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ROLE OF HRCT IN DISTINGUISHING POST TUBERCULOSIS PULMONARY FIBROSIS AND OTHER INTERSTITIAL LUNG DISEASE HAVING FIBROSIS AT TERTIARY CARE HOSPITALS DERA ISMAIL KHAN

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Abstract

Background: *A prevalent long-term complication of pulmonary tuberculosis, post-tuberculosis pulmonary fibrosis (PTPF) shares a number of clinical and radiological characteristics with other interstitial lung diseases (ILDs). For proper patient care, it is crucial to distinguish between these disorders accurately. Because of its superior spatial resolution and capacity to show distinctive pulmonary abnormalities, High-Resolution Computed Tomography (HRCT) has emerged as the preferred imaging modality for assessing fibrotic lung disorders.*

Objective: *To assess how well High-Resolution Computed Tomography (HRCT) uses distinctive radiological characteristics to differentiate Post-Tuberculosis Pulmonary Fibrosis (PTPF) from other Interstitial Lung Diseases (ILDs).*

Methods: *One hundred individuals with fibrotic lung disease who had an HRCT chest examination participated in a retrospective observational study. The distribution of fibrosis, symmetry, dense scar development, cavitation, fibrotic bands, honeycombing, traction bronchiectasis, ground-glass opacities, calcification, granulomas, and other distinctive imaging features were examined in HRCT pictures. HRCT results were compared between patients with PTPF and other ILDs using descriptive statistics and SPSS data analysis.*

Results: *Among the 100 patients, 68% were diagnosed with PTPF and 32% with other ILDs. Patients with PTPF predominantly demonstrated upper lobe involvement (61.8%), localized fibrosis (76.5%), asymmetrical disease distribution (75.0%), dense scar formation (70.6%), irregular fibrotic bands (66.2%), and cavitation (47.1%). In contrast, other ILDs more commonly exhibited lower lobe predominance (43.8%), bilateral fibrosis (75.0%), symmetrical distribution (71.9%), and fine reticular fibrosis (75.0%). Mixed fibrotic and post-inflammatory HRCT patterns were the most frequent imaging findings in PTPF, while predominantly fibrotic patterns were more characteristic*

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of other ILDs. The majority of patients were aged 31–50 years (54%), males constituted 59% of the study population, and breathlessness (84%) and cough (86%) were the most common presenting symptoms.

Conclusion: *For the purpose of distinguishing Post-Tuberculosis Pulmonary Fibrosis from other Interstitial Lung Diseases, HRCT is a very efficient, dependable, and non-invasive imaging technique.*

Upper lobe predominance, localised asymmetrical fibrosis, extensive scarring, cavitation, and post-inflammatory alterations are typical HRCT findings that reduce the need for invasive diagnostic procedures while facilitating correct diagnosis and appropriate therapeutic care.

INTRODUCTION

Interstitial lung diseases (ILDs) comprise a broad group of pulmonary disorders characterized by inflammation, structural damage, and varying degrees of fibrosis of the lung tissue. These disorders may produce progressive dyspnoea, persistent cough, impaired oxygenation, reduced lung function, and bilateral abnormalities on chest imaging. Among the fibrotic ILDs, idiopathic pulmonary fibrosis (IPF) is particularly important because of its progressive nature and poor prognosis. Accurate identification of the underlying fibrotic pattern is therefore essential for appropriate diagnosis and clinical management.

Tuberculosis (TB) remains an important cause of chronic pulmonary morbidity. Although effective treatment can achieve microbiological cure, previous pulmonary TB may leave permanent structural abnormalities in the lungs. Post-tuberculosis pulmonary disease may include fibrosis, bronchiectasis, calcification, and residual cavities, with pulmonary fibrosis representing an important long-term consequence of previous infection. These structural changes can produce respiratory symptoms and radiological abnormalities that overlap with those observed in other fibrotic interstitial lung diseases, creating a diagnostic challenge.

High-resolution computed tomography (HRCT) has an important role in the assessment of diffuse and fibrotic lung disease because of its ability to demonstrate fine parenchymal abnormalities in greater detail than conventional CT. HRCT can identify characteristic features such as reticulation, traction bronchiectasis, honeycombing, ground-glass opacities, and other patterns of parenchymal involvement. Recognition of the distribution and combination of these findings can assist in differentiating various fibrotic lung diseases and may improve diagnostic confidence. Distinguishing post-tuberculosis pulmonary fibrosis from other fibrotic ILDs is particularly relevant because the clinical presentation and imaging findings may overlap. Misclassification can result in inappropriate investigations or management. A systematic assessment of HRCT patterns may therefore provide valuable information for establishing the likely underlying cause of pulmonary fibrosis.

