ISSN: 2755-6328

Research Article

Open Access Journal of Pharmaceutical Sciences and Drugs

Prevalence and Risk Factors of Gastroesophageal Varices in Myeloproliferative Neoplasm Patients with Portal Hypertension in a Tertiary Government Hospital: A 5-year Cross-sectional Study

Sam N Fandood[1*] and Michael Chu[2]

[1]*MD Fellow, Section of Gastroenterology, Department of Internal Medicine East Avenue Medical Center, Philippines*

[2]*Section of Gastroenterology, Department of Internal Medicine East Avenue Medical Center, Quezon City, Philippines*

[*]**Corresponding author**

Sam N Fandood, MD Fellow, Section of Gastroenterology, Department of Internal Medicine East Avenue Medical Center, Philippines

Received: June 17, 2026; **Accepted:** July 02, 2026; **Published:** July 10, 2026

ABSTRACT

Background: Myeloproliferative neoplasms (MPNs) are an established cause of non-cirrhotic portal hypertension and may lead to gastroesophageal varices with significant clinical consequences. However, local data on the burden of varices and associated risk factors among MPN patients remain limited.

Methods: This cross-sectional study included 40 adult patients diagnosed with MPNs who underwent esophagogastroduodenoscopy at a tertiary government hospital between 2021 and 2025. Sociodemographic, clinical, laboratory, and endoscopic data were obtained through chart review. The prevalence of gastroesophageal varices was determined. Logistic regression analyses were performed to identify clinicodemographic factors associated with the presence of varices.

Results: Gastroesophageal varices were identified in 23 patients (57.5%), including esophageal varices alone in 27.5%, gastric varices alone in 2.5%, and combined esophageal and gastric varices in 27.5%. Varices were most prevalent among patients with primary myelofibrosis (78.9%), followed by polycythemia vera (45.5%) and chronic myeloid leukemia (30%). The distribution of variceal size differed significantly across groups ($p = 0.024$), with small varices observed only among patients with chronic myeloid leukemia. In univariate analysis, age 40–59 years (OR: 0.06; 95% CI: 0.01–0.57; $p=0.015$) and >60 years (OR: 0.03; 95% CI: 0.00–0.38; $p=0.006$) were associated with lower odds of varices compared with younger patients. Splenic vein diameter was positively associated with varices (OR: 1.38; 95% CI: 1.05–1.80; $p=0.020$), while platelet count showed an inverse association (OR: 0.99; 95% CI: 0.99–1.00; $p=0.004$). On multivariate analysis, only platelet count remained independently associated with varices (adjusted OR: 0.99; 95% CI: 0.98–1.00; $p=0.020$).

Conclusions: Gastroesophageal varices are highly prevalent among MPN patients with portal hypertension, particularly in primary myelofibrosis. Thrombocytopenia is an independent factor associated with variceal presence and may serve as a practical marker to guide endoscopic surveillance in this high-risk population.

Keywords: Myeloproliferative Neoplasms, Portal Hypertension, Esophageal Varices, Platelet Count, Risk Factors

Introduction

Background of the Study

Myeloproliferative neoplasms (MPNs) are a heterogenous group of disorders of clonal hematopoiesis characterized by the abnormal overproduction of one or more blood cell types in the bone marrow, associated in certain cases with bone marrow fibrosis, splenomegaly, and/or hepatomegaly [1]. Although rare compared to other cancers with an estimated annual incidence rate of 2.17 cases per 100,000 people per year, it is a significant cause of portal hypertension which can lead to recurrent gastroesophageal variceal bleeding (GVB) [2,3].

Studies that investigated patients developing GVB reported identification of an underlying myeloproliferative neoplasm in the absence of any known etiology [4]. Gastroesophageal varices, while not directly caused by MPNs, can be a complication of MPN-related portal hypertension with incidence rate of 7–18% [3,5]. Consequently, the development of varices can lead to severe, even life-threatening bleeding, requiring monitoring and treatment, often via endoscopy, to prevent or manage complications [3].

Citation: Sam N Fandood, Michael Chu. Prevalence and Risk Factors of Gastroesophageal Varices in Myeloproliferative Neoplasm Patients with Portal Hypertension in a Tertiary Government Hospital: A 5-year Cross-sectional Study. Open Access J Pharma Sci and Drug. 2026. 2(3): 1-10.

DOI: doi.org/10.61440/OAJPSD.2026.v2.47

Although MPN-associated variceal bleeding portends a poor prognosis, it lacks specific guidelines and clinical consensus desiderating more clinical studies [5,3]. Moreover, while splenomegaly, genetic factors like JAK2V617F and thrombotic events contribute to portal hypertension in MPN [3,6], clinicodemographic factors influencing gastroesophageal variceal development are not yet fully elucidated. In the Philippines, MPN-related portal hypertension is well-recognized but an under-studied complication.

Due to limited data availability, this current study focused on addressing data gaps by determining the burden and identifying risk factors that increase the likelihood of developing gastroesophageal varices among MPN patients seen in a tertiary government hospital.

Significance of the Study

Clinicians and healthcare providers involved in the care of MPN patients are primary end users of the research findings. They can apply the insights gained from the study to determine certain subgroups of populations are at higher risk for gastroesophageal varices, optimize patient management, tailor treatment strategies, and improve clinical outcomes.

Training institutions and hospitals may utilize the research output to inform clinical practices, develop standardized protocols, and enhance quality improvement initiatives aimed at reducing GVB complications rates among patients with MPN.

Government health agencies, regulatory bodies, and health organizations responsible for policy development and healthcare planning may use the research findings to inform policy decisions, resource allocation, and quality assurance measures related to care of MPN patients with gastroesophageal varices. This may help in crafting hospital policies for MPN patients at risk for variceal bleeding.

