

Original Research Article

FIBROSIS BEYOND FAMILIAR: VARIANT HRCT FIBROTIC PATTERNS IN RHEUMATOID ARTHRITIS-ASSOCIATED ILD

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ABSTRACT

Background: Rheumatoid arthritis (RA) is the most common connective tissue disease (CTD) associated with interstitial lung disease (ILD), contributing significantly to morbidity and mortality. High-resolution computed tomography (HRCT) is essential for diagnosis and classification. While the usual interstitial pneumonia (UIP) pattern predominates, several variant fibrotic HRCT signs, such as Exuberant Honeycombing, Straight Edge, and Anterior Upper Lobe fibrosis, have been described in CTD-related UIP but remain underexplored in RA-ILD. **Objectives:** To determine the prevalence of variant fibrotic HRCT signs in RA-associated ILD and evaluate their role in differentiating RA-related UIP from idiopathic pulmonary fibrosis (IPF).

Materials and Methods: A retrospective observational study was conducted in the Department of Radiology, Malabar Medical College, Kozhikode, Kerala. HRCT chest scans of 60 clinically diagnosed RA patients (ACR/EULAR 2010 criteria) between January and December 2024 were reviewed. Patients with overlap CTDs or suboptimal HRCT quality were excluded. HRCT patterns were classified as UIP, NSIP, OP, LIP, or normal. Variant fibrotic signs, Exuberant Honeycombing (EHC), Straight Edge (SE), Anterior Upper Lobe (AUL), Four-Corner, Island-like Fibrosis, and Heterogeneous Lung Destruction were assessed.

Results: Of 60 patients, UIP was the predominant pattern (73.3%), followed by NSIP (16.7%) and OP (1.7%). Five (8.3%) had normal HRCT findings. Variant fibrotic signs were observed in 32 patients (53.3%). Exuberant Honeycombing was the most frequent (40.7%), followed by Straight Edge (29%) and Anterior Upper Lobe fibrosis (29%). Four-Corner sign, Island-like Fibrosis, and Heterogeneous Lung Destruction were absent. Over half the patients exhibited at least one variant sign.

Conclusion: Variant fibrotic signs are common in RA-UIP, with Exuberant Honeycombing being the most frequent and diagnostically useful. Their identification can help distinguish RA-related UIP from IPF. Incorporating these features into structured HRCT reporting may improve recognition of RA-ILD and guide multidisciplinary management.

Keywords: Rheumatoid arthritis, Interstitial lung disease, HRCT, Exuberant honeycombing, Straight edge sign, Anterior upper lobe fibrosis, UIP pattern.

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic systemic autoimmune disease primarily affecting synovial

joints but also associated with extra-articular manifestations, including interstitial lung disease (ILD). RA-associated ILD (RA-ILD) contributes significantly to patient morbidity and mortality, with

a reported prevalence of 10–30%. High-resolution computed tomography (HRCT) plays a vital role in detecting, classifying, and monitoring RA-ILD. The usual interstitial pneumonia (UIP) pattern is the most common, followed by nonspecific interstitial pneumonia (NSIP). However, subtle HRCT features traditionally described in other CTD-ILDs such as systemic sclerosis (SSc) and systemic lupus erythematosus (SLE), are often overlooked in RA. Variant fibrotic signs such as Exuberant Honeycombing (EHC), Straight Edge (SE), and Anterior Upper Lobe (AUL) fibrosis have been identified as markers of CTD-related UIP, helping distinguish it from idiopathic pulmonary fibrosis (IPF). Yet, their prevalence in RA-UIP remains poorly characterized. This study aims to assess the occurrence of these variant fibrotic signs in RA-ILD and evaluate their potential diagnostic utility.

MATERIALS AND METHODS

This retrospective observational study was conducted in the Department of Radiology, Malabar Medical College, Modakkallur, Kozhikode, Kerala, a tertiary care, multispecialty teaching hospital. HRCT chest scans performed between January 2024 and December 2024 were evaluated. A total of 60 patients with a clinical diagnosis of RA (as per ACR/EULAR 2010 criteria) who underwent HRCT were included.

