6.06 cm/s. Conclusions: Liver cirrhosis causes prominent changes in the texture of liver as compared to the texture in normal individuals. This study showed that mean velocity of portal vein was decreased in patients with liver cirrhosis as compared to normal individuals.

Keywords: Liver cirrhosis, Portal Vein, Chronic Liver Parenchymal Diseases, Doppler Ultrasound, Mean Portal Vein Velocity

Introduction

Chronic liver diseases (CLD) and liver cirrhosis is a serious health problem due to its high mortality rate worldwide. The mortality rate of liver cirrhosis is approximately 2 % of all deaths(Hanafiah et al., 2013). The exact prevalence of cirrhosis worldwide is unknown, but reasonably to be estimated around 1%(Shah et al., 2015). The prevalence of liver cirrhosis in the United States was 0.27%(Scaglione et al., 2015), CLD causes an estimated 36,000 deaths in the United States each year (Wong et al., 2000). Cirrhosis is the leading cause of mortality in Pakistani population, due to widespread diseases of viral hepatitis(Ahmad et al., 2010). According to WHO, Pakistan has 2nd highest estimated prevalence of hepatitis C after Egypt(Organization, 2008). Individuals infected with HBV and HCV are 370 and 130 million respectively and it is anticipated that 15%-40% of chronic hepatitis B virus infected patients will develop cirrhosis(Sami et al., 2009, Shepard et al., 2005).

Cirrhosis is a complication of liver disease that involves gradual damage of normal architecture of liver cell and irreversible scarring of the liver(Friedman, 2003). Scar tissues replaces healthy tissues and partially blocks the flow of blood through the liver(Zhou et al., 2014). It results from multiple pathologic processes including inflammation, fibrosis and regeneration of nodules(Wynn and Ramalingam, 2012). Ultrasound has very high overall reliability in the assessment of liver pathologies(Hernaez et al., 2011). It is an effective modality to see the texture of the liver and measure the velocity of the portal vein(Gerstenmaier and Gibson, 2014). The sensitivity of U/S for severe fibrosis and cirrhosis was 91.1%, the specificity of 93.5% and the accuracy of 92.3%. Positive predictive value of 91.8% and negative predictive value of 91.5%(Simonovský, 1999).

The gold standard for assessing cirrhosis is liver biopsy, however this procedure is invasive, expensive and carries high risk of complications including bleeding, pneumothorax and perforation of colon or gallbladder(Bedossa and Carrat, 2009, Herrine and Friedman, 2005). Grayscale sonography along with color Doppler is modality of choice for assessing cirrhosis and has advantage over other modalities. According to Ashis Saha et al, ultrasonography is inexpensive, readily available, and free of bio-effects, non-invasive procedure that is performed in patients with liver cirrhosis(Mukhopadyay and Saha, 2015, Jeong et al., 2014). This research is an effort to diagnose liver cirrhosis (Chronic liver parenchymal diseases), with the help of (US). With the application of US in the patients of liver cirrhosis make it possible to diagnose it timely, managed properly and treat accordingly(Pavlov et al., 2016). Doppler US velocimetry is also used to quantify the blood flow velocity in the PV. Hence PV mean velocity could be predictor of liver cirrhosis(Martínez-Noguera et al., 2002).

Methods

This cross-sectional comparative study was conducted at Gilani Ultrasound Center, Ferozpur Road, Lahore, while recruiting 188 individuals. This research was commenced after approval of Institution Review Board (IRB). The study duration was 8 months (March - October, 2018). Ninety four patients of liver cirrhosis and similar number of normal individuals from the same population with same ages were included. The procedure and aim of research was briefly explained to the patients and consent form was signed. All the patients were examined according to American Institute of ultrasound in Medicine (AIUM) guidelines. Patients were scanned by Toshiba Xario using transabdominal transducer of 3-6 MHz. Portal vein velocity was measured while locating it in long axis view. Angle was kept below 60 degree and parallel to the vessel wall. (Figure 1 and 2). Maximum, median and minimum velocity were measured and mean velocity was calculated by the machine automatically(Medicine, 2003). Data was tabulated and analyzed by SPSS version 24.0.

