

International Journal of Radiology and Diagnostic Imaging



E-ISSN: 2664-4444
P-ISSN: 2664-4436
IJRDI 2019; 2(2): 135-139
Received: 05-07-2019
Accepted: 22-07-2019

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Radiologic: Pathologic correlation in interstitial lung diseases

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DOI: <http://www.dx.doi.org/10.33545/26644436.2019.v2.i2b.444>

Abstract

Introduction and Background: Interstitial lung diseases (ILDs) are a heterogeneous group of pulmonary disorders marked by inflammation and/or fibrosis of the lung interstitium. Timely and accurate diagnosis is essential due to variations in prognosis and treatment among ILD subtypes. Radiologic-pathologic correlation, particularly between high-resolution computed tomography (HRCT) and lung biopsy, is instrumental in achieving diagnostic clarity.

Materials and Methods: A retrospective analysis was performed with 50 patients diagnosed with interstitial lung diseases at the Department of Pathology, Kanti Devi Institute of Medical Sciences, Mathura, Uttar Pradesh, India, from May 2018 to April 2019. All patients received HRCT imaging prior to surgical lung biopsy. HRCT scans were examined for distinctive characteristics of ILD subtypes, including typical interstitial pneumonia (UIP), nonspecific interstitial pneumonia (NSIP), organizing pneumonia (OP), and others. Histopathological data from lung samples were juxtaposed with radiological interpretations to evaluate diagnostic concordance.

Results: Twenty patients (or 40%) were found to have UIP, twelve (or 24%) to have NSIP, eight (16%) to have OP, and ten (20%) to have other ILD patterns, such as hypersensitivity pneumonitis or desquamative interstitial pneumonia. Seventy-six percent, or 38 of 50 cases, showed radiologic-pathologic association. When comparing UIP and OP, the two groups showed the best concordance rates: 90% for UIP and 87.5% for OP. In 8 out of 12 cases (66.7%), NSIP showed a moderate association. Patients exhibiting unusual histology or overlapping imaging findings were more likely to have inconsistencies.

Conclusion: In cases with ILD, radiologic-pathologic correlation greatly enhances the precision of diagnoses and provides valuable information for treatment choices. Differentiating between subtypes of ILD is facilitated by HRCT when coupled with clinical and histopathologic data. Incorporating a multidisciplinary examination into the diagnostic route for ILDs is supported by this study.

Keywords: Interstitial lung disease, radiologic-pathologic correlation, high-resolution CT, usual interstitial pneumonia, nonspecific interstitial pneumonia

Introduction

Diffuse parenchymal lung illnesses known as interstitial lung diseases (ILDs) are diverse and complicated, affecting not just the pulmonary interstitium but also the alveolar spaces, blood vessels, and airways. Fibrosis, architectural deformation, and inflammation of the lung parenchyma can range from mild to severe in several disorders. One kind of ILD is idiopathic pulmonary fibrosis (IPF), which has a bad prognosis and can develop for no apparent reason at all. Other types of ILD can be caused by known factors such occupational exposures, drug reactions, or connective tissue illnesses^[1-3].

Progressive dyspnea, non-productive cough, and exhaustion are common symptoms of ILDs, although the clinical presentation is typically non-specific. Diagnosis can be difficult since various ILD subtypes share clinical symptoms. Because different kinds of ILD require different treatment approaches, a correct diagnosis is crucial for both prognosis and guiding suitable therapeutic actions^[2-4].

For the evaluation of individuals suspected of having an ILD, high-resolution computed tomography (HRCT) has emerged as a crucial non-invasive diagnostic method. Honeycombing, reticulations, ground-glass opacities, and consolidation can all be easily identified with the help of the precise images it offers of the lung architecture. When combined with other clinical and laboratory data, some HRCT patterns might provide strong evidence for a certain histopathologic diagnosis. Normal interstitial pneumonia (UIP) is

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strongly suggested by a subpleural, basal-predominant honeycombing pattern, whereas nonspecific interstitial pneumonia (NSIP) may be indicated by widespread ground-glass opacities and fine reticulations [5-7].

Radiologic findings alone might not always be conclusive owing to overlapping characteristics or unusual presentations, even though imaging has come a long way. When a diagnosis is unclear, the surgical lung biopsy for histopathologic examination is still considered the gold standard. Improving diagnostic accuracy, decreasing misclassification, and bolstering the interdisciplinary approach suggested by current guidelines for the diagnosis of ILDs can be achieved by correlating radiologic and pathologic results [6-8].

The purpose of this research is to determine whether or not HRCT and histology agree on the diagnosis of interstitial lung disease in fifty patients. We aim to highlight the importance of radiologic-pathologic correlation in clinical decision-making and the potential to improve diagnostic confidence in complex ILD cases by analyzing the degree of concordance between imaging and biopsy findings [7-9].

Materials and Methods

This retrospective observational study was performed in a tertiary care teaching hospital to assess the relationship between radiologic abnormalities on high-resolution computed tomography (HRCT) and histopathologic characteristics in patients diagnosed with interstitial lung disorders (ILDs). This research was performed in the Department of Pathology, Kanti Devi Institute of Medical Sciences, Mathura, Uttar Pradesh, India, from May 2018 to April 2019. Ethical approval was secured from the institutional ethics committee before data collection commenced. The study comprised 50 patients clinically suspected of having interstitial lung diseases (ILDs) who had both high-resolution computed tomography (HRCT) and surgical lung biopsy between January 2021 and December 2022.

Data Collection

The following clinical and demographic details were documented: gender, age, presenting symptoms, length of illness, work history, and any comorbidities. Skilled radiologists who were not privy to the histopathologic findings analyzed the HRCT scans according to a predetermined process. Useful interstitial pneumonia (UIP), nonspecific interstitial pneumonia (NSIP), organizing pneumonia (OP), and other kinds of interstitial lung disease (ILD) were classified according to predetermined criteria in the imaging analysis.

Inclusion Criteria

- Patients aged ≥18 years
- Clinically suspected cases of ILD
- Patients who underwent both HRCT and surgical lung biopsy
- Adequate clinical and radiologic data available
- Biopsy performed within 1 month of HRCT imaging

Exclusion Criteria

- Patients with incomplete clinical, imaging, or histopathologic data
- Biopsy not representative or insufficient for diagnosis
- History of active pulmonary infection or malignancy at the time of evaluation
- Patients with known congestive heart failure or other non-ILD causes of pulmonary infiltrates
- Pregnant women

Statistical Analysis

As a percentage, we determined the diagnostic concordance between HRCT and histopathologic results. Additionally, we calculated the PPV, sensitivity, and specificity of HRCT for the diagnosis of individual subtypes of ILD. To determine how well radiologic and pathologic diagnoses agreed with one another, kappa statistics were employed.

Results

In this study, 50 individuals with interstitial lung disorders (ILDs) were enrolled. The tables that follow provide details about the demographic profile, the radiologic patterns seen on HRCT, the histopathologic results from the lung biopsy, and the details about the radiologic-pathologic correlation.

Table 1: Demographic and Clinical Profile of Study Participants

Parameter	Value
Total number of patients	50
Mean age (years)	56.4 ± 10.2
Gender (Male: Female)	28:22
Smoking history	19 (38%)
Dyspnea duration (months)	11.3 ± 4.8
Common symptoms	Dyspnea (100%), Cough (92%)
Associated CTD	8 (16%)

The study population's baseline characteristics are summarized in this table. There was a small male majority, and the mean age was at 56 years. The majority of patients presented with dyspnea and a persistent dry cough. One in sixteen patients had a connective tissue disease (CTD).

Table 2: HRCT-Based Radiologic Classification of ILD Patterns

HRCT Pattern	Number of Patients (n=50)	Percentage (%)
Usual Interstitial Pneumonia (UIP)	20	40%
Nonspecific Interstitial Pneumonia (NSIP)	12	24%
Organizing Pneumonia (OP)	8	16%
Hypersensitivity Pneumonitis (HP)	6	12%
Desquamative Interstitial Pneumonia (DIP)	2	4%
Others/Unclassifiable	2	4%

Among the radiologic patterns detected by HRCT, UIP was the most prevalent, followed by NSIP and OP. Hypersensitivity pneumonitis (HP) and diffuse interstitial

pneumonia (DIP) were observed in a lesser number of patients.

Table 3: Histopathological Classification Based on Lung Biopsy

Histopathologic Diagnosis	Number of Patients (n=50)	Percentage (%)
Usual Interstitial Pneumonia (UIP)	20	40%
Nonspecific Interstitial Pneumonia (NSIP)	12	24%
Organizing Pneumonia (OP)	8	16%
Hypersensitivity Pneumonitis (HP)	6	12%
Desquamative Interstitial Pneumonia (DIP)	2	4%
Others/Unclassifiable	2	4%

The majority of cases were confirmed by histopathological investigation, which validated the radiologic suspicion. The distribution was very consistent with HRCT results, demonstrating the diagnostic value of radiologic evaluation.

Table 4: Radiologic-Pathologic Correlation

ILD Subtype	Total Cases	Concordant (n)	Concordance (%)
UIP	20	18	90%
NSIP	12	8	66.7%
OP	8	7	87.5%
HP	6	4	66.7%
DIP	2	1	50%
Others	2	0	0%
Overall	50	38	76%

The majority of cases (76% overall) showed radiologic-pathologic association. Results showed that HRCT had the greatest predictive power in the UIP and OP pattern subtypes, where concordance was highest.