The present study was conducted to evaluate the role of HRCT in distinguishing post-tuberculosis pulmonary fibrosis from other interstitial lung diseases with fibrosis at tertiary care hospitals in Dera Ismail Khan. The study focuses on identifying characteristic HRCT features of post-tuberculosis pulmonary fibrosis, assessing patterns observed in other fibrotic ILDs, and comparing the imaging findings between these groups.

MATERIAL AND METHODS

This retrospective observational study was conducted in the Radiology Department of D.H.Q Hospital, Al-Shifa Ali Hospital, and selected private radiology facilities in Dera Ismail Khan. A sample of 100 patients with suspected post-tuberculosis pulmonary fibrosis or interstitial lung disease who underwent high-resolution computed tomography (HRCT) of the chest was included. Clinical and radiological data were obtained from hospital records, radiology information systems, and picture archiving and

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communication systems. Patients aged 18–70 years with clinical suspicion of interstitial lung disease or a history of treated pulmonary tuberculosis were included, while those with active tuberculosis, lung malignancy, poor-quality HRCT images, or refusal to participate were excluded. Ethical approval was obtained from the relevant institutional ethical committee, and patient confidentiality was maintained. A structured data collection proforma was used to record demographic and clinical information, including age, gender, occupation, history and duration of treated tuberculosis, presenting symptoms, and relevant environmental or occupational exposure. HRCT images were systematically evaluated for the distribution and symmetry of fibrosis, dense scar formation, cavitation, fibrotic bands, honeycombing, traction bronchiectasis, ground-glass opacities, nodules, calcification, granulomas, architectural distortion, pleural involvement, and other characteristic radiological features. Based on clinical history and HRCT findings, patients were categorized as having post-tuberculosis pulmonary fibrosis, other fibrotic interstitial lung diseases, or indeterminate findings. Data was analyzed using the Statistical Package for the Social Sciences (SPSS), with descriptive statistics including means, frequencies, and percentages used to compare HRCT findings between the groups.

RESULTS

A total of **100 patients** were included in this retrospective study to evaluate the role of High-Resolution Computed Tomography (HRCT) in distinguishing Post-Tuberculosis Pulmonary Fibrosis (PTPF) from other Interstitial Lung Diseases (ILDs). Among the study population, **68 (68%)** patients were diagnosed with PTPF, while **32 (32%)** patients were diagnosed with other ILDs based on HRCT findings.

Table 4.1: Combined HRCT Findings based on distribution characteristics

Combined Feature Category	PTPF (n=68) & ILDs (n=32)		Total (N=100)	p-value
	N	%	n	%
Distribution Pattern				
Upper Lobe Predominant	42	61.80%	6	18.80%
Middle Lobe Predominant	12	17.60%	12	37.50%
Lower Lobe Predominant	14	20.60%	14	43.80%
Fibrosis Type				
Localized Fibrosis	52	76.50%	8	25.00%
Bilateral Fibrosis	16	23.50%	24	75.00%
Symmetry				
Asymmetrical Pattern	51	75.00%	9	28.10%
Symmetrical Pattern	17	25.00%	23	71.90%
Associated Features				
Dense Scar Present	48	70.60%	6	18.80%
Dense Scar Absent	20	29.40%	26	81.30%
Fibrotic Bends (Irregular)	45	66.20%	8	25.00%
Fine Reticular Fibrosis	23	33.80%	24	75.00%
Cavitation Present	32	47.10%	3	9.40%

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Cavitation Absent	36	52.90%	29	90.60%