Results

Total 188 individuals were included in this study, half (94) were cirrhotic and half (94) were normal. The mean age of patients was 46.15 ± 15.88 years (9-83years). The mean velocity of portal vein in cirrhotic patients was 10.72 ± 1.91 cm/s and in 23.36 ± 6.06 cm/s in normal individuals. The standard deviation in normal individuals was 6.06 cm/s, which show a large variation, while the standard deviation in cirrhotic patients was 1.91 cm/s, focus on a narrow range of variation (Figure-3**).** Relation of the portal vein velocity in liver cirrhosis with 95% confidence interval was significant (p-value was 0.000). (Table-1). Cross tabulation of the liver sonographic texture in normal and cirrhotic patients shows that, coarse liver texture was present in 33 (18%) in cirrhotic

while 0 (0%) in normal individuals. Heterogeneous texture was present in 61 (32%) cirrhotic while 26 (14%) in normal individuals. However homogeneous texture was present in 68 (36%) in normal individuals and 0 (0%) in cirrhotic patients. Gender cross tabulation of the liver texture shows that, that the total number of females in this study were 77 (41%), in which 33 (18%) were cirrhotic and 44 (23%) were normal. Detail is given in (Table-2, Figure-4).

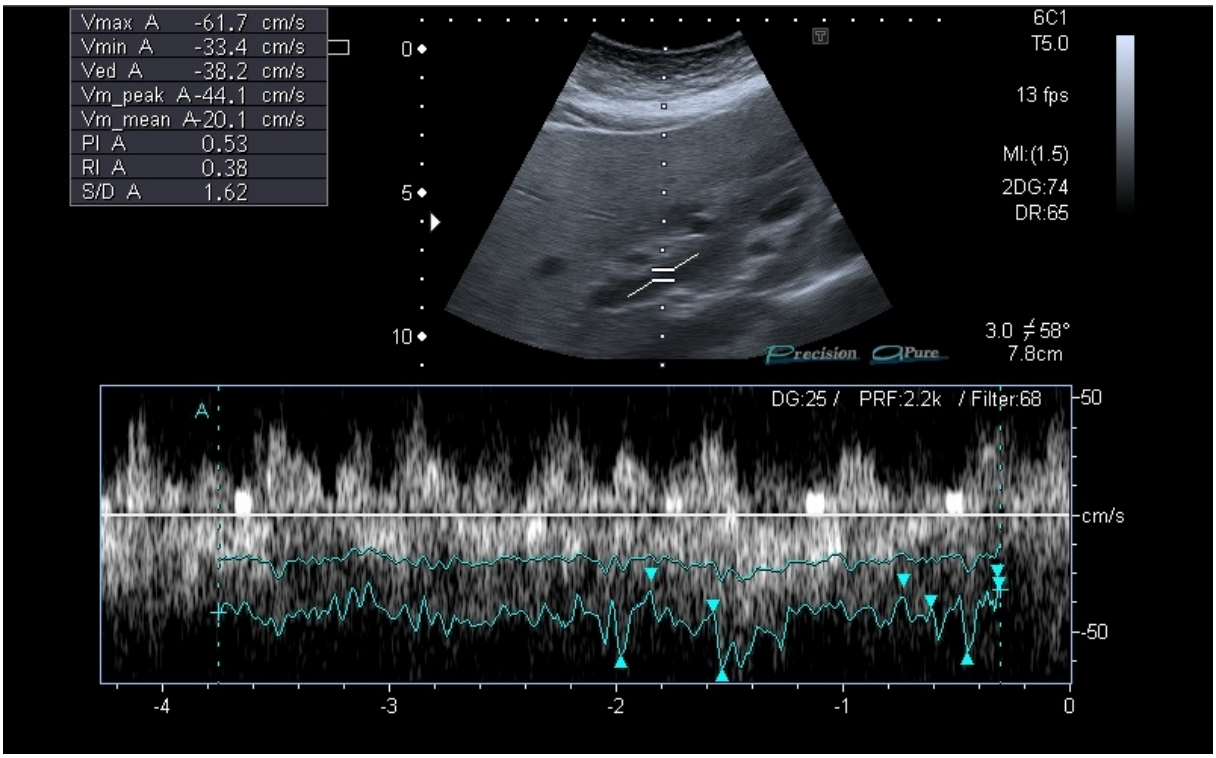

Fig 1: Homogeneous echotexture of liver in normal individual, mean PV velocity is 20.1 cm/s.

