

Original Article**Rheumatoid Arthritis Related Interstitial Lung Disease: Patterns in High-Resolution Computed Tomography****Nawaraj Ranabhat *, Bipin Poudel, Buddhi Prasad Paudyal, Rakshya Bhattarai, Mahesh Gautam, Ashok Chapagain, Rakshya Aryal**

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Article Received: 25th May, 2025; Accepted: 26th June, 2025; Published: 31st July, 2025**DOI: <https://doi.org/10.3126/jonmc.v14i1.83559>****Abstract****Background**

Rheumatoid arthritis is a systemic inflammatory disease with extra-articular manifestations, among which interstitial lung disease is one of the most severe, contributing significantly to morbidity and mortality. Early detection of RA-associated ILD is critical, and high-resolution computed tomography has emerged as a highly sensitive diagnostic tool.

Materials and Methods

A retrospective, cross-sectional analytical study was conducted at the Department of Radiology, Patan Academy of Health Sciences, from June 2021 to June 2024. High Resolution Computed Topography (HRCT) scans of 400 patients diagnosed with Rheumatoid Arthritis were reviewed for interstitial lung abnormalities. Patterns were analyzed based on lung zones and laterality.


Results

Pulmonary abnormalities suggestive of Rheumatoid Arthritis - Interstitial Lung Disease were present in 78% of the patients. The most frequent High Resolution Computed Topography (HRCT) findings were ground glass opacities (39.1%), honeycombing (19.9%), traction bronchiectasis (16.6%), and parenchymal bands (14.8%). UIP (43.75%) and NSIP (30.25%) were the predominant diagnostic patterns. Right lung and lower zone involvement were more common. Nodules, tree-in-bud appearance, and crazy-paving were notably absent.

Conclusion

The study found a high prevalence of interstitial lung disease (ILD) among rheumatoid arthritis (RA) patients, with usual interstitial pneumonia (UIP) and nonspecific interstitial pneumonia (NSIP) as the dominant High Resolution Computed Topography (HRCT) patterns. Ground glass opacities and fibrotic changes, especially in the lower lung zones, were the most common radiologic features. Routine High Resolution Computed Topography screening in Rheumatoid Arthritis patients can facilitate early diagnosis of Interstitial Lung Disease and improve clinical outcomes, particularly in resource-limited settings.

Keywords: *Interstitial Lung Disease, HRCT Chest, Rheumatoid Arthritis*

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Introduction

Rheumatoid arthritis (RA) is a common, chronic, systemic inflammatory condition affecting approximately 0.5% to 1% of the population [1]. One notable extra-articular manifestation of RA is pulmonary involvement, occurring in 40-50% of patients [2]. Of significant concern is Interstitial Lung Disease (ILD), which is linked to a high mortality rate, with an average survival of only three years following an ILD diagnosis and is the second most common cause of death among RA patients, following infections [3,4].

Early-stage RA-related lung disease is hard to detect as symptoms typically appear only after significant interstitial damage [5]. Pulmonary Function Tests (PFTs) are used to assess lung function, but abnormalities may be evident in only 20-30% of asymptomatic RA patients [6]. High-Resolution Computed Tomography (HRCT) of the lung is a non-invasive and highly sensitive imaging method for identifying ILD, with sensitivity rates reported to be as high as 80% in patients with RA [7].

Research shows that pulmonary complications are common in RA patients, though their onset timing varies, with some studies suggesting they may develop within the first three years of the disease [8]. This study aims to assess the effectiveness of HRCT scans in detecting lung abnormalities in RA.

A literature review shows extensive global research on HRCT patterns in rheumatoid arthritis-related lung issues, but studies in our context are scarce. Therefore, this study aims to explore the prevalence, variations, risk factors and proportions of onset of ILD in RA patients presented to tertiary care settings in developing nations.

Material and Methods

A retrospective, cross-sectional analytical study was conducted to review people with Rheumatoid Arthritis (RA) who underwent High Resolution Computed Tomography (HRCT). The study was carried out in the Department of Radiology and Imaging, Patan Academy of Health Sciences (PAHS), Lalitpur, Nepal. The study covered the period from June 2021 to June 2024. The total study duration was 1 year, including 6 months for

data collection, 2 months for data analysis, and 2 months for final article writing.

Ethical approval was obtained from the Institutional Review Committee of Patan Academy of Health Sciences. Since this was a retrospective study, a waiver for patient consent was obtained.

Patients diagnosed with Rheumatoid Arthritis by clinicians or rheumatologists (inside or outside Patan Hospital) fulfilling the revised criteria of the American College of Rheumatology 2010, who underwent HRCT chest evaluation due to history or suspicion of interstitial lung disease (ILD) at PAHS.

