ORIGINAL ARTICLE

Doppler Ultrasound Detection and Grading of Portal Vein Thrombosis in Patients with Liver Cirrhosis: Results from a Cross-Sectional Study, Abbottabad

Maaz Khan[1*], Muhammad Ali Zul Hasnain[1], Sara Khan[1], Muhammad Ishtiaq Ahmad[2]

ABSTRACT

Objective: To ascertain the portal vein thrombosis frequency via ultrasound in liver cirrhosis patients at the Combined Military Hospital, Abbottabad**.**

Study Design: Cross-sectional study.

Place and Duration of Study: This study was conducted at the Department of Radiology, Combined Military Hospital (CMH), Abbottabad, Pakistan from 29th December 2023 to 29th June 2024.

Methods: The study utilized a sequential sampling strategy to recruit participants, excluding those with hepatocellular carcinoma, coagulopathies, malignancy, infections, or pregnancy. Doppler ultrasound assessed portal vein thrombosis, with pertinent clinical and laboratory data being recorded. Data analysis was performed using SPSS v25, considering $P \leq 0.05$ as significant.

Results: This study involving 137 patients revealed a mean age of 43.52 ± 15.08 years. The average duration of liver cirrhosis was 3.9 ± 1.29 months. Patients had a mean serum albumin level of 2.31 ± 0.24 g/dL and a mean prothrombin time/international normalized ratio (INR) of 1.40 ± 0.11 seconds. Chronic viral hepatitis was identified as the leading cause of liver disease, accounting for 33.6% of cases. Other causes included non-alcoholic fatty liver disease (NAFLD) 20.4%, autoimmune hepatitis 19.7%, and drug-induced liver injury 15.3%. Portal vein thrombosis was found in 17 patients (12.4%), with Grade I being the most common type, accounting for 4.4%, followed by Grade II and Grade III, be 3.6% & 2.9%, respectively.

Conclusion: This study demonstrates a notable prevalence of portal vein thrombosis (PVT) (12.4%) in cirrhotic patients, underscoring the critical role of Doppler ultrasound as a non-invasive, accessible tool for early detection and grading of PVT.

Keywords: *Hepatitis, Liver Cirrhosis, Portal Vein, Thrombosis, Ultrasonography.*

How to cite this: *Khan M, Hasnain MAZ, Khan S, Ahmad MI. Doppler Ultrasound Detection and Grading of Portal Vein Thrombosis in Patients with Liver Cirrhosis: Results from a Cross-Sectional Study, Abbottabad. Life and Science. 2025; 6(4): 490-496. doi: http://doi.org/10.37185/LnS.1.1.973*

Introduction

Liver cirrhosis is a progressive, irreversible condition that disrupts standard hepatic architecture through fibrosis, regenerative nodules, and vascular remodeling. Alcohol abuse, nonalcoholic fatty liver disease (NAFLD), autoimmune liver conditions, and chronic viral hepatitis represent a few of the causes.[1] It poses a diabolical challenge to global health, accounting for about 1.48 million deaths in 2019, with an alarming rise from previous years. In Pakistan, the burden of cirrhosis is particularly severe due to the high prevalence of hepatitis B and C.[2,3] As cirrhosis advances, patients are prone to developing serious vascular complications, among which portal vein thrombosis (PVT) is of paramount concern. PVT involves the development of clots within the portal vein, which can impair hepatic perfusion and exacerbate portal hypertension, ultimately leading to hepatic decompensation.[4]

[1]*Department of Radiology*
Combined Military Hospital (CMH), Abbottabad, Pakistan
[2]*Department of Radiology*
Combined Military Hospital (CMH), Bahawalpur, Pakistan
Correspondence:
Dr. Maaz Khan
Department of Radiology
Combined Military Hospital (CMH), Abbottabad, Pakistan
E-mail: maazkhan.gmc@gmail.co
Received: Nov 05, 2024; Revision Revised Mar 18, 2025
2nd Revision Revised Aug 29, 2025, Accepted: Sep 08, 2025

