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PATTERNS OF CLINICAL SYMPTOMS AND IMAGING IN INTERSTITIAL LUNG DISEASE: EVALUATING THE ROLE OF HRCT

Dr. Priya Singh[1*], Dr. Asit S. Natekar[2], Dr. Rohit Barne[3], Dr. VijayKumar S. Mane[4], Dr. Pradeep Raghavendra Kulkarni[5]

[1*]Junior Resident, Department of Radiology, Bharati Vidyapeeth Deemed to Be University Medical College & Hospital, Sangli, Maharashtra, India.
[2]Associate Professor, Department of Radiology, Bharati Vidyapeeth Deemed to Be University Medical College & Hospital, Sangli, Maharashtra, India.
[3]Senior Resident, Department of Radiology, Bharati Vidyapeeth Deemed to Be University Medical College & Hospital, Sangli, Maharashtra, India.
[4]Professor, Department of Radiology, Bharati Vidyapeeth Deemed to Be University Medical College & Hospital, Sangli, Maharashtra, India.
[5]Professor, Department of Radiology, Bharati Vidyapeeth Deemed to Be University Medical College & Hospital, Sangli, Maharashtra, India.

***Corresponding Author:** Dr. Priya Singh,
*Email Id: p.singh161219@gmail.com

ABSTRACT

OBJECTIVES:

To assess the clinical symptoms and radiological features of interstitial lung disease (ILD) in a tertiary care hospital, and to identify correlations between these clinical and imaging findings.

METHODS:

This cross-sectional study was conducted over 18 months, involving 30 ILD patients who underwent clinical evaluations and high-resolution computed tomography (HRCT) scans. Key clinical symptoms, including cough and dyspnea, were recorded, and radiological features such as septal lines and ground-glass opacities were analyzed. Radiological assessments were conducted using a Philips MX 16-slice CT scanner, and the data were analyzed using SPSS version 26.0. Correlational matrix analysis was employed to identify significant associations between clinical symptoms and radiological findings.

RESULTS:

Cough and dyspnea were the most frequent observed symptoms, with prevalence rates of 66.67% and 53.33%, respectively. HRCT revealed septal lines in 56.67% of cases and ground-glass opacities in 30%. A significant positive correlation was observed between dyspnea and ground-glass opacities ($p < 0.05$), suggesting that symptom severity may be associated with parenchymal changes on HRCT. The study provides an insight into ILD characteristics within a rural patient population, which may differ from urban cohorts.

CONCLUSIONS:

The study highlights common clinical and radiological patterns of ILD with notable correlations between specific symptoms and imaging findings. These findings accentuate the importance of HRCT

in assessing ILD severity and may help tailor management strategies for healthcare providers. Further research with a larger sample and additional diagnostic tools is recommended to validate these results.

Key Words: High-resolution computed tomography, rural health, respiratory symptoms, septal lines, ground-glass opacity

INTRODUCTION

ILDs are a heterogeneous group of disorders characterized by the diffuse involvement of the pulmonary parenchyma, usually derived from various environmental exposures, drugs, systemic diseases, or idiopathic origin. All of them primarily feature inflammation and fibrosis of the lung interstitium that eventually lead to impairment of lung function and respiratory failure. Heterogenicity of ILDs poses a formidable challenge at diagnosis and thus at management, hence making it an important area of research in pulmonary medicine. Epidemiologically, these are considered more than 200 disorders and are often grouped into broad categories such as IPF, hypersensitivity pneumonitis, and CTD-ILD.

The clinical presentation of ILDs is often nonspecific—symptoms are chronic cough, dyspnea, and fatigue, which can be evolutive over months to years. Diagnostic approaches are multidisciplinary and usually include high-resolution computed tomography combined with lung biopsy in selected cases for better clarification of the extent and nature of pulmonary involvement. The approaches to managing the condition of ILD indeed vary and depend on its etiology but generally include immunosuppressive therapy for the inflammatory types and antifibrotic agents, as can be seen in fibrotic diseases like IPF.

Imaging techniques, especially high-resolution computed tomography (HRCT), have seen phenomenal development in recent years, revolutionizing the diagnosis and classification of ILDs. HRCT has facilitated clinicians in identifying minute patterns of fibrosis, among other changes, that play a vital role in early identification and management of these diseases. In this direction, there has been a growing interest in research regarding multidisciplinary team approaches toward the diagnosis and therapeutic management of ILDs, mainly by underscoring the role of multifaceted decision-making in improving patient outcomes.

This study was thus conceived within a clinical setting from the streams of ILD cases presenting diversely with regard to severity and response to treatment, influenced often by various demographic factors such as age, sex, and comorbidities. Recent epidemiological data also suggest that the prevalence of ILDs is increasing in certain regions and thus point out the need for conducting localized studies to make clear various demographic and clinical characteristics in affected populations.

The primary aim of the research is the analysis of clinical and radiological features of patients with ILD in our cohort. This study will identify the factors associated with disease progression. By answering these research questions, we would like to contribute to a more personalized approach in the management of ILD and to the development of better-targeted therapeutic possibilities.

Interstitial lung diseases (ILDs) represent a complex group of disorders characterized by diffuse pulmonary parenchymal involvement, which may result from a variety of causes, including environmental exposures, drugs, systemic diseases, and idiopathic origins [1]. These diseases are primarily manifested through inflammation and fibrosis of the lung interstitium, leading to progressive decline in lung function and respiratory failure [2]. The heterogeneity of ILDs poses significant challenges in diagnosis and management, making them a critical area of study in pulmonary medicine [3]. Epidemiologically, ILDs encompass over 200 different conditions, including idiopathic pulmonary fibrosis (IPF), hypersensitivity pneumonitis, and connective tissue disease-associated ILD (CTD-ILD) [4].

The clinical presentation of ILDs is often non-specific, with symptoms which include chronic cough, dyspnea, and fatigue, which may evolve over months to years [5]. Diagnostic approaches typically involve a combination of high-resolution computed tomography (HRCT) and, in certain cases, lung biopsy to ascertain the specific type and extent of pulmonary involvement [6]. Management strategies

for ILD vary based on the underlying etiology but generally include immunosuppressive therapy for inflammatory types and antifibrotic agents for fibrotic diseases like IPF [7].

In recent years, advancements in imaging techniques, particularly high-resolution computed tomography (HRCT), have greatly improved our ability to diagnose and classify ILDs accurately. HRCT allows clinicians to detect subtle patterns of fibrosis and other abnormalities, which are critical for the early identification and management of these diseases [8,9]. Moreover, research has increasingly focused on the importance of multidisciplinary team approaches in the diagnosis and therapeutic management of ILDs, emphasizing the role of collaborative decision-making in improving patient outcomes.

This study was conceived following clinical observations of ILD cases presenting with varying severity and responses to treatment, often influenced by demographic factors such as age, sex, and comorbidities. Recent epidemiological data also suggest an increasing prevalence of ILDs in specific regions, highlighting the need for localized studies to understand the demographic and clinical characteristics of affected populations better.

The primary objective of this research is to evaluate the clinical and radiological features of ILD patients in our cohort. This study aims to identify factors associated with disease progression. By addressing these research questions, we hope to contribute to a more personalized approach to ILD care and to support the development of better-targeted therapeutic options.

Materials and Methods

Study Design and Population

Patients for the present observational, cross-sectional study were selected over a period of 18 months from the Radiology Department of Bharati Vidyapeeth Deemed to Be University College and Hospital, Sangli. The population consisted of those showing interstitial lung disease, which was further confirmed clinically supported by high-resolution computed tomography. In this respect, eligible participants included those male and female patients over the age of 18 years who manifested symptoms of ILD, which include cough, dyspnea, and general fatigue. Overall, 30 patients were enrolled by using the described inclusion criteria.

Ethical Considerations

Present study was approved by the Institutional Ethics Committee of Bharati Vidyapeeth Deemed to be University College and Hospital. All the participants were informed prior to the collection of data about the purpose of the study, potential risks, and their rights to withdraw at any time without posing any threat to their ongoing treatment.