Patients with HRCT findings indicating emphysematous changes or pathologies other than rheumatoid arthritis were excluded. Data from patients who underwent CT scans outside Patan Hospital were not included. Pediatric patients below 14 years of age were excluded. A census study was conducted; all HRCT scans performed in the Department of Radiology at PAHS from June 2021 to June 2024 were reviewed, totaling 391 scans. Those meeting inclusion criteria were selected for analysis.

Data were entered into Microsoft Excel 2016 and analyzed using Statistical Package for Social Sciences (SPSS) version 16. Continuous variables were described as mean \pm standard deviation (SD) or median with interquartile range (IQR), depending on data distribution. Categorical variables, including Ground Glass Opacities, Irregular Pleural Margins, Septal or Subpleural Lines, Honeycombing, and Subpleural Cysts, were expressed as frequencies and proportions.

Results

Pulmonary abnormalities suggestive of RA-ILD were present in 78% of the patients. The most frequent HRCT findings were ground glass opacities (39.1%), honeycombing (19.9%), traction bronchiectasis (16.6%), and parenchymal bands (14.8%). UIP (43.75%) and NSIP (30.25%) were the predominant diagnostic patterns. Right lung and lower zone involvement were more common. Nodules, tree-in-bud appearance, and crazy-paving were notably absent.



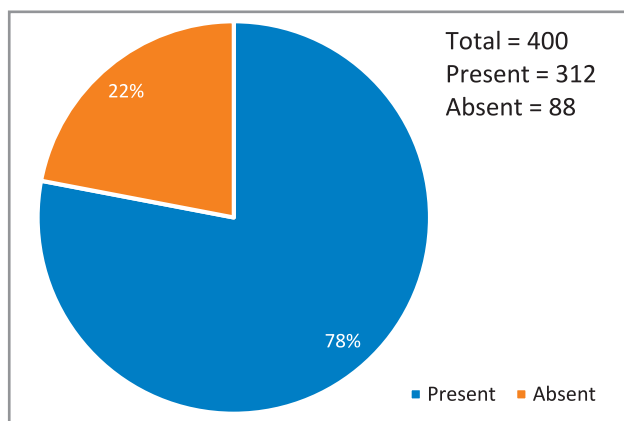


Figure 1: Proportion of Rheumatoid Arthritis patients with pulmonary abnormalities not attributed to other known disease entities.

Table 1: HRCT patterns of pulmonary involvement in rheumatoid arthritis

HRCT Findings	Frequency/%
Ground Glass Opacities	122 (39.1)
Irregular Pleural Margins	11
Septal or Subpleural Lines	56
Honeycombing	78
Subpleural Cyst	43
Interlobular septal thickening	2
Nodule	0
Air trapping	31
Bronchiectasis	9
Traction bronchiectasis	65
Emphysema	8
Tree-in-bud appearance	0
Crazy-paving appearance	0
Mosaic perfusion	9
Architectural distortion	5
Thickening of Broncho vascular bundle	1
Peripheral consolidations	12
Reversed halo (atoll) sign	6
Parenchymal bands	59

The table lists high-resolution computed tomography (HRCT) findings of pulmonary involvement in rheumatoid arthritis, detailing the frequency and percentage of each pattern observed in a study population. Ground glass opacities are the most common finding, present in 39.1% of cases (122 patients), indicating areas of increased lung opacity that may suggest inflammation or fibrosis. Honeycombing, seen in 78 cases, and traction bronchiectasis, in 65 cases, are also prevalent, reflecting advanced fibrotic changes and airway distortion, respectively. Other notable findings include parenchymal bands (59 cases) and septal or subpleural lines (56 cases), which point to interstitial lung disease and fibrotic processes. Less frequent patterns include

subpleural cysts (43 cases), air trapping (31 cases), and peripheral consolidations (12 cases), suggesting varied manifestations like cystic changes, obstructive small airway disease, and localized inflammation. Rare findings, such as interlobular septal thickening (2 cases) and thickening of the bronchovascular bundle (1 case), indicate minimal occurrence of these specific patterns. Notably, nodules, tree-in-bud appearance, and crazy-paving appearance were absent, suggesting these are not typical features of rheumatoid arthritis-related lung involvement in this cohort.

