



CHEST X-RAY AND HRCT EVALUATION OF DIFFUSE INTERSTITIAL LUNG DISEASE

Radio-diagnosis

Dr. Md. Irfan Ahmad	M.D. (Radio-diagnosis), Assistant Professor, Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar.
Dr. Nisha Rai*	M.D. (Radio-diagnosis), Assistant Professor, Department of Radio-diagnosis, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand. *Corresponding Author
Dr. Md. Nazrul Haque	M.D. (Radio-diagnosis), Consultant Radiologist, Spandan Diagnostic Centre, Baguiati, Kolkata, West Bengal.
Dr. [Prof.] Dilip Kumar	Professor and Head, Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar.

ABSTRACT

Background: Interstitial lung diseases (ILDs) are defined as a heterogeneous group of disorders that primarily affect the interstitium, a tissue of the alveolar wall between the capillary and the alveolar epithelium. These disorders can progress to irreversible pulmonary fibrosis and are important cause of morbidity and mortality. It is therefore imperative that a prompt and accurate diagnosis of the underlying cause is made so that appropriate management can be instituted.

Material And Methods: This was a cross sectional study. Total 80 Patients, who referred from OPD of medicine to the department of radio-diagnosis, for diagnosis and evaluation of interstitial lung disease were included in the study and were subjected to chest radiograph followed by HRCT. Study duration was one and half years from November 2010 to October 2011. The results were tabulated, statistically analysed and compared with previous studies.

Result: The main result of the study was that HRCT was able to detect more abnormalities than conventional chest radiograph in the diagnosis of interstitial lung diseases. The differences between the two modalities were found to be statistically significant in certain findings.

Conclusion: Chest radiograph remain the basic and primary radiological tool for the diagnosis. HRCT is the best imaging modality and is an indispensable and crucial radiological tool in the diagnosis of ILD. As our understanding of these disorders advances and new therapeutic agents aimed at specific molecular targets are developed, it becomes increasingly important to achieve a specific diagnosis to facilitate the optimal management for patients with ILDs.

KEYWORDS

Interstitial Lung Disease; HRCT; Connective Tissue Disease, Idiopathic Pulmonary Fibrosis, Usual Interstitial Pneumonia

INTRODUCTION

Diffuse Interstitial lung disease (ILD) represent large number of condition that involve the parenchyma of the lung-the alveoli, the alveolar epithelium, the capillary endothelium and spaces between these structure, as well as the perivascular and perilymphatic tissues. Interstitium consists of collagen, elastine, amorphous substance fibronectine and proteoglycan. In majority of case thickening of interstitium may be due to accumulation of fluid, cells (inflammatory) and fibres.

Interstitial lung disease is difficult to classify because of more than 200 known and unknown individual diseases.

The cases of ILD are rises in recent times. This could be attributed to number of cause/reasons. Environmental pollution is one of the important causes for the upwing. Increased amount of exposure to inorganic dust and toxic fumes, cause inflammation in the air space and alveolar wall and if the exposure is chronic, interstitium and vasculature are involved eventually causing fibrosis. Exposure to organic dust results in condition of hypersensitivity pneumonitis. Certain drugs (Gold, amiodarone, antibiotics, bleomycin, busalfan etc.) and radition can cause ILD. ARDS (Acute respiratory distress syndrome) can lead to ILD. Besides there are unknown causes of ILD contributing to majority of the cases, associated with considerable mortality and morbidity. So, it is important to detect these diseases early so that progression of the disease can be stymied. Chest x-ray used to be the only tool at disposal with rather poor sensitivity and detecting disease at advanced stages. As a result number of patient had to get open lung biopsy for diagnosis of ILD. HRCT has changed all that for better. By using thin section in HRCT one can diagnose ILD in it early stage even when chest radiography is normal. HRCT also help to choose the proper site for biopsy and good number of case specific diagnosis can be made even without the biopsy.

In this view, the need for HRCT in patient with persistent dyspnea, cough, unexplained fatigue and respiratory distress. HRCT also helps in avoiding open lung biopsy thus reducing morbidity. In a group of patients open lung biopsy could be life threatening as in the case of low

blood oxygen saturation. In such patients HRCT has come to play a very important role. Hence every patient with mild dyspnea, non productive cough and history of environmental exposure need to be followed up with a HRCT.