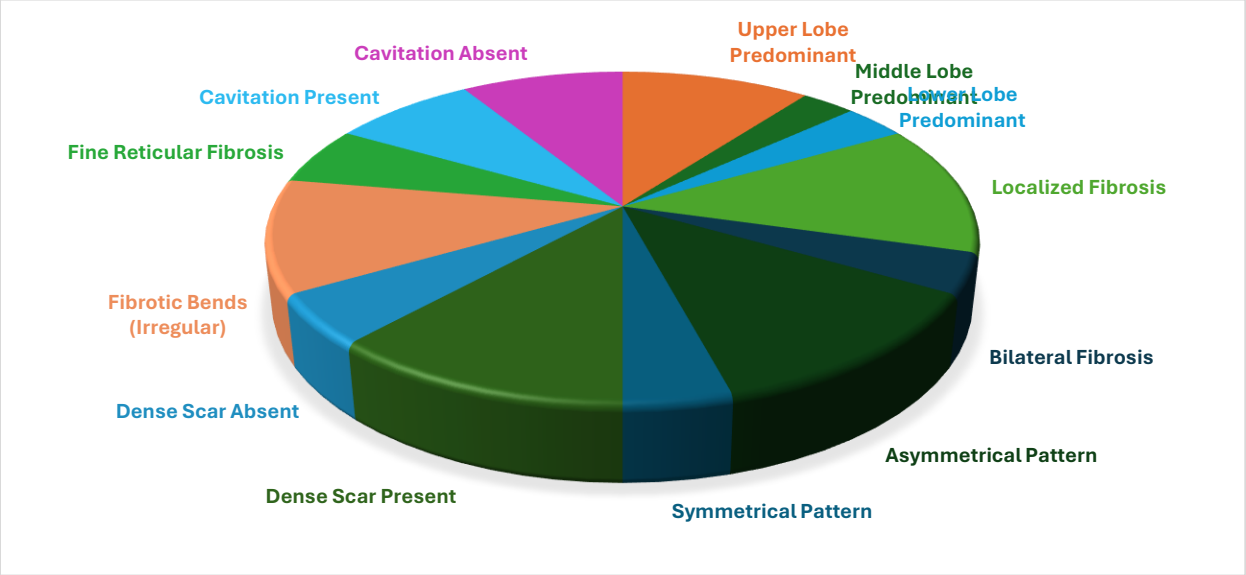


Figure 4.1: Combined HRCT Findings based on distribution characteristics

Table 4.1 Comparison of HRCT findings demonstrated several distinguishing imaging characteristics between PTPF and other ILDs. Upper lobe predominance was observed in **61.8%** of patients with PTPF compared with **18.8%** of patients with other ILDs, whereas lower lobe predominance was more frequent in ILDs (**43.8%**) than in PTPF (**20.6%**). Localized fibrosis was identified in **76.5%** of PTPF patients compared with **25.0%** of ILD patients, while bilateral fibrosis was considerably more common among ILDs (**75.0%**) than PTPF (**23.5%**).

The distribution of fibrosis also differed between the two groups. An **asymmetrical pattern** was observed in **75.0%** of PTPF patients, whereas a **symmetrical pattern** predominated in **71.9%** of patients with ILDs. Dense scar formation was present in **70.6%** of PTPF patients but in only **18.8%** of ILD patients. Similarly, irregular fibrotic bands were observed more frequently in PTPF (**66.2%**) than in ILDs (**25.0%**). Fine reticular fibrosis was the predominant feature in ILDs, occurring in **75.0%** of patients, compared with **33.8%** of patients with PTPF. Cavitary lesions were identified in **47.1%** of PTPF patients but in only **9.4%** of ILD patients, indicating that cavitation is a characteristic finding of post-tuberculous fibrosis.

Table 4.2: Summary of Combined HRCT Findings.

Key Combined Features	PTPF	ILDs	Interpretation
Upper lobe involvement	61.80%	18.80%	PTPF typically affects upper lobes
Lower lobe involvement	20.60%	43.80%	ILDs commonly affect lower lobes
Asymmetry	75.00%	28.10%	PTPF is usually asymmetrical
Localized fibrosis	76.50%	25.00%	PTPF shows localized scarring
Bilateral fibrosis	23.50%	75.00%	ILDs are typically bilateral
Dense scar	70.60%	18.80%	PTPF commonly shows dense scarring
Cavitation	47.10%	9.40%	Cavitation is very common in PTPF

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Post-inflammatory pattern	22.10%	6.30%	Significantly more common in PTPF
Predominantly fibrotic pattern	14.70%	43.80%	More common in ILDs

