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Original Article

Spectrum of Interstitial Lung Disease on High Resolution Computed Tomography- A Cross-Sectional Analysis

Authors
Dr Madhumita Chandrasekaran[1], Dr Anand.A.M.[2], Dr Kulasekaran Nadhamuni[3], Dr Vasanthapriya Janarthanan[4], Dr Mohamed Rafi Kathar Hussain[5]

[1]Post Graduate, Department of Radiodiagnosis, Sri Manakula Vinayagar Medical College and Hospital, Madagadipet, Puducherry
[2]DMRD, DNB (Radiology), Assistant Professor, Department of Radiodiagnosis, Sri Manakula Vinayagar Medical college and Hospital, Madagadipet, Puducherry
[3]MD (Radiology), DMRD, FICR, Ph.D, Professor, Head of the Department, Department of Radiodiagnosis, Sri Manakula Vinayagar Medical college and Hospital, Madagadipet, Puducherry
[4]Post Graduate, Department of Radiodiagnosis, Sri Manakula Vinayagar Medical College and Hospital, Madagadipet, Puducherry
[5]Assistant Professor, Department of Radiodiagnosis, Sri Manakula Vinayagar Medical College and Hospital, Madagadipet, Puducherry

Introduction

Interstitial lung disease (ILD) which is also known as diffuse infiltrative lung disease is a group of disorders which includes more than 200 entities mainly affecting the pulmonary interstitium in the lung parenchyma[1]. Pulmonary interstitium is the network of connective tissue fibers that supports the lung which includes interlobular septa, alveolar walls, and the peri-bronchovascular interstitium. It is characterized by interlobular/ interlobularseptal thickening, fibroblast proliferation, and pulmonaryfibrosis[1].

Clinically they most commonly present with shortness of breath, dry cough, fatigue, and discomfort in the chest. The chest radiograph which is the initial imaging modality shows diffuse interstitial patterns like reticular, nodular, or reticulonodular opacities. In about 10 to 20 % of patients, a chest radiograph was found to be normal, even though lung biopsy was found to be positive[2]. Hence high resolution computed tomography of thorax is important in early diagnosis of interstitial lung disease with the assessment of its types and severity.

Methods

This study was a hospital-based, cross-section and descriptive study conducted in a period of 18 months from November 2017 to April2019 at the Department of Radiodiagnosis, Sri Manakula Vinayagar Medical College and Hospital (SMVMCH), Puducherry, India. It is a well-equipped, multispecialty, 900 bedded hospital, offering free curative and preventive services to the rural population of Puducherry. Considering the average number of cases with interstitial lung disease referred to our department, the sample size was fixed as 60. Patients with the symptoms like

dyspnea, cough, chest pain, fever and also, patients with plain radiographic features of interstitial lung disease are considered as study participants and considered as inclusion criteria in this study. Exclusion criteria included patients with severe respiratory distress. After obtaining informed written consent from the patient's own language HRCT thorax with multiplanar reconstruction using a 16 slice CT (Philips MX – 16). HRCT thorax protocol includes imaging with 120kv and 100- 200 mAs, slice thickness of 0.625 to 1.25 mm and scan time of 0.5 to 1 seconds. The scan will be taken in full inspiration. Additional expiratory and prone imagings were performed if needed. All the observed radiological findings were tabulated and the data collected was analyzed using SPSS 24 version software.

Results

Among 60 patients, 45% were found to be presented above 45 years of age. Both sexes were found to be almost equally affected (Male ~54.2% and Female ~ 45.8%). Around 48% of ILD showed asymmetric distribution.

The most common clinical presentation was found to be breathlessness in this study.

Among 60 participants, with the maximum number, it was found that17 (28%) had usual interstitial pneumonia pattern (UIP) and 13 (22%) had nonspecific interstitial pneumonia (NSIP). Others like cryptogenic organizing pneumonia (8.5%), idiopathic interstitial pneumonia, and silicosis were found in 6.8%[Table: 1].

Table 1: Shows the frequency and percentage of common interstitial lung disease found in this study.

Diagnosis	Frequency	Percentage (%)
Usual interstitial pneumonia	17	28.8
Nonspecific interstitial pneumonia	13	22
Cryptogenic organizing pneumonia	5	8.5
Idiopathic interstitial fibrosis	4	6.8
Silicosis	4	6.8
Hypersensitivity pneumonia	3	5.1
Pulmonary alveolar proteinosis	2	3.4

Among the UIP pattern of ILD, 16 (6.78%) patients were found to be associated with connective tissue disorders. The common associations were found to be rheumatoid arthritis (4 patients) and scleroderma (4 patients).