Patient advocacy groups, cancer support organizations, and patient communities and their families can benefit from the research output by gaining insights into factors that can increase the risk of gastroesophageal varices in MPN and providing education and support to patients.

Researchers and academicians in the field of oncology, gastroenterology, and public health may use the research findings to further investigate related topics, develop new research hypotheses, and contribute to the scientific literature through publications, presentations, and academic collaborations.

Objectives

General Objective

This study evaluated the prevalence and risk factors of gastroesophageal varices in MPN patients with portal hypertension

Specific Objectives

- To determine the sociodemographic and clinical profiles of the study population in terms of the following:
  - Age
  - Sex
  - Types of MPN
  - Time interval between MPN diagnosis and endoscopic screening
  - Hepatomegaly
  - Thrombosis
  - Portal vein diameter
  - Splenic vein diameter
  - Splenic Index
  - Platelet count
- To determine the prevalence of gastric and esophageal varices in MPN patients with portal hypertension from 2021 to 2025
- To determine the endoscopic findings of MPN patients with gastroesophageal varices
- To determine the clinicodemographic factors significantly associated with gastroesophageal varices among MPN patients with portal hypertension

Null Hypothesis

- There are no significant differences in endoscopic findings across MPN subtypes
- There is no significant association between clinicodemographic factors and varices among MPN patients with portal hypertension
- There is no significant independent association between clinicodemographic factors and varices among MPN patients with portal hypertension

Research Question

Among patients with MPN, what are the prevalence and risk factors associated with gastroesophageal varices?

Scope And Limitations of the Study

This single-center, cross-sectional study focused on determining the prevalence of gastroesophageal varices and identifying clinicodemographic and clinical factors associated with their presence among patients with MPNs and portal hypertension seen at a tertiary government hospital between 2021 and 2025. The study included adult MPN patients who underwent esophagogastroduodenoscopy as part of the evaluation or management of portal hypertension during the study period.

The scope of the analysis was limited to variables that were consistently available in medical records and clinically relevant to portal hypertension and variceal development. This included age, sex, type of MPN, time interval between MPN diagnosis and endoscopic screening, presence of hepatomegaly, history of thrombosis, portal vein diameter, splenic vein diameter, splenic index, and platelet count. Logistic regression analysis was used to evaluate factors associated with the presence of gastroesophageal varices.

Several limitations should be considered when interpreting the findings. First, the cross-sectional design precludes determination of temporal relationships and causal inferences between identified factors and variceal development. Second, the relatively small sample size, reflecting the rarity of MPN-associated portal hypertension and the use of total enumeration sampling, may have limited statistical power and resulted in wide confidence

intervals for some predictors. Third, certain potentially relevant variables, such as JAK2 mutation status, severity and etiology of portal hypertension, liver fibrosis, ascites, edema, and detailed imaging parameters, could not be included in the final analysis because of incomplete or inconsistent documentation.

In addition, the study did not assess clinical outcomes such as variceal bleeding, rebleeding, or mortality, nor did it evaluate the impact of therapeutic interventions, including anticoagulation, beta-blocker use, or endoscopic treatment. As a single-center study conducted in a tertiary government hospital, the findings may not be fully generalizable to other settings or patient populations.

Despite these limitations, the study provides valuable preliminary data on the burden of gastroesophageal varices and associated factors among MPN patients with portal hypertension in a local setting and may inform future multicenter and prospective studies aimed at improving risk stratification and surveillance strategies in this high-risk population.

Review Of Literature and Related Studies

Burden of MPN

In the Philippines, MPNs are rare, potentially life-threatening blood cancers. While specific incidence data for the Philippines is limited, studies indicate that the incidence of MPNs is approximately 6 per 100,000 people per year [7]. The classification and diagnostic criteria of MPNs have undergone relevant changes over the years, reflecting the increased awareness on these conditions and a better understanding of their biological and clinical-pathological features and complications [8]. Chronic myeloid leukemia (CML), polycythemia vera (PV), essential thrombocythemia (ET), and primary myelofibrosis (PMF) are four classic types of myeloproliferative neoplasms. WHO classification also included chronic neutrophilic leukemia (CNL), chronic eosinophilic leukemia (CEL), and MPN, unclassifiable [9]. The estimated annual incidence rates for PV, ET, and PMF are as follows: 0.84, 1.03, and 0.47 per 100,000. Prevalence is much higher, particularly for PV and ET, as mortality rates are relatively low [2].

Complications, such as thrombosis and progression to overt forms of myelofibrosis and acute leukemia, contribute significantly to morbidity and mortality of patients with MPN [10]. While the prognosis for MPNs varies depending on the specific type, generally, individuals can live for many years after diagnosis with 5-year mortality rate of 23.0% for all MPNs combined [11].

Epidemiology of varices in MPN

About 13.8% of the patients with MPN develop portal hypertension with which can lead to esophageal varices [3] as a result of the massively increased splenoportal blood flow and the decreased hepatic vascular compliance or hepatic venous thrombosis [4]. The precise prevalence of esophageal varices in MPNs is not precisely known and the potential predictors of esophageal varices in this population have not been identified. Usually, for chronic non-cirrhotic, non-tumoral PVT, the incidence of newly developed varices is 2 % at 1 year and 22 % at 3 years, and a probability of worsening of existing esophageal varices of 13 % and 40 % at 1 and 3 years, respectively [12]. Once varices develop, they have a risk of bleeding, and a bleeding episode significantly increases the risk of future bleeds. MPN-associated variceal bleeding is a serious complication with poor prognosis [3]. The probability of bleeding in patients with large esophageal varices is 9 % at 1 year and 20 % at 3 years [12].

