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Prevalence and patterns of pulmonary involvement in patients with systemic lupus erythematosus: A cross-sectional study

[1]Dr Virendra Kalwar, Senior Resident, Department of General Medicine, Jaipur National University Institute for Medical Sciences and Research Centre (JNUIMSRC), Jaipur, Rajasthan

[2]Dr Ashish, Senior resident, Department of General Medicine, JLN Medical College, Ajmer, Rajasthan

[3]Dr Yashvardhan Soni, Senior resident, Department of General Medicine, Government Medical College, Jhunjhunu, Rajasthan

Corresponding Author: Dr Virendra Kalwar, Senior Resident, Department of General Medicine, Jaipur National University Institute for Medical Sciences and Research Centre (JNUIMSRC), Jaipur, Rajasthan

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Abstract

Introduction: Lung involvement is common in systemic lupus erythematosus (SLE) but is often silent, and data from India are limited. This study estimated how often adults with SLE have pulmonary involvement and described its clinical and radiological patterns.

Methodology: This cross-sectional observational study at a tertiary care hospital in New Delhi (2023–2024) included 60 adults with SLE who met the ACR/EULAR classification criteria. Each patient underwent history, examination, sputum studies, chest X-ray, high-resolution computed tomography (HRCT) of the chest, pulmonary function tests (PFT) and echocardiography. Smokers and patients with known lung or heart disease were excluded. Groups were compared with the chi-square or Fisher's exact test, with $p < 0.05$ considered significant.

Results: The mean age was 37.4 years and 91.7% of patients were women. Twenty-six patients (43.3%) had respiratory symptoms: pleurisy in 25.0%, dyspnoea in 18.3% and cough in 13.3%. HRCT was abnormal in 39 patients (65.0%) and the chest X-ray in 21 (35.0%); 9 patients (15.0%) had a restrictive PFT pattern and none had pulmonary hypertension. The commonest HRCT findings were pleural effusion (30.0%), interstitial thickening (25.0%) and ground-glass opacities (23.3%). HRCT was abnormal in 47.1% of patients without respiratory symptoms. Pleural effusion was associated with younger age, male sex and disease duration under 10 years ($p \leq 0.025$), whereas interstitial thickening,

parenchymal bands, ground-glass opacities and restrictive PFT were associated with older age and longer disease duration ($p \leq 0.015$). Lupus nephritis was not associated with any finding.

Conclusion: About two in three adults with SLE had abnormal HRCT, including nearly half of those without respiratory symptoms. Pleural effusion marked earlier disease and parenchymal change later disease. A low threshold for chest imaging, with HRCT where available, is justified in SLE even in the absence of respiratory symptoms.

Keywords: HRCT, SLE, PFT, ILD.

Introduction

Lung involvement affects 40–70% of patients with systemic lupus erythematosus (SLE), often silently, and data on its frequency and pattern from resource-limited settings such as India remain sparse. SLE is a chronic autoimmune disease marked by autoantibodies against nuclear antigens and multi-organ damage. Its cause is multifactorial, with genetic, hormonal and environmental contributors such as infections, ultraviolet light, silica dust, tobacco, exogenous oestrogen, air pollution and stress, and it is far commoner in women of reproductive age.[1-5] Prevalence is about 241 per 100,000 in the United States and an estimated 3.2 per 100,000 in India, which still means roughly 50,000 Indians living with SLE.[6,7]

Presentations range from mucocutaneous disease and arthritis to nephritis, neuropsychiatric, cardiac, haematological and pulmonary involvement.[8] More than 95% of patients are antinuclear antibody (ANA) positive,[4] and the 2019 EULAR/ACR classification requires an ANA titre of at least 1:80 plus a weighted score of 10 or more.[10]

