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RADIOLOGICAL ANALYSIS OF INTERSTITIAL LUNG DISEASES - AT GMCH, UDAIPUR

Radiodiagnosis

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ABSTRACT

INTRODUCTION: Interstitial lung diseases are a diverse group of diseases which affect the lung interstitium and share similar clinical and radiological manifestations. HRCT of the chest has become an invaluable tool in the diagnostic process of interstitial lung diseases. The ability to characterize different disease processes and to provide a specific diagnosis by HRCT is a big advantage in clinical situations.
AIMS AND OBJECTIVES: 1. To diagnose interstitial lung diseases using HRCT and Chest X-Ray. 2. To study and compare the different radiographic patterns evident in both conventional chest radiography and HRCT.
MATERIAL AND METHOD: The present study is a prospective and observational (non interventional) type of study. This study aims evaluating patients coming to the radiology department of GMCH, Udaipur. This study comprised of 48 patients during the period of 18 months.
RESULTS: The overall M:F ratio was 1.4:1. The age of the patients ranged from 39 years to 80 years. Maximum number of patients i.e. 45.8% had usual interstitial pneumonitis pattern, next most common was non specific interstitial pneumonitis. HRCT was more sensitive in detecting nodular opacity, honeycombing, traction bronchiectasis and emphysema than x-rays.
CONCLUSION: Chest X-ray is a modality for preliminary diagnosis and screening of patients and HRCT proves to be a ultimate modality for near to accurate diagnosis of the pathology.

KEYWORDS

ILD, HRCT, Lung Disease, Chest X-Ray, Lung Interstitium.

INTRODUCTION

Interstitial lung diseases are a diverse group of diseases which affect the lung interstitium and share similar clinical and radiological manifestations. They are a heterogeneous group of disorders of the lower respiratory tract that are characterised by both acute and chronic inflammation and a generally irreversible and relentless process of fibrosis in the interstitium and the alveolar walls[1]. The interstitium refers to tissues of the alveolar wall between the capillary endothelium and the alveolar epithelium and it is the site of primary injury.

The term "interstitial" can be misleading as most of these conditions also affect the airway spaces and even the blood vessels, but it is the predominant and primary involvement of the interstitium that characterizes them[2]. The interstitