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Original Article

Effect of Increased Portal Vein Diameter on Portal Vein Thrombosis in Decompensated Chronic Liver Disease

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Abstract

Objective: To determine the association between portal vein diameter and portal vein thrombosis in patients with decompensated chronic liver disease.

Methods: This case-control study was conducted at the Department of Medicine, Lahore General Hospital, Lahore, involving 84 patients with decompensated chronic liver disease observed over six months. Of these, 42 patients who developed portal vein thrombosis were categorized as cases, while the remaining 42 served as controls. Portal vein diameter was measured using ultrasonography, and chi-square analysis was used to test the association between portal vein diameter and portal vein thrombosis. Statistical analysis was performed using SPSS version 17.0.

Results: Among the 84 patients, 32 (38%) were female, and 52 (62%) were male. The average age was 54.4 ± 2.2 years. Portal vein diameter greater than 13 mm was observed in 20 (24%) patients. No significant association was found between portal vein diameter and portal vein thrombosis (p-value = 0.306).

Conclusion: Portal vein diameter is not associated with portal vein thrombosis in patients with decompensated chronic liver disease. Larger, multicenter studies are needed to validate these findings and identify preventive measures.

Keywords: Portal Vein Thrombosis, Liver Cirrhosis, Portal Vein Diameter, Child Pugh's

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Introduction

In liver cirrhosis portal vein thrombosis develops as a major complication than in the general population which is <1%.[1,2] It is found in 6-11% cirrhotic patients and related to the severity of disease.[3,4,5] Many studies revealed that cirrhotic patients with PVT have poor prognosis, like increasing hepatic artery thrombosis, transplantation mortality, and hepatic de-compensation.[2-6]

The development of PVT in cirrhosis patients is multifactorial and not yet clarified, which may include inherited and acquired thrombotic risk factors.[5] Structural changes that develop in cirrhosis and portal hypertension, slowed portal vein blood flow can lead to stasis, damaged vessel wall due to portal hypertension, and induced hypercoagulability as a result of pro-coagulant and anticoagulant imbalance, serve as vital processes in PVT development.[7,8] The presence of portal vein obstruction creates a porto-systemic shunt that causes decreased bacterial endotoxin clearance which then enter the systemic circulation and activate NO (nitrous oxide) leading to angiogenesis that play a role in vasodilatation and collaterals formation.[9]

Prevalence in atopic studies is 6-64% while USG reported 5-24% in cirrhosis which is around 1% in compensated and 8-25% in decompensated cases.[9,10,11]

CT angiography is an imaging technique which can detect the portal vein thrombosis[12]. CTA is not suitable due to its high cost and increased radiation exposure in high-risk population screening. The European association for liver disease guidelines states USG is the first tool for diagnosis.[13] Ultrasonography with its diagnostic accuracy of 88% to 98% is good and widely used for screening of high-risk populations with PVT.[14] It is safe, economical and portable. Moreover other parameters of the portal vein could be measured, such as portal vein diameter, blood flow velocity, and filling defect. The portal vein blood flow velocity is found to be associated with PVT development.[7] However, work

on association of portal vein diameter with portal vein thrombosis is not studied much. Although studies have shown continuous dilatation of portal vein in cirrhosis which leads to endothelial cell damage and stasis,[10-11] and this is one of the major factors for thrombosis. As only a few studies are available about this association, we aimed to evaluate the effect of portal diameter on PVT development in cirrhotic patients. If association could be proved, patients could be picked early for monitoring and prophylaxis or early treatment.

Methods

This case control study was conducted at the Department of Medicine, Lahore General Hospital, Lahore, from 10th April 2015 to 9th October 2015. The sample size was calculated by selecting power of study 80% at 5% significance level. After informed consent 42 cases and 42 controls according to selection criterion were entered in the study by using non-probability consecutive sampling. Selected cases and controls underwent ultrasonography for portal vein diameter.

Outcome Variable: Portal vein thrombosis is the response variable that is categorized as cases or controls.

Risk Factors: Portal vein diameter, duration of CLD, Child Pugh class along with background characteristics of patients (age, gender) were taken as potential risk factors for the current study.

Inclusion criteria: The patients with age 18-60 years of either sex (both male and female) had decompensated chronic liver disease according to operational definition for at least 6 months. Cases were patients with portal vein thrombosis while control group was without portal vein thrombosis.

Exclusion Criteria: Patients previously treated for portal vein thrombosis according to their history were excluded. Also participants with a history of aspirin intake, SLE, rheumatoid arthritis, antithrombotic treatment, splenectomy, liver transplant and taking warfarin or heparin were not included.

