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Original Research Article

Assessment of the Prevalence and Risk Factors for Pulmonary Artery Hypertension and Corpulmonale in Post Tuberculosis Pulmonary Sequelae

K. Krishna Prabhakar[1], S. Ananth Kumar[2], D. Raghotham Reddy[3*]

[1]Associate Professor, Department of General Medicine, Apollo Institute of Medical Sciences and Research, Jubilee Hills, Hyderabad

[2]Associate Professor, Department of General Medicine, Apollo Institute of Medical Sciences and Research, Jubilee hills, Hyderabad, Telangana, India

[3*]Professor, Department of Pulmonology, Apollo Institute of Medical Sciences and Research, Jubilee hills, Hyderabad, Telangana, India

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Corresponding Author: Dr. D. Raghotham Reddy

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Abstract:

Introduction: Pulmonary tuberculosis (PTB) is a growing worldwide health issue that still leads to substantial illness and death. The effects of PTB have been assessed in relation to both morbidity and death, with little emphasis placed on the persistent respiratory impairment experienced by individuals who have been successfully treated. Pulmonary hypertension (PHT) is a severe respiratory impairment caused by structural lung damage and persistent hypoxia. Nevertheless, the extent of TB-associated PH has not been measured before and must be assessed to understand the impact of this illness. Therefore, the purpose of this research was to evaluate the occurrence and potential causes of pulmonary artery hypertension and corpulmonale in individuals with post TB pulmonary sequelae.

Material and Methods: A total of 122 individuals, aged 21 years and above, with a medical history of pulmonary TB, were selected from those who visited the Outpatient Department (OPD) and were admitted to the Department of Pulmonology. A comprehensive assessment was performed, which included detailed demographic information and clinical characteristics such as drug sensitivity, smoking history, history of TB, extent and type of complications, areas affected and side in chest X-Ray, Transthoracic echocardiography, and spirometry pattern.

Results: The overall prevalence of pulmonary hypertension was 60.66% and occurrence of corpulmonale was 60% among pulmonary hypertension. The statistical analysis revealed a significant association between BMI, smoking status, diabetes mellitus, medication sensitivity, and spirometry data ($p<0.05$). Fibrosis was the most prevalent kind of pulmonary TB sequelae in 55.73% of patients, followed by bronchiectasis (18.85%), cavity (9.83%), bullae (6.55%), aspergilloma (4.91%), and pleural thickening and calcification (4.09%)

Conclusion: Preventing pulmonary hypertension, corpulmonale, morbidity, and mortality from TB requires early diagnosis, appropriate treatment, and adherence. Strong national policies and dedicated health workers reduce TB post-treatment burden.

Keywords: Pulmonary Hypertension, Pulmonary Tuberculosis, Corpulmonale, Sequalae, Fibrosis.

Introduction

Tuberculosis (TB) accounts for a considerable portion of the global disease burden. In 2021, there were an estimated 10.6 million recorded cases of TB. Tuberculosis is a leading cause of death worldwide, driven by a single infectious pathogen.

Pulmonary hypertension (PH) is a condition defined by a resting mean pulmonary arterial pressure (mPAP) more than 20 mmHg. It is estimated that around 1% of the world's population is afflicted by PH, with more than 80% of those affected living in low- and middle-income countries [3]. Over 40% of the Indian population is infected with the mycobacterium. It causes the deaths of 220,000 people each year [4]. Regardless of the aetiology or clinical categorization, PH is often associated with poor outcomes and greater mortality rates [5,6]. Both present and previous occurrences of pulmonary TB are associated with the development of pulmonary hypertension, perhaps owing to various underlying physiological mechanisms [7,8].

Nearly half of TB patients who were microbiologically healed showed pulmonary damage [9]. Sequelae may result in the return of

respiratory symptoms, a decline in quality of life, recurrent exacerbations requiring hospitalisation, numerous complications such as haemoptysis, and an increased risk of mortality. It adds to the unfathomable burden of TB [10]. Sequelae may induce degeneration of the pulmonary vascular bed, resulting in increased pulmonary vascular resistance and the development of pulmonary hypertension.