Risk factors varices in MPN

In individuals with MPNs, there may be several factors that can increase the risk of developing esophageal varices. MPNs can lead to portal hypertension, either directly or through complications like portal vein thrombosis, which can disrupt normal blood flow through the liver. This increase in pressure forces blood into the smaller veins of the esophagus, leading to their enlargement and the formation of varices [4].

Splanchnic vein thrombosis, including portal vein thrombosis, is a common complication of MPNs, particularly in ET and PV. This thrombosis obstructs blood flow, increasing pressure in the portal vein and contributing to variceal formation [13]. JAK2 mutations are commonly found in MPNs, and they can contribute to the development of thrombosis and portal hypertension. While the exact mechanism is not fully understood, these mutations can play a role in the increased risk of esophageal varices [14]. In addition, other sociodemographic and clinical risk factors like excessive alcohol consumption, diabetes mellitus low, ascites, low platelet count, Child Pugh class B/C, spleen diameter, portal vein diameter are predictors for esophageal varices in general population [15,16,3].

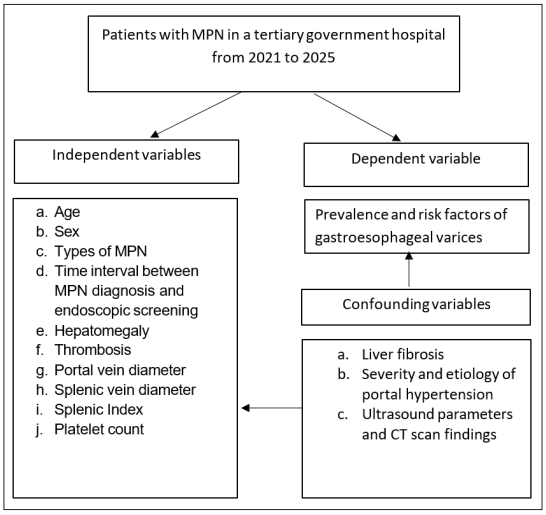

Figure 1: Conceptual Framework of the Study

The study population includes patients with MPN in a tertiary government hospital from 2021 to 2025. The independent variables of the study are the following: age, sex, types of MPN, time interval between MPN diagnosis and endoscopic screening, hepatomegaly, thrombosis, portal vein diameter, splenic vein diameter, splenic Index,b platelet count. On the other hand, the dependent variables are prevalence and risk factors of gastroesophageal varices. However, there are also extraneous variables which include the following: liver fibrosis, severity and etiology of portal hypertension, and ultrasound parameters and CT scan findings.

Methodology

Research Design

This cross-sectional study performed a posteriori, using information and data from chart review to determine the prevalence and risk factors of gastroesophageal varices among MPN patients with portal hypertension in a tertiary government hospital from 2021 to 2025.

Study Locale

The study was conducted at East Avenue Medical Center (EAMC), a tertiary government referral hospital located in Diliman, Quezon City, Philippines. The institution serves as a major referral center in the National Capital Region and is equipped with a dedicated endoscopy unit staffed by experienced gastroenterologists. Patients with diagnosed MPNs are routinely referred to EAMC for evaluation of gastrointestinal and vascular complications, including gastroesophageal varices. The availability of a comprehensive electronic medical record system facilitated systematic data retrieval and management.

Study Period

The study period is from January 1, 2021 to December 31, 2025.

Eligibility Criteria

Inclusion Criteria

Patients were eligible for inclusion if they met all of the following criteria:

- Adult patients aged ≥18 years at the time of endoscopic evaluation.
- A confirmed diagnosis of myeloproliferative neoplasm (including polycythemia vera, essential thrombocythemia, primary myelofibrosis, or chronic myeloid leukemia) established according to World Health Organization (WHO) diagnostic criteria, as documented in the medical records.
- A final diagnosis of portal hypertension, explicitly documented in the patient's medical chart by the attending physician or consultant, based on clinical, radiologic, and/or endoscopic assessment.
- Patients who were admitted or managed as outpatients at East Avenue Medical Center between January 1, 2021 and December 31, 2025.
- Patients who underwent esophagogastroduodenoscopy (EGD) during the study period as part of the evaluation or management of portal hypertension.
- Availability of complete and adequate clinical, laboratory, imaging, and endoscopic data required for analysis of study variables.

Exclusion Criteria

- Presence of esophageal or gastric varices diagnosed prior to the diagnosis of MPN, to ensure temporal association between MPN-related portal hypertension and variceal development.
- Documented history or evidence of chronic liver disease unrelated to MPN, including but not limited to alcoholic liver disease, chronic viral hepatitis (hepatitis B or C), nonalcoholic fatty liver disease, autoimmune hepatitis, primary biliary cholangitis, primary sclerosing cholangitis, or schistosomiasis.
- Presence of hepatic malignancy (e.g., hepatocellular carcinoma) or other intra-abdominal malignancies known to cause portal hypertension.
- Prior major abdominal or portal-systemic surgical interventions, including splenectomy, liver transplantation, transjugular intrahepatic portosystemic shunt (TIPS), or surgical portosystemic shunt procedures.
- Patients with incomplete, missing, or inaccessible medical records, including absent endoscopic reports or key laboratory and imaging data required for outcome assessment.
- Pediatric patients (<18 years old) and pregnant patients, due to differing physiological and hemodynamic considerations.

Sample Size and Sampling Technique

Sample size was recalculated based on the primary outcome, the presence of gastroesophageal varices, using the logistic regression sample size formula described by Hsieh et al., which estimates the number of subjects required to detect an association between a predictor and a binary outcome.