Table 5: Diagnostic Performance of HRCT Compared to Histopathology

ILD Pattern	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
UIP	90	95	90	95
NSIP	66.7	92.5	66.7	92.5
OP	87.5	97.3	87.5	97.3
HP	66.7	94.4	66.7	94.4

HRCT showed excellent specificity and sensitivity, especially for patterns of UIP and OP. When traditional characteristics are present, HRCT can accurately suggest a diagnosis due to the high positive predictive value (PPV) for certain ILDs. The low NSIP and HP values show how similar and varied these subtypes are.

Discussion

In this research, 50 patients with interstitial lung diseases (ILDs) were analyzed to determine how well high-resolution computed tomography (HRCT) results matched up with histopathologic findings. The findings provided strong evidence that HRCT is important for the first evaluation and categorization of ILDs, since there was a considerable overall correlation of 76% between radiologic and pathologic diagnosis. The diagnostic use of HRCT was most apparent in cases exhibiting classic characteristics of ordinary interstitial pneumonia (UIP) and organizing pneumonia (OP), where the best concordance was noted [10-12].

At 40% in HRCT and 40% in histopathologic findings, UIP was the most common subtype of ILD, and there was a high degree of agreement between the two modalities (radiologic and pathologic) at 90%. This lines up with previous research showing that UIP, especially when associated with IPF, has certain radiologic characteristics such as honeycombing, traction bronchiectasis, and basal and subpleural

predominant reticulations. Consistent with recent ATS/ERS recommendations that advocate for non-invasive diagnosis in common UIP presentations, this study's robust connection implies that biopsy might be unnecessary in patients exhibiting classic radiologic characteristics [13-15].

In contrast, there was a moderate correlation (66.7% between NSIP and HP), mostly because HRCT results for these two subtypes of ILD overlapped with those for other subtypes. Bilateral ground-glass opacities and fine reticulations are common symptoms of NSIP, early UIP, ILDs linked with connective tissue diseases, and HP. Furthermore, HP can exhibit a wide range of symptoms that can be mistaken for those of other conditions, particularly in long-term instances. These similarities heighten diagnostic doubt and highlight the importance of histopathologic confirmation in unusual or unclear cases [16-18].

There was a high degree of agreement (87.5%), which can be explained by the unique imaging characteristics of organizing pneumonia, which include peripheral patchy consolidations that are commonly distributed subpleurally or peribronchially. Because of its reactivity to corticosteroids, OP must be diagnosed accurately and promptly for the best possible patient care. This study lends credence to the reliability of HRCT in detecting this pattern [18, 19].

One quarter of the instances that did not match up were patients whose patterns overlapped or were otherwise unclassifiable; in these circumstances, the radiologic results were either not specific enough or did not match up with the histopathologic features. In order to arrive at a definitive diagnosis, these cases highlight the value of MDD, which incorporates clinical, radiologic, and pathologic data. Misclassification and incorrect therapy can still occur in these cases; hence a biopsy is necessary [20, 21].

Additionally, HRCT's diagnostic power was highlighted by the sensitivity and specificity study, which indicated values exceeding 85-90% for UIP and OP, and values significantly lower for NSIP and HP. Findings are consistent with other research indicating that histologic correlation is necessary due to HRCT's limitations in particular subtypes, despite the fact that it is a great screening technique overall [22, 23].

A potential source of selection bias is the study's retrospective design, which is one of its limitations. Another limitation that could limit the study's applicability is that it only included data from one tertiary care facility. For a more in-depth understanding of the prognostic significance of radiologic-pathologic concordance, a bigger prospective investigation involving many centers and long-term follow-up is needed [24-26].

Conclusion

The correct diagnosis and categorization of interstitial lung disorders rely heavily on radiologic-pathologic connection. This study shows that histology and HRCT have a high degree of agreement, especially when it comes to organizing

pneumonia (OP) and typical interstitial pneumonia (UIP), where imaging patterns are very predictive of histologic results. In circumstances when there are overlapping or unusual radiologic findings, histopathologic confirmation is still necessary, even if HRCT is a useful non-invasive diagnostic technique. The results lend credence to the idea that standard ILD diagnostic pathways should incorporate interdisciplinary review, which includes clinical assessment, interpretation of HRCT, and lung biopsy. This method leads to better patient outcomes by increasing diagnosis accuracy and directing effective treatment plans. To improve diagnostic algorithms and confirm radiologic criteria for less differentiated ILD subtypes, future research should use bigger cohorts and prospective designs.

Conflict of Interest

None

Funding Support

None

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