Chronic hypoxia also plays a role, since it causes blood vessels to constrict due to a lack of oxygen, resulting in structural abnormalities. Prolonged pulmonary hypertension may cause right ventricular hypertrophy and dysfunction, often known as corpulmonale. However, pulmonary tuberculosis has not been found as a risk factor for the development of pulmonary hypertension. The present study was designed to assess the prevalence and risk factors for pulmonary artery hypertension and corpulmonale in post-tuberculosis pulmonary sequelae.

Materials and Methods

The present cross-sectional study was conducted in the Department of Pulmonology in association with Department of General Medicine at Apollo Institute of Medical Sciences and Research, located in Jubilee Hills, Hyderabad from July 2022 to December 2023. A source of 122 cases attending OPD and admitted to department of Pulmonology above 21 years of age was recruited. Cases with history of pulmonary tuberculosis, Chest X-ray depicting the features of post tuberculosis pulmonary sequelae, and not willing to participate were included. Cases with HIV, pregnancy, active lactation, Cardiac complications, History of lung surgeries, malignancies to lungs and not willing to participate were excluded. Written informed consent was obtained from all the study participants and study protocol was reviewed and approved by institutional ethics committee.

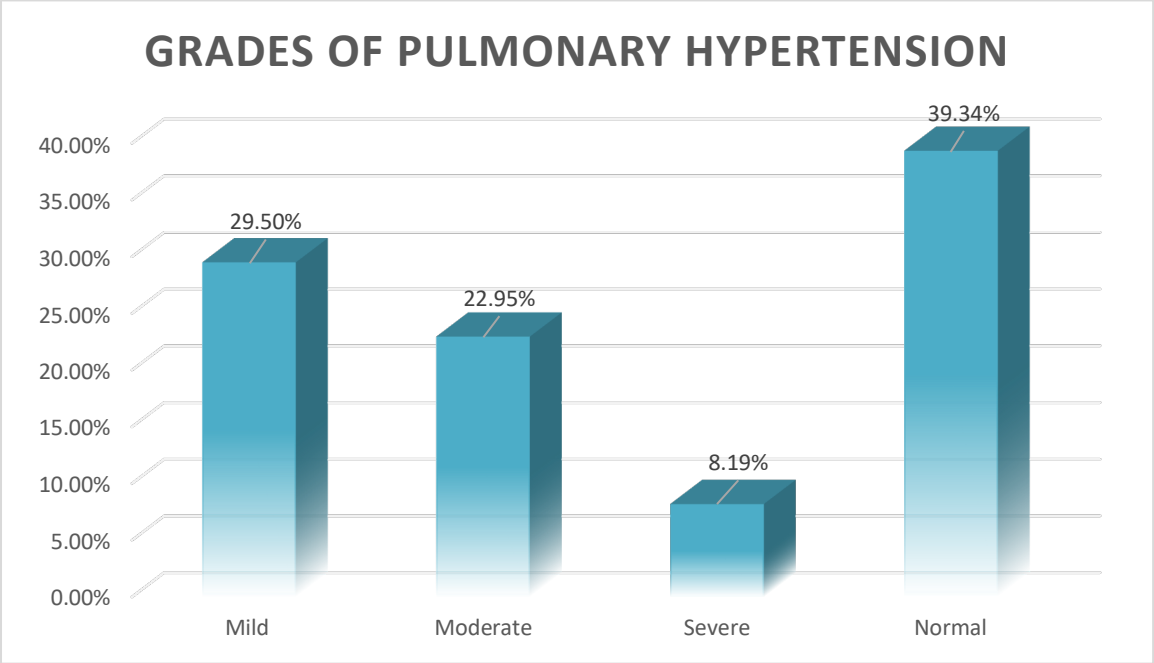
The demographic details and complete clinical profile of study participants including history of pulmonary tuberculosis was collected. Sputum AFB was done to exclude active disease. Chest X-ray was taken and analysed for the type of sequelae and extend of involvement. Spirometry was done and the pattern recorded. ECG was taken. Transthoracic 2D echocardiography (conventional and tissue Doppler analysis) was done in lateral decubitus position from parasternal view, apical four chamber view and the subcostal view. All of the measurements were performed in accordance with the American Society of Echocardiography/ European Association of Echocardiography recommendation.

The collected data was analysed by using SPSS version 32.0. Chi-square test was used to test the significance. Categorical variable was represented in frequency and percentages. Continuous variables were analysed by student's t test. $P<0.05$ was considered s statistically significant outcome.