Assuming a two-sided alpha of 0.05, 80% power, a moderate effect size corresponding to an odds ratio of approximately 3.0 for clinically relevant predictors, and a probability of gastroesophageal varices of 0.55 among exposed patients, the minimum required sample size was estimated to be approximately 38–40 subjects.

Due to the rarity of myeloproliferative neoplasms and the infrequent occurrence of portal hypertension requiring endoscopic evaluation, total enumeration sampling was employed. All eligible patients meeting the inclusion criteria within the defined study period were included. Although the final sample size did not reach the initially estimated minimum, the study provides valuable preliminary data in a rare patient population and offers clinically relevant insights that may inform future larger-scale investigations.

Study Plan

Requests for Permission/Approval

The study protocol was reviewed and approved by the adviser and technical review board prior to submission to the East Avenue Medical Center – Institutional Ethics Review Board (EAMC-IERB). Ethical approval was obtained before data collection commenced. The study was conducted in accordance with the Declaration of Helsinki, the National Ethical Guidelines for Research Involving Human Participants (2022), and Republic Act No. 10173 (Data Privacy Act of 2012). Permission to access patient records was secured from the Medical Records Section of East Avenue Medical Center.

Data Gathering Procedure

Medical records of all patients diagnosed with myeloproliferative neoplasms at EAMC between January 1, 2021 and December 31, 2025 were reviewed. Data abstraction was performed using a standardized data collection form to ensure consistency, accuracy, and reliability. The principal investigator served as the sole data abstractor and reviewed each medical record to ensure data completeness and quality.

The following variables were extracted from the medical records: age, sex, body mass index, history of alcohol use, comorbidities, type of MPN, time interval between MPN diagnosis and endoscopic screening, presence of hepatosplenomegaly, ascites, edema, history of thrombosis including splanchnic vein thrombosis, JAK2 mutation status, and laboratory parameters including red blood cell count, hemoglobin, platelet count, white blood cell count, total bilirubin, alanine aminotransferase, and aspartate aminotransferase.

Endoscopic findings were obtained from official EGD reports. Patients were categorized into two groups based on EGD results: those with gastroesophageal varices and those without varices. Varices were graded as follows: Grade 1 (small, straight varices), Grade 2 (enlarged, tortuous varices occupying less than one-third of the esophageal lumen), and Grade 3 (large varices occupying more than one-third of the esophageal lumen).

Outcomes of the Study

The primary outcome was the identification of clinicodemographic and clinical factors associated with the presence of gastroesophageal varices using logistic regression analysis. The secondary outcome was the prevalence of gastroesophageal varices among patients with myeloproliferative neoplasms and portal hypertension during the study period computed as follows:

$$\Pr evalence\ of\ esophageal\ \text{var}ices = \frac{patients\ with\ esopnageat\ \text{var}ices}{All\ patients\ diagnosed\ with\ MPNs\ from\ 2021-2025}$$

Data Management and Archiving

All collected data were de-identified prior to analysis. Raw paper records were scanned and stored as PDF files, while electronic data were encoded in Microsoft Excel spreadsheets. The final dataset was stored in CSV format and made accessible only to the principal investigator and the statistician.

De-identified datasets were archived securely and retained for a period of three years following study completion. All electronic data were permanently deleted thereafter using irreversible deletion methods.

Statistical Treatment of Data

Data were encoded and analyzed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA) and Epi Info version 7 (Centers for Disease Control and Prevention, Atlanta, GA, USA). Continuous variables were summarized using mean and standard deviation (SD) for normally distributed data or median and interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as frequencies and percentages.

Normality of continuous variables was assessed using the Shapiro–Wilk test. For comparisons between groups, appropriate inferential statistical tests were applied based on data type and distribution. Differences in categorical variables were analyzed using the Chi-square test or Fisher's exact test, as appropriate.

For comparison of continuous variables between two independent groups (patients with and without gastroesophageal varices), the independent samples t-test was used for normally distributed data, while the Mann–Whitney U test was applied for non-normally distributed data. For comparison of continuous variables across three or more groups, particularly among different types of myeloproliferative neoplasms, one-way analysis of variance (ANOVA) was employed for normally distributed variables. When ANOVA demonstrated a statistically significant difference, post hoc pairwise comparisons were conducted using the Tukey honestly significant difference (HSD) test to identify specific group differences. For non-normally distributed variables across multiple groups, the Kruskal–Walli's test was used.

Univariate logistic regression analysis was performed to evaluate the association between individual clinicodemographic and clinical variables and the presence of gastroesophageal varices. Variables with a p-value of <0.20 in univariate analysis and those deemed clinically relevant were considered for inclusion in the multivariate logistic regression model to identify factors independently associated with varices.

Multicollinearity was assessed prior to model construction, and variables demonstrating significant collinearity or unstable estimates were excluded from the final model to ensure robustness.

Results of logistic regression analyses were reported as odds ratios (ORs) with corresponding 95% confidence intervals (CIs). A two-tailed p-value of <0.05 was considered statistically significant for all analyses.

Results and Discussion

Results

A total of 40 patients diagnosed with myeloproliferative neoplasms (MPNs) and who underwent endoscopic evaluation between 2021 and 2025 were included in the analysis. The sociodemographic and baseline clinical characteristics of the study population are summarized in Table 1. The largest proportion of patients belonged to the 40–59-year age group (40%), followed by those aged 18–39 years (35%) and those older than 60 years (25%). Females comprised slightly more than half of the cohort (52.5%), while males accounted for 47.5%. Primary myelofibrosis was the most common MPN subtype (47.5%), followed by polycythemia vera (27.5%) and chronic myeloid leukemia (25%). No patients with essential thrombocythemia were included.

