A Cross-Sectional Study of Radiological Profile of Interstitial Lung Disease Using High Resolution Computed Tomography of Patients Attending Medical College at Ahmedabad

Nikunj C. Desai[1], Nilesh P. Parkar[2], Asutosh N. Dave[3]

[1, 2, 3] Department of Radiodiagnosis, G.C.S. Medical College, Hospital & Research Centre, Ahmedabad, Gujarat, India.

ABSTRACT

BACKGROUND

Interstitial lung disease (ILD) is an unpredictable diffuse parenchymal lung disease, which involves interstitium of lung (tissue around the alveoli of the lungs). High resolution computed tomography (HRCT) is one of the confirmatory, easily accessible methodology for the conclusion and follow up assessment of interstitial lung disease. We wanted to study the normal HRCT patterns found with interstitial lung disease and contrastingly different HRCT designs and clinical information in differential determination of pulmonary fibrosis. We also wanted to study the different patterns of interstitial lung disease on high resolution computed tomography and thereby provide accurate diagnosis and management to the patients.

METHODS

The study was a hospital based prospective, cross sectional study. In the present study, total fifty patients referred from Department of Medicine and Department of Pulmonary Medicine of GCS Medical College having suspicion of interstitial lung disease were studied from April 2019 to September 2019. All patients underwent HRCT thorax on 16 slice Siemens computerised tomography (CT) scan machine in recumbent position utilising usual HRCT protocol. Lung abnormalities were noticed and classified for explicit diagnosis of interstitial lung pathologies.

RESULTS

Most of the patients (N = 25) were found to be in the age group of 50 - 80 years (17 female & 8 male). Progressive dyspnoea (N = 47; 94 %) was the most common chief complaint. The most common form of interstitial lung disease was usual interstitial pneumonia (UIN) (N = 18; 36 %) in our study. Acute interstitial pneumonia (AIP) (N = 7; 14 %) and non-specific interstitial pneumonia, NSIP (N = 7; 14 %) were the next common interstitial lung diseases.

CONCLUSIONS

The most well-known interstitial lung disease seen in our examination was usual interstitial pneumonia. Cases of interstitial lung disease are on the rise. Interstitial lung disease should be ruled out in all patients with progressive dyspnoea, particularly when there are no obvious or known causes of dyspnoea. Clinical and laboratory findings, pulmonary function tests, history of exposure along with HRCT workup is indispensable for the identification or exclusion of interstitial lung disease. HRCT is also useful for the follow-up study.

KEYWORDS

Acute Interstitial Pneumonia (AIP)**,** High Resolution Computed Tomography (HRCT), Interstitial Lung Disease (ILD), Nonspecific Interstitial Pneumonia (NSIP), Usual Interstitial Pneumonia (UIP)

Corresponding Author:
Dr. Nikunj C. Desai,
 # 3, Neelgagan Tower,
Nr. Management Enclave,
Vastrapur, Ahmedabad - 380015,
Gujarat, India.
E-mail: desainikunj65@gmail.com