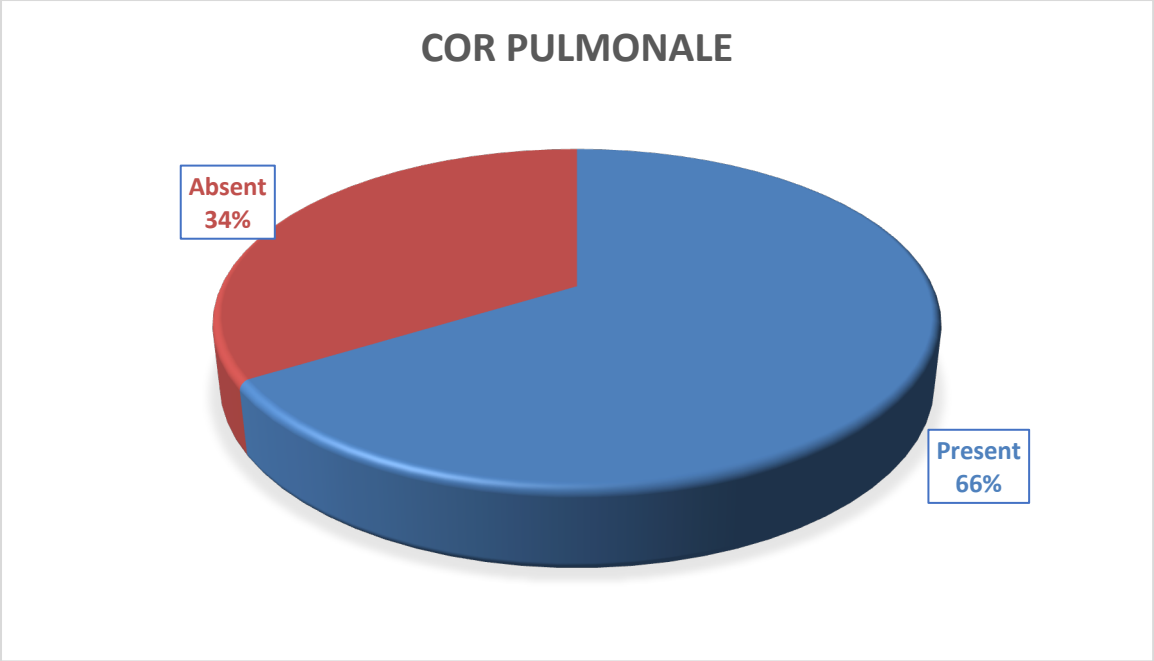
Results

Table 1: Clinico-demographic profile of study participants

Clinico-demographic data	Total no of cases (n=122)	
	Frequency	Percentage
Age (In years)		
21-30	12	9.83%
31-40	23	18.86%
41-50	35	28.68%
51-60	24	19.68%
>60	28	22.96%
Gender		
Male	88	72.13%
Female	34	27.86%
BMI (kg/m^2)		
≤25	54	44.26%
≥25	68	55.73%
Smoking status		
Yes	48	39.34%
No	74	60.65%
Diabetes mellitus	17	13.93%
Status of pulmonary tuberculosis sequelae		
Fibrosis	68	55.73%
Bronchiectasis	23	18.85%
Cavity	12	9.83%
Bullae	08	6.55%
Aspergilloma	06	4.91%
Pleural thickening & calcification	05	4.09%



Graph 1: Distribution of cases as per grades of pulmonary hypertension



Graph 2: Occurrence of corpulmonale among study participants

Table 2: Comparison of risk factors leading for pulmonary hypertension and corpulmonale

Risk factors	Pulmonary hypertension		Corpulmonale	
	Present (n=74)	Absent (n=48)	Present (n=49)	Absent (n=25)
BMI (Kg/m^2)				
≤25	25 (33.78%)	33 (68.75%)	31 (63.27%)	14 (56%)
≥25	49 (66.21%)	15 (31.25%)	18 (36.73%)	11 (44%)
p-value	0.001		0.001	
Smoking status				
Smokers	39 (52.70%)	09 (18.75%)	29 (59.18%)	16 (64%)
Non-smokers	35 (47.29%)	39 (81.25%)	20 (40.81%)	09 (36%)