With respect to the timing of endoscopic screening, 60% of patients underwent endoscopy within the first year after MPN diagnosis, with equal proportions screened at <6 months and 6–11 months (30% each). The remaining patients were screened between 1 and 3 years (12.5%), 3 to 5 years (17.5%), and beyond 5 years (10%). Hepatomegaly was documented in 25% of patients, while thrombosis was present in 12.5%. The mean portal vein diameter was 12.7 ± 3.95 mm, splenic vein diameter was 13.18 ± 2.96 mm, splenic index was 1802.03 ± 981.87, and mean platelet count was 392.26 ± 364.99 ×10⁹/L.

Table 1: Sociodemographic and clinical profiles of the study population

Variables	Frequency	Percentage
Age		
18-39 years	14	35%
40-59 years	16	40%

>60 years	10	25%
Sex		
Male	19	47.50%
Female	21	52.50%
Types of myeloproliferative neoplasms		
Polycythemia Vera	11	27.50%
Chronic Myeloid Leukemia	10	25%
Primary Myelofibrosis	19	47.50%
Essential Thrombocythemia	0	0%
Time interval between MPN diagnosis and endoscopic screening		
< 6 months	12	30%
6 to 11 months	12	30%
1 to 3 years	5	12.50%
3 to 5 years	7	17.50%
> 5 years	4	10%
Hepatomegaly	10	25%
Thrombosis	5	12.5%
Portal vein diameter (mm)	12.7	3.95
Splenic vein diameter (mm)	13.18	2.96
Splenic Index	1802.03	981.87
Platelet count (×10⁹/L)	392.26	364.99

The prevalence of gastroesophageal varices among patients with MPN is shown in Table 2. Overall, 23 patients (57.5%) were found to have varices on endoscopic examination, while 17 patients (42.5%) had no varices. Among those with varices, esophageal varices alone were present in 27.5% of patients, gastric varices alone in 2.5%, and combined esophageal and gastric varices in 27.5%.

Table 2: Prevalence of gastroesophageal varices in MPN patients with portal hypertension between 2021 to 2025

Variables	Frequency	Percentage
No varices	17	42.50%
With varices	23	57.50%
Esophageal	11	27.50%
Gastric	1	2.50%
Both esophageal and gastric	11	27.50%

The distribution of varices according to MPN subtype is illustrated in Figure 1. Varices were most frequently observed among patients with primary myelofibrosis (78.95%), followed by polycythemia vera (45.45%) and chronic myeloid leukemia (30%). No cases of varices were observed among patients with essential thrombocythemia.

A comparison of endoscopic parameters among patients with varices stratified by MPN subtype is presented in Table 3. The distribution of variceal size differed significantly across disease groups (two-sided Fisher exact test, p = 0.024), with small varices observed only among patients with chronic myeloid leukemia. No statistically significant differences were observed in the number of columns (p=0.317), portal vein diameter (p=0.797), splenic vein diameter (p=0.310), or splenic index (p=0.162) among the different MPN subtypes. The presence of collateral vessels was noted in 80% of patients with polycythemia vera, 33.33% of those with chronic myeloid leukemia, and 80% of those with primary myelofibrosis, with no statistically significant difference among groups (p=0.229).

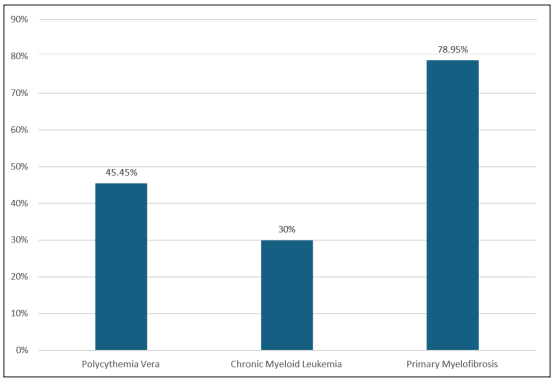

Figure 2: Prevalence of varices according to type of MPN

Table 3: Endoscopic findings according to type of myeloproliferative neoplasm

Polycythemia Vera	Polycythemia Vera	Chronic Myeloid Leukemia	Primary Myelofibrosis	P-value
Size of Varices				
Small	0 (0%)	2 (66.67%)	0 (0%)	0.024
Large	5 (100%)	1 (33.33%)	15 (100%)	
Columns	3.60 (2.70)	2.00 (1.73)	3.60 (1.18)	0.317
Portal vein diameter	13.20 (3.42)	11.67 (5.51)	13.33 (3.77)	0.797
Splenic vein diameter	13.40 (1.67)	12.67 (3.21)	14.73 (2.46)	0.310
Splenic Index	1896.33 (654.57)	892.10 (129.81)	1981.32 (975.19)	0.162
Presence of collateral vessels	4 (80%)	1(33.33%)	12 (80%)	0.229

The results of univariate and multivariate logistic regression analyses evaluating factors associated with the presence of varices are shown in Table 4. In the univariate logistic regression analysis, age demonstrated a statistically significant association with the presence of varices. Compared with patients aged 18–39 years, those aged 40–59 years had lower odds of having varices (OR: 0.06, 95% CI: 0.01–0.57, p = 0.015), while patients older than 60 years likewise had reduced odds (OR: 0.03, 95% CI: 0.00–0.38, p

= 0.006). Splenic vein diameter was also significantly associated with the presence of varices in the univariate model, with increasing diameter associated with higher odds of varices (OR: 1.38, 95% CI: 1.05–1.80, p = 0.020). Platelet count showed a significant inverse association, wherein higher platelet counts were associated with lower odds of varices (OR: 0.99, 95% CI: 0.99–1.00, p = 0.004). Other variables, including sex (OR: 0.45, 95% CI: 0.13–1.62, p = 0.221), type of myeloproliferative neoplasm, hepatomegaly (OR: 0.21, 95% CI: 0.05–1.01, p =

0.052), thrombosis (OR: 3.37, 95% CI: 0.34–33.26, p = 0.299), portal vein diameter (OR: 1.06, 95% CI: 0.90–1.25, p = 0.468), and splenic index(OR: 1.01, 95% CI: 1.00–1.03, p = 0.887), were not statistically significant.