Pulmonary disease in SLE includes pleuritis and pleural effusion (the most common, in about 43% of patients), interstitial lung disease (ILD), acute lupus pneumonitis, shrinking lung syndrome, pulmonary hypertension, pulmonary embolism, diffuse alveolar haemorrhage and opportunistic infection related to immunosuppression[9]. Because onset is gradual, many manifestations are subclinical and are found late. Pulmonary involvement is a significant independent predictor of poor quality of life in SLE,[12] and higher age, pneumonitis and anti-ribonucleoprotein antibodies predict early permanent lung damage.[9]

Published prevalence figures vary widely with design and method. Pleuropulmonary involvement was 33% in a Saudi retrospective series[13], 31% in the 3,215-patient Spanish RELESSER registry,[19] 44.4% in a Chinese series of 320 patients[18] and 65.9% in an Egyptian hospital cohort.[20] Studies that used high-resolution CT (HRCT) found more: abnormalities in 70% of 34 patients in the study by Fenlon et al.[14] and in 55% of 38 patients in an Indian series, where many with normal chest X-rays and pulmonary function tests still had abnormal HRCT.[17] Indian studies reported lung pathology in 67% of 70 patients[15] and restrictive lung disease as the most common pattern on function tests.[16] Few studies have compared symptoms, chest X-ray, HRCT and pulmonary function side by side in one adult Indian cohort.

We therefore assessed the prevalence and pattern of pulmonary involvement in adults with SLE at a tertiary hospital in New Delhi. The primary objective was to determine how many patients had pulmonary involvement. The secondary objective was to describe its clinical and radiological manifestations and the patient factors associated with them.

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Methodology

This was a cross-sectional observational study conducted in the Department of General Medicine of Dr. Baba Saheb Ambedkar Medical College and Hospital, Rohini, New Delhi, over one year (2023–2024). Adults with SLE attending the medical outpatient and inpatient departments were enrolled.

Patients aged 18–60 years, of either sex, who met the ACR/EULAR classification criteria for SLE (ANA at a titre of at least 1:80 as the entry criterion, plus a weighted score of 10 or more) were eligible.[10] We excluded patients with pre-existing lung disease such as chronic obstructive pulmonary disease or bronchial asthma, chronic smokers, pregnant women, patients with known cardiac disease (cardiomyopathy or rheumatic heart disease) and those who declined consent.

The sample size was estimated from the prevalence of lung involvement reported by Sahu et al.[15] The required size was 59 patients, and 60 were enrolled.

After written informed consent, each patient gave a detailed history, with attention to respiratory symptoms (breathlessness, cough, expectoration, haemoptysis and pleuritic chest pain) and co-morbidities, and underwent a full clinical examination, recorded on a structured proforma. Investigations comprised routine laboratory tests (complete blood count, renal function and inflammatory markers), sputum Gram stain and culture, a postero-anterior chest X-ray, HRCT of the chest, pulmonary function tests (PFT), and two-dimensional echocardiography to exclude cardiac disease and screen for pulmonary hypertension.

The primary outcome was the prevalence of pulmonary involvement. Secondary outcomes were the proportion of patients with clinical manifestations of lung involvement, the proportion with radiological evidence of it, and the patterns of involvement.

Data were entered in Microsoft Excel and analysed with SPSS version 17.0. Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables as numbers and percentages. Continuous variables were compared with the unpaired t-test, and categorical variables with the chi-square test or Fisher's exact test. A p value below 0.05 was considered statistically significant.

The protocol was approved by the Institutional Ethics Committee and the Scientific Research Committee of the hospital. Written informed consent was obtained from every participant in their preferred language, confidentiality was maintained, and participants were free to withdraw at any time without any effect on their standard care.

Results

A total of 60 adults with SLE were included. HRCT was abnormal in 39 patients (65.0%) and the chest X-ray in 21 (35.0%), while 9 patients (15.0%) had a restrictive pattern on pulmonary function tests. These counts were derived from the cross-tabulations of symptoms against imaging.