p-value	0.001		0.001	
Diabetes melilites	12 (16.21%)	05 (10.41%)	09 (18.36%)	04 (16%)
Drug sensitivity				
Sensitivity	66 (89.19%)	06 (12.5%)	36 (73.46%)	10 (40%)
Resistant	08 (10.81%)	42 (87.5%)	13 (26.53%)	15 (60%)
p-value	0.0156		0.001	
Spirometry				
Normal	15 (20.27%)	09 (18.75%)	09 (18.36%)	08 (32%)
Obstruction	09 (12.16%)	07 (14.58%)	05 (10.20%)	05 (20%)
Possible restriction	32 (43.24%)	16 (33.33%)	24 (48.98%)	06 (24%)
Obstruction with reduced FVC	18 (24.32%)	16 (33.33%)	11 (22.44%)	06 (24%)
p-value	0.001		0.001	

Table 3: Comparison of X-ray findings among cases with pulmonary hypertension and corpulmonale

Radiographic findings	Pulmonary hypertension		Corpulmonale	
	Present (n=74)	Absent (n=48)	Present (n=49)	Absent (n=25)
Zone involved				
One	04 (5.40%)	22 (45.83%)	01 (2.08%)	03 (12%)
Two	11 (14.86%)	13 (27.08%)	08 (16.32%)	06 (24%)
Three	38 (51.35%)	09 (18.75%)	23 (46.93%)	11 (44%)
Four	16 (21.62%)	03 (6.25%)	10 (20.40%)	04 (16%)
Five	05 (6.75%)	01 (2.08%)	07 (14.28%)	01 (4%)
p-value	0.001		0.001	
Laterality of involvement				
Unilateral Right	16 (21.62%)	12 (25%)	07 (14.28%)	05 (20%)
Unilateral Left	20 (27.02%)	14 (29.16%)	06 (12.24%)	10 (40%)
Bilateral	38 (51.35%)	22 (45.83%)	36 (73.46%)	10 (40%)
p-value	0.001		0.0271	

Table 4: Comparison of different types of sequalae as risk factors for pulmonary hypertension and corpulmonale

Risk factors	Pulmonary hypertension	p-value	Corpulmonale	p-value
	Frequency (%)		Frequency (%)	
Fibrosis (n=68)	38	0.001	26	1.267
Bronchiectasis (n=23)	12	0.920	08	0.116
Cavity (n=12)	07	0.001	04	0.045
Bullae (n=08)	03	0.0215	02	0.0688
Aspergilloma (n=06)	02	0.134	01	0.0862
Pleural thickening & calcification (n=05)	03	1.460	01	1.765

Discussion

The majority of participants were between the ages of 41 and 50 (28.68%), followed by those over 60 (22.96%), 51 to 60 (19.68%), and 31 to 40 (18.86%), with a male plurality (72.13%). In 44.26% of instances, the BMI was less than 25 kg/m2, whereas in 55.73%, it was more than 25 kg/m2. 39.34% of patients had a positive smoking history, while 13.93% of individuals had diabetes mellitus. Fibrosis was the most prevalent kind of pulmonary TB sequelae in 55.73% of patients, followed by bronchiectasis (18.85%), cavity (9.83%), bullae (6.55%), aspergilloma (4.91%), and pleural thickening and calcification (4.09%) (Table 1). Mild pulmonary hypertension was found in 29.50% of patients, moderate in 22.95%, severe in 8.19%, and normal in 39.34% (Graph 1). Corpulmonale occurred in 49 (66%) of the cases (Graph 2). Out of the patients with a body mass index (BMI) below 25 kg/m2 and over 25 kg/m2, 33.78% and 66.21% respectively exhibited pulmonary hypertension. Similarly, 63.27% and 36.73% of cases in each BMI category respectively demonstrated corpulmonale. 52.70% and 59.18% of those who smoke had pulmonary hypertension, whereas 47.29% and 40.81% of individuals who do not smoke showed corpulmonale. Among those with diabetes mellitus, 16.21% had pulmonary hypertension, whereas 18.36% displayed corpulmonale. 89.19% and 73.46% of individuals exhibiting medication sensitivity had pulmonary hypertension and corpulmonale, respectively.