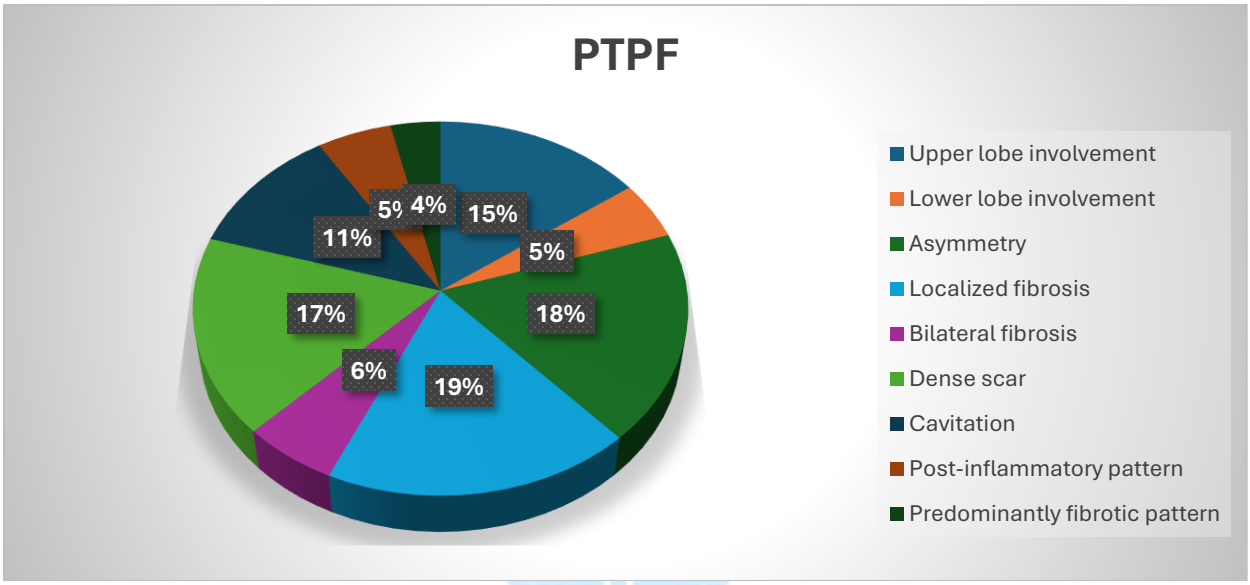


Figure 4.2: Summary of Combined HRCT Findings.

Table 4.2 Analysis of combined HRCT feature patterns revealed that the **Fibrotic and Post-Inflammatory Mixed Pattern** was the most frequent finding in patients with PTPF, accounting for **32.4%** of cases. This was followed by the **Predominantly Post-Inflammatory Pattern** (**26.5%**) and the **Post-Inflammatory Pattern** (**22.1%**). Among the individual combined imaging features, **interseptal thickening with granulomas** was observed in **8.8%** of patients, **interseptal thickening with calcification** in **7.4%**, and **interseptal thickening with parenchymal destruction** in **5.9%**. These findings indicate that mixed fibrotic and post-inflammatory changes are characteristic HRCT features of PTPF.

Table 4.3: Combined HRCT Features in PTPF vs Other ILDs.

Combined HRCT Feature Pattern	PTPF (n=68)	ILDs (n=32)
	n	%
Predominant Features		
Interseptal Thickening + Granulomas	6	8.80%
Interseptal Thickening + Calcification	5	7.40%
Interseptal Thickening + Parenchymal Destruction	4	5.90%
Ground Glass Haziness + Interseptal Thickening	3	4.40%
Honey Combing + Reticular Pattern	1	1.50%
Combination Patterns		
Fibrotic Pattern (Honeycombing + Reticular + Traction Bronchiectasis)	3	4.40%
Post-Inflammatory Pattern (Granulomas + Calcification + Parenchymal Destruction)	15	22.10%

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Fibrotic + Post-Inflammatory Mixed Pattern	22	32.40%
Predominantly Fibrotic Pattern (without post-inflammatory changes)	10	14.70%
Predominantly Post-Inflammatory Pattern (without fibrosis)	18	26.50%