The occurrence of PVT in cirrhotic patients is multifactorial, encompassing elements of Virchow's triad, i.e., diminished portal venous flow due to fibrotic resistance, endothelial injury from chronic inflammation, and an altered coagulation profile fostering a hypercoagulable state.[5] Studies report that the occurrence of PVT among cirrhotic patients ranges between 0.6% and 15.8%, with even higher rates among those awaiting liver transplantation. In Pakistan, local estimates place the prevalence at approximately 15%, predominantly among patients with hepatitis C.[3,4] Risk factors include higher Child-Pugh class, esophageal varices, ascites, and increased D-dimer levels. However, many cases remain clinically silent until complications arise.[5]

In this setting, radiological imaging plays a pivotal role in prompt detection and management. Doppler ultrasound is the modality of choice for identifying PVT, offering a non-invasive, radiation-free, and widely accessible method to evaluate portal vein patency, flow direction, and thrombus characteristics. With reported sensitivity and specificity as high as 89.3% and 95.8%, respectively, ultrasound provides a reliable means of early detection, even in asymptomatic patients.[6] Importantly, it enables clinicians to grade PVT — from partial occlusion (Grade I) to complete thrombosis with superior mesenteric vein involvement (Grade IV) — which informs both prognosis and treatment strategies. Compared to CT or MRI, ultrasound offers practical advantages for routine surveillance, especially in resource-limited healthcare settings.[7,8]

Therapeutic decisions in cirrhotic PVT cases remain complex. Anticoagulation, though effective in promoting recanalization in acute non-cirrhotic PVT, carries bleeding risks in cirrhotic patients. Transjugular intrahepatic portosystemic shunt (TIPS) and Catheter-directed thrombolysis are two advanced interventional radiology techniques that are accessible but require careful patient selection.[9,10] In all scenarios, serial Doppler ultrasound plays a pivotal role both in diagnosis and in monitoring therapeutic outcomes and guiding intervention.

To provide crucial local data to guide imaging-led therapy, this study aimed to determine the frequency and grading of PVT using ultrasound in patients with liver cirrhosis.

Methods

The study was conducted at the Department of Radiology, Combined Military Hospital (CMH), Abbottabad, Pakistan, from 29th December 2023, to 29th June 2024. The study used a sequential (non-probability) sampling strategy to find participants. The sample size was determined using the WHO sample size calculator, assuming a 15% prevalence of portal vein thrombosis in cirrhotic patients, with a 95% confidence interval and an absolute precision of 6%. The sample size was set at a minimum of 137 individuals.

The criterion for inclusion comprised patients aged 18 to 70 years, of either gender, with a confirmed diagnosis of liver cirrhosis as per the operational definition (clinical, biochemical, and sonographic findings). Patients were excluded if they had hepatocellular carcinoma, other known causes of PVT (e.g., inherited or acquired coagulopathies [e.g., paroxysmal nocturnal hemoglobinuria (PNH), protein C&S deficiency, Factor-V Leiden mutation], systemic infections, other malignancies, or were pregnant females. These exclusion criteria were applied to minimize potential confounding factors and avoid bias in study results.

The Institutional Ethical Review Committee of the hospital approved the study on 22 September 2023, vide letter no: CMHAtd-ETH-106-Radio-23. After providing detailed information about the study and obtaining written informed consent, each participant was assigned a unique patient ID to maintain confidentiality. Demographic data was collected, including age, gender, residence, socioeconomic status, BMI, and address. Clinical history was documented with particular attention to duration of liver cirrhosis, Child-Pugh classification, and etiological factors, including viral hepatitis (HBV, HCV), autoimmune hepatitis, NAFLD, alcohol use, and others. Patients were also assessed for cirrhosis-related complications like oesophageal varices, ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and hepatorenal syndrome.

All participants underwent ultrasound and Doppler evaluation of the portal vein. Examinations were performed by qualified radiologists using

standardized protocols. The presence or absence of PVT was documented, and if present, thrombosis was graded from Grade I to Grade IV based on the extent and degree of luminal occlusion. Additional investigations included HBV and HCV serology, prothrombin time (PT), international normalized ratio (INR), and serum albumin levels. All data were collected using a structured proforma and verified for completeness and accuracy before being entered into the analysis database.