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BACKGROUND

Interstitial lung disease is an intricate gathering of diffuse parenchymal lung condition, portrayed by prohibitive physiology, impaired gas perfusion, inflammation of lung parenchyma and fibrosis. By and large, the pathology of interstitial lung disease lies in the pulmonary interstitium, which is composed of connective tissue space between the alveolar epithelial cells and the adjoining capillary endothelial cells. The pulmonary interstitium is not visible usually on radiographs. It is visualized only when it is involved by a disease process. The inflammation and scarring of the lung tissue makes it stiff, making breathing difficult. Complications of interstitial lung disease includes pulmonary hypertension, right side heart failure–Cor P. Interstitial lung disease is a major cause of morbidity & mortality. Early detection of ILD is essential to prevent the pulmonary fibrosis and starting proper treatment. In majority of cases, roughly 30 % of the cause of interstitial lung disease remains idiopathic. Extensive work up is needed for the diagnosis of interstitial lung disease. Rather, in some cases a positive history of cigarette smoking, aspiration, certain drugs, radiation therapy, cancer, systemic diseases, environmental and occupational factors have been reported in association with the interstitial lung disease.[1] Recently, smoking has been identified as a potential cause of interstitial lung disease. The chemical agents in smoking leads to tissue irritation making lung parenchyma stiff. Interstitial lung disease like usual interstitial pneumonia, rheumatoid arthritis, sarcoidosis and hypersensitive pneumonitis have high association with smoking. Anti-cancer drugs like Methotrexate, Busulfan, drugs used in certain cardiac condition like amiodarone, antipyretic drugs like acetylsalicylic acid are likely to cause lung damage.[2,3,4] Hence, history of drug exposure is vital. Plain x-ray of chest is the common and easiest available investigation, however it has got limitations. Chest radiograph (CXR) might be inconclusive during early course of the disease and shows not much changes thus incapable to distinguish the particular aetiology of interstitial lung disease. HRCT scan, pulmonary function test (PFT) and lung biopsy are routinely done to diagnose interstitial lung disease. Pulmonary function test is not able to analyse a particular interstitial lung disease or recognize dynamic lung inflammation against fibrosis. With lung biopsy, there is risk of pneumothorax and often patient is not keen to undergo lung biopsy. There is high detection rate of HRCT in interstitial lung disease when pulmonary function test or other parameters are normal. Various types of patterns are seen on plain x-ray chest as well as on CT scan.[5] The patterns are linear, reticular, nodular, reticulonodular and honeycomb. Thickening of interlobular septa gives rise to linear pattern. Superimposition of linear opacities gives rise to reticular pattern. Reticular pattern can be fine, coarse as well as medium, depending on the width of opacity. Multiple round opacities give rise to nodular patterns, which may vary in size from 1 mm to 10 mm. Combination of reticular and nodular opacities gives rise to reticulo-nodular pattern. Honeycomb pattern occurs when the reticular opacities converge to form cystic spaces. The most precise noninvasive, high spatial resolution cross sectional imaging methodology for assessment of lung parenchyma is high resolution computed tomography. The existence of disease in lung, type of disease, changes of active lung disease, biopsy site localization, change in disease movement following therapy, portrayal of interstitial lung disease (ILD) every one of them can be assessed by HRCT. It is more sensitive than the plain radiograph in recognizing interstitial lung disease (sensitivity more prominent than 90 %) and the picture example of Parenchymal anomalies on high resolution computed tomography frequently recommends a specific arrangement of analytic potential outcomes. Present investigation intends to consider essential HRCT patterns related with interstitial lung disease and connection of (HRCT) patterns with clinical information in differential analysis of interstitial lung disease.

METHODS

The study was hospital based prospective, cross sectional study conducted from April 2019 to September 2019 in Department of Radiology, GCS Medical College and Hospital, a tertiary care center providing medical services in Ahmedabad, Gujarat in Western India after taking approval of institutional ethical committee. Fifty outdoor patients from Department of Medicine & Department of Respiratory Medicine of GCS Medical College, Ahmedabad having clinical history suggestive or suspicious of interstitial lung disease were studied. Inclusion and exclusion criteria were formulated. Patients of all age and gender were enrolled for the investigation. Patients with known instances of pulmonary Koch's disease, acquired immunodeficiency syndrome (AIDS), chronic obstructive pulmonary disease (COPD), heart failure, malignant mass of lung, and hemodynamically unstable patients were excluded. After incorporation of the patient in the investigation, proforma was filled in detail. It incorporates patient's gender, age, address, clinical record number, major presenting complaints, associated risk factors if any, occupational related history, any set of experiences of allergy, history of smoking, any medications, previous history, laboratory examination, and chest radiograph discoveries. After that HRCT scan of Thorax was done on 16-slice siemens CT scanner in supine position utilizing standard HRCT convention. Prone and expiratory scanning was done if required. Lung parenchymal changes from the investigation were summed up into four fundamental examples of HRCT with their dispersion and prevalent contribution. Final possible confirmatory conclusion was made according to HRCT findings and available clinical data.