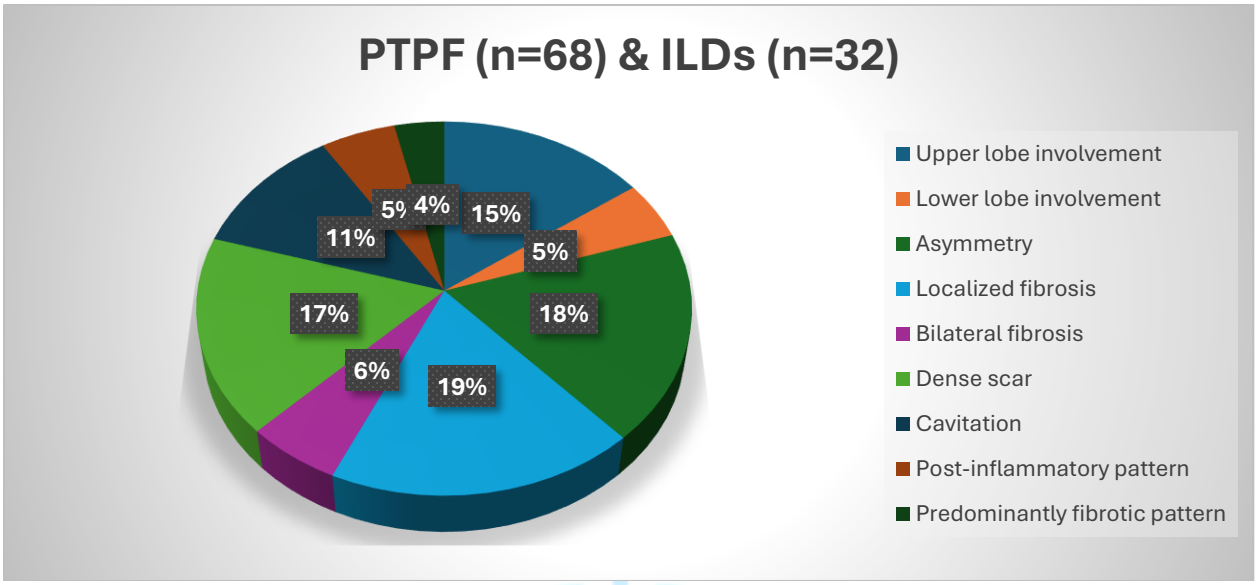


Figure 4.3: Combined HRCT Features in PTPF vs Other ILDs.

Table 4.3 demonstrates the combined HRCT feature patterns observed in patients with Post-Tuberculosis Pulmonary Fibrosis (PTPF). The most common combined pattern was the Fibrotic and Post-Inflammatory Mixed Pattern (32.4%), followed by the Predominantly Post-Inflammatory Pattern (26.5%) and the Post-Inflammatory Pattern (22.1%). Individual HRCT features such as interseptal thickening associated with granulomas (8.8%), calcification (7.4%), and parenchymal destruction (5.9%) were less frequently observed. These findings indicate that mixed fibrotic and post-inflammatory HRCT changes are the characteristic imaging pattern in patients with PTPF, aiding in its differentiation from other interstitial lung diseases.

Table 4.4: Age wise distribution of subjects

Age	Percent	Frequency	Cumulative Percent
18-30	11	11	11
31-50	54	54	65
51-70	35	35	100
Total	100	100	

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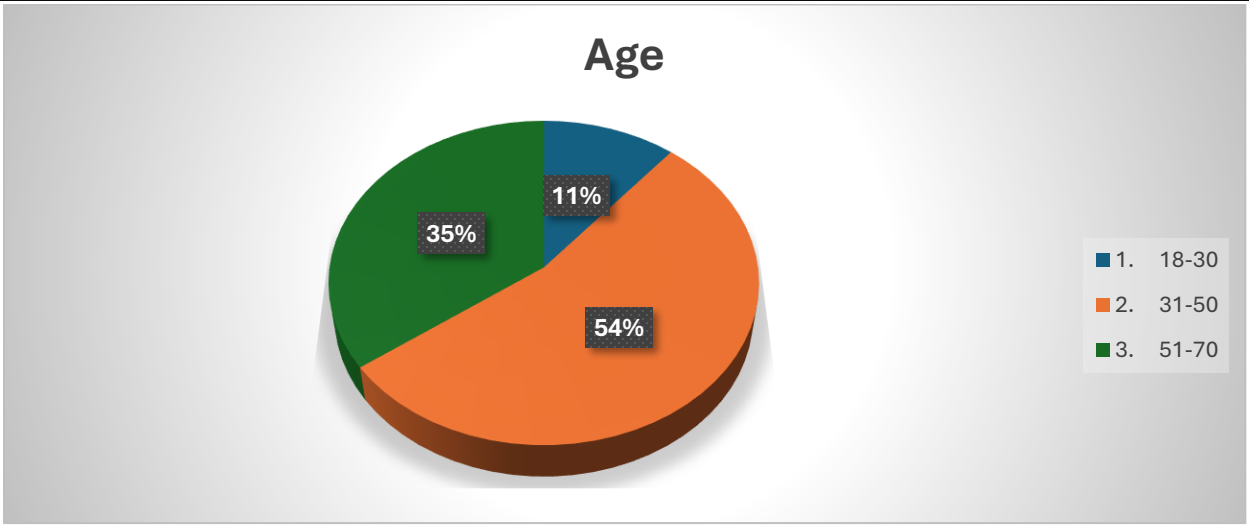


Figure 4.4: Age wise distribution of subjects

Table 4.4 demonstrate the majority of patients belonged to the **31–50 years** age group **(54%)**, followed by the **51–70 years** age group **(35%)**, whereas only **11%** of patients were between **18 and 30 years** of age.