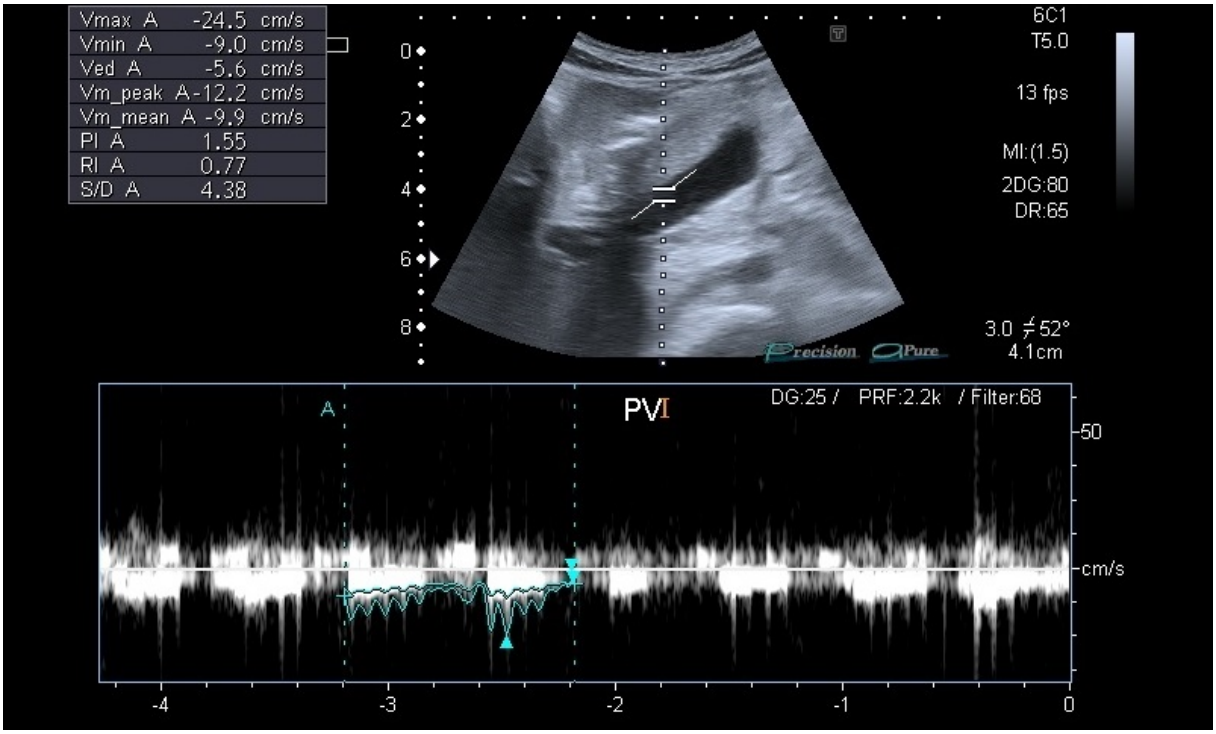

Fig 2: heterogeneous echotexture of liver in cirrhotic patient, mean velocity of PV is 9.9 cm/s.

Discussion

Portal vein velocity decreases with liver congestion and resultant portal hypertension. Previously some data is published regarding chronic liver diseases and portal vein velocities. According to study in 2005, conducted by Irandati Mukhopadhyay and Ashis Saha; in West Bengal, the study shows that Duplex ultrasound is excellent investigation of choice in assessing pathophysiological hemodynamics, judging the severity of disease in patients with liver diseases. The mean velocity of portal vein in normal individual in was 15.5 ± 4.0 cm/sec in 100 individuals. The mean velocity of portal vein in Liver Cirrhosis was 9.8 ± 2.8 cm/sec in 80 patients(Mukhopadyay and Saha, 2015). Another study conducted in 2005, on cirrhotic patients with portal hemodynamics, by Arvind Chouhan et al, they studied 100 patients. Portal vein mean velocity is estimated by using correction factor to a true average mean velocity. Portal vein velocity was in the range of 12.9 cm/s in cirrhotic and 15-18cm/s in control group(Chouhan et al., 2015). A study was conducted in 2008, on portal vein hemodynamics in patients with non-alcoholic fatty liver diseases (NAFLD), in Turkey by Besir Erdogmus et al. The Mean flow velocity was 14.6 cm/s in grade 1 patients, 12.6 cm/s in grade 2 patients and 10.3 cm/s in grade 3 patients. The mean flow velocity in control group was 16.5 cm/s and 12.3 cm/s in NAFLD patients(Erdogmus et al., 2008). A study was conducted in 2016, on Doppler assessment of children with liver cirrhosis and portal hypertension in comparison with a healthy control group, in Iran, by Maryam Riahinezhad et al. Portal vein mean velocity were 15.03 ± 7.3 cm/s in a group of 33 children with cirrhosis, 16.47 ± 6.4 cm/s in 19 controls (*P* = 0.51), 11.6 ± 4.7 cm/s in cirrhotic patients with varices. Alteration in Doppler parameter of portal vein velocity may be helpful indicators in liver cirrhosis(Riahinezhad et al., 2018). The results of this study were correlated with the previous studies, that shows decrease in portal vein velocity provide useful information in the diagnosis of liver cirrhosis.