Of the 60 patients, 55 (91.7%) were women and 5 (8.3%) were men. The mean age was 37.4 years, and 29 patients (48.3%) were in the 30–40-year band. The mean disease duration was 13.5 ± 6.2 years, and 6 patients (10.0%) had lupus nephritis. (Table 1)

Twenty-six patients (43.3%) had at least one respiratory symptom. Pleurisy was the most frequent (25.0%), followed by dyspnoea (18.3%) and cough (13.3%), and no patient had haemoptysis. Gram stain of sputum was positive in 2 patients (3.3%), with negative cultures. Pulmonary function tests were normal in 51 patients

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(85.0%) and restrictive in 9 (15.0%). Two-dimensional echocardiography showed no pulmonary hypertension in any patient. (Table 2)

On chest X-ray, pleural effusion was the commonest abnormality (21.7%), followed by reticular opacities (6.7%) and consolidation (5.0%); no patient had atelectasis. On HRCT, pleural effusion again led (30.0%), followed by interstitial thickening (25.0%), ground-glass opacities (23.3%), parenchymal bands (16.7%), lymphadenopathy (6.7%) and consolidation (3.3%). No patient had pleural thickening or bronchiectasis. (Table 3)

Imaging was abnormal far more often in symptomatic patients, but HRCT also found disease in nearly half of those without symptoms. All 15 patients with pleurisy had abnormal chest X-rays and HRCT. HRCT was abnormal in 31 of 49 patients (63.3%) without dyspnoea and in 31 of 52 (59.6%) without cough, which points to subclinical lung disease. (Table 4)

Pleural effusion on chest X-ray clustered in younger patients, in men and in early disease: it was present in 9 of 14 patients aged 20–30 years but in 1 of 17 aged over 40, in 4 of 5 men against 9 of 55 women, and in 10 of 23 patients with disease under 10 years but none of 12 with disease over 20 years. Reticular opacities showed no association with any factor, and lupus nephritis was not associated with effusion. (Table 5)

On HRCT, pleural effusion was associated with younger age (10 of 14 patients aged 20–30 years), male sex (4 of 5 men against 14 of 55 women) and disease duration under 10 years. Interstitial thickening, parenchymal bands and ground-glass opacities were associated with older age and longer disease duration: of 17 patients over 40 years, 12 had interstitial thickening, 7 had parenchymal bands and 9 had ground-glass opacities. Sex was also associated with HRCT consolidation, but this rests on only 2 cases. A restrictive PFT pattern occurred in 6 of 17 patients over 40 years, in 3 of 29 aged 30–40 years and in none of 14 aged 20–30 years, and in none of the 23 patients with disease under 10 years. Lymphadenopathy showed no association with any factor, and lupus nephritis was not associated with any finding. (Table 6)

Discussion

In this study, about two in three adults with SLE had abnormal HRCT of the chest, most of them without a matching symptom, and the pattern of findings differed with age and disease duration.

Our cohort was 91.7% female, with a mean age of 37.4 years and most patients in the 30–40-year band. The female preponderance matches other series.[7,42-44] Mean age was higher than the 23.3 years reported by Mathur et al.[42] and close to the 35 years in the 928 adults studied by Merola et al.[43] Pleurisy (25.0%), dyspnoea (18.3%) and cough (13.3%) were the main respiratory symptoms, and none had haemoptysis. Narayanaswamy et al. reported cough in 8%, dyspnoea in 16% and pleurisy in 26%,[45] and Alhammadi et al. found dyspnoea, cough and chest pain in 18% each.[27] Alamoudi and Attar reported higher figures (chest pain 50%, breathlessness 49%, cough 34%).[13] Differences in setting and selection probably explain the spread.

Pulmonary function was normal in 85% of our patients and restrictive in 15%. Reported figures vary widely: Andonopoulos et al. found normal function in 32.9%, small-airway disease in 24% and a restrictive pattern in 5.7%,[46] while Mohammad et al. found restriction in 80%.[47] Indian and Omani studies likewise list restriction as the most common abnormality,[16,25] and Silberstein et al. found PFT more sensitive than clinical signs or chest

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X-ray[28]. Our low yield may reflect that we excluded smokers and patients with known lung or heart disease.