To analyze the data, SPSS version 25 was used. To summarize the data, descriptive statistics were employed. Standard deviations and means were computed for continuous variables, including cirrhosis duration, age, BMI, serum albumin, and PT/INR. Gender, socioeconomic position, domicile, cirrhosis severity (Child-Pugh class), etiology, complications, and the existence and grading of PVT were among the categorical factors for which frequencies and percentages were calculated. PVT status was stratified by gender, age, BMI, residence, socioeconomic status, cirrhosis duration, and severity to assess potential associations. Chi-square tests were applied, followed by stratification, and a *P*-value of ≤ 0.05 was considered to be statistically significant.

Results

One hundred thirty-seven patients with liver cirrhosis in total were included in this study. The mean age of participants was 43.52 ± 15.08 years, and the mean body mass index (BMI) was 23.07 ± 2.53 kg/m². The average duration of liver cirrhosis was 3.9 ± 1.29 months, with a mean serum albumin level of 2.31 ± 0.24 g/dL and a mean prothrombin time/INR of 1.40 ± 0.11 seconds. These variables are depicted below in Table 1.

In terms of age distribution, 36.5% of patients were between 18 and 35 years, 29.9% were aged 36 and 50 years, and 33.6% were in the 51–70-year age group. Male patients comprised the majority (63.5%), while females accounted for 36.5%. Regarding place of residence, 55.5% were from urban areas and 44.5%

Table 1: Descriptive Statistics (N = 137)

Variables	Mean	Std. Deviation
Age (Years)	43.52	15.083
BMI (Kg/m^2)	23.0731	2.53392
Duration of Liver Cirrhosis (Months)	3.90	1.291
Serum Albumin	2.3171	0.23913
Prothrombin Time/ INR [in sec]	1.4048	0.11153

Table 2: Demographic Variables (N=137)

Variable	Category	Frequency	Percentage (%)
Age distribution (Years)	18 to 35	50	36.5
	36 to 50	41	29.9
	51 to 70	46	33.6
Gender	Male	87	63.5
	Female	50	36.5
Residence	Urban	76	55.5
	Rural	61	44.5
Socioeconomic status	Low (< 50K Rs/Month)	39	28.5
	Middle (50K to 100K Rs)	77	56.2
	High (> 100K Rs/Month)	21	15.3

were from rural settings. The majority (56.2%) belonged to the middle socioeconomic class, followed by 28.5% in the low-income group and 15.3% in the high-income category. Table 2 provides detailed demographics.

Table 3 describes the severity of liver cirrhosis based on the Child-Pugh classification. According to it, 39.4% of patients had Class A cirrhosis, 42.3% had Class B, and 18.2% had Class C. The leading etiology was chronic viral hepatitis (33.6%), followed by NAFLD (20.4%), autoimmune hepatitis (19.7%), drug-induced liver injury (15.3%), toxins (6.6%), and alcoholic liver disease (4.4%), depicted via a pie graph in Figure.1.

Table 3: Severity of liver cirrhosis (N=137)

Severity of liver cirrhosis	Frequency	Percent (%)
Child class A	54	39.4
Child class B	58	42.3
Child class C	25	18.2
Total	137	100.0

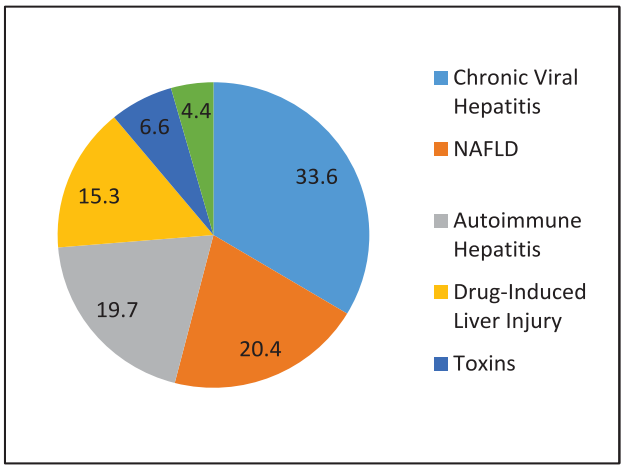

Fig.1: Etiology of Liver Cirrhosis by Percentage (%)