Conclusion

Liver cirrhosis causes prominent changes in the texture of liver as compared to the texture in normal individuals. This study showed that mean velocity of portal vein was decreased in patients with liver cirrhosis as compared to normal individuals.

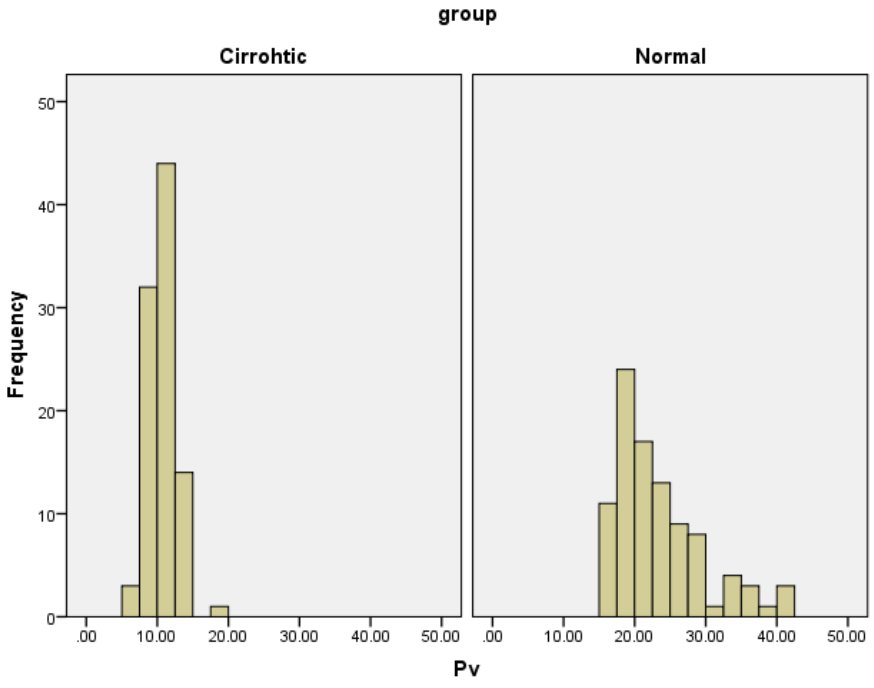

Figure 3: Frequency of portal vein mean velocity in cirrhotic and normal individuals

Table-1: Relation of the portal vein velocity in liver cirrhosis with 95% confidence interval was significant (p-value was 0.000).

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
PV	Equal variances assumed	61.282	0.000	-19.268	186	0.000	-12.64255	0.65615	-13.93701	-11.34809
	Equal variances not assumed			-19.268	111.366	0.000	-12.64255	0.65615	-13.94272	-11.34239

Table 2: Cross tabulation of gender wise texture of liver in cirrhotic and normal individuals.