Table 2: Pulmonary Findings: Frequency and Distribution of Unilateral and Bilateral Lung Involvement in rheumatoid Arthritis

Findings	Unilateral Right Lung Involvement Frequency/%	Unilateral Left Lung Involvement Frequency/%	Bilateral Involvement Frequency/%
Ground Glass Opacities	59	52	11
Irregular Pleural Margins	6	3	2
Septal or Subpleural Lines	28	19	6
Honeycombing	37	23	14
Subpleural Cyst	17	19	7
Interlobular Septal Thickening	2	0	0
Nodule	0	0	0
Air trapping	16	12	3
Bronchiectasis	5	2	2
Traction bronchiectasis	41	16	8
Emphysema	4	4	4
Tree-in-bud appearance	0	0	0
Crazy-paving appearance	0	0	0
Mosaic perfusion	4	3	2
Architectural distortion	2	1	2
Thickening of broncho-vascular bundle	1	0	0
Peripheral consolidations	9	3	3
Reversed halo (atoll) sign	4	5	0
Parenchymal bands	43	16	12

The table presents the frequency and percentage of various lung abnormalities observed in a study, categorized by their occurrence in the right lung, left lung, or both (bilateral involvement). Ground glass opacities are the most common finding, appearing in 59% of cases in the right lung, 52% in the left lung, and 11% bilaterally, indicating a widespread presence of this feature, often associated with inflammatory or fibrotic lung conditions. Other notable findings include

parenchymal bands (43% right, 16% left, 12% bilateral) and traction bronchiectasis (41% right, 16% left, 8% bilateral), suggesting significant structural changes, possibly linked to fibrosis. Honeycombing, a sign of advanced lung disease, is observed in 37% of right lung cases, 23% of left lung cases, and 14% bilaterally. Less frequent findings, such as interlobular septal thickening, nodules, tree-in-bud appearance, and crazy-paving appearance, are either rare or absent, indicating they are not prominent in this study's population. Bilateral involvement is generally less common across most findings, with emphysema showing equal distribution (4% in all categories). The data highlights a predominance of right lung involvement for most abnormalities, which may reflect disease asymmetry.

Table 3: HRCT Imaging Patterns of Right and Left Lung Findings Across Upper, Middle, and Lower Zones in Rheumatoid Arthritis Patient

HRCT Findings	Right Lung			Left Lung	
	Upper Frequen cy/%	Mid Frequen cy/%	Lower Frequen cy/%	Upper Frequen cy/%	Lower Frequen cy/%
Ground Glass Opacities	7	20	32	12	40
Irregular Pleural Margins	1	1	4	1	2
Septal or Subpleural Lines	4	3	21	8	11
Honeycombing	1	2	33	3	20
Subpleural Cyst	3	4	10	5	14
Interlobular septal thickening	0	0	2	0	0
Nodule	0	0	0	0	0
Air trapping	3	5	8	5	7
Bronchiectasis	1	1	3	1	1
Traction bronchiectasis	29	10	2	11	5
Emphysema	3	1	0	3	1
Tree-in-bud appearance	0	0	0	0	0
Crazy-paving appearance	0	0	0	0	0
Mosaic perfusion	0	2	2	1	2
Architectural distortion	0	0	2	0	1
Thickening of bronchovascular bundle	0	0	1	0	0
Peripheral consolidations	3	4	2	2	1
Reversed halo (atoll) sign	1	2	1	2	3
Parenchymal bands	28	8	7	7	9

The table presents HRCT imaging findings in the lungs of a rheumatoid arthritis patient, detailing patterns across upper, middle, and lower zones of both lungs. Ground glass opacities are most frequent in the lower zones (right: 32%, left: 40%), indicating inflammation or fibrosis. Honeycombing, suggestive of advanced fibrosis, is prominent in the lower right lung (33%) and lower left lung (20%). Traction bronchiectasis is notable in the upper right lung (29%), reflecting structural distortion. Parenchymal bands are

common in the upper right lung (28%). Other findings like nodules, tree-in-bud, and crazy-paving are absent, while subpleural cysts, air trapping, and mosaic perfusion are less frequent. The distribution suggests more severe fibrotic changes in the lower lobes, with some asymmetry between lungs.

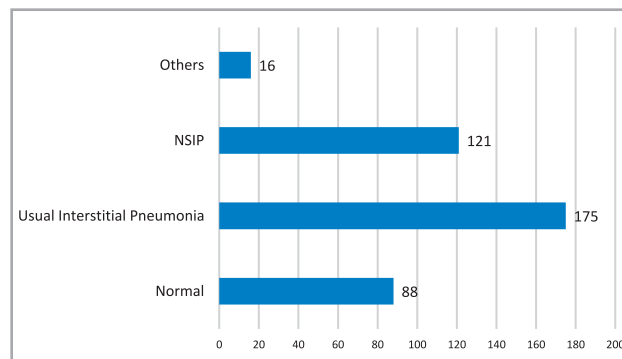


Figure 2: Frequency distribution of the HRCT Diagnosis in patients with early Rheumatoid Arthritis.