Table 4.5: Gender wise distribution of subjects

Gender	Percent	Frequency	Cumulative Percent
Male	59	59	59
Female	41	41	100
Total	100	100	

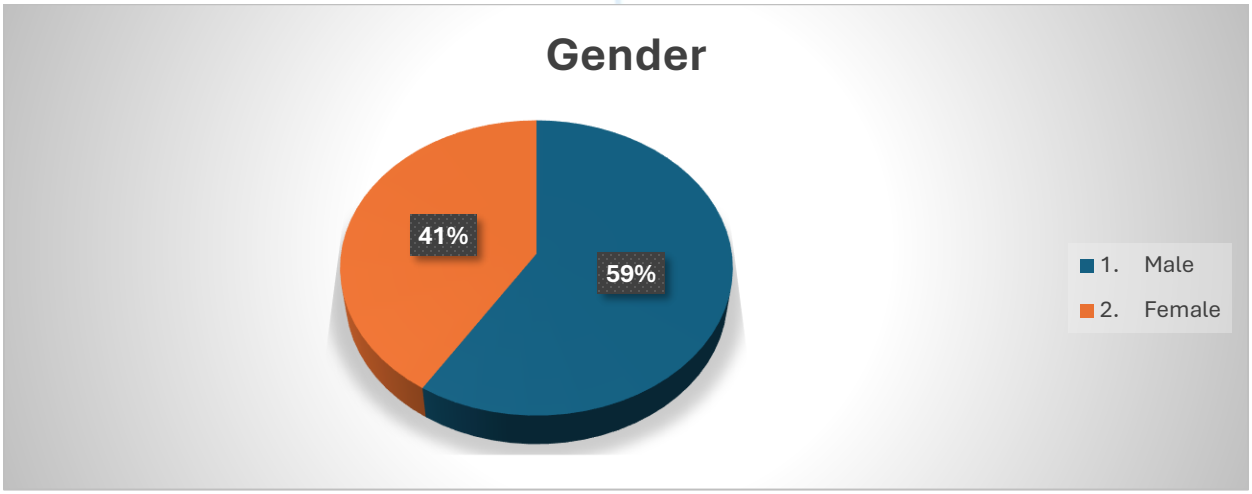


Figure 4.5: Gender wise distribution of subjects

According to Table 4.5 Male patients constituted **59%** of the study population, while **41%** were females.

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Table 4.6: Smoking history of subjects

Smoking Status	Percent	Frequency	Cumulative Percent
Present	53	53	53
Absent	47	47	100
Total	100	100	