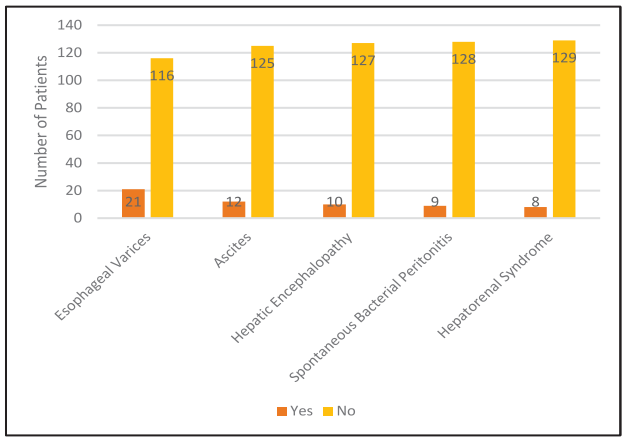

Fig.2: Complications of Liver Cirrhosis by Frequency (N=137)

Among cirrhosis-related complications, esophageal varices were present in 21 (15.3%), ascites in 12 (8.8%), hepatic encephalopathy in 10 (7.3%), spontaneous bacterial peritonitis in 9 (6.6%), and hepatorenal syndrome in 8 (5.8%) of patients, shown in Figure.2.

Table 4 shows that the overall frequency of portal vein thrombosis (PVT) was 12.4% (n = 17). Grading of PVT revealed that Grade I was the most common, observed in 4.4% of patients, followed by Grade II (3.6%), Grade III (2.9%), and Grade IV (1.5%) (Table 5).

Table 4: Frequency of portal vein thrombosis (N=137)

Portal vein thrombosis	Frequency	Percent (%)
Yes	17	12.4
No	120	87.6

Table 5: Grading of portal vein thrombosis (N=137)

Gradating of portal vein thrombosis	Frequency	Percent (%)
I	6	4.4
II	5	3.6
III	4	2.9
IV	2	1.5
No PVT	120	87.6

Table 6: Association Between Demographic and Clinical Variables and Presence of Portal Vein Thrombosis (PVT)

Variable	Category	PVT Present N (%)	PVT Absent N (%)	χ^2	*P*-value
Gender	Male (N = 87)	10 (11.5%)	77 (88.5%)	0.16	0.69
	Female (N = 50)	7 (14.0%)	43 (86.0%)		
Age Group (Years)	18–35 (N = 50)	5 (10.0%)	45 (90.0%)	0.51	0.77
	36–50 (N = 41)	6 (14.6%)	35 (85.4%)		
	51–70 (N = 46)	6 (13.0%)	40 (87.0%)		
Residence	Urban (N = 76)	9 (11.8%)	67 (88.2%)	0.03	0.86
	Rural (N = 61)	8 (13.1%)	53 (86.9%)		
Socioeconomic Status	Low (N = 39)	6 (15.4%)	33 (84.6%)	0.57	0.75
	Middle (N = 77)	8 (10.4%)	69 (89.6%)		
	High (N = 21)	3 (14.3%)	18 (85.7%)		
Child-Pugh Class	A (N = 54)	4 (7.4%)	50 (92.6%)	6.95	0.03*
	B (N = 58)	8 (13.8%)	50 (86.2%)		
	C (N = 25)	5 (20.0%)	20 (80.0%)		

**Statistically significant at P ≤ 0.05*

Note: The Chi-square (χ^2) value represents the test statistic used to assess the association between categorical variables. A higher χ^2 value indicates a greater difference between observed and expected frequencies. In this analysis, only the association between PVT and Child-Pugh class reached statistical significance ($\chi^2 = 6.95$, $P = 0.03$), suggesting that PVT occurrence increases with the severity of liver cirrhosis