The table shows the frequency distribution of high-resolution computed tomography (HRCT) diagnoses in 400 patients with early rheumatoid arthritis. The majority, 175 patients, were diagnosed with Usual Interstitial Pneumonia (UIP), followed by 121 with Nonspecific Interstitial Pneumonia (NSIP). Eighty-eight patients had normal HRCT findings, while 16 were categorized under other diagnoses. This distribution highlights that UIP and NSIP are the most common lung abnormalities in early rheumatoid arthritis, with normal scans being less frequent.

Discussion

This study highlights the substantial prevalence and pattern distribution of interstitial lung disease (ILD) among patients with rheumatoid arthritis (RA) based on high-resolution computed tomography (HRCT). Among 400 RA patients, 78% showed pulmonary abnormalities on HRCT, a figure consistent with earlier studies indicating that up to 80% of RA patients may develop subclinical or clinical pulmonary involvement over time.

International literature consistently shows that the predominant HRCT patterns in rheumatoid arthritis-associated interstitial lung disease (RA-ILD) are usual interstitial pneumonia (UIP) and nonspecific interstitial pneumonia (NSIP) [11,12]. Our data a prevalence of UIP in 43.75% and NSIP in 30.25% closely mirrors findings from major cohort studies, which also report UIP as the most frequent pattern, followed by NSIP. Usual Interstitial Pneumonia (UIP) emerged as

the most common HRCT pattern in our cohort, accounting for 43.75% (175 cases), followed by Nonspecific Interstitial Pneumonia (NSIP) in 30.25% (121 cases). This aligns with previous findings, such as those by Kim et al., where UIP was found to be the predominant pattern in RA-ILD and correlated with a poorer prognosis compared to NSIP [13]. UIP is typically associated with older age, male gender, and a smoking history, factors which should be explored further in future prospective studies in this population.

The most common radiological finding was ground glass opacities (GGO), observed in 39.1% of cases, followed by honeycombing at 19.9%, parenchymal bands at 14.8%, and traction bronchiectasis at 16.6%. These results are consistent with international data and studies. A large multi-center review in the United States found ground-glass changes, reticulation, traction bronchiectasis, and honeycombing as the most frequent HRCT features [14,15]. The high incidence of GGOs suggests an active inflammatory component or early fibrotic changes, which underscores the importance of timely imaging and intervention. Notably, features such as nodules, tree-in-bud appearance, and crazy-paving patterns which may suggest alternative or concurrent pulmonary pathologies were absent, supporting the specificity of these HRCT findings for RA-related ILD in this population.

Interestingly, our data demonstrated a right lung predominance in most HRCT findings. This asymmetry has been sparsely reported in literature and may warrant further anatomical or physiological explanation, such as differences in lymphatic drainage or vascular architecture. In addition, a predilection for lower lung zones was observed in patterns like GGO, honeycombing, and subpleural cysts, which is characteristic of RA-ILD and fibrosing interstitial lung diseases in general. The proportion of bilateral lung involvement was lower than expected, which may reflect the early or patchy nature of disease in this cohort or variability in disease progression. The fact that many findings were unilateral highlights the utility of HRCT in detecting subtle and early changes that may be missed on plain radiographs or clinical evaluation alone. This study contributes valuable data from a low-resource, developing nation setting, where access to HRCT is often limited, and RA-ILD may remain under diagnosed. Given the high mortality associated with RA-ILD, particularly UIP, our findings support the routine inclusion of HRCT in the workup of RA

patients, especially those with respiratory symptoms or abnormal pulmonary function tests.

Limitations of this study include its retrospective design and the lack of correlation with pulmonary function test results or clinical symptomatology. Future prospective studies incorporating longitudinal follow-up, treatment response, and survival analysis would enhance understanding of RA-ILD progression and outcomes in this population.

Conclusion

This study highlights the significant prevalence of pulmonary abnormalities in rheumatoid arthritis (RA) patients, with 78% exhibiting lung involvement on HRCT scans, primarily ground glass opacities, honeycombing, and traction bronchiectasis. Usual Interstitial Pneumonia (UIP) and Nonspecific Interstitial Pneumonia (NSIP) were the most common diagnoses, emphasizing the burden of interstitial lung disease (ILD) in early RA. The findings underscore the critical role of HRCT as a sensitive, non-invasive tool for detecting RA-related lung abnormalities, particularly in lower lung zones with fibrotic changes. The predominance of right lung involvement suggests potential disease asymmetry.

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Conflict of interest: None

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