Data Collection

A combination of clinical assessments and high-resolution computed tomography imaging analysis was used to collect data. The clinical information was derived through interviews with the patients regarding demographic data, history, and complaints. These symptoms were then coded utilizing standard medical nomenclature, paying particular attention to complaints related to the respiratory system, such as cough, dyspnea, chest pain, and hemoptysis. HRCT was performed in all patients on a Philips MX 16-slice CT scanner manufactured by Philips Healthcare, Amsterdam, Netherlands. All scans were done according to the standard protocols for HRCT: the patients were positioned in a supine position, and the scans were booked during full inspiration. The minimum thickness of the slice was chosen as 1 mm to optimize displaying the lung parenchyma and interstitial abnormalities.

Radiological Analysis

Radiological features of ILD were reviewed, including septal lines, ground-glass opacities, honeycombing, and consolidation, by two trained radiologists. Each reviewer viewed the HRCT images independently to assure inter-rater agreement in reviews. Disagreements in observations were resolved by consensus. These features were charted according to the standard radiological criteria for ILD and further tabulated on frequency and prevalence observed in the patient cohort.

Drug and Chemical Details
No specific drug treatments were administered as part of this observational study.

Statistical Analysis
All data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Mean, SD, and percentages of prevalence are calculated as descriptive statistics for all clinical and radiological variables. The correlational matrix was used to assess the relations of clinical symptoms with their corresponding radiological features.

RESULTS

The analysis revealed that Cough and Dyspnea were the most frequently observed clinical symptoms, with a significant prevalence, while Chest Pain and Hemoptysis were rare among the patients (Table 1).

Table 1: Frequency and Prevalence of Clinical Features

Symptom/Feature	Frequency	Prevalence (%)
Cough	20	66.67%
Dyspnea	16	53.33%
Chest Pain	2	6.67%
Hemoptysis	1	3.33%

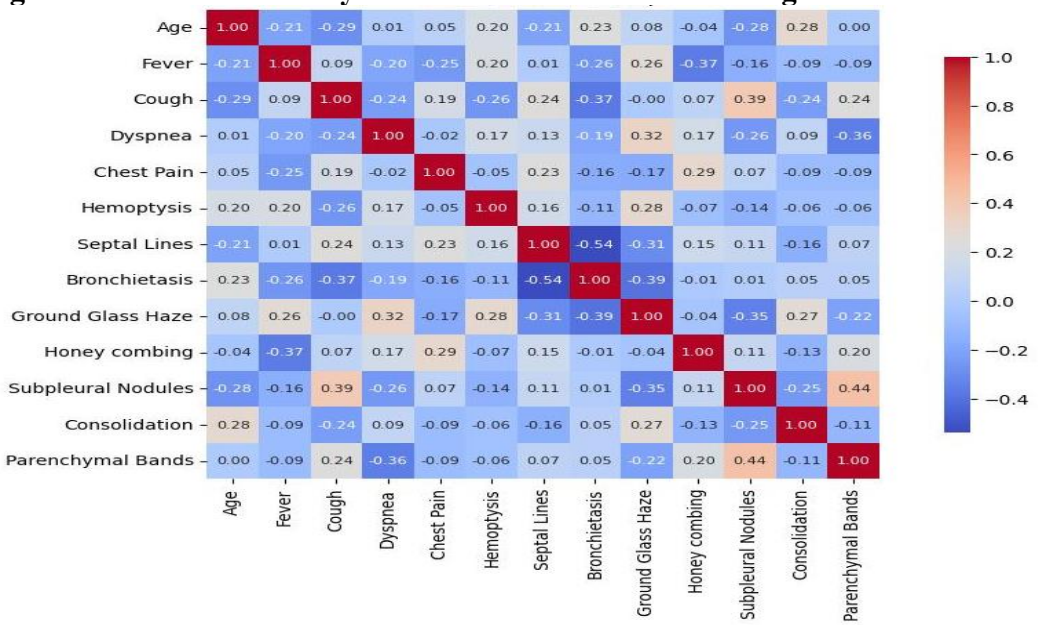
Among radiological features, Septal Lines appeared most frequently, followed by Subpleural Nodules and Ground Glass Haze, suggesting these are the predominant findings in imaging studies. In contrast, Honey Combing and Consolidation were least observed (Table 2).

