Section: General Medicine

Original Research Article

PREVALENCE AND CLINICAL CORRELATES OF PULMONARY ARTERIAL HYPERTENSION IN CIRRHOSIS OF THE LIVER: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Pulmonary arterial hypertension (PAH) is a crucial, yet often underdiagnosed, complication of liver cirrhosis. When identified, the latter signals a bad prognosis and involves added risks during LT, so an early diagnosis becomes necessary for its treatment. **Objectives:** This study aimed to investigate the prevalence of PAH in cirrhotic patients and evaluate its association with patient demographic details, the etiology of liver disease, and the severity of liver function.

Materials and Methods: This cross-sectional study was conducted on 50 patients admitted with cirrhosisover two years. All patients received a detailed clinical examination, laboratory studies, and 2D echocardiography. Liver disease was classified according to the Child-Pugh system and the MELD score.

Results: There were 50 patients in the study group, 44 males and six females, with an average age of 47 years (ranging from 27 to 66 years). Of the 50 subjects, 11 were found to have pulmonary arterial hypertension (22% of the population studied). It was disproportionately more prevalent in women, although they had a shorter duration of alcohol use compared with men. Patients were detected to have a mean age of 46 years in men and 55 years in women. Statistical analysis showed that PAH was associated with the severity of cirrhosis based on CP classification and MELD score.

Conclusion: In this study, nearly one-fifth of cirrhotic patients had pulmonary arterial hypertension. Because of the strong correlation with disease stage, echocardiographic screening should be considered as part of the regular assessment, even in patients scheduled for liver transplant.

Keywords: Cirrhosis, pulmonary arterial hypertension, Child-Pugh score, MELD score, echocardiography.

INTRODUCTION

Cirrhosis is the late stage of chronic liver disease and a cause of significant morbidity and mortality worldwide.[1] It is characterized by a gradual process of fibrosis (scarring of the liver) and the development of regenerative nodules (lumps that indicate areas of new liver growth) and nodules of abnormal architecture of liver cells. The global burden of cirrhosis is high, and it is one of the leading causes of death across the globe.[2] Besides liver function failure, patients frequently present with systemic and extrahepatic involvement, which significantly influences prognosis.[3]

Pulmonary vascular complications are a significant cause of morbidity in cirrhosis.[4] Two well-characterized diseases illustrate this relationship: hepatopulmonary syndrome (HPS) with vascular dilatation in the lungs and arterial hypoxemia and portopulmonary hypertension (POPH) with pulmonary arterial hypertension in the setting of portal hypertension.[5] In contrast to HPS, where the pathophysiology is really that of abnormal gas exchange, the development of the PAH associated with liver disease is characterized by progressive

elevation of the pulmonary artery pressures, an increase in the resistance, and ultimately the development of right-sided cardiac failure.[6]

Pulmonary arterial hypertension in cirrhosis is more than a pathophysiological finding; it is a clinically relevant complication with serious consequences.[7] Symptomatic patients may present with exertional dyspnoea, fatigue, episodes of syncope, and signs of right heart strain.[8] The symptoms frequently overlap with advanced liver disease, which leads to delayed diagnosis.[9] It is a poor quality of life, a high percentage of decompensation, and a low survival status that are observed with the presence of PAH. In potential liver transplant candidates, it also significantly contributes to the peri-transplantation risks, which emphasizes the importance of its timely diagnosis.[10]

The reported prevalence of PAH in cirrhosis varies, but most studies suggest a frequency between 20% and 23%.[11] Despite this, routine screening is not universally practiced, and many cases go unrecognized until advanced disease develops.[12] Transthoracic echocardiography offers a simple, non-invasive method to detect elevated pulmonary pressures, enabling clinicians to identify patients at risk and refer them for further evaluation.[13]

Given the clinical consequences and limited therapeutic options once advanced PAH is established, recognizing its occurrence in cirrhosis is of paramount importance. Therefore, this study was undertaken to determine the prevalence of pulmonary arterial hypertension in patients with liver cirrhosis and to explore its association with demographic characteristics and severity of liver disease, as assessed by Child-Pugh classification and MELD score.

MATERIALS AND METHODS

Study design and setting: This was a cross-sectional, hospital-based study in the Department of General Medicine at a tertiary care teaching hospital over two years, from September 2017 to August 2019. The study was designed to evaluate the prevalence of pulmonary arterial hypertension among patients with liver cirrhosis and its correlation with disease severity.