AIMS AND OBJECTIVES

1. The main objective of this study is to show relevance of chest X-ray and HRCT in diffuse interstitial lung disease.
2. To identify those cases that are not fully diagnosed by chest x-ray, HRCT aiding in providing appropriate diagnosis and therapy much earlier.
3. With the help of HRCT avoiding open lung biopsy in group of patients in which lung biopsy could be life threatening thus reducing morbidity of patients.

MATERIALS AND METHODS

This was a cross-sectional study, conducted in the department of radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar for a period of 12 months (from November 2010 to October 2011). Total 80 Patients, referred from OPD of medicine to the department of radio-diagnosis, DMCH for diagnosis and evaluation of interstitial lung disease were subjected to conventional chest radiograph followed by HRCT. Informed consent was obtained from the concerned patients.

All case of x-ray examination done on 1000 mA digital X-ray SHIMADZU. Chest x-ray taken with patient in standard position and in full inspiration and expiration. 60-80 kVp and 15-20mAs were used with a film focus distance of 180cm (6ft).

All cases CT examination done on using Siemens Somatom AR-SP – Third generation special scanner and Siemens SOMATOM spirit dual slice CT scanner. Thin section (1 mm) slices were taken at the areas showing abnormal shadows on chest radiograph.

When the chest radiograph was normal, 3 mm section were taken at 10 mm interval from the lung apices to the lung base. 110-130 kVp and 100-200 mAs were used on the CT machine.

The cases were selected for HRCT on the basis of following criteria :

1. History of dyspnea and nonproductive cough
2. History of exposure to organic/inorganic dust
3. Known cases of collagen vascular diseases (Eg. Rheumatoid Arthritis)
4. Abnormal lung function tests
5. Normal/Abnormal chest X-ray

The objective of the present study is to evaluate the efficacy of HRCT and chest x-ray in the diagnosis and management of interstitial lung disease.

Patients with acute respiratory tract infection and chronic infection like tuberculosis were excluded. Dyspnoea occurring due to cardiac or renal causes were also excluded from the present study. Patients with primary neoplasm of lungs were also excluded.

Statistical Analysis

Data entered in excel sheet, statistical analysis done by SPSS 23 software by using descriptive statistics and chi-square test.

RESULTS

Radiological observation made in 80 patients with dyspnea, cough, lung function test abnormality and abnormal blood oxygen saturation. The results are enumerated below.

Table – I : Demographic Data Of The Patients Of Interstitial Lung Diseases

	Number	Percentage
Age		
0-10	0	0%
11-20	0	0%
31-30	4	5%
31-40	18	22.5%
41-50	24	30%
51-60	22	27.5%
61-70	12	15%
Sex		
Male	56	70%
Female	24	30%
Socio-economic Status		
Rich	18	22.5%
Middle	38	47.5%
Poor	24	30%
Habits		
Smokers	50	62.5%
Non-smokers	30	37.5%

The maximum number of cases was in the age group of 41-50 years and minimum number was in the age group of 21-30 years. Males were more affected than females.

The division into different classes were done using Kuppaswamy's scale. This study shows that people belonging to the middle group were more affected by the disease.

Kuppaswamy (1976), prepared a scale based on education, occupation and income, which are the three major variable contributing to socio-economic status.

A majority of patients were smokers. They either smoked bidi or cigarette.

Majority of the patients in our series were dyspneic. Dyspnea was graded as mild, moderate and severe.

- Mild Dyspnea - Dyspnea occurring after prolonged effort.
- Moderate Dyspnea - Dyspnea occurring after minimal effort.
- Severe Dyspnea - Dyspnea occurring at rest.

Table – II : Showing Incidence According To Dyspnea

Degree	Number	Percentage
Mild	14	17.5%
Moderate	52	65%
Severe	14	17.5%

This table shows that a majority of patients presented with moderate dyspnea i.e. when it started affecting their daily routine.