In the multivariate logistic regression model, platelet count remained independently associated with the presence of varices after adjustment for covariates (adjusted OR: 0.99, 95% CI: 0.98–1.00, p = 0.020). Sex (adjusted OR: 0.46, 95% CI: 0.05–3.88, p = 0.473), hepatomegaly (adjusted OR: 1.45, 95% CI: 0.88–2.39, p = 0.149), splenic vein diameter (adjusted OR: 1.45, 95% CI: 0.88–2.39, p = 0.149), and splenic index (adjusted OR: 1.01, 95% CI: 1.00–1.03, p = 0.202) did not demonstrate statistically significant associations in the adjusted model. Variables such as age group and portal vein diameter were not included in the multivariate model because of collinearity. Thrombosis and type of MPNs were excluded from the final adjusted model due to small subgroup sizes and wide confidence intervals that limited model stability. These exclusions were made to ensure the robustness and validity of the multivariate regression analysis.

Table 4: Logistic regression analysis of factors associated with varices among patients with MPNs

Variables	Univariate		Multivariate	
	OR [95% CI]	P-value	OR [95% CI]	P-value
Age (18-39 years as reference)				
40-59 years	0.06 [0.01 - 0.57]	0.015	-	-
>60 years	0.03 [0.00 - 0.38]	0.006	-	-
Sex (female as reference)	0.45 [0.13 - 1.62]	0.221	0.46 [0.05 - 3.88]	0.473
Types of myeloproliferative neoplasms (Polycythemia Vera as reference)				
Chronic Myeloid Leukemia	0.51 [0.09 - 3.11]	0.469	-	-
Primary Myelofibrosis	4.5 [0.89 -22.74]	0.069	-	-
Essential Thrombocythemia	-	-	-	-
Hepatomegaly	0.21 [0.05 - 1.01]	0.052	1.45 [0.88 - 2.39]	0.149
Thrombosis	3.37 [0.34 -33.26]	0.299		
Portal vein diameter	1.06 [0.90 - 1.25]	0.468	-	-
Splenic vein diameter	1.38 [1.05 - 1.80]	0.020	1.45 [0.88 - 2.39]	0.149
Splenic Index	1.01 [1.00 - 1.03]	0.887	1.01 [1.00 - 1.03]	0.202
Platelet count	0.99 [0.99 - 1.00]	0.004	0.99 [0.98 - 1.00]	0.020

Discussion

MPNs are well recognized as a cause of non-cirrhotic portal hypertension through mechanisms distinct from chronic liver disease. The development of portal hypertension in MPNs is multifactorial and is driven by splanchnic vein thrombosis, progressive splenomegaly with increased splenoportal blood flow, extramedullary hematopoiesis, and increased intrahepatic vascular resistance despite preserved hepatic architecture [3,4,18]. These hemodynamic alterations promote the formation of portosystemic collaterals, leading to esophageal and gastric varices. Portal hypertension has been reported in approximately 10–15% of patients with myeloproliferative neoplasms, although its true prevalence may be underestimated due to subclinical disease and delayed recognition [3,17]. In this population, variceal bleeding may represent the initial clinical manifestation, particularly in patients without underlying liver disease [4,21]. Consistent with these observations, the present study demonstrated a high prevalence of esophageal and gastric varices among MPN patients with portal hypertension. While lower prevalence rates of 7–18% have been described in unselected MPN cohorts [3,5], gastroesophageal varices are frequently present and clinically significant once portal hypertension develops, reflecting its pivotal role in the progression and clinical burden of MPN-related vascular complications [4,17,18].

Primary myelofibrosis was the most common MPN subtype among patients with varices in this cohort. This is consistent with multiple studies identifying primary myelofibrosis as having a particularly strong association with portal hypertension and variceal formation [2,6,18]. Progressive marrow fibrosis, marked splenomegaly, and extensive extramedullary hematopoiesis contribute to increased portal venous inflow and altered splanchnic circulation in these patients. Polycythemia vera and essential thrombocythemia have also been frequently linked to portal hypertension, particularly through splanchnic vein thrombosis, while chronic myeloid leukemia has been less commonly implicated but remains a recognized cause [3,6,13].

Several clinical and laboratory factors have been proposed as predictors of varices in patients with portal hypertension, including splenomegaly, ascites, thrombocytopenia, portal vein diameter, splenic vein diameter, and the presence of collateral vessels on imaging [15,16]. In cirrhotic and non-cirrhotic portal hypertension alike, platelet count has been consistently reported as a surrogate marker of portal hypertension severity, reflecting hypersplenism and portal pressure elevation [15,20]. Although multiple parameters were evaluated in the present study, platelet count emerged as an independent factor associated with varices, supporting its role as a readily available and clinically useful indicator in MPN patients. This finding aligns with prior studies demonstrating the utility of platelet-based indices in predicting varices, particularly in settings where access to advanced imaging or hepatic venous pressure measurements is limited [15,16]. Other factors reported in the literature, such as ascites, edema, portal vein thrombosis, JAK2 mutation status, and hepatic synthetic dysfunction, have been variably associated with variceal development and bleeding risk in MPN-related portal hypertension [6,13,21].