Statistical Data Analysis: Data collected was entered and analyzed in the SPSS version 17. Mean with standard deviation was calculated for quantitative variables like age, portal vein diameter and frequency and percentages in case of categorical variables like gender, portal vein diameter >13mm, Child Pugh class (B & C). Chi-square test was calculated to measure the strength of association between portal vein thrombosis and wider portal vein diameter in patients with decompensated chronic liver disease.

Results

In the present study the mean age of CLD patients was

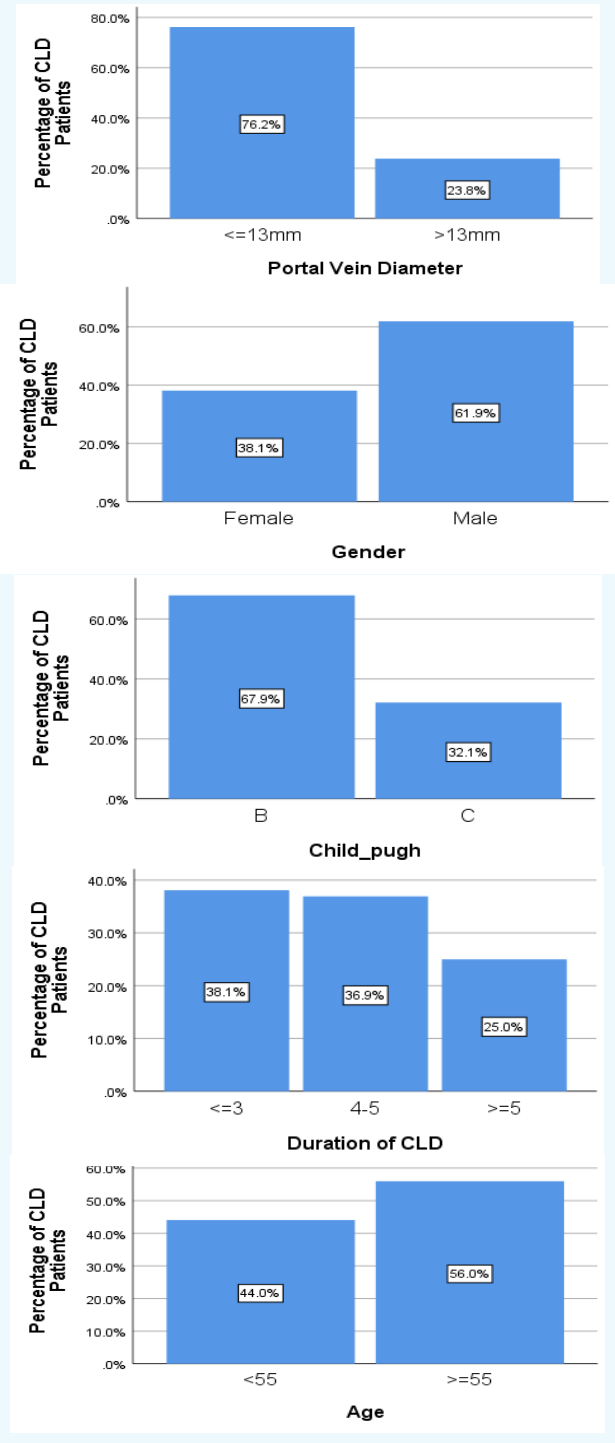

Figure 1: *Bar Chart showing Percentage Distribution with Clinical and Background Characteristics of CLD Patients*

found to be 55.47±2.28 years. Among these CLD patients 32 (38%) were females and remaining 52 patients (62%) were males (Table 1 or Figure 1). Only 20 patients (24%) had Portal Vein Diameter greater than 13 mm. It was found that 27 (32%) patients belonged to Child Pugh class C and 57 (68%) to B from a total of 84 patients. Duration of CLD in 32 patients (38%%) was 3 years and

less, in 31 patients (37%) it was 4 to 5 years whereas in rest of the 21 (25%) patients it was more than 5 years.

It can be observed from Table 2 that 12 patients (60%) had wider (>13mm) portal vein diameter in case group out of the total 20 patients with portal vein diameter greater than 13mm. No significant association (p-value =0.306) was found between portal vein diameter and portal vein thrombosis. Similarly, rest of the background characteristics and clinical factors had found no significant association with portal vein thrombosis.