Study population: The study included fifty consecutive patients admitted with a diagnosis of liver cirrhosis. The diagnosis was based on clinical features, biochemical abnormalities, ultrasonographic findings, and endoscopic evidence of portal hypertension. Patients were recruited after fulfilling the eligibility criteria, and informed consent was obtained before enrollment.

Inclusion and exclusion criteria: Patients were considered for the study population if they were 18 years old or above and were diagnosed with liver cirrhosis. Exclusion criteria included the presence of underlying primary heart or lung disease, tense ascites, systemic hypertension, severe anemia (hemoglobin level <8 g/dL), chronic pulmonary thromboembolism, or the presence of HIV antibodies. These exclusion criteria were selected to minimize confounders that could otherwise influence pulmonary artery pressure measurements.

Data collection: All participants had a thorough clinical examination that started with a past medical and historical review, followed by a complete review of systems. Complaints such as abdominal bloating, edema of the lower extremities, jaundice, dyspnoea, and markers of hepatic encephalopathy were focused on. Systemic examination to seek signs of portal hypertension (splenomegaly, ascites, dilated abdominal wall veins, and other signs of disease of the liver).

Laboratory and imaging investigations: Baseline assessment consisted of CBC and evaluation of liver, renal, and coagulation functions (PT, APTT, INR). Viral markers, namely HBsAg and anti-HCV, were also tested. Abdominal ultrasound was used for imaging to assess the liver, degree of splenomegaly, ascitic collection, and portal vein size. Varices were found up to the upper part of the gastrointestinal tract by endoscopy, and features of portal hypertension were confirmed. All patients also underwent chest radiography and ECG to rule out underlying cardiac or pulmonary disease.

Echocardiographic evaluation: Two-dimensional transthoracic echocardiography was performed in all patients. The pulmonary artery systolic pressure was estimated from tricuspid regurgitant jet velocity with the Bernoulli equation. Resting pressures greater than 25 mmHg were accepted as indicative of PAH. Right atrium and ventricular dimensions were also measured to assess cardiac remodelling concerning pulmonary hypertension.

Assessment of the severity of cirrhosis: The severity of hepatic dysfunction was defined according to the Child-Pugh class and MELD scores. The former classifies patients into three categories (A, B, and C) according to the clinical and laboratory parameters, and the latter provides a calculated number to represent the objective marker of disease severity.

Statistical Analysis: Descriptive statistics were generated to summarize the study population, and inferential tests were used to test the hypothesis. For continuous data, the means with standard deviations were given; for categorical data, the counts were presented as absolute numbers and percentages. Group differences in categorical variables were assessed using the Chi-square test, while correlation analysis explored the relationship between pulmonary arterial hypertension and the degree of liver dysfunction. A threshold of $p < 0.05$ denoted statistical significance.

RESULTS

Baseline characteristics: The study included 50 liver cirrhosis patients, 44 (88%) males and 6 (12%) females. [Figure 1]

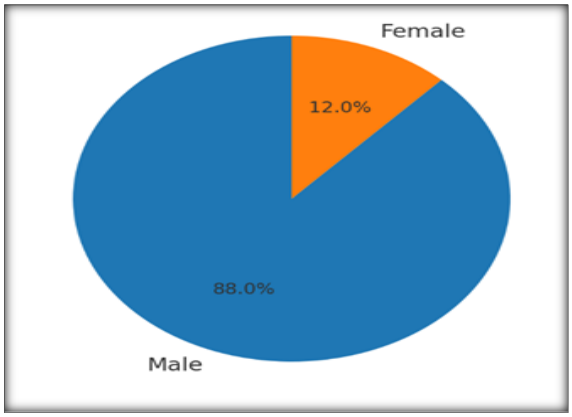

Figure 1: Sex Distribution of Patients

The cohort's mean age was 47.2, ranging from 27 to 66. Most male patients were 41–50 years old (47%), while most female patients (66%) belonged to the 51–60-year age group. All patients reported chronic alcohol intake as the etiology of cirrhosis, and no cases related to viral hepatitis were observed in this series.

Clinical presentation: The most common presenting complaints were abdominal distension, pedal edema, and jaundice, all of which were observed in every patient. Dyspnoea was present in 98% of cases, while reversal of sleep rhythm was seen in 36%. Confusion and altered sensorium were noted in 16% of patients. Fever was reported in 26%, melena in 12%, and hematemesis in 2%.