From a clinical standpoint, the findings of this study highlight the substantial burden of gastroesophageal varices among MPN patients with portal hypertension and underscore the importance of vigilant surveillance. Variceal bleeding in this population is associated with significant morbidity and a poorer prognosis, and management is often complicated by concurrent thrombosis,

cytopenias, and the need for long-term anticoagulation [3,5,19]. Early identification of high-risk patients using accessible clinical markers such as platelet count and splenic vascular parameters may facilitate timely endoscopic screening and prophylactic interventions, particularly in tertiary government hospitals where resource constraints are common.

Overall, this study contributes to the growing body of evidence characterizing portal hypertension and its complications in MPN patients within a local setting. The results emphasize the need for heightened awareness among clinicians managing MPNs and support a multidisciplinary approach integrating hematologic and gastroenterologic care. Further prospective and multicenter studies are needed to refine risk stratification strategies, explore the prognostic impact of molecular and thrombotic factors, and evaluate preventive measures aimed at reducing variceal bleeding in this high-risk population.

Conclusion and Recommendations

Conclusion

This study demonstrated the high prevalence of gastroesophageal varices among patients with myeloproliferative neoplasms (MPNs) and portal hypertension in a tertiary government hospital, with more than half of the cohort affected. Varices were most frequently observed in patients with primary myelofibrosis, followed by polycythemia vera and chronic myeloid leukemia, highlighting important differences across MPN subtypes. Endoscopic characteristics varied by MPN type, with significantly larger varices noted in polycythemia vera and primary myelofibrosis. Among the clinicodemographic and clinical factors evaluated, platelet count emerged as the only independent factor significantly associated with the presence of varices, with lower platelet levels conferring higher risk. These findings underscore the substantial burden of gastroesophageal varices in MPN patients with portal hypertension and support the use of readily available clinical markers, particularly platelet count, to aid in risk stratification and guide timely endoscopic surveillance in this high-risk population.

Recommendations

Based on the findings of this study, routine vigilance for gastroesophageal varices should be emphasized among patients with myeloproliferative neoplasms (MPNs), particularly those with established portal hypertension. Given the high prevalence of varices observed, early and proactive endoscopic screening should be strongly considered, even in the absence of overt gastrointestinal bleeding, to allow timely detection and prevention of potentially life-threatening complications.

Patients with primary myelofibrosis should be given particular consideration for closer surveillance, as this subgroup demonstrated the highest burden of gastroesophageal varices and larger variceal size on endoscopy. This supports the integration of MPN subtype into clinical risk assessment when determining the need and timing for endoscopic evaluation.

Platelet count, which emerged as the only independent factor associated with the presence of varices, should be utilized as a readily available and cost-effective marker to aid in risk stratification. Lower platelet counts may reflect hypersplenism and more advanced portal hypertension; thus, MPN patients with thrombocytopenia should be considered at higher risk and evaluated promptly for varices. Incorporating platelet count into institutional screening algorithms may improve early identification of high-risk patients, particularly in resource-limited tertiary government hospitals.

Multidisciplinary collaboration between hematology and gastroenterology services is strongly recommended to optimize the care of MPN patients. Coordinated management may facilitate appropriate timing of endoscopy, balanced anticoagulation strategies in patients with concurrent thrombosis, and individualized prophylactic interventions such as non-selective beta-blockers or endoscopic variceal ligation when indicated.

At the institutional level, the development of standardized clinical pathways or local guidelines for the screening and monitoring of portal hypertension and varices in MPN patients is encouraged. These protocols may help reduce variability in care, improve early detection, and potentially decrease morbidity related to variceal bleeding.

Future research should involve larger, multicenter, and preferably prospective studies to validate the prevalence estimates and risk factors identified in this study and improve generalizability. A larger sample size would allow more robust multivariate modeling and enable inclusion of additional variables that could not be fully analyzed in the present study.

Further studies should evaluate the role of molecular and thrombotic factors, including JAK2 mutation status and splanchnic vein thrombosis, in the development and progression of portal hypertension and gastroesophageal varices among MPN patients. Clarifying these associations may enhance risk stratification and guide targeted surveillance strategies.

Longitudinal studies assessing clinical outcomes, such as variceal bleeding, rebleeding rates, and mortality, are warranted to determine the prognostic impact of gastroesophageal varices in this population. Additionally, future research should explore the effectiveness of early endoscopic screening and prophylactic interventions in reducing bleeding-related complications and improving patient outcomes.

Finally, the development and validation of non-invasive predictive models incorporating platelet count, splenic vascular parameters, and clinical features may provide practical tools for identifying high-risk MPN patients in settings where access to routine endoscopy is limited.

PUBLICATION AND PRESENTATION

The results of the study will be made accessible to the scientific community and otherwise generally benefit society by submitting manuscripts for publication in scientific journals, presenting research results at scientific conferences, posting research data to a publicly available web site, providing data to clinicians and researchers on request, and participating in media interviews fulfill expectations and requirements for dissemination of results. The Principal Investigator (PI) is responsible for validation of results to be disseminated and for determining when and how they will

be circulated upon the approval of EAMC-IERB Collaborators should be consulted regarding all of these activities, as appropriate.

ETHICAL CONSIDERATIONS

The research study adhered to the national/international ethical guidelines such as the International Conference on Harmonization – Good Clinical Practice (ICH-GCP), Declaration of Helsinki, WHO Guidelines, Data Privacy Act of 2012 and its Implementing Rules and Regulations and the National Ethical Guidelines for Research Involving Human Participants of 2022. It underwent review and approval of the EAMC-IERB before data collection was done.

Conflict of Interest

This study was self-funded by the principal investigator. There was be no conflict of interest in this study.