Table 6 demonstrates the chi-square analysis, which was applied to examine the relationship between the presence of portal vein thrombosis (PVT) and various demographic and clinical factors in patients with liver cirrhosis. This test compared observed frequencies of PVT across different groups, such as gender, age, residence, socioeconomic status, and Child-Pugh class. The results showed no significant association between PVT and most demographic factors ($P > 0.05$), indicating that age, gender, and social background did not influence PVT occurrence. However, a significant association was observed with Child-Pugh class ($\chi^2 = 6.95$, $P = 0.03$), suggesting that PVT was more common in patients with advanced liver disease. This implies that disease severity plays a key role in the development of PVT, while other factors have a limited statistical impact.

Discussion

The main purpose of the current study was to determine the frequency of portal vein thrombosis (PVT) via Doppler ultrasound in patients with liver cirrhosis. Despite large number of studies that have already been conducted locally and other regions of the world regarding PVT frequency, our study, unlike many, excluded patients who had developed Hepatocellular carcinoma or any coagulopathy. Therefore, this study was carried out to add to the existing literature as the data was deficient, especially in the KPK region. It had been shown in one of the bibliometric and visualized studies that the USA is a major contributor in studies regarding PVT prevalence in cirrhosis and HCC.[11] 13.7% cirrhotic patients in our study had portal vein thrombosis (PVT) detected on Doppler ultrasound. These results were comparable to one of the studies done in Pakistan, in which around 15% had PVT. Also, as in the current study, the most frequent cause was found to be Hepatitis C.[12] In another study carried out in the region of Punjab, Pakistan , there was a significant prevalence (29%) of PVT among patients of HCC secondary to cirrhosis.[13] Similarly, one of the major studies was conducted at Agha Khan University Hospital for a duration of around 2 years, which demonstrated that there was a 24 % prevalence of PVT in early cirrhosis and increased to 31% in HCC, highlighting the importance of regular follow-up screening of cirrhotic patients to diagnose PVT.[14]

A systematic review with meta-analysis was conducted on around 26 studies (1441 patients) and found a 24 % prevalence of PVT in cirrhosis. These results were also comparable to our study as being statistically significant.[15] We couldn't find the leading cause of PVT in cirrhotic patients; however, one of

studies demonstrated that metabolic disorders, especially increased BMI and impaired glucose tolerance, are more likely to be the cause of rapid development of PVT in cirrhotic patients.[16] One of the research works done in India showed results comparable to our population, i.e 17.2% PVT prevalence using Doppler USG.[17]

Our study demonstrated a significant risk of esophageal bleed secondary to varices in 15.3% patients with portal vein thrombosis. The results were comparable to one of the large-scale studies carried out for the management of esophageal varices in Portal venous thrombosis.[18] Another study was done in a tertiary care hospital KPK which demonstrated significantly increased risk of esophageal varices and bleed (84%) in portal venous thrombosis with higher prevalance among males.[19] This was in contrast to our study where esophageal varices were indeed the most typical complication, but the prevalance was only 15%. Such results can be justified by the fact that we selected asymptomatic patients who were diagnosed via Doppler ultrasound as a screening test. At the same time, the other study had a mixed patient pool with the majority of symptomatic individuals.

Literature showed that a study demonstrated the frequency of PVT as low as 8 % in a larger population.[20] These results, in contrast to our study, were likely due to the inclusion of NAFLD patients, while our sample population was mostly cirrhotic, which was a more severe complication.

Another study done on a cohort of 928 individuals revealed a similar magnitude of PVT as ours, i.e, 17.4%, which was slightly higher; however, this could be due to the inclusion of a mixed sample population, or they might have detected PVT more rigorously beyond Doppler.[21,22]

In a nutshell, overall, the prevalence of portal vein thrombosis in our study was lower than in more recent studies. This might be attributable to our sample selection criteria that included quite an asymptomatic and low-risk population. Also, we exclusively used Doppler ultrasound for the detection of PVT in contrast to other studies, which also utilized advanced imaging techniques like CT/MRI.

