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Original Research Article

Patterns of HRCT in Connective Tissue Disorders

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Abstract:

Interstitial lung diseases (ILDs) are challenging to diagnose with traditional chest radiographs due to their low resolution and overlapping anatomical features. High-resolution computed tomography (HRCT) has transformed the diagnosis and characterization of ILDs. This study uses HRCT to evaluate pulmonary involvement in connective tissue diseases (CTDs) such as rheumatoid arthritis (RA), systemic lupus erythematosus (SLE), systemic sclerosis, scleroderma, polymyositis, dermatomyositis, mixed connective tissue disease (MCTD), and undifferentiated connective tissue disease (UCTD). Significant patterns like non-specific interstitial pneumonia (NSIP) and usual interstitial pneumonia (UIP) are identified, with 42% of RA subjects and 54% of SLE subjects showing pulmonary involvement. Early detection of pulmonary abnormalities through HRCT can precede symptoms, aiding in better prognosis and treatment. HRCT is essential for diagnosing, assessing disease severity, guiding biopsies, and monitoring antifibrotic treatment efficacy in ILDs associated with CTDs.

Keywords: HRCT (High Resolution Computed Tomography), Interstitial Lung Diseases (ILDs), Connective Tissue Diseases (CTDs), Usual Interstitial Pneumonia (UIP), Non-Specific Interstitial Pneumonia (NSIP), Ground Glass Opacities (GGOs), Pulmonary Fibrosis.

Introduction

Since the advent of x-rays, radiologists have relied on plain chest radiography to detect interstitial lung diseases, albeit with limitations in spatial resolution and specificity [5]. High Resolution Computed Tomography (HRCT), introduced by Zerhouni et al. in 1985 [1], revolutionized the diagnosis of diffuse lung disorders, offering detailed anatomical insights crucial for classifying conditions such as interstitial lung diseases (ILDs) [3]. These diseases, encompassing diverse connective tissue disorders (CTDs) like systemic sclerosis and rheumatoid arthritis, often manifest pulmonary abnormalities detectable on HRCT before clinical symptoms appear [6]. This imaging modality plays a pivotal role in assessing disease severity, guiding treatment decisions, and improving prognostic outcomes in patients with CTD-associated ILDs [7].

Methods

1. **Study Design and Participants:**

- Data collection utilized a structured case proforma to gather demographic details such as age, gender, and including RF levels [4].
- Participants included individuals diagnosed with connective tissue diseases (CTDs) and presenting with pulmonary symptoms. Newly diagnosed cases undergoing HRCT at King George Hospital, Visakhapatnam were also included [2].

2. HRCT Protocol:

- HRCT scans were performed with patients in a supine position.
- Parameters included a slice thickness of 0.625 mm at 5 mm intervals, 140 kVp, and 150 mAs [1].

3. Ethical Considerations: Prior approval was obtained from the Institutional Ethics Committee to ensure compliance with ethical standards and patient confidentiality.

4. Statistical Analysis:

- Data were analyzed using SPSS version 17.
- Statistical measures included percentages, proportions, means, and standard deviations [3].

5. Data Presentation: Tabular representations were employed to effectively present the findings to facilitate clear interpretation and analysis of the data.

Results

Table 1: Distribution of Study Population According to Age and Gender Categories

Age: Majority in the 31-40 years age group (34%), followed by 41-50 years (30%).		
Age	**Frequency**	**Percentage**
31-40 years	34	34%
41-50	30	30%
Gender: Predominantly female (72%).		
Gender	**Frequency**	**Percentage**
Female	72.0	72%

Table 2: Distribution of Study Population According to Presence of Different Categories on HRCT Lung

Category	**Percentage**
Honeycombing	24%
Traction Bronchiectasis	17%
Volume Loss	14%
Reticulation	14%
Ground Glass Opacities (GGO)	25%
Nodules	4%
Cysts	9%
Emphysema	7%

Table 3: Distribution of Lung Lesions

Category	**Percentage**		
Diffuse Patchy Involvement	49%		
Nil Findings	48%		
Other distributions	**Perihilar**	**Subpleural**	**Unilateral left lung**
	1%	1%	1%