Among the patients that had pulmonary hypertension, 20.27% had normal spirometry results, 12.16% had obstruction, 43.24% had probable restriction, and 24.32% had obstruction

with decreased forced vital capacity (FVC). Among patients with corpulmonale, 18.36% exhibited normal spirometry results, 10.20% had obstructive findings, 48.98% indicated potential restriction, and 22.44% had obstruction together with lower FVC. The statistical analysis revealed a significant association between BMI, smoking status, diabetes mellitus, medication sensitivity, and spirometry data ($p<0.05$) (Table 2).

According to chest X-ray findings, cases with pulmonary hypertension showed one zone involvement in 5.40%, two zone in 14.86%, three zones in 51.35%, four zones in 21.62% and five zones in 6.75% of cases. The comparison of zone s involved and laterality of condition showed statistical significance ($p<0.05$) (Table 3). The comparison of different types of sequalae as risk factors for pulmonary hypertension showed statistical significance for fibrosis, cavity and bullae ($p<0.05$). Cavity is the only significant risk factor for corpulmonale ($p<0.05$) (Table 4).

Rajeev GS et al., conducted research on 46 patients with sequelae and found that 21 (45.65%) of them had pulmonary hypertension, with 15 (71.43%) of those individuals also having corpulmonale. The most common pathological finding seen was fibrosis. Cases with several sequelae lesions had a greater risk compared to those with a single lesion. Additionally, 61.9% of patients had a mixed pattern in spirometry, which was linked with a higher risk than patients with either one of the patterns. [11] A cross-sectional study conducted by Louw E et al. examined a sample of 100 individuals and identified a likely occurrence of pulmonary hypertension in 9% of cases, with 7% showing borderline high levels. The study also found a significant association between pulmonary hypertension and the frequency of previous tuberculosis episodes. 22% of patients had normal spirometry, whereas 14% showed blockage, 33% had probable restriction, and 31% had obstruction with reduced FVC. While spirometric tests are often used to assess lung damage, they have not been shown to be associated with the diagnosis of probable pulmonary hypertension [12].

Van Heerden JK et al. conducted a thorough investigation and meta-analysis, which revealed that the prevalence of pulmonary hypertension is 67% [13]. Mani Tiwari et al. discovered that out of 728 individuals with pulmonary TB, 104 of them also had pulmonary hypertension. Moreover, there is a strong correlation between pulmonary TB and pulmonary hypertension, which is linked to a worse prognosis [14]. Kotresh N et al. conducted a study on 100 cases and determined that corpulmonale was seen in 11% of the patients with pulmonary tuberculosis [15]. Lynch DA et al. discovered that the extent of parenchymal damage shown in radiography was a distinct factor that might predict the occurrence of pulmonary hypertension in individuals with idiopathic pulmonary fibrosis. The observed phenomenon may be explained by a decrease in the cross-sectional area of the pulmonary vascular bed due to increased fibrosis, leading to elevated pulmonary vascular resistance [16].

A study conducted by L. Farkas and colleagues investigated idiopathic pulmonary fibrosis (IPF) and discovered that fibrotic areas generate several mediators that stimulate pulmonary vascular remodelling and thrombosis, resulting in an elevation in pulmonary vascular resistance. Fibrosis causes the mechanical closure of blood arteries, among other techniques. Plexiform lesions are more often seen in fibrosis [17]. According to Di Naso F C et al., the effects are a result of anomalies in the bronchial and parenchymal areas. Pulmonary TB may impact the airway, leading to a decrease in diameter and an elevation in airway resistance, which ultimately causes an obstructive pattern. The fibrosis process also leads to a limited pattern [18]. Andre F S et al. discovered that in spirometry, the odds ratio for the presence of an obstructive pattern was 3.33, while the odds ratio for a restrictive pattern was 2.02 in individuals with a history of tuberculosis compared to those without [19]. The present study has limitations in terms of low sample size focused on few risk factors for pulmonary hypertension. Further large-scale studies are required to assess link between different pulmonary tuberculosis contexts with pulmonary hypertension and sequalae and compare with radiological findings.

Conclusion

The high prevalence of pulmonary hypertension and corpulmonale in post-TB pulmonary sequelae requires long-term follow-up and preventative guidance for healed tuberculosis patients. Preventing pulmonary hypertension, corpulmonale, morbidity, and mortality from TB requires early diagnosis, appropriate treatment, and adherence. Strong national policies and dedicated health workers reduce TB post-treatment burden.

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