Table –III : Signs And Symptoms

	Number of cases	Percentage
Cough		
Present	48	60%
Absent	32	40%
Connective Tissue Disorder		
Present	20	25%
Absent	60	75%
Clubbing		
Present	44	55%
Absent	36	45%
Crepitation		
Present	50	62.5%
Absent	30	37.5%

This data shows that more than half of the patients had cough. In our series most of the patients presented with dry cough.

Our series also had patients suffering from connective tissue disorder. These patients had developed breathlessness and so were evaluated for interstitial lung disease.

This data shows that patients with connective tissue disorder form an important subgroup as a cause for interstitial lung disease.

Clubbing is an important sign of interstitial lung disease present in 55% of case.

PLEURALEFFUSION

Only two patient in our series had pleural effusion. It was bilateral and case of Rheumatoid arthritis.

Table – IV

	Number of cases	Percentage
Lung Function Test (FEV₁/FVC)		
Normal	10	12.5%
Raised	70	87.5%
Blood oxygen saturation (PaO₂)		
Normal	70	87.5%
Decreased	10	12.5%
Total count WBC (for leucocytosis)		
Normal	70	87.5%
Raised	10	12.5%

This table depicts that most of the patients has raised FEV₁/FVC ratio, which indicates restrictive lung disease. Patients with interstitial lung disease can have normal or raised value (ratio).

This data shows relatively preserved oxygen saturation of blood in majority of patients. Only 12.5% patient had leucocytosis.

Table – V : Showing Number Of Normal And Abnormal Chest Radiographs

Chest X-ray	Number of cases	Percentage
Normal	14	17.5%
Abnormal	66	82.5%

The data emphasize that although 82.5% of patient had abnormal chest, significant no. of patient 17.5% had absolutely normal radiograph.

Table –VI : Showing Chest Radiograph Findings

Findings	Number of cases	Percentage
Septal lines	4	5%
Reticular Shadows	44	55%
Nodular/Reticulonodular	18	22.5%
Groundglass Opacity	28	35%
Honey combing	24	30%
Pleural Effusion	2	2.5%
Mediastinal L.N.	4	5%

This table shows that four patients (5%) had septal lines (Kerley B), 44 patients (55%) had reticular shadow, 18 patients (22.5%) had nodular/reticulonodular shadow, 28 patients (35%) had ground glass

opacity, 24 patients (30%) showed honeycombing, 2 patients (2.5%) had pleural effusion and 4 patient had mediastinal lymphadenopathy.

Table –VII : Showing Important Findings On HRCT/CT

Findings	No. of cases	Percentage
Reticular Striations	48	60%
Interlobular Septa Thickening	54	67.5%
Groundglass Opacity	34	42.5%
Peribronchial Fibrosis	28	35%
Honeycombing	32	40.0%
Pleural Effusion	2	2.5%
Mediastinal lymphadenopathy	10	12.5%
Nodule	8	10%

This table shows that reticular striations were present in 60% of patients, interlobular septa thickening in 67.5% of patients, ground glass opacity in 42.5% of patients, peribronchial fibrosis in 35% of patients honeycombing in 40% of patient and 2.5% of the patients had pleural effusion 12.5% of patient had M.L.N. and 10% had nodule.

Table – VIII : Showing Additional Findings On HRCT

Findings	No. of cases	Percentage
Secondary Infection	8	10%
Bronchiectasis (Traction)	8	10%
Emphysema	4	5%
Cor- Pulmonale	2	2.5%

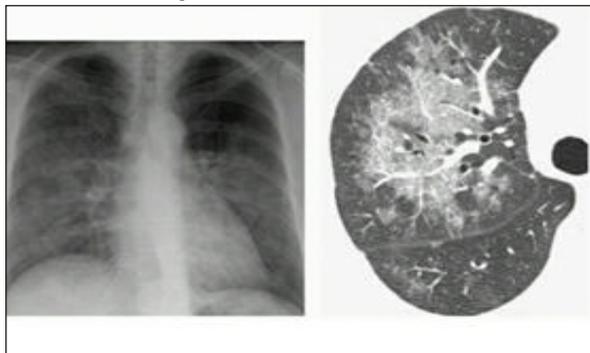
The above data represent associated finding/sequelae of ILD. HRCT was able to detect it in significant number of cases.