On clinical examination, ascites and visible abdominal veins were seen in all patients. Spider naevi were present in 62%, flapping tremors in 52%, and palmar erythema in 36%. Splenomegaly was detected in 14%, while gynecomastia and hepatomegaly were less frequent. Altered sensorium was noted in 16% of cases. [Table 1]

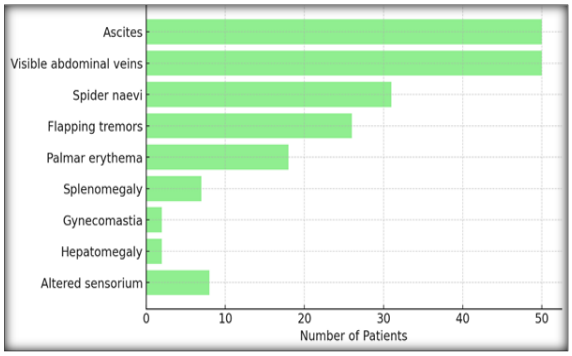

Figure 2: Frequency of signs inpatients

Hematological and biochemical profile: All patients were anaemic, with hemoglobin levels below 12 g/dL. Laboratory profiles showed varying degrees of deranged liver function. Coagulation parameters were prolonged in most cases, reflecting advanced disease.

Echocardiographic findings and prevalence of pulmonary arterial hypertension: Two-dimensional echocardiography demonstrated evidence of pulmonary arterial hypertension in 11 out of 50 patients, giving a prevalence of 22%. The mean pulmonary artery systolic pressure in affected individuals was significantly higher thanthat of individuals without PAH. Notably, pulmonary hypertension was observed more commonly in females despite their shorter duration of alcohol exposure compared with males. The average age at diagnosis of PAH was 46 years in men and 55 years in women. [Figure 2]

Correlation with the severity of cirrhosis: Analysis of severity scores showed that pulmonary arterial hypertension was strongly associated with advanced liver disease. Patients in **Child-Pugh Class C** had a higher prevalence of PAH compared with those in Class A or B, and this association was statistically significant ($p < 0.05$). [Table 3]

Similarly, higher **MELD scores** were positively correlated with the presence of pulmonary hypertension ($p < 0.05$), indicating that worsening hepatic dysfunction is linked to increased risk of pulmonary vascular involvement. [Table 4]

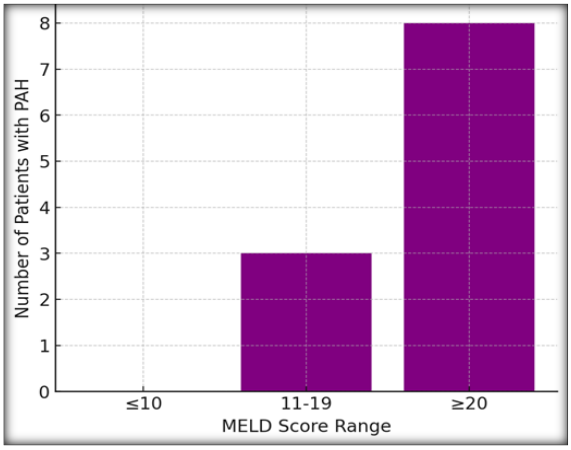

Figure 3: MELD Score and Prevalence of PAH

Electrocardiographic findings

ECG changes consistent with pulmonary hypertension, including right atrial enlargement, right ventricular hypertrophy, and right bundle branch block, were observed more frequently in patients with PAH compared with those without, though these findings were not universal. [Figure 3]

Table 1: Age distribution of patients

Age group (years)	Males	Females	Total
21–30	1	0	1
31–40	12	0	12
41–50	21	1	22
51–60	6	4	10
61–70	4	1	5

Table 2: Frequency of symptoms in patients

Symptom	Number of Patients	Percentage (%)
Abdominal distension	50	100
Pedal edema	50	100
Jaundice	50	100
Dyspnoea	48	98
Confusion	8	16
Reversal of sleep pattern	18	36
Anxiety	8	16
Fever	13	26
Melena	6	12
Hematemesis	1	2

Table 3: Echocardiographic findings (PAH prevalence)

ECHO finding	Number of Patients	Percentage (%)
Patients with PAH	11	22
Patients without PAH	39	78

Table 4: Correlation of Child-Pugh class with PAH

Child-Pugh Class	Total Patients	Patients with PAH	Prevalence (%)
A	7	0	0.0
B	18	2	11.1
C	25	9	36.0

DISCUSSION

This study demonstrated that pulmonary arterial hypertension is a relatively common complication among patients with liver cirrhosis, with an overall prevalence of 22%.[14] This figure falls within the range reported in earlier studies, which have estimated the frequency of PAH in cirrhosis to be between 20% and 23%. The similarity of these findings with global data suggests that the occurrence of PAH in cirrhosis is not confined to a particular geographic or ethnic group but reflects a consistent pathophysiological association.