Table 2: Frequency and Prevalence of Radiological Features

Symptom/Feature	Frequency	Prevalence (%)
Septal Lines	17	56.67%
Bronchiectasis	8	26.67%
Ground Glass Haze	9	30.00%
Honey Combing	4	13.33%
Subpleural Nodules	11	36.67%
Consolidation	3	10.00%
Parenchymal Bands	3	10.00%

The correlation analysis (Figure 1) highlights several key relationships between clinical and radiological features. Subpleural nodules showed moderate positive correlation with parenchymal bands. Parenchymal Bands showed a moderate positive correlation with Subpleural Nodules. Similarly, Dyspnea demonstrated a notable correlation with Ground Glass Haze.

Figure 1: Correlation analysis between clinical and radiological features.



The study results shows that Rheumatoid Arthritis (RA) is the most frequently occurring condition among the patients, representing the highest prevalence in the group (Table 3). Other autoimmune diseases like Scleroderma, Idiopathic Pulmonary Fibrosis (IPF), and Systemic Lupus Erythematosus (SLE) also showed significant representation, sharing similar prevalence rates (Table 3). Occupational Fibrosis and Myelofibrosis were the least common conditions, contributing the smallest proportion to the overall disease distribution (Table 3).

Table 3: Frequency and Prevalence of Diseases in the Patient Cohort

Disease	Frequency (n)	Prevalence (%)
Rheumatoid Arthritis (RA)	9	30.00%
Occupational Fibrosis (OCCUP F)	2	6.67%
Idiopathic Pulmonary Fibrosis (IPF)	6	20.00%
Scleroderma (SCLERO)	6	20.00%
Systemic Lupus Erythematosus (SLE)	6	20.00%
Myelofibrosis (MF)	1	3.33%

DISCUSSION

The analysis of clinical symptoms in this study shows that cough and dyspnea are predominant in patients with interstitial lung disease (ILD), highlighting the respiratory burden that these patients experience. This finding is consistent with the broader literature, where chronic cough and progressive dyspnea are frequently reported as primary symptoms in ILD patients due to underlying fibrotic changes in the lung parenchyma. Similar results were observed by Lynch et al., who documented that dyspnea correlates with the extent of interstitial changes observed on high-resolution computed tomography (HRCT) in idiopathic pulmonary fibrosis cases [10].

In contrast, chest pain and hemoptysis were rare, suggesting that these symptoms may not be as strongly associated with the primary pathophysiological processes in ILD but could arise from secondary complications or comorbidities. This finding corroborates with studies by Flaherty KR et al., which emphasize that while hemoptysis can occasionally occur in ILD, it is generally indicative of either advanced disease or additional pulmonary vascular involvement [11]. The relatively low frequency of chest pain supports the notion that ILD manifestations are primarily centered on respiratory impairment rather than pleuritic complications, as noted by Bonini M et al [12].

The radiological analysis in this study reveals that septal lines, subpleural nodules, and ground-glass haze are the most common findings among ILD patients. This pattern aligns with previous studies, where septal thickening and ground-glass opacities are frequently observed features in various ILD subtypes due to interstitial inflammation and fibrosis [13]. Subpleural nodules, particularly, have been associated with connective tissue disease-related ILD, underscoring the importance of comprehensive imaging to differentiate between ILD subtypes [14].

Honeycombing and consolidation, on the other hand, were less commonly observed in our cohort. Honeycombing is typically associated with more advanced fibrosis and is a defining feature in the diagnosis of idiopathic pulmonary fibrosis (IPF), as noted in the Fleischner Society's criteria [15]. The relatively low prevalence of honeycombing in our study may indicate that the most common of patients were in earlier stages of fibrosis, where these changes are not yet prominent. Consolidation, although rare, may suggest concomitant infection or alveolar inflammation, consistent with findings by Gaillard F et al., who emphasized the need for differential diagnosis when these features are present [16].