Inclusion Criteria

- Clinically diagnosed RA cases
- HRCT chest performed within the study period

Exclusion Criteria

- Overlap with other CTDs (e.g., SSc, SLE, MCTD)
- Suboptimal HRCT image quality

Imaging Technique: All HRCT scans were performed using a multidetector CT scanner. Thin-section axial images (1–1.5 mm) were obtained at full inspiration in the supine position, with additional prone images when necessary. Images were reconstructed using high-spatial-frequency algorithms and evaluated in lung windows.

Image Analysis: Two radiologists (with >5 years of thoracic imaging experience) independently reviewed the scans, blinded to clinical data. HRCT patterns were categorized into UIP, NSIP, OP, LIP, or normal based on established criteria. The following variant fibrotic signs were specifically assessed: Exuberant Honeycombing (EHC), Straight Edge (SE) sign, Anterior Upper Lobe (AUL) fibrosis, Four-Corner sign, Island-like Fibrosis, and Heterogeneous Lung Destruction. Disagreements were resolved by consensus.

Statistical Analysis: Descriptive statistics were used to determine frequencies and percentages of HRCT patterns and variant signs. Co-occurrence of multiple signs within patients was also analyzed.

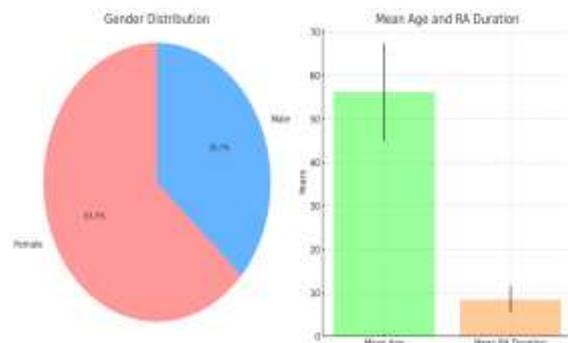


Figure 1A: Pie chart illustrating the gender distribution of the study population. Female patients constituted the majority (63.3%), while male patients accounted for 36.7% of cases, reflecting the known female predominance of rheumatoid arthritis figure 1B. Bar graph depicting the mean age and mean duration of rheumatoid arthritis among the study population. The mean age was approximately 56 years, while the mean duration of rheumatoid arthritis was approximately 8.5 years

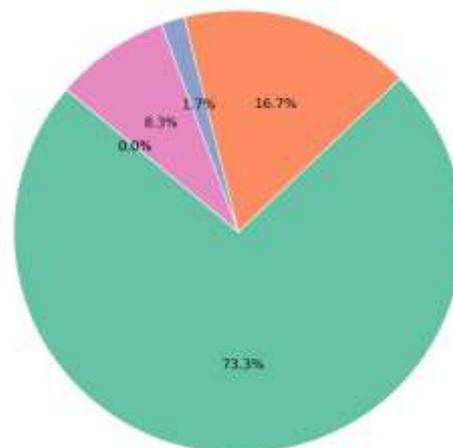


Figure 2: Figure Pie chart demonstrating the distribution of HRCT patterns among patients with RA-ILD. The usual interstitial pneumonia (UIP) pattern was predominant (73.3%), followed by nonspecific interstitial pneumonia (NSIP) (16.7%) and organizing pneumonia (O)

RESULTS

HRCT Pattern Distribution:

UIP was the most frequent HRCT pattern (73.3%), followed by NSIP (16.7%), OP (1.7%), and 8.3% of patients had normal scans.

Variant Fibrotic Signs:

Over half the patients (53.3%) exhibited at least one variant fibrotic sign, with Exuberant Honeycombing being the most prevalent (40.7%) (Figure 3), followed by Straight Edge (29%)(Figure 4) and Anterior Upper Lobe fibrosis (29%)(Figure 5). Four-Corner Sign, Island-like Fibrosis, and Heterogeneous Lung Destruction were absent.