Since none of 95% confidence interval (CI) for portal vein diameter (OR=0.588; CI=0.212,1.632), gender (OR=1.224 ; CI=0.507; 2.957), age (OR=1.980 ; CI= 0.826,4.748), Child Pugh class (OR=0.559; CI= 0.235, 1.334) and duration of CLD (OR=0.525; CI=0.191; 1.442) contain "1" so it can be concluded that none of the clinical and background factors significantly affect portal vein thrombosis.

Only the duration of CLD ≥5 years had a significant effect (OR=47.200; CI=11.339, 196.473) on increased portal vein diameter, >13mm. It was found that approximately 47 times more chance (OR=47.200) to increase the portal vein diameter>13mm for patients who had more than 5 years duration of CLD as compared to those who had less than 5 year duration of CLD.

Table 1: *Percentage Distribution of Clinical and Background Characteristics of CLD Patients*

Clinical and Background Characteristics of CLD Patients		N	%age
Gender	Female	32	38%
	Male	52	62%
Age	<55	37	44%
	≥55	47	56%
Portal Vein Diameter	≤13mm	64	76%
	>13mm	20	24%
Child pugh	B	57	68%
	C	27	32%
Duration of CLD (years)	≤3	32	25%
	4-5	31	37%
	>5	21	38%
Total		84	100%

Discussion

Thrombosis in the portal vein, splenic and superior mesenteric veins, or intrahepatic portal vein branches as they create an interacting vascular system without valves is referred to as portal vein thrombosis (PVT), which is frequent in a cirrhotic individual.[13-15] PVT may worsen liver function and raise portal venous pressure, which may increase the risk of upper gastrointestinal bleeding and bowel infarction.[8,13]

Significant studies have highlighted the association between portal vein diameter and PVT. Nadinskaia et al. concluded in their study that Child-Pugh B-C and diseases linked to portal hypertension, such as refractory ascites, varices treated endoscopically or surgically, portal hypertensive gastropathy (PHG), and increased portal vein diameter, are substantially correlated with PVT.[16] The

Table 2: *Percentage Distribution of Portal Vein Thrombosis across Clinical and Background Characteristics of CLD Patients*

Clinical and Background Characteristics of CLD Patients		Portal Vein Thrombosis		Total	Chi-Square Value (p-value)	Odds Ratio (95% Confidence Interval for Odd Ratio)[2]
		Cases (Yes)	Controls (No)			
Portal Vein Diameter	≤13mm	30 (46.9%)	34 (53.1%)	64 (100%)	1.050	0.588[1]
	>13mm	12 (60.0%)	8 (40.0%)	20 (100%)	(0.306)	(0.212;1.632)
Gender	Female	17 (53.1%)	15 (46.9%)	32 (100%)	0.202	1.224[1]
	Male	25 (48.1%)	27 (51.9%)	52 (100%)	(0.653)	(0.507;2.957)
Age	<55	22 (59.5%)	15 (40.5%)	37 (100%	2.367	1.980[1]
	≥55	20 (42.6%)	27 (57.4%)	47 (100%)	(0.124)	(0.826;4.748)
Child-Pugh Class	B	16 (42.1%)	22 (57.9%)	38 (100%)	1.730	0.559[1]
	C	26 (56.5%)	20 (43.5%)	46 (100%)	(0.188)	(0.235;1.334)
Duration of CLD	<5	29 (46.0%)	34 (54.0%)	63 (100%)	1.587	0.525
	≥5year	13 (61.9%	8 (38.1%)	21 (100%)	(0.208)	(0.191;1.442)

[1]Odds Ratio (OR) for PVT are given for (≤13mm/>13mm; Female/Male;<55/≥55;B/C;<5/≥5 year), CI=95% Confidence Interval for OR

Table 3: *Percentage Distribution of Portal Vein Diameter across Clinical and Background Characteristics of CLD Patients*

Clinical and Background Characteristics of CLD Patients		Portal Vein Diameter		Total	Chi-Square Value (p-value)	Odd Ratio (95% Confidence Interval for Odd Ratio)[2]
		>13mm	≤13mm			
Gender	Female	10 (31.3%)	22 (68.8%)	32 (100%)	1.578	0.524[1]
	Male	10 (19.2%)	42 (89.8%)	52 (100%)	(0.209)	(0.189;1.448)
Age	<55	10 (27.0%)	27 (73.0%)	37 (100%	0.377	0.730[1]
	≥55	10 (21.3%)	37 (78.7%)	47 (100%)	(0.539)	(0.267;1.998)
Child Pugh Class	B	5 (13.2%)	33 (86.8%)	38(100%)	4.340	3.194[1]
	C	15 (32.6%)	31(67.4%)	46(100%)	(0.037)	(1.037;9.833)
Duration of CLD	<5	4 (6.3%)	59 (93.7%)	63 (100%)	42.350	47.200[1]
	≥5 year	16 (76.2%)	5 (23.8%)	21 (100%)	(0.000)	(11.339;196.473)
Total		20 (23.8%)	64 (76,2%)	84		