This study has several limitations. The sample size of 137 patients from a single center may limit the generalizability of the findings to broader populations. Additionally, the cross-sectional design limits our ability to determine causal relationships between cirrhosis severity and the development of portal vein thrombosis. While imaging is a valuable diagnostic tool, it may lead to the underdetection of subclinical thrombi. Furthermore, factors such as variations in anticoagulation practices, cirrhosis etiology, and the presence of hepatocellular carcinoma were not fully controlled, potentially affecting the observed outcomes.

Conclusion

This study demonstrates a notable prevalence of portal vein thrombosis (PVT) (12.4%) in cirrhotic patients, underscoring the critical role of Doppler ultrasound as a non-invasive, accessible tool for early detection and grading of PVT. The occurrence of PVT across all Child-Pugh classes, without significant associations with demographic or clinical factors, supports routine ultrasound surveillance in cirrhosis regardless of severity. These findings advocate for integrating Doppler imaging into standard cirrhosis care, particularly in resource-limited settings, to enhance risk stratification, guide timely management, and ultimately improve patient outcomes.

Acknowledgement: None

Conflict of Interest: The authors declare no conflict of interest

Grant Support and Financial Disclosure: None

REFERENCES

1. Tapper EB, Parikh ND. Diagnosis and management of cirrhosis and its complications: a review. Journal of the American Medical Association. 2023; 329: 1589-1602. doi: 10.1001/jama.2023.5997
2. Liu YB, Chen MK. Epidemiology of liver cirrhosis and associated complications: current knowledge and future directions. World Journal of Gastroenterology. 2022; 28: 5910-30. doi: 10.3748/wjg.v28.i41.5910
3. Zahoor S, Khan A, Asif S, Tabraiz SA, Mustafa H, Ansar S, et al. Past and future perspectives for hepatitis B and C in Pakistan. Cureus. 2021; 13: e17521. doi: 10.7759/cureus.17521
4. Mantaka A, Augoustaki A, Kouroumalis EA, Samonakis DN. Portal vein thrombosis in cirrhosis: diagnosis, natural history, and therapeutic challenges. Annals of Gastroenterology. 2018; 31: 315-29. doi: 10.20524/aog.2018.0245
5. Prakash S, Bies J, Hassan M, Mares A, Didia SC. Portal vein thrombosis in cirrhosis: a literature review. Frontiers in