The correlation analysis in this study identifies significant associations between specific clinical symptoms and radiological features in ILD patients. Notably, the positive correlation between subpleural nodules and parenchymal bands suggests that these radiological findings may frequently co-occur, potentially indicating a common pathological process related to interstitial thickening and nodularity. This observation aligns with prior research by Rohit sharma who noted that such features are often present in fibrosing ILDs, including connective tissue disease-related ILD [17].

Additionally, the correlation between dyspnea and ground-glass haze highlights the clinical relevance of ground-glass opacities as an indicator of symptom severity. Ground-glass haze is often linked to early inflammatory changes within the lung interstitium, which can contribute to respiratory symptoms like dyspnea. Lee et al. have similarly documented that ground-glass opacities correlate with reduced lung function, emphasizing their role in the progression of respiratory symptoms in ILD [18]. This relationship underscores the importance of regular HRCT monitoring to assess disease activity, especially in patients presenting with worsening dyspnea.

These radiological findings support the role of high-resolution computed tomography (HRCT) as an essential tool in the initial evaluation and monitoring of ILD patients, providing insights into the disease's extent and progression. Further studies incorporating longitudinal HRCT data could help to better understand the transition from early findings such as ground-glass opacities to more advanced features like honeycombing and consolidation.

While the study offers substantial contributions, several limitations warrant discussion. Firstly, the relatively small sample size limits the generalizability of the findings to broader ILD populations. Larger studies are essential to validate these results and provide a more comprehensive understanding of ILD in rural settings. Additionally, although HRCT is an invaluable tool, the study lacked histopathological confirmation, which could have strengthened diagnostic accuracy. The lack of biopsy data is particularly relevant because certain ILD subtypes, such as hypersensitivity pneumonitis and non-specific interstitial pneumonia, may have overlapping HRCT features.

Another potential limitation involves the cross-sectional study design. Since data were collected at a single point in time, it was not possible to assess disease progression or the long-term impact of different clinical and radiological characteristics on patient outcomes. Future longitudinal studies could address this limitation by examining ILD patients over an extended period, which would offer insights into the natural history of the disease and potential prognostic factors.

Despite these limitations, the study adds to the growing body of evidence on the role of imaging in managing ILD. By elucidating the relationship between clinical symptoms and HRCT features, the findings could inform more personalized approaches to ILD treatment. For instance, patients presenting with severe dyspnea and corresponding extensive ground-glass opacities may benefit from closer monitoring and possibly more aggressive therapeutic interventions. This approach aligns with recent recommendations advocating for personalized management plans tailored to individual symptom burden and radiological findings.

Further research could explore integrating HRCT findings with additional diagnostic modalities, such as pulmonary function tests and biomarker analysis, to develop a more holistic assessment framework for ILD patients. Studies have shown that combining imaging with other diagnostic tests can improve disease classification and treatment precision, which is crucial for conditions like IPF that have variable clinical courses and treatment responses. Additionally, research focusing on rural populations can help delineate environmental or occupational factors unique to these settings, which may influence ILD prevalence and progression.

CONCLUSION

It points out the common clinical presentations and radiological patterns of the diseases in a tertiary care setting. The correlations presented between clinical and radiological findings underscore the value of HRCT in assessing the severity of ILD. Although the present study makes some worthy contributions, further studies on larger cohorts with a variety of diagnostic tools will be required to consolidate our understanding of ILD in such settings. These findings have implications for the improvement of diagnostic precision and management approaches for patients with ILD within rural health settings.

Conflict of Interests

The authors declare that they have no conflicts of interest related to this study.

Sources of Funding

No funding was received for the conduct of this research.

Abbreviations

ILD: Interstitial Lung Disease
HRCT: High-Resolution Computed Tomography
IPF: Idiopathic Pulmonary Fibrosis
CTD-ILD: Connective Tissue Disease-associated Interstitial Lung Disease
RA: Rheumatoid Arthritis
OCCUP F: Occupational Fibrosis
SLE: Systemic Lupus Erythematosus
MF: Myelofibrosis
SD: Standard Deviation
SEM: Standard Error of Mean
SPSS: Statistical Package for the Social Sciences

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