Radiologically, on HRCT the most common pattern of ILD in this study was found to be interlobular/ intralobularseptal thickening (78%) [Table: 2].

Table 2: Shows the frequency of interstitial pattern on HRCT

HRCT pattern	Present	Percentage (%)
Interstitial Septal Thickening	46	78
Reticular thickening	32	54.2
Nodular thickening	29	49.2
Peribronchovasular Thickening	21	35.6
Ground glass opacity	29	49.2
Consolidation	11	18.6

Among 60 participants, reticular opacities were found in 32 (54.2%) patients. Patients with UIP and NSIP pattern shows reticular opacities in maximum. In three cases who presented with primary malignancies like carcinoma breast and esophagus, reticular interstitial opacities were found so diagnosed as Lymphangitic carcinomatosis.

Nodular opacities were noted in the 29 (49.2%) patients in this study.

Ground glass opacities were found among 49 % of patients with maximum distribution among NSIP and pulmonary alveolar proteinosis patients. Consolidation pattern noted in 11 participants of which maximum found among NSIP and cryptogenic organizing pneumonia.

The complications of ILD like honeycombing and traction bronchiectasis were found in 21 patients (35%) and 26 patients (44%) respectively with reduced lung volume. These complications were found to be presented in all patients with UIP and IPF in this study.

In this study among 13 participants with increased lung volume, 3 (5.1%) were found to be

diagnosed to have langerhans cell histiocytosis and 1 (1.7%) diagnosed as lymphangiomyomatosis.

In this study, 6 patients (~10% of total ILD) had a history of occupational exposure out of which 4 diagnosed as silicosis, others had asbestosis and pneumoconiosis.

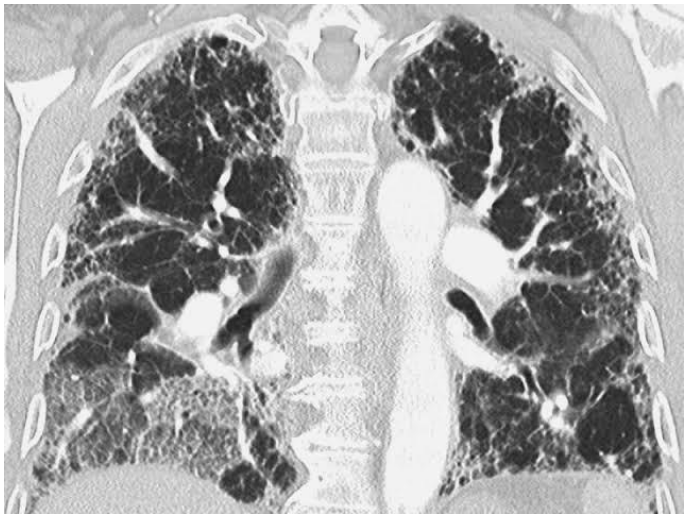

Fig: 1 High resolution computed tomography lung coronal reformatted image showing reticulo-nodular thickening with diffuse ground glass opacity without honeycombing – **suggestive of idiopathic interstitial pneumonia**

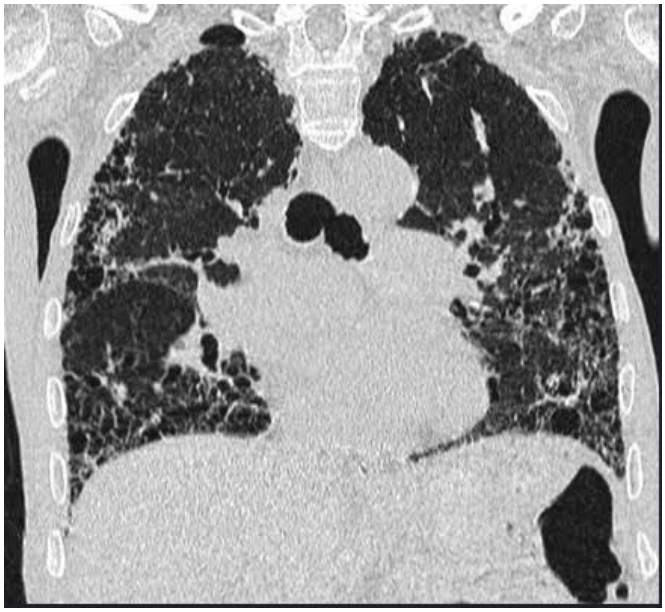

Fig 2: HRCT thorax coronal reformatted image shows bilateral symmetrical interstitial thickening with honey combing in apico-basal gradient – **Suggestive of Usual interstitial pneumonia.**

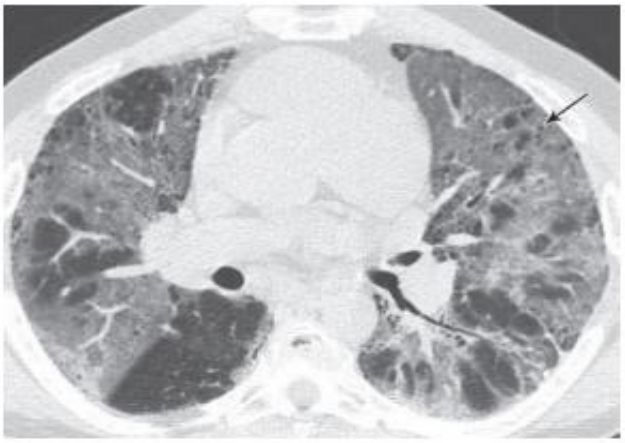

Fig 3: HRCT thorax axial section shows diffuse ground glass opacity with randomly distributed overlying cysts suggestive of NSIP

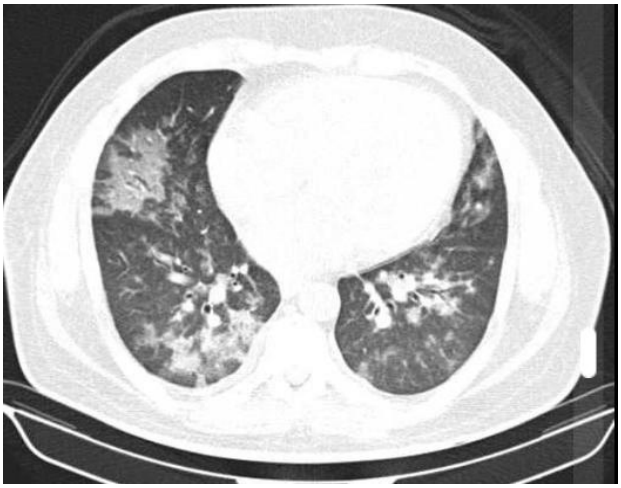

Fig 4: HRCT thorax in axial section shows patchy areas of consolidation predominantly in subpleural location with few areas of ground glass opacity – **suggestive of cryptogeninc organizing pneumonia.**

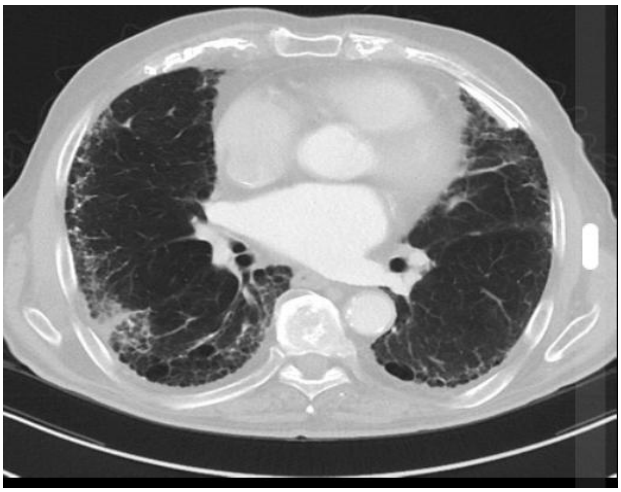

Fig 5: High resolution computed tomography lung axial image showing diffuse reticulation and pleural plaque in the left upper lobe – **Suggestive of asbestosis.**

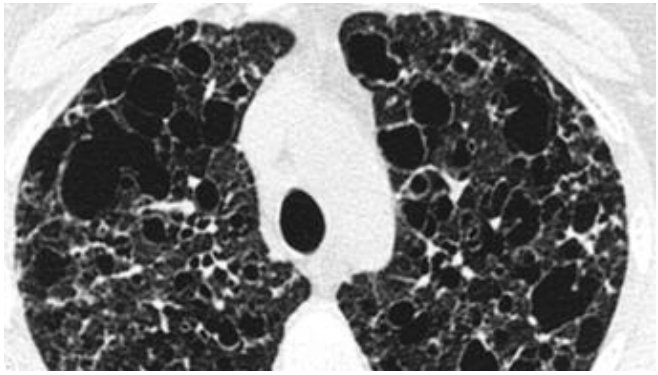

Fig 6: HRCT lung axial image showing bilateral bizarre shaped cysts distributed diffusely predominantly in the upper lobe. –**Suggestive of Langerhans cell histiocytosis.**

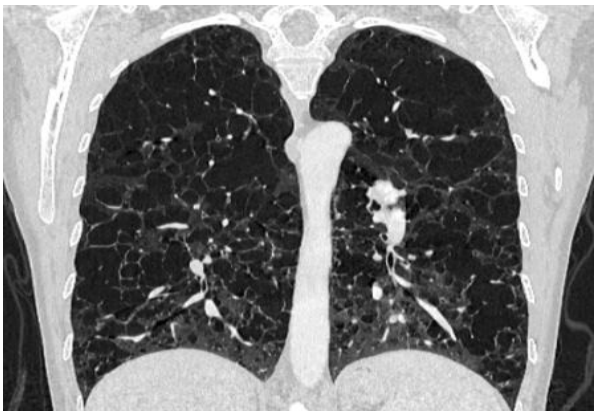

Fig 7: High resolution computed tomography thorax coronal reformatted image showing bilateral uniform distribution of multiple thin walled cyst –**Suggestive of lyphangioleiomyomatosis**

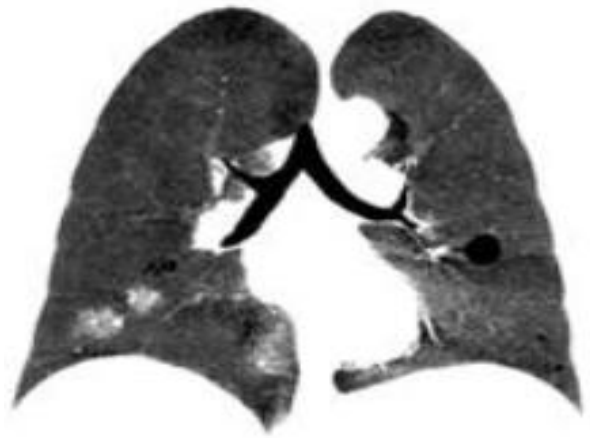

Fig 8: High resolution computed tomography thorax coronal reformatted image shows few thin walled cysts mainly in the lower lobe with nodules - **Suggestive of lymphoid interstitial pneumonia**.

Discussion

Diffuse infiltrative lung disease is a heterogeneous group of disorders with so many entities under this spectrum. The revised classification of ILD divides them into three categories: (1) major group which includes idiopathic pulmonary fibrosis [IPF]; idiopathic non- specific interstitial pneumonia [NSIP]; respiratory bronchiolitis-interstitial lung disease [RBILD]; desquamative interstitial pneumonia [DIP]; cryptogenic organizing pneumonia [COP] and acute interstitial pneumonia [AIP]), (2) rare group (includes idiopathic lymphoid interstitial pneumonia and idiopathic pleuroparenchymal fibroelastosis), and (3) unclassifiable group[3].

High-resolution CT is particularly efficient in assessing patients with a normal chest radiograph. Comparative studies in patients with disease proved by biopsy have shown that HRCT had a sensitivity of about 94% for the detection of chronic interstitial lung disease, compared with chest radiography which had a sensitivity of 80%[4]. It has a valuable role in patients with radiographic abnormalities, as it defines the pattern and anatomical location of lung parenchymal abnormalities, which in many cases are characteristic to provide specific definite diagnosis[5].

HRCT is an investigation which gives information not only about the precise extent of the disease but also about the likely histopathological diagnoses, an optimal site for biopsy when indicated and in some cases the stage of the disease activity too[6].

Idiopathic Pulmonary Fibrosis

It is a separate entity of chronic fibrosing interstitial pneumonia limited to the lung and associated with histopathological appearances of usual interstitial pneumonia (UIP) on lung biopsy. The etiology for IPF is unknown; patients with IPF are often middle-aged commonly between 40 and 70 years of age. Potential risk factors include smoking. The definitive diagnosis of IPF will be done after the exclusion of other causes of ILD such as collagen vascular disease, drug toxicity,

and environmental exposure. Typical HRCT patterns include inter/intralobularseptal thickening, honeycombing, and ground-glass attenuation[7].

In our study, 20 (33.9%) patients were smokers, who developed interstitial lung disease. Among which four diagnosed as idiopathic pulmonary fibrosis [Fig:1].

Usual Interstitial Pneumonia

The expert will make a confident HRCT diagnosis of UIP in only two-third of patients with histological UIP[8].The gross morphologic findings include bilateral symmetrical interstitial thickening with apicobasal and anteroposterior gradient and diffuse honeycombing in later stages of the disease process. It was found to be associated with connective tissue disorders like scleroderma, rheumatoid arthritis, systemic lupus erythematosus, etc.

In our study, the most common ILD was found to be UIP (28.8%) with the above-mentioned imaging features among which all were associated with connective tissue disorders. Rheumatoid arthritis and scleroderma were found to be commonly associated with this study [Fig:2].

Nonspecific Interstitial Pneumonia

Nonspecific interstitial pneumonia (NSIP) is the second most common morphological and pathological pattern of ILD. On HRCT, the most common features are relatively symmetrical reticular and ground-glass opacities with pulmonary volume loss resulting in traction bronchiectasis. Subpleural sparing, when present is considered very specific[9].

In our study also it was found to be the second most common pattern of ILD (22%) with associated complications like traction bronchiectasis in almost all patients [Fig:3].

Cryptogenic Organising Pneumonia

Cryptogenic organizing pneumonia (COP) is associated with nonspecific clinical, radiographic findings, and pulmonary function test results and corresponds to a histological pattern that is characterized by polyps of granulation tissue within alveolar ducts and alveoli, with chronic inflammation of the adjacent lung parenchyma. The common HRCT pattern include ground-glass opacities, consolidation and peri-bronchovascular interstitial thickening[10].

In our study among five patients of COP, almost all presented predominantly with ground-glass opacities and consolidation [Fig:4].

Occupational Interstitial Lung Disease

Occupational ILD includes silicosis, asbestosis, and coal workers pneumoconiosis. All were upper lobe predominance except for asbestosis. HRCT lung revealed multiple confluent areas of subpleural consolidation, centrilobular nodules, and interlobular septal thickening as parenchymal bands. Involvement was bilateral and there was upper lobe predominance.

In our study, 100% of industrial workers (No: 6) demonstrated the presence of ILD with the above-mentioned imaging features [Fig:5].

Hypersensitive Pneumonitis (HP)

HPis also known as extrinsic allergic alveolitis (EAA), is an inflammatory reaction to inhalation of an allergen which can lead to lung fibrosis. DA lynch et al. evaluated 11 patients of HP almost all showed bilateral ill-defined centrilobular nodules with ground-glass opacities. In our study also three patients had this typical presentation[11].

Cystic Interstitial Lung Disease

Under this spectrum of cystic lung disease, comes the langerhans cell histiocytosis (LCH), lymphangioleiomyomatosis (LAM), lymphocytic interstitial pneumonia (LIP), and desquamative interstitial pneumonia (DIP). Based on the shape and distribution of cysts they can be diagnosed. Bizarre shaped cysts with upper lobe predominance was seen in LCH [Fig:6]. Lower lobe predominant subpleural cysts with interstitial thickening will be found LIP [Fig:8]. When a similar pattern is associated with ground-glass

opacities it is DIP. In LAM there will be a uniform distribution of cysts throughout the lung fields[12] [Fig:7].

In our study among this spectrum, the typical LCH pattern is noted in three patients.

Wells et al., found that the presence of ground-glass opacity its extent and fibrosis (honeycomb, traction bronchiectasis) was related to the patient's prognosis to treatment[13]. So HRCT plays a major role in the early diagnosis and assessment of disease activity, before biopsy and treatment.

Limitations

This study was mainly depended on the patient's history, clinical examination findings, response to treatment. Histopathological correlation was not done in this study. The sample size was fixed as 60 which was considered to be less in number.

Conclusion

HRCT is a simple non-invasive method of investigation in detecting interstitial lung diseases without the need for an open lung biopsy. HRCT can accurately demonstrate the distribution, pattern, and extent of interstitial lung disease. The extent of pulmonary fibrosis including reticulation, traction bronchiectasis, ground-glass attenuation, and honeycombing can all be easily characterized.

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