Privacy and Confidentiality

The following actions were applied to maintain data confidentiality:

1. Patients were given a unique (random) study identification number. The ID number represented all participant data that are gathered, entered, and analyzed for the study.
2. The connection between participants' names and study ID numbers was kept in a different electronic file (using password protected computers), guaranteeing that all information prepared for analysis is de-identified. Directly identifying information was never be kept in the same files.
3. Whenever possible, paper data were only marked with the participant's study ID. Any direct identifiers were stripped off from paper data as soon as it is processed for data entry.
4. Electronic data were removed of participants' names and other identifiable information.
5. It was ensured that data, especially in electronic format, are accessible to authorized personnel only, and appropriately archived or deleted. These files were limited to the researcher's access and were not released for other purposes except for this study only.
6. Tabulations of the data gathered were stored only in the private computer of the principal investigator, which is password- and biometric-protected. It was then passed exclusively to the statistician for computation of data.

Direct or Indirect Benefits to the Patients or Institution

There is no direct benefit to the study participants. However, any generalizable information can be used to develop patient education and guidelines aimed at improving patient outcomes.

Risks Involved in the Conduct of Study

There is minimal risk of data breach in the study. To avoid data being exposed to a person who is not authorized to access it, the use of control numbers in hard copies of data were employed; for electronic data, the use of strong password, latest version of software system and creation of response plan for reporting to appropriate authorities. EAMC-IERB was informed in the event that breach is detected.

Plan for Disposing Electronic Data

All electronic data were deleted permanently three years after completion of the study. When data is destroyed it must be irreversible with no possibility of recovery. Digital data may be destroyed by deleting or overwriting data or destroying the physical media (e.g. CD-ROMS).

Informed Consent and Recruitment Process

Being retrospective in nature, this study did not entail any recruitment of human subjects hence, there is no need for informed consent. The permission of the Medical Records Section of EAMC was secured before access to medical records is done.

Vulnerability: No vulnerability issues are anticipated.

Assent: Not applicable. No human subjects were involved.

Compensation, and Incentive: There was none. This study was self-funded by the principal investigator.

References

1. Hermouet S, Bigot-Corbel E, Gardie B. Pathogenesis of myeloproliferative neoplasms: role and mechanisms of chronic inflammation. Mediators Inflamm. 2015;2015:145293. doi:10.1155/2015/145293.
2. McMullin MF, Anderson LA. Aetiology of myeloproliferative neoplasms. Cancers (Basel). 2020;12(7):1810. doi:10.3390/cancers12071810.
3. Huang X, Zhang M, Ai Y, Jiang S, Xiao M, Wang L, et al. Characteristics of myeloproliferative neoplasm-associated portal hypertension and endoscopic management of variceal bleeding. Ther Adv Chronic Dis. 2022. 13: 20406223221125691.
4. Toros AB, Gokcay S, Cetin G, Ar MC, Karagoz Y, Kesici B. Portal hypertension and myeloproliferative neoplasms: a relationship revealed. ISRN Hematol. 2013. 2013: 673781
5. Reilly CR, Babushok DV, Martin K, Spivak JL, Streiff M, Bahirwani R, et al. Multicenter analysis of the use of transjugular intrahepatic portosystemic shunt for management of MPN-associated portal hypertension. Am J Hematol. 2017. 92: 909-914.
6. Chia YC, Siti Asmaa MJ, Ramli M, Woon PY, Johan MF, Hassan R, et al. Molecular genetics of thrombotic myeloproliferative neoplasms: implications in precision oncology. Diagnostics (Basel). 2023. 13:163.
7. Yassin MA, Taher A, Mathews V, Hou HA, Shamsi T, Tuğlular TF, et al. MERGE: a multinational, multicenter observational registry for myeloproliferative neoplasms in Asia, including Middle East, Turkey, and Algeria. Cancer Med. 2020. 9: 4512-4526.
8. Pizzi M, Croci GA, Ruggeri M, Tabano S, Dei Tos AP, et al. The classification of myeloproliferative neoplasms: rationale, historical background and future perspectives with focus on unclassifiable cases. Cancers (Basel). 2021. 13: 5666.
9. Ozygała A, Rokosz-Mierzwa J, Widz P, Skowera P, Wiliński M, et al. Biological markers of myeloproliferative neoplasms in children, adolescents and young adults. Cancers (Basel). 2024. 16: 4114.
10. Tremblay D, Yacoub A, Hoffman R. Overview of myeloproliferative neoplasms: history, pathogenesis,

diagnostic criteria, and complications. Hematol Oncol Clin North Am. 2021. 35: 159-176.

11. Verstovsek S, Yu J, Scherber RM, Verma S, Dieyi C, et al. Changes in the incidence and overall survival of patients with myeloproliferative neoplasms between 2002 and 2016 in the United States. Leuk Lymphoma. 2022. 63: 694-702.
12. Pescia C, Lopez G, Cattaneo D, Bucelli C, Gianelli U, et al. The molecular landscape of myeloproliferative neoplasms associated with splanchnic vein thrombosis: current perspective. Leuk Res. 2024. 136: 107420.
13. Liu A, Naymagon L, Tremblay D. Splanchnic vein thrombosis in myeloproliferative neoplasms: treatment considerations and unmet needs. Cancers (Basel). 2023. 15: 11.
14. Link CS, Platzbecker U, Kroschinsky F, Pannach S, Thiede C, et al. Association of oesophageal varices and splanchnic vein thromboses in patients with JAK2-positive myeloproliferative neoplasms: presentation of two cases and data from a retrospective analysis. Case Rep Oncol. 2013. 6: 311-315.
15. Sutton R, Shields R. Alcohol and oesophageal varices. Alcohol Alcohol. 1995. 30: 581-589.
16. Cherian JV, Deepak N, Ponnusamy RP, Somasundaram A, Jayanthi V. Non-invasive predictors of esophageal varices. Saudi J Gastroenterol. 2011. 17: 64-68.