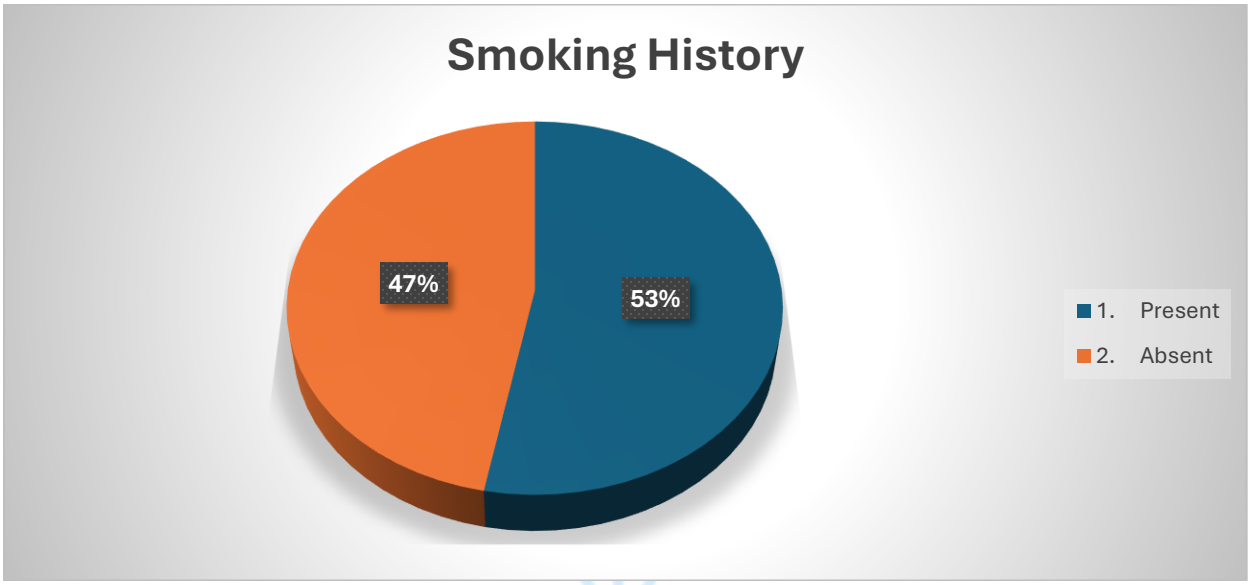


Figure 4.6: Smoking history of subjects

A history of smoking was present in 53% of patients, whereas 47% had no smoking history, Table 4.6.

Symptoms:

Table 4.7: Frequency of subjects having Dyspnoea

Breathlessness	Percent	Frequency	Cumulative Percent
Yes	84	84	84
No	16	16	100

Out of 100 subjects, 84 has complain of Breathlessness while rest 16 has no complain .

Table 4.8: Frequency of subjects having Cough

Coughing	Percent	Frequency	Cumulative Percent
Yes	86	86	86
No	14	14	100

Of 100 subjects 86 faces coughing and 14 were not.

Table 4.9: Frequency of subjects complain of Fatigue

Fatigue	Percent	Frequency	Cumulative Percent
Yes	67	67	67
No	33	33	100

Of 100 subjects 67 with complain of fatigue and 33 were not.

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Table 4.10: Subjects with Physical & Mental Distress

Physical and Emotional Distress	Percent	Frequency	Cumulative Percent
Yes	53	53	53
No	47	47	100

Out of 100 subjects 53 were faces physical or emotional distress and 47 were not facing it.

Regarding clinical presentation, **breathlessness** was the most common symptom and was reported by **84**% of patients. **Cough** was present in **86**% of patients, while **67**% experienced fatigue. In addition, **53**% of patients reported physical or emotional distress associated with their respiratory disease. (Table 4.7, 4.8, 4.9, & 4.10).

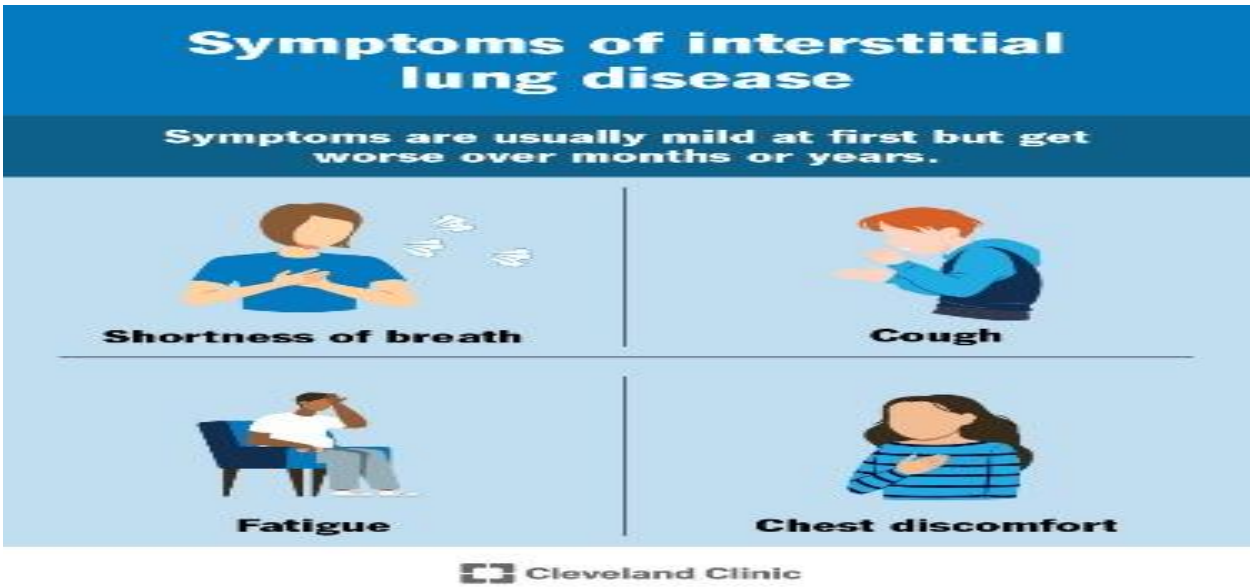


Figure 4.7: Symptoms of interstitial lung disease get worse over time. You may have additional symptoms depending on the cause.