[1]1Odd Ratio=OR for PVD are given for (≤13mm/>13mm; Female/Male;<55/≥55;B/C;<5/≥5 year)), 2CI=95% Confidence Interval for OR

slow blood flow due to dilatation of the portal vein leading to portal vein thrombosis was demonstrated in a study of 100 patients with cirrhosis in 200.[15] From a case series of three patients with hepato-pulmonary syndrome, each had a dilated portal vein with portal vein thrombosis and collateral.[14] Maruyama et al. revealed that sudden progress in PVT was adversely correlated with the diameter and flow capacity in the greatest collateral channel at the moment of PVT diagnosis; nevertheless, these results need prospective external validation.[5]

Local studies, such as those by Ali et al. and Khan et al., reported prevalence rates of PVT among cirrhotic patients in Pakistan and highlighted its association with Child-Pugh scores, adding valuable regional insight into disease progression and risk stratification.[1,2] These studies suggest a need for improved screening strategies in local populations, which may differ from global findings due to genetic and environmental factors.

Recent guidelines and comprehensive reviews also emphasize the utility of the Child-Pugh classification as a superior prognostic tool for liver cirrhosis and its complications.[21] Moreover, a study in Pakistan identified esophageal varices as predictors of disease severity and associated complications like PVT, underlining the interconnectedness of portal hypertension syndrome.[22]

The European Association for the Study of the Liver (EASL) provides clinical guidelines for the management of vascular liver diseases, including PVT, advocating for tailored diagnostic approaches based on regional and patient-specific factors.[23] Furthermore, recent radiological advances, such as those discussed by Kenji et al., have elucidated unique associations of PVT with portosystemic shunting, expanding the understanding of its pathophysiology.[24] Anton et al. have delved deeper into Virchow's triad, highlighting systemic inflammation as a contributor to PVT development, particularly in cirrhotic patients.[25]

Radiological tools continue to play a pivotal role in diagnosing PVT. Minoda et al. proposed a systematic radiological approach for detecting and classifying PVT in cirrhotic populations, emphasizing its clinical significance for treatment planning. On the other hand, some studies have found no significant association between portal vein thrombosis and a wider portal vein diameter. According to the results of the present study, only 20 patients (24%) had portal vein diameter above 13 mm. The prevalence of portal vein thrombosis varies with ethnicity and ranges from 16% to 25%.[8,10] Twelve patients (28.5%) in the case group and 8 (19%) in controls had portal vein diameter above 13 mm. It has been concluded that there is no association between portal vein thrombosis and wider portal vein diameter in patients with decompensated chronic liver disease.

Differences from other studies may be due to the smaller sample size in the present study and the fact that the sample was taken from a single center. Stratification of the study group and portal vein diameter (>13 mm) with gender represented an equal distribution among males and females. It implies that there was no association of portal vein thrombosis with wider portal vein diameter among male and female patients with cirrhosis. Similarly, according to the cross-tabulation of the study group and portal vein diameter (>13 mm) with Child-Pugh class, there was a significant association with a p-value of 0.03, indicating more prevalence in Child-Pugh C.

Local studies, however, suggest the importance of stratified approaches in screening, particularly in high-risk populations.[1,2] These insights underline the necessity for further research involving larger sample sizes and multicenter data to validate findings on portal vein thrombosis in cirrhotic patients.

Conclusion

This study found no significant association between portal vein diameter and portal vein thrombosis in patients with decompensated chronic liver disease. However, portal vein diameter was significantly associated with Child-Pugh Class C and the duration of chronic liver disease. These findings suggest the need for further multicenter studies with larger sample sizes to explore the potential predictive factors and develop targeted strategies for early detection and management of portal vein thrombosis in high-risk patients.

Ethical Approval: The IRB/EC approved this study via letter no.457/24/PGMI.

Conflict of Interest: None

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Authors' Contribution

RA: Conception
KUM, QuA: Design of the work
AK, AK: Data acquisition, analysis, or interpretation
KUM, QuA: Draft the work
RA, AK, AK: Review critically for important intellectual content
RA, KUM, QuA, AK, AK: Approve the version to be published
RA, KUM, QuA, AK, AK: Agree to be accountable for all aspects of the work

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