Table 4: Clinical Diagnoses

Category	**Percentage**
Rheumatoid Arthritis (RA)	33%
Systemic Lupus Erythematosus (SLE)	31%
Scleroderma	15%
Mixed Connective Tissue Disorder (MCTD)	8%

Table 5: Associations with HRCT Findings

Category	**Clinical Conditions**			
	SLE	**RA**	**Scleroderma**	**MCTD**
Honeycombing	41%	12%	26%	
Traction Bronchiectasis	32.3%	9%		37.5%
Ground Glass Opacities (GGO)	12%	24%	38%	
Enlarged Pulmonary Artery	12.9%		13.3%	

Discussion

The lungs, crucial for respiratory gas exchange, develop from respiratory diverticula, forming bronchial buds that mature into lobular and segmental bronchi. Throughout maturation, the interstitium supports alveolar sacs and communicates between compartments, crucial for maintaining lung function. Interstitial lung diseases (ILDs), encompassing diverse pathologies, are categorized into idiopathic and associated with connective tissue diseases (CTDs)[1]. Usual interstitial pneumonia (UIP), characterized by fibrosis and poor prognosis, contrasts with non-specific interstitial pneumonia (NSIP), where inflammation predominates [3]. Cryptogenic organizing pneumonia (COP) shows intraluminal pneumonia, while respiratory bronchiolitis-associated ILD (RB-ILD) links to smoking, less severe symptoms [5]. Desquamative interstitial pneumonia (DIP), characterized by macrophage accumulation, resembles RB-ILD. Lymphoid interstitial pneumonia (LIP) and acute interstitial pneumonia (AIP) present with diffuse lymphocyte infiltration and rapid onset, respectively [7].

CTDs like rheumatoid arthritis (RA) and systemic sclerosis (SSc) commonly involve ILD, with RA showing UIP patterns on HRCT and SSc exhibiting NSIP patterns with axial involvement. Dermatomyositis (DM) and polymyositis (PM) present with nonspecific interstitial pneumonia (NSIP), influencing morbidity [6]. Systemic lupus erythematosus (SLE) exhibits varied pulmonary

manifestations, including UIP and NSIP patterns, with significant pleural involvement. Mixed connective tissue disorder (MCTD) displays overlapping features of SSc, PM/DM, and SLE, often presenting as NSIP on HRCT. Understanding the diverse HRCT patterns and clinical implications of ILDs in CTDs is pivotal for early detection and tailored management strategies, significantly enhancing patient outcomes and quality of life.

Conclusion

The analysis of HRCT findings across different connective tissue disorders reveals significant variability in pulmonary involvement and patterns. In rheumatoid arthritis (RA), approximately 42% of patients exhibit pulmonary manifestations, with NSIP (24.2%) and UIP (12%) patterns being predominant. Systemic lupus erythematosus (SLE) shows pulmonary involvement in 54% of cases, often presenting as UIP (41%) and NSIP (12%) patterns, alongside pulmonary arterial hypertension (12%) and pulmonary edema (3.3%). Systemic sclerosis demonstrates diffuse axial lung parenchymal involvement (24%) without UIP patterns, while scleroderma highlights a higher prevalence of UIP (26%) and NSIP (33.3%) patterns, with pulmonary arterial hypertension noted in 13.3% of cases.

In dermatomyositis, HRCT typically shows GGOs (100%) indicative of NSIP. Mixed connective tissue disease (MCTD) frequently presents with pulmonary involvement (60%), predominantly showing UIP (36%) and GGOs (36%) patterns [1]. HRCT findings in undifferentiated connective tissue disease (UCTD) are less common but can include NSIP patterns.

In conclusion, understanding these diverse HRCT patterns is crucial for early detection and tailored management strategies in CTDs, aiming to improve patient outcomes and quality of life [5]. Further research is warranted to explore the underlying mechanisms driving these pulmonary manifestations and to refine diagnostic and therapeutic approaches.

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