Overall, the results demonstrate that HRCT is highly effective in differentiating Post-Tuberculosis Pulmonary Fibrosis from other Interstitial Lung Diseases. Patients with PTPF predominantly exhibited upper lobe involvement, localized and asymmetrical fibrosis, dense scar formation, irregular fibrotic bands, cavitation, and mixed post-inflammatory changes. In contrast, patients with other ILDs more frequently demonstrated lower lobe predominance, bilateral symmetrical fibrosis, fine reticular fibrosis, and predominantly fibrotic patterns. These characteristic HRCT findings support the diagnostic value of HRCT as a reliable, non-invasive imaging modality for distinguishing PTPF from other fibrotic interstitial lung diseases.

DISCUSSION

This retrospective study evaluated the role of high-resolution computed tomography (HRCT) in differentiating post-tuberculosis pulmonary fibrosis (PTPF) from other interstitial lung diseases (ILDs). Among the 100 patients, 68% were diagnosed with PTPF and 32% with other ILDs. Overall, the findings demonstrate that HRCT provides characteristic morphological and distributional patterns that can assist in distinguishing these conditions.

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Most patients were between 31 and 50 years of age, with a male predominance (59%) and a history of smoking in 53% of cases. Cough (86%) and dyspnoea (84%) were the most frequent symptoms, while fatigue was reported in 67%. These findings are consistent with the observations of Jafri et al. (2020), who identified cough and dyspnoea as common clinical manifestations of ILDs. The overlap in symptoms highlights the limited ability of clinical presentation alone to differentiate PTPF from other fibrotic lung diseases and emphasizes the importance of HRCT.

A key finding was the difference in the distribution of fibrosis. Upper-lobe fibrosis was more frequent in PTPF (61.8%), whereas lower-lobe involvement predominated among patients with other ILDs (43.8%). PTPF was also more frequently associated with localized and asymmetric fibrosis, while bilateral and symmetrical involvement was more common in other ILDs. These findings are consistent with the observations of Jacob and Hansell (2015), who emphasized the importance of disease distribution on HRCT in narrowing the differential diagnosis of fibrosing lung diseases.

Features reflecting previous tuberculous lung destruction, including cavitation, dense scar formation, irregular fibrotic bands, calcification, and granulomas, were more frequently observed in PTPF. The combination of these findings with upper-lobe predominance and asymmetric structural distortion provides useful radiological clues for distinguishing post-tuberculous changes from other fibrotic ILDs. The predominance of mixed fibrotic and post-inflammatory changes in PTPF further supports the chronic structural consequences of previous tuberculosis.

CONCLUSION

This study concludes that high-resolution computed tomography (HRCT) is a valuable imaging modality for distinguishing post-tuberculosis pulmonary fibrosis (PTPF) from other fibrotic interstitial lung diseases (ILDs). Among the 100 patients, PTPF was the predominant diagnosis (68%). PTPF was characterized mainly by upper-lobe predominance, localized and asymmetric fibrosis, dense scarring, cavitation, calcification, granulomas, and parenchymal destruction, whereas other ILDs more commonly demonstrated bilateral, symmetrical, and lower-lobe-predominant fibrotic changes. These findings suggest that careful evaluation of HRCT distribution and morphological patterns can improve diagnostic differentiation, reduce misclassification, and support appropriate clinical management, particularly in settings with a high burden of tuberculosis.

LIMITATIONS

This study had several limitations. The relatively small sample size of 100 patients and retrospective design may limit the generalizability of the findings. The study was conducted in a limited number of centers in Dera Ismail Khan, which may not reflect the HRCT patterns observed in other populations. In addition, the study relied primarily on clinical and radiological assessment, and histopathological confirmation was not available for all cases. Variations in the quality of available records and HRCT images may also have influenced the assessment of radiological features. Larger multicenter prospective studies with standardized HRCT protocols and histopathological or clinical follow-up correlation are recommended to further validate these findings.

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