Pleural effusion was the most frequent finding on both chest X-ray (21.7%) and HRCT (30.0%), a ranking shared by most earlier work.[13,15,16,29,45] Narayanaswamy et al. found effusion in 61.5% of abnormal films[45], and Alamoudi and Attar in 55%;[13] their figures are higher than ours, but the order of findings was similar. On HRCT, Alamoudi and Attar found effusion in 58%, consolidation and atelectasis in 42% and lymphadenopathy in 23%, with interlobular septal thickening and ground-glass opacities in about one in five.[13] Narayanaswamy et al. recorded effusion in 41.2%, ILD in 38.2% and pneumonitis in 8.8%.[45] Our HRCT picture, with interstitial thickening in 25.0% and ground-glass opacities in 23.3%, sits within these ranges, but we saw less consolidation and no bronchiectasis.

HRCT was more sensitive than chest X-ray: 65.0% of our patients had an abnormal HRCT against 35.0% an abnormal film. This agrees with Fenlon et al., who found abnormal HRCT in 70% against 41% of chest X-rays and 24% of PFTs,[14] and with Kakati et al., who found abnormal HRCT in 55% of patients, many with normal films and PFTs.[17] We found abnormal HRCT in 47.1% of asymptomatic patients and in 63.3% of those without dyspnoea. Absence of respiratory symptoms therefore does not exclude lung involvement, and symptom-based screening alone will miss it.

Pleural effusion was linked to younger age, male sex and disease duration under 10 years, whereas interstitial thickening, parenchymal bands, ground-glass opacities and restrictive PFT were linked to older age and longer disease. One reading is that serositis, effusion in particular, belongs to the earlier and more active phase, and that parenchymal change accumulates with time and age. Our data cannot test this because disease activity was not scored. The literature is mixed. Alamoudi and Attar tied lung involvement to active disease and the early years after diagnosis,[13] Alhammadi et al. to increasing age,[27] and Kim et al. to sex, age, diabetes and airway disease.[48] Gerosa et al. found that younger age, male sex, joint involvement and constitutional symptoms predicted lung involvement[49], which is consistent with our male finding. Only five of our patients were men, so the sex comparisons are fragile. Lupus nephritis, present in 6 patients, was unrelated to any lung finding.

The topic is under-researched in India, every patient had symptom review, chest X-ray, HRCT, PFT and echocardiography, and patient factors were analysed against each pattern of involvement separately. The study is, however, single-centre and cross-sectional, with 60 patients and only 5 men. Several laboratory parameters were not assessed, and disease activity scores, autoantibody profile and treatment were not analysed against lung findings. Many subgroup comparisons were made without correction for multiple testing, and some cells (for example consolidation, 2 cases) are very small, so the p values should be read as exploratory.

Conclusion

In this study of 60 adults with SLE, HRCT showed lung abnormalities in 65.0% against 35.0% on chest X-ray, and 15.0% had a restrictive PFT pattern. Pleural effusion was the commonest finding on both imaging methods, followed on HRCT by interstitial thickening and ground-glass opacities. Abnormal HRCT was found in 47.1% of patients without respiratory symptoms, and every patient with pleurisy had abnormal imaging. Effusion was linked to younger age, male sex and shorter disease duration, whereas interstitial thickening, parenchymal

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bands, ground-glass opacities and restrictive PFT were linked to older age and longer disease duration. These findings support a low threshold for chest imaging in SLE, with HRCT where available, even without respiratory symptoms, and PFT for older patients and those with long-standing disease. Larger multicentre studies that record disease activity and follow patients over time are needed to confirm these associations.