Statistical Analysis

Statistical analysis was done with the assistance of SPSS software and data was tabulated in Microsoft Excel. Distribution of various types, pattern of interstitial lung disease, patient's presenting complaints and risk factors were evaluated for bivariate analysis. The appropriate statistical test to find out significant association was chi–

square test. P-value less than 0.05 for calculated chi-square value was considered as statistically significant association. In current study P-value was found to be 0.002 in patients with complaint of dry cough signifying the strong association between dry cough and interstitial lung disease. P-value of 0.001 was observed in patients having history of smoking, justifying that smoking is a potential cause of interstitial lung disease. In other presenting features like complaints of dyspnoea, joint pain, allergy etc. P-value was found more than 0.05, signifying no statistically significant association between the presenting complaints and interstitial lung disease. Similarly, the P-value for various types of interstitial lung disease and patterns of interstitial lung disease was more than 0.05, suggesting no statistically significant association between the types and patterns of interstitial lung disease. Probably the comparatively smaller sample size is responsible for lesser significance between studied variables in the present study.

RESULTS

Out of total 50 patients, 25 patients were found to be in the age group of 50 - 80 of age (Table 1). In majority of patients, (in 47 patients: 94 %) progressive dyspnoea was the presenting complaint. Dry cough was the second most common complaint (N = 37, 74 %). Complaint of joint pain (N = 22; 44 %) was observed in patients with connective tissue disorders, very few patients complained about high grade fever, productive cough and skin changes. (Table 1).

History of smoking was found in nine patients (18 %) of interstitial lung disease. Positive history of allergy was seen in 8 patients. (16 %). (Table 1). Only few patients (N = 2; 4 %) gave history of exposure to chemotherapy and radiotherapy. (Table 1) Usual interstitial pneumonia (UIP) (N = 18; 36 %) is the commonest form of interstitial lung disease in present study. Second most common form of interstitial lung disease in present study is non-specific interstitial pneumonia (NSIP) (N = 7; 14 %). (Table 2). Usual interstitial pneumonia has a poor prognosis as compared to non-specific interstitial pneumonia.[6]

Gender Distribution	Number of Patients	Male Patients	Female Patients	Mean Age	Standard Deviation
Total patients	50	18	32	62.28 (male) 57.94 (female)	19.13 (male) 16.16 (female)
Clinical features					
Progressive dyspnoea	47 (94 %)	89.5 %	96.8 %	---------	---------
Dry cough	37 (74 %)	50 %	87.5 %	---------	---------
Joint pain	22 (44 %)	44.4 %	43.8 %	---------	---------
Other complaints like Fever, productive cough, skin changes etc.	10 (20 %)	16.7 %	21.9 %	----------	----------
Risk factors					
Connective tissue disorder	19 (38 %)	44.4 %	34.4 %	----------	----------
Smoking	9 (18 %)	34.4 %	3.1 %	---------	----------
Allergy	8 (16 %)	--------	-------	---------	----------
Radiotherapy - chemotherapy	2 (4 %)	2 (4 %)	-------	---------	----------

Table 1. Association between Gender Distribution, Clinical Features & Risk Factors

Acute interstitial pneumonia (AIP) (N = 7; 14 %) is comparatively less common. Our study shows incidence of 36 % & 14 % in usual interstitial pneumonia & nonspecific interstitial pneumonia respectively. In 19 patients (38 %), connective tissue disorder was found to be the most recurring risk factor with interstitial lung disease. In patients with rheumatoid arthritis, common pattern was reticular opacity.

Interstitial Lung Disease	Number of Patients	Percentage	Male	Female
Usual interstitial pneumonia (UIP)	18	36	33.3 %	37.5 %
Non-specific interstitial pneumonia (NSIP)	7	14	11.1 %	15.6 %
Acute interstitial pneumonia	7	14	11.1	15.6
Hypersensitivity pneumonitis	5	10	11.1	9.4
Lymphangitic carcinomatosis	5	10	11.1	9.4
Drugs and radiation	4	8	5.6	9.4
Occupational and environmental	4	8	11.1	6.3

Table 2. Distribution of Various Types of ILD

HRCT Patterns	Number of Patients	Percentage
Reticulo-nodular	30	60
Septal thickening	24	48
Honeycombing	20	40
Microcysts	20	40
Parenchymal nodules	18	36
Ground glass opacity	17	34
Reticular	14	28