X-ray Versus HRCT :

In this study HRCT well picked up the lesion even in the patient with normal Chest X-ray and as the figure says a good number of patient (17.5%) had normal Chest X-ray. In this cluster of patient the main HRCT finding were few areas of reticular striations, interlobular septa thickening few areas of ground glass opacity (alveolar haze) and honeycombing. After analyzing above data we can definitely say that HRCT has clear edge over Chest X-ray in detecting early and very early pathological changes in lung.

Biopsy :

In our series 10 patient refer to higher centre for lung biopsy. Three patients had positive finding, one patient had non-conclusive report. One patient develop iatrogenic pneumothorax so biopsy not done. Five patients not traced. In the remaining 70 patients HRCT was able to make a confident diagnosis.



GROUND GLASS PATTERN ON CHEST X-RAY & HRCT

DISCUSSION

This study involves 80 patients with interstitial lung disease that has been followed for two years. The disease is relatively less in our population. However, incidence of interstitial lung disease has been increased due to environmental pollutants (Taylor PM, 2001). High resolution computed tomography has made possible the only detection of the disease (Muller et al, 1986; Mathieson et al, 1989).

In present study, 70% were males and 30% females. Males are more exposed to environmental and industrial pollutants because they are bread earner in our culture. So there is male predilection which is in accordance with the studies by Muller et al, 1991.

72.5% of patients are in the age of 41 to 70 years, 30% of 80 patients are in age group of 41 to 50 years. Interstitial lung diseases are rare in

children and adolescent (Leland L Fan 1995). Muller et al. 1991 study also shows majority of patient in the age group of 40 to 70 years.

Three socio-economic groups, high income, average income and low income, were made based on Kuppuswamy's scale. 22.5% of patient of high income, 47.50% were of average income and 30% of low income group. Because of unknown etiology of interstitial lung diseases in majority of cases, it appears to affect people of all socio-economic group.

Smoking habits are found in 62.5% of the patient in our series and 37.5% were nonsmokers. High number of smokers in our series makes smoking likely to be involved in causation of the disease, directly or indirectly.

According to Muller et al, 1991 and Leland L Fan 1995, dyspnea is the commonest symptoms of interstitial lung disease. In present study – 65% had moderate dyspnea and 17.5% had mild dyspnea and 17.5% of patients had severe dyspnea.

Most of the patients had non-productive cough 60% of patient, presented with cough in our series. Few patients presented with productive cough due to superadded respiratory infection.

According to Muller et al. 1991 nearly all the connective tissue disorder can affect the lung. Our study shows that 20 patients (25%) were suffering from connective tissue disorders. 14 had Rheumatoid arthritis, four patient were suffering from ankylosing spondylitis and two patients had progressive systemic sclerosis.

In our study 62.5% of patients had crepitations. Secondary infection and bronchiectasis in some patients led to increased number of cases with crepitations. According to Muller et al. 1991, crepitations are present in patients with interstitial fibrosis.

Clubbing was seen in 55% patient. Clubbing is more commonly seen in fibrosing alveolitis according to Muller et al. 1991. Because relatively more number of cases of fibrosing alveolitis has been included in the study, that's why clubbing is found more than half of the patients.

According to King TE Jr. 2002; Restrictive lung pattern is common in interstitial lung disease. In restrictive lung disease, FEV₁/FVC is either normal or raised. 70 patients (87.5%) had increased FEV₁/FVC values. 10 patients revealed normal FEV₁/FVC.

Raised total leucocyte count was found in 12.5% patients that were associated with secondary infections. In two patient cause was not determined and leucocytosis returned to normal. Hypoxemia is also found in interstitial lung disease. Only 10 patients (12.5%) showed reduced oxygen saturation of blood at rest. Major cases had normal oxygen saturation.

In plain chest x-ray 66 patient had positive findings while 14 patients were normal. According to Epler et al. 1978 and Carrington and Gaensler 1978, 10% of patients with interstitial lung disease had normal chest radiograph.