A striking feature in the present study was the higher relative prevalence of PAH among women compared to men, despite women constituting a much smaller proportion of the total cohort. The average age of onset of PAH was also higher in women (55 years) compared with men (46 years). This observation aligns with previous reports, which suggest that female gender may be an independent risk factor for the development of pulmonary hypertension, possibly due to hormonal or genetic influences on vascular remodelling.[15] However, the smaller number of women in the present study limits the strength of this inference, and larger studies are required to clarify this relationship.

The study also confirmed a strong association between the presence of PAH and the severity of liver disease. Patients in Child-Pugh Class C had a significantly higher prevalence (36%) compared with those in Class B (11.1%) or Class A (0%). Similarly, patients with higher MELD scores showed progressively greater risk, with half of those with MELD scores≥20 demonstrating PAH. These findings indicate that worsening hepatic dysfunction is closely linked to pulmonary vascular involvement. The underlying mechanisms involve increased pulmonary vascular resistance due to vasoconstriction, vascular remodelling, and an imbalance between vasodilators (such as nitric oxide) and vasoconstrictors (such as endothelin-1).

Symptoms of PAH, particularly dyspnoea and fatigue, were observed in nearly all affected patients in this study. However, these features are nonspecific and often overlap with manifestations of cirrhosis itself, which explains why PAH frequently goes unrecognized in clinical practice.[16] The reliance on echocardiography in this study highlights the usefulness of this non-invasive screening tool for early detection. Although right heart catheterization remains the gold standard for diagnosis, echocardiography provides a practical and widely available alternative for routine evaluation.

The presence of pulmonary arterial hypertension in cirrhosis carries crucial prognostic significance. Previous reports have demonstrated that patients with PAH experience higher morbidity, poorer survival rates, and substantially greater perioperative risk when undergoing liver transplantation.[17] This makes early detection essential, as it enables timely referral to specialized care, initiation of appropriate therapy, and more informed decisions regarding transplant candidacy. This study does have certain limitations. The relatively small sample size may reduce the ability to generalize the findings. In addition, right heart catheterization, which remains the gold standard for confirming pulmonary hypertension, was not performed; instead, diagnosis relied on echocardiographic evaluation. Nevertheless, echocardiography has been validated as a practical and reliable screening tool. Despite these constraints, the findings contribute meaningful information on the occurrence of PAH in cirrhotic patients and highlight the importance of incorporating echocardiographic screening into the routine evaluation of those with advanced disease.

CONCLUSION

The findings of this study highlight pulmonary arterial hypertension as a notable complication in patients with liver cirrhosis, with a prevalence of 22% in the examined group. The condition appeared more common in females and was strongly linked with advanced stages of hepatic dysfunction, as indicated by higher Child-Pugh classification and MELD scores. These results emphasize the value of incorporating routine echocardiographic screening into the evaluation of cirrhotic patients, particularly those being considered for transplantation, where undetected pulmonary hypertension may compromise surgical outcomes. Timely identification and appropriate intervention may improve survival prospects and assist clinicians in making informed therapeutic decisions.

Recommendations

Echocardiographic evaluation should form part of the routine assessment of all cirrhotic patients, particularly those with advanced disease and those being considered for liver transplantation, as it enables early recognition of pulmonary arterial hypertension. Management is best achieved through a collaborative approach that brings together hepatologists, cardiologists, and pulmonologists. Including pulmonary pressure measurements in standard pre-transplant evaluations could strengthen risk stratification and aid therapeutic planning. Clinician awareness must also be enhanced, since symptoms such as fatigue and breathlessness are often misattributed to liver disease alone, resulting in missed diagnoses. Further multicentric research, ideally with invasive hemodynamic confirmation, must define PAH's actual burden in cirrhosis and identify effective interventions.

Conflict of Interest: The authors declare no conflict of interest.

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