Table 3. Various Findings in HRCT

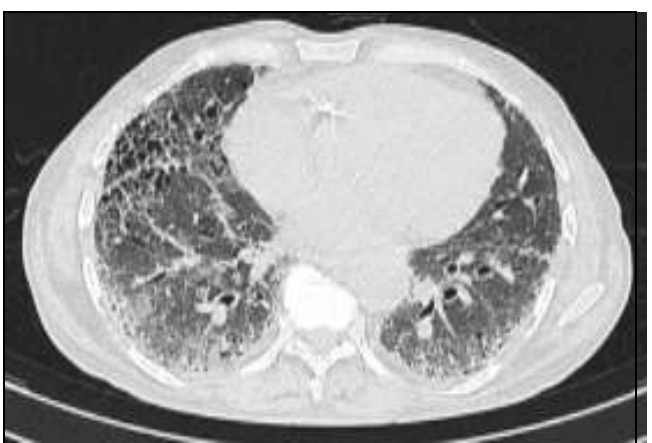

Figure 1. HRCT Thorax in Usual Interstitial Pneumonia (UIP) Demonstrating Classic Honeycombing

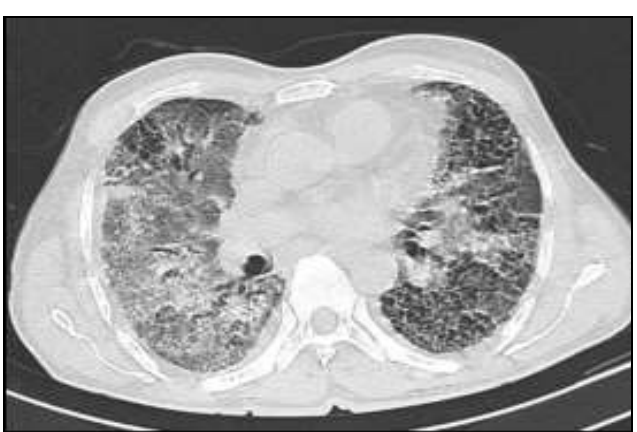

Figure 2. HRCT Thorax in Non-Specific Interstitial Pneumonia (NSIP) Delineating Patchy Ground Glass Opacities with Fibrosis and Honeycombing

We observed reticular pattern in 22 % in our study. Reticulo-nodular opacity (N = 30; 60 %) was the most

common pattern of interstitial lung disease in our study followed by septal thickening (N = 24, 48 %), honey combing (N = 20, 40 %), micro cysts (N = 20, 40 %), parenchymal nodules (N = 18, 36 %), ground glass opacity (N = 17, 34 %). (Table 3). Our study shows ground glass haziness in 34 % of cases, septal thickening in 48 % cases and honeycombing in 40 %. Ground glass haziness & septal thickening were the commonest distinct HRCT findings in current study. Lower lobes were predominantly involved in 35 cases.

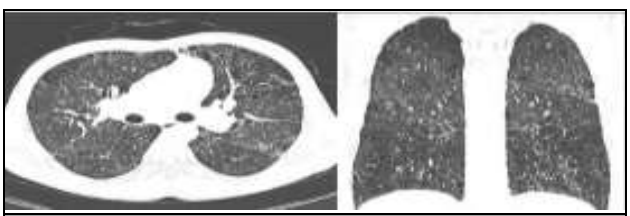

Figure 3. HRCT Thorax of a Known Case of Rheumatoid Arthritis Revealing Reticulonodular Pattern with Hyperinflation and Extensive Areas of Centrilobular and Paraseptal Emphysema with Overinflation and Extensive Fibrosis

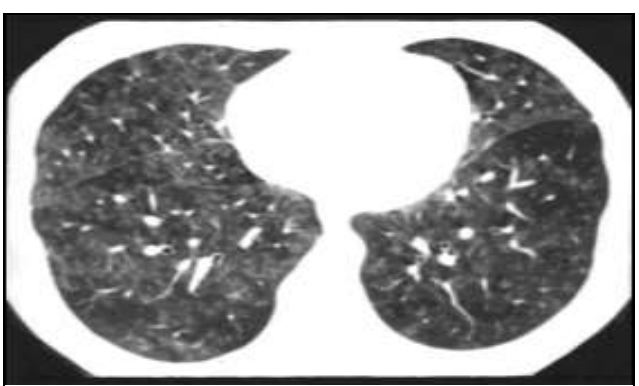

Figure 4. HRCT Thorax of Hypersensitivity Pneumonitis Showing Perihilar Alveolar Infiltrates with Ground Glass Opacities and Mosaic Attenuation

DISCUSSION

Amongst the fifty cases, forty-four cases (88 %) indicated explicit examples related to interstitial lung disease. Progressive dyspnoea was the commonest complaint present in 47 patients (94 %). Dry cough (74 %) and concurrent joint pain (44 %) was the next commonest complaints.