Table 1: Baseline Characteristics of Study Participants (N=60)

Variable	Category	n (%)
Age group	20–30 years	14 (23.3)
	30–40 years	29 (48.3)
	>40 years	17 (28.3)
Sex	Female	55 (91.7)
	Male	5 (8.3)
Duration of SLE	<10 years	23 (38.3)
	10–20 years	25 (41.7)
	>20 years	12 (20.0)
Lupus nephritis	Present	6 (10.0)

Table 2: Respiratory Symptoms, Sputum, Pulmonary Function and Echocardiographic Findings (N=60)

Parameter	n (%)
Dyspnoea	11 (18.3)
Cough	8 (13.3)
Pleurisy	15 (25.0)
Haemoptysis	0 (0.0)
Any respiratory symptom	26 (43.3)
Sputum Gram stain positive (culture negative)	2 (3.3)
PFT normal	51 (85.0)
PFT restrictive	9 (15.0)
Pulmonary hypertension on echocardiography	0 (0.0)

Table 3: Chest X-ray and HRCT Findings of Pulmonary Involvement (N=60)

Modality	Finding	Present n (%)	Absent n (%)
Chest X-ray	Pleural effusion	13 (21.7)	47 (78.3)
	Reticular opacities	4 (6.7)	56 (93.3)
	Atelectasis	0 (0.0)	60 (100.0)
	Consolidation	3 (5.0)	57 (95.0)
HRCT	Pleural effusion	18 (30.0)	42 (70.0)
	Thickened pleura	0 (0.0)	60 (100.0)
	Interstitial thickening	15 (25.0)	45 (75.0)
	Bronchiectasis	0 (0.0)	60 (100.0)
	Parenchymal bands	10 (16.7)	50 (83.3)
	Ground-glass opacities	14 (23.3)	46 (76.7)
	Consolidation	2 (3.3)	58 (96.7)
	Lymphadenopathy	4 (6.7)	56 (93.3)

Table 4: Abnormal Imaging by Presence of Respiratory Symptoms (N=60)

Respiratory symptoms	Patients	Abnormal chest X-ray n (%)	Abnormal HRCT n (%)
Present	26	18 (69.2)	23 (88.5)
Absent	34	3 (8.8)	16 (47.1)
All patients	60	21 (35.0)	39 (65.0)

Table 5: Association of Patient Factors with Chest X-ray Findings (N=60)

Factor	Category	Pleural effusion n/N (%)	p value	Reticular opacities n/N (%)	p value
Age	20–30 years	9/14 (64.3)	<0.001	0/14 (0.0)	0.439
	30–40 years	3/29 (10.3)		3/29 (10.3)	
	>40 years	1/17 (5.9)		1/17 (5.9)	
Sex	Male	4/5 (80.0)	0.006	0/5 (0.0)	0.533
	Female	9/55 (16.4)		4/55 (7.3)	
Lupus nephritis	Yes	1/6 (16.7)	0.754	0/6 (0.0)	0.490
	No	12/54 (22.2)		4/54 (7.4)	
Duration of SLE	<10 years	10/23 (43.5)	0.004	0/23 (0.0)	0.242
	10–20 years	3/25 (12.0)		3/25 (12.0)	
	>20 years	0/12 (0.0)		1/12 (8.3)	

Table 6: Values for Association of Patient Factors with HRCT Findings and Restrictive PFT (bold = $p < 0.05$)

Finding (n)	Age	Sex	Lupus nephritis	Disease duration
HRCT: pleural effusion (18)	<0.001	0.025	0.260	<0.001
HRCT: interstitial thickening (15)	<0.001	0.178	0.136	<0.001
HRCT: parenchymal bands (10)	0.004	0.296	0.248	<0.001
HRCT: ground-glass opacities (14)	0.001	0.854	0.154	<0.001
HRCT: consolidation (2)	0.033	0.030	0.055	0.189
HRCT: lymphadenopathy (4)	0.130	0.212	0.301	0.782
Restrictive PFT (9)	0.015	0.327	0.278	<0.001

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