Gender			Group		Total	
			Cirrhotic	Normal		
Female	texture	Coarse	12 (6.3%)	0 (0%)	12 (6.3%)	
		heterogeneous	21 (11.1%)	8 (4.2%)	29 (15%)	
		homogenous	0 (0%)	36 (19%)	36 (19%)	
	Total		33 (18%)	44 (23%)	77 (41%)	
Male	texture	Coarse	21 (11%)	0 (0%)	21 (11%)	
		heterogeneous	40 (21%)	18 (10%)	58 (30%)	
		homogenous	0 (0%)	32 (17%)	32 (17%)	
	Total		61 (32%)	50 (27%)	111 (59%)	
Total	texture	Coarse	33 (18%)	0 (0%)	33 (18%)	
		heterogeneous	61 (32%)	26 (14%)	87 (46%)	
		homogenous	0 (0%)	68 (36%)	68 (36%)	
	Total		94 (50%)	94 (50%)	188 (100%)	

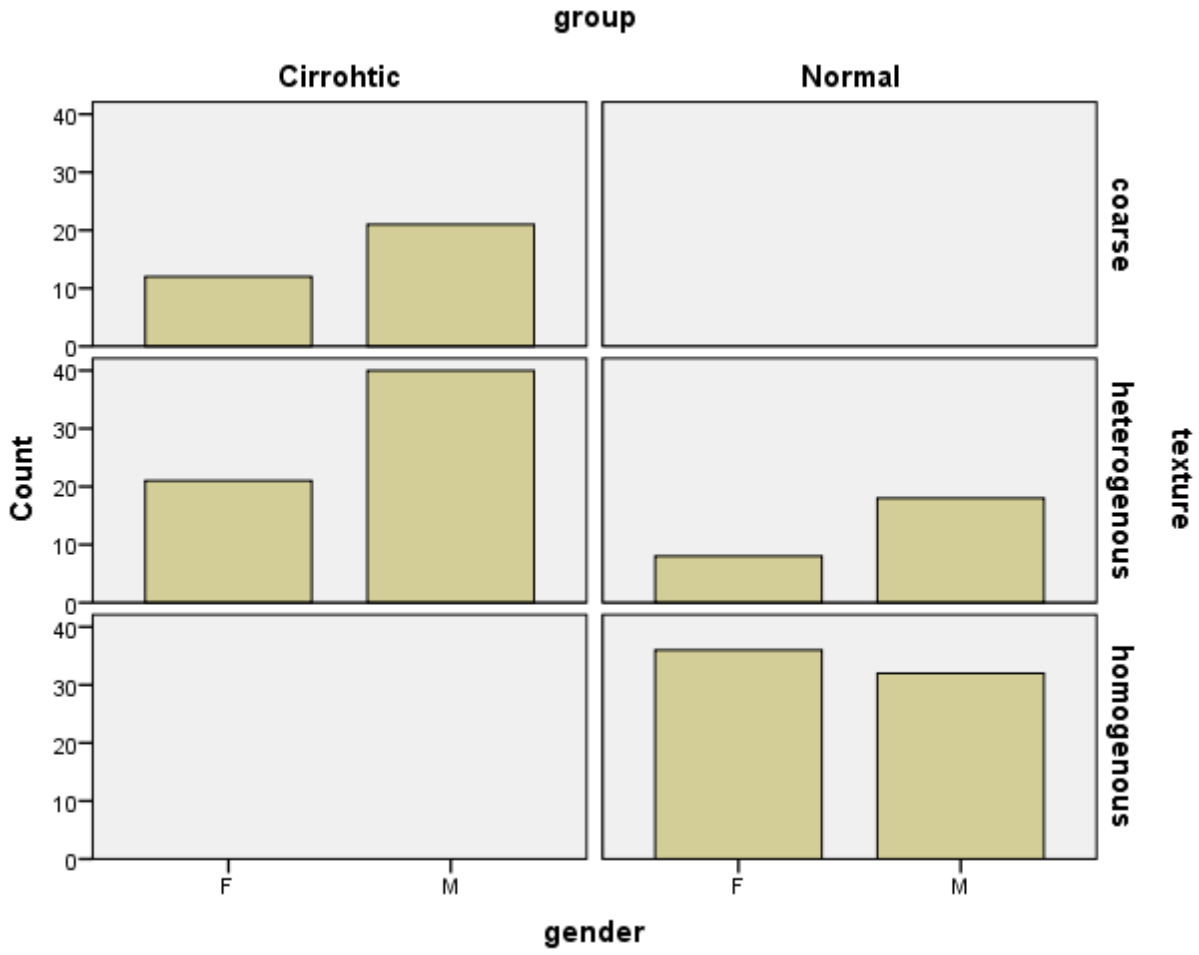

Figure 4: Texture of liver in cirrhotic and normal individual's gender wise.

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