Medicine (Lausanne). 2023; 10: 1134801. doi: 10.3389/fmed.2023.1134801
6. Samad M, Shah R, Khan MR, Afsar M, Wahid G, Tamkeen N. Diagnostic accuracy of Doppler ultrasound in detection of portal vein thrombosis in hepatocellular carcinoma. Khyber Journal of Medical Sciences. 2022; 15: 43-9. doi: 10.70520/kjms.v15i1.349
7. Prakash S, Bies J, Hassan M, Mares A, Didia SC. Portal vein thrombosis in cirrhosis: a literature review. Frontiers in medicine. 2023; 10: 1134801. doi: 10.3389/fmed. 2023.1134801
8. Marra P, Dulcetta L, Carbone FS, Muglia R, Muscogiuri G, Cheli M, et al. The role of imaging in portal vein thrombosis in liver cirrhosis. European Journal of Gastroenterology & Hepatology. 2018; 30: 555-63. doi: 10.3390/diagnostics 12112628
9. Shakeel L, Perveen R. Doppler ultrasound evaluation of portal vein thrombosis in cirrhotic patients with and without hepatocellular carcinoma. Journal of Biological and Allied Health Sciences. 2025; 5: 103-9. doi: 10.56536/jbahs.v5i1.121
10. García-Pagán JC, Saffo S, Mandorfer M, Garcia-Tsao G. Where does TIPS fit in the management of patients with cirrhosis? JHEP Reports. 2020; 2: 100122. doi: 10.1016/j.jhepr.2020.100122
11. Zhong L, Ren TT, Shi L, Deng Q, Hong L, Yu C, et al. Global research on portal vein thrombosis and liver transplantation: a bibliometric and visualized study. Medicine. 2023; 102: e34497. doi: 10.1097/MD. 0000000000034497
12. Ahmad W, Jan N, Anjum S, Islam F, Marwat AG, Saeed L. Adult patients with liver cirrhosis and portal vein thrombosis: an experience at a tertiary care hospital. Journal of Pharmaceutical Negative Results. 2023; 14: 203-7. doi: 10.47750/pnr.2023.14.04.27
13. Safdar TA, Nazir MU, Iqbal SH, Ikram M, Sajid NK, Fuaad M. Determine the frequency of portal vein thrombosis in patients with liver cirrhosis. Pakistan Journal of Medical and Health Sciences. 2021; 15: 1617-9. doi: 10.53350/pjmhs 211561617
14. Shafqat MN, Saeed NS, Javed S, Chouhdary MA, Shafqat G, Aftab MA. Frequency of Portal Vein Thrombosis in Patients with Hepatocellular Carcinoma: Portal Vein Thrombosis in Patients with Hepatocellular Carcinoma. Pakistan Journal of Health Sciences. 2022: 115-9. doi: 10.54393/pjhs. v3i05.219
15. Siddiqui MTU, Fareed G, Khan MR, Riaz A, Hamid SS. Portal vein thrombosis in patients with hepatocellular carcinoma and early cirrhosis-prevalence and risk factors. Ecancermedicalscience. 2023; 17: 1581. doi: 10.3332/ ecancer.2023.1581
16. Giri S, Singh A, Kolhe K, Kale A, Shukla A. Natural history of portal vein thrombosis in cirrhosis: a systematic review with meta-analysis. Journal of Gastroenterology and Hepatology. 2023; 38: 1710-7. doi: 10.1111/jgh.16263
17. Li J, Wang Q, Yang M, Sun X. Metabolic Disorders and Risk of Portal Vein Thrombosis in Liver Cirrhosis: A Systematic Review and Meta-Analysis. Turkish Journal of Gastroenterology. 2022; 33: 541-53. doi: 10.5152/tjg. 2022.211022
18. Koumar L, Senthamizhselvan K, Barathi D, Verma A, Rao P, Selvaraj J, et al. Portal vein thrombosis in patients with cirrhosis of the liver: prevalence and risk factors. Cureus. 2023; 15: e50134. doi: 10.7759/cureus.50134
19. Jothimani D, Rela M, Kamath PS. Liver Cirrhosis and Portal Hypertension: How to Deal with Esophageal Varices? Medical Clinics of North America. 2023; 107: 491-504. doi: 10.1016/j.mcna.2023.01.002
20. Shahid M, Ullah I, Ali F, Abidduddin. Frequency of Esophageal Varices in Patients with Cirrhosis. Indus Journal of Bioscience Research. 2025; 3: 565-8. doi: 10.70749/ijbr.v3i6.1733
21. Stupia R, Lombardi R, Cattazzo F, Zoncapè M, Mantovani A, De Marco L, et al. Prevalence of portal vein thrombosis in non-alcoholic fatty liver disease: a meta-analysis of observational studies. Journal of Thrombosis and Thrombolysis. 2024; 57: 330-6. doi: 10.1007/s11239-023-02912-9
22. Arabpour E, Hatami B, Pasharavavesh L, Rabbani AH, Shahraki SZ, Amiri M, et al. Clinical characteristics and predictors of benign portal vein thrombosis in patients with liver cirrhosis: A retrospective single-center study. Medicine. 2024; 103: e39823. doi: 10.1097/MD. 0000000000039823

Author Contributions

MK: Manuscript writing for methodology design and investigation, data acquisition, curation, and statistical analysis, validation of data, interpretation, and write-up of results

MAZH: Revising, editing, and supervising for intellectual content

SK: Writing the original draft, proofreading, and approval for final submission

MIA: Conception and design of the work