In present study, the following radiographic signs, were encountered Septal Line (5%), Reticular shadows (55%), nodular or reticulonodular shadows (22.5%) ground glass opacities (35%), honeycombing (30%), pleural effusion (2.5%) and mediastinal LN seen in (5%).

Above mentioned findings matches with the radiographic findings described by Muller et al. 1991 and Hansell and Muller 1997. The distribution of the percentage of these findings are dependent on the number of the particular disease in difference studies. For example, if a study has more number of patients with coal worker pneumoconiosis, then reticular or reticulonodular shadow will predominate.

Findings of chest radiography were divided into predominantly upper lung involvement or lower lung involvement or nonspecific distribution. 37.5% of patients had lower lung distribution. These included patients of fibrosing alveolitis, rheumatoid arthritis and idiopathic pulmonary fibrosis. 37.5% patients had involved both the upper and lower lungs without any marked predilection. 6 patients (7.5%) had upper lung involvement.

Mathieson et al. 1989 had studied 118 patients of chronic interstitial lung disease. 23% cases were diagnosed confidently based on chest radiography alone. In our study confident diagnosis was made in 24 cases (30%) on chest x-ray alone.

All cases were subjected to HRCT. Zcrhouni et al, 1985 showed reticular striations in 89% of cases in a series. 48 patients (60%) has reticular striations in present study. On HRCT, presence of numerous clearly visible interlobular septa always indicate the presence of an interstitial abnormality. 54 patients (67.5%) shows interlobular septal thickening. In a study by Leung AN et al. 54% patients who had ground glass opacity had primarily interstitial abnormality. In our study, 42.5% shows ground glass opacity. On HRCT, honeycombing is visible as cystic thick walled area of less than one centimeter. This is indicator of lung fibrosis or irreversible lung damage. 32 patients showed honeycombing. Two patient (2.5%) had pleural effusion which was a case of Rheumatoid arthritis. 10 patient had M.L.N.

According to Webb WR et al 1998 and West Cott JL, 1986. Bronchial dilatation and irregularity occurs in patients who have pulmonary fibrosis because of traction by fibrous tissue on the bronchial wall. In our series, 8 patients has tractional bronchiectasis. These patients were also suffered from secondary infection.

In our series, 10(12.5%) patient refer in higher centre for lung biopsy. Four of them had low oxygen saturation. Three patient had positive finding, one patient had non-conclusive report. One patient develop iatrogenic pneumothorax so biopsy not done. 5 patient not traced. In the remaining 70(87.5%) patient HRCT was able to make confident diagnosis.

According tomitshiro koyama (2003) 81% interstitial lung disease could be dignosed with specificity and still role of biopsy for definitive diagnosis.

CONCLUSION

Interstitial lung disease affects older age group. It shows male predominance. All socio-economic groups are affected. Smoking is related to causation of the interstitial lung disease.

Connective tissue disorder are related to lung involvement in good number of cases. Dyspnea with non-productive cough are the main symptoms. Clubbing and crepitations are important clinical findings on examination.

Lung function test (FEV₁/FVC) shows restrictive patterns of interstitial lung disease. Blood oxygen saturation is normal in mild disease but tends to fall in advanced cases.

Clinical features and lung function tests doesnot give complete assessment of lung pathology. That's why Radioimaging has important central role in the diagnosis of interstitial lung disease.

Chest radiography is the initial investigation to assess a case of interstitial lung disease. In proper clinical scenario. Chest radiography can make a confident diagnosis in small proportion of cases. Majority of the patients with interstitial lung show abnormality on a chest radiograph, but a normal chest radiograph does not rule out interstitial lung disease.

HRCT is far superior than a radiography to show changes within the interstitium even when chest radiograph is normal. Distribution of the disease in the lung parenchyma is accurately localized by HRCT.

HRCT helps in confident diagnosis as compare to chest radiograph. Thus avoiding lung biopsies in a large number of patients. In case of equivocal findings, it helps to guide the biopsy site.

HRCT is useful for follow up of cases. Frequent biopsies is not feasible to know the course of the disease and chest radiograph not adequate for follow up.

Therefore, HRCT is essential for the diagnosis, management and follow-up of the cases of interstitial lung disease.

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