Study done by Muhammed SK et al. shows incidence of usual interstitial pneumonia in 39 % of cases and incidence of 24 % in cases of non-specific interstitial pneumonia.[7] Our study shows incidence of 36 % & 14 % in usual interstitial pneumonia & non-specific interstitial pneumonia respectively. Study carried out by Sen T and Udwadia ZF shows incidence of 43 % in usual interstitial pneumonia & 18 % in non-specific interstitial pneumonia which was slightly more as compared to our study, 36 % & 18 % respectively in our study.[8] However, in our study, the incidence of acute interstitial pneumonia was high (14 %) as compared to study carried out by Muhhammed SK et al. & Sen T Udwadia ZF which was 0 % and 1 % respectively [Table 4]. Similar results were found in our study and study carried out by Pankaj Badarkhe-Patil et al. which shows incidence of 36 % of usual interstitial pneumonia and 14 % of non-specific interstitial pneumonia .[9]

Study carried out by JK Dawson reported an incidence of 19 % to 44 % of interstitial lung disease with patients of connective tissue disorder.[10] In patients with rheumatoid arthritis, common pattern was reticular opacity. Study carried out by JK Dawson et al shows reticular pattern in 19 % in their study.[10] Our study observed reticular pattern in 22 % of cases.

Study carried out by Varun Das, Unnati Desai et al. shows septal thickening in 79.8 % of cases, ground glass haziness in 15 % cases and honeycombing in 40 % cases.[11] While our study shows ground glass haziness in 34 % of cases, septal thickening in 48 % cases and honeycombing in 40 % of cases. [Table 4].

The most well-known interstitial lung disease revealed on HRCT was usual interstitial pneumonia (36 %). Non-specific interstitial pneumonia and acute interstitial pneumonia was accounted for 7 cases (14 %) each.

The different observations discovered to be related with patterns of interstitial lung disease in our examination populace, on HRCT were reticulonodular opacities (N = 30; 60 %) trailed by septal thickening (N = 24; 48 %) and honeycombing (N = 20; 40 %).

Most common pattern seen on HRCT is reticulonodular pattern. Chest radiograph may come normal in many cases and can be considered as a screening procedure in the work up of interstitial lung disease. HRCT of lungs is essential for the diagnosis of interstitial lung disease. It is also useful in follow-up cases.

Risk Factor	Research Study by J. K. Dawson	Present Study		
Rheumatoid arthritis	19 - 44 %	38 %		
HRCT diagnosis / patterns	Research study by Muhammed SK	Research study by Sen T & Udwadia ZF		Present study
UIP	39 %	43 %		36 %
NSIP	24 %	18 %		14 %
AIP	0 %	1 %		14 %
HRCT Findings	Research study by varun Das, Unnati Desai	T. Suresh	JK Dawson	Present study
Septal thickening	79.8 %	----------	----------	48 %
Ground glass haziness	15 %	----------	----------	34 %
Reticular pattern	----------	25 %	19 %	22 %
Honeycombing	40 %	----------		40 %