Figure 3: Extensive honeycombing occupying more than expected lung volume relative to reticulation, a characteristic CTD-related fibrotic sign observed in RA-UIP, demonstrates Exuberant honeycombing

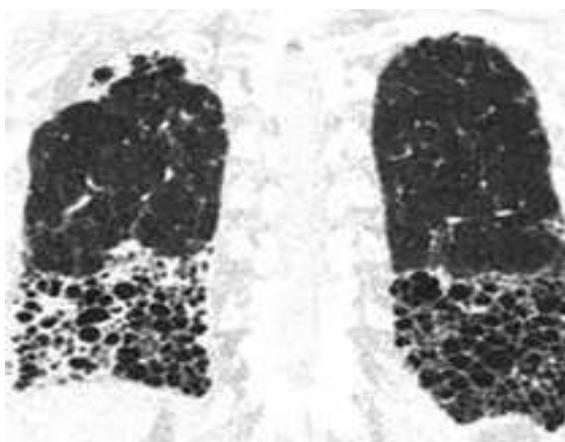


Figure 4: Sharp horizontal demarcation of fibrosis at the lung bases with relative sparing of upper lung zones, demonstrating the straight edge sign



Figure 5: Fibrotic changes involving the anterior segments of the upper lobes, a variant fibrotic sign favoring CTD-related UIP, showing anterior upper lobe sign

DISCUSSION

This study highlights the prevalence and diagnostic relevance of variant fibrotic signs in RA-associated ILD. While UIP was the dominant pattern, more than

half of RA-UIP patients demonstrated at least one CTD-related fibrotic sign.

Comparison with Literature:

Previous studies have shown that CTD-related UIP can often mimic IPF morphologically. Chung et al. reported that 32% of UIP cases may be CTD-related, while Augustine et al. found Exuberant Honeycombing, Straight Edge, and Anterior Upper Lobe fibrosis strongly associated with CTD-related UIP. Our findings echo these results, showing a similar distribution in RA, though the Four-Corner and Island-like Fibrosis signs were absent suggesting disease-specific fibrotic patterns.

Clinical Implications:

Recognizing variant signs on HRCT can guide radiologists toward a CTD etiology even when UIP morphology predominates. This distinction is clinically crucial, as CTD-related UIP generally has a better prognosis and different therapeutic implications compared to IPF.

Possible Explanations:

The absence of certain signs (Four-Corner, Island-like Fibrosis) in RA may reflect differences in fibrotic remodeling pathways compared to systemic sclerosis. Fibrosis in RA-ILD tends to be basal and peripheral, with less apical involvement, aligning with our observations.

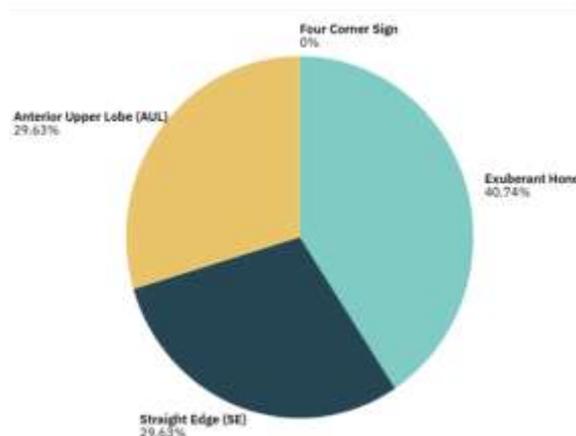


Figure 6: Pie chart illustrating the prevalence of variant fibrotic HRCT signs in patients with RA-associated ILD. Exuberant honeycombing was the most common finding (40.7%), followed by the straight edge sign (29.6%) and anterior upper lobe fibrosis (29.6%)

CONCLUSION

Variant HRCT fibrotic signs, particularly Exuberant Honeycombing, Straight Edge, and Anterior Upper Lobe fibrosis are common in RA-associated UIP and may help differentiate it from IPF. Routine assessment of these signs and inclusion in structured HRCT reporting templates can enhance diagnostic confidence and multidisciplinary decision-making in RA-ILD.

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