Table 4. Comparison with Other Studies

Septal thickening, honeycombing and traction bronchiectasis were the most widely recognized observations seen in practically all instances of UIP mainly seen transcendently in basal and subpleural area. In non-specific interstitial pneumonia, HRCT discoveries overwhelmingly elaborate the lower lobes and subpleural locales like UIP yet the dissemination was sketchy in conflicting to UIP, which indicated diffuse distribution of all the discoveries. Honeycombing is uncommon in non-specific interstitial pneumonia. HRCT indicated sketchy zones of ground glass opacity with discrete regions of alveolar consolidation including the two lungs in acute interstitial pneumonia with dominating inclusion of upper lobes (4 cases) and subpleural locations. HRCT discoveries comprising of ground glass opacities (80 %) as well as

consolidative zones (80 %) conveyed along the broncho vascular bundles and along the subpleural lungs are supportive of cryptogenic organizing pneumonitis.[12] Hypersensitive pneumonitis (HP) is a type of interstitial lung disease where history of antigen inhalation is the causative factor. Inhaled antigen may be avian, fungi or bacteria found in the air. Some chemical agents are also known to cause hypersensitive pneumonitis. Patients of hypersensitive pneumonitis usually present with dyspnoea, wheezing, cough, fever and malaise. Diffuse inclusion was observed on HRCT in hypersensitive pneumonitis, which incorporate little centrilobular nodules with ground glass opacity.[13] Hypersensitive pneumonitis can be acute, chronic or sub-acute in nature. The acute phase of hypersensitive pneumonitis may mimic pulmonary oedema. In addition of diffuse involvement and centrilobular nodule, decreased attenuation & decreased vascularity is observed in subacute hypersensitive pneumonitis. Reticulation & traction bronchiectasis is usually seen in chronic hypersensitive pneumonitis. Microcyst can be observed in subacute hypersensitive pneumonitis. Hypersensitive pneumonitis can be best diagnosed with clinical history and HRCT. Sarcoidosis is a granulomatous disease which can affect any part of the body, particularly lungs and it is one of the major causes of morbidity & mortality. The CT findings may manifest with hilar lymphadenopathy followed by changes of interstitial lung disease as the disease advances. In sarcoidosis, HRCT uncovered inadequate dissemination of septal thickening, peripheral and irregular nodules. The nodules are situated along the perilymphatic distribution. The lymph nodes may show calcification. Eleven (22 %) cases, which were serologically confirmed for rheumatoid arthritis, were accounted in our investigation. Out of eleven patients, ten were (91 %) female patients and only one was male patient (9 %), there by indicating a reasonable female dominance. Rheumatoid arthritis is a connective tissue disorder presented with symmetrical inflammatory arthritis. It is a disease of multisystem involvement with a female dominance.

Rheumatoid arthritis presents with wide variety of pulmonary as well as pleural manifestations. In patients with rheumatoid arthritis, common pattern was reticular opacity. Study carried out by JK Dawson et al. shows reticular pattern in 19 % in their study. We observed reticular pattern in 22 % in our study. Study carried out by Dr. T Suresh reveals reticular pattern in 25 % of cases.[14] Similar findings were seen in study carried out by Biederer J et al.[15] HRCT scan is the modality of choice in diagnosing the changes of interstitial lung disease in patients with history of rheumatoid arthritis. It is also useful in follow-up cases of rheumatoid arthritis with changes of interstitial lung disease. One case of systemic lupus erythromatosus demonstrated highlights of acute interstitial pneumonia and indicated focal ground glass opacity in left lower lobe which may speak to early changes of inflammation.[16] In the second patient, the discoveries were non-specific. Scleroderma is an autoimmune connective disorder of unknown aetiology. Three (75 %) out of four instances of scleroderma indicated nonspecific interstitial pneumonia pattern and one case demonstrated usual interstitial pneumonia pattern with protected lung volume. This demonstrated a solid connection amongst scleroderma and non-specific interstitial pneumonia pattern in our study.

CONCLUSIONS

Interstitial lung disease is often a neglected lung condition. The most common interstitial lung disease observed is usual interstitial pneumonia. This finding was also the most common pattern seen with rheumatoid arthritis. Interstitial lung disease should be ruled out in patients with progressive dyspnoea, as this is the most common complaint in such patients. HRCT lung is the most preferred choice of investigation in clinically suspicious cases with interstitial lung disease as it shows distorted architecture of lung parenchyma. HRCT, clinical information, pulmonary function test and applicable laboratory examinations help in affirmation or avoidance of the correct interstitial lung disease. By identifying the specific pattern of interstitial lung disease with the help of HRCT, patients can be managed best by proper medication and thereby relieving or reducing the complaints. HRCT is also helpful in follow-up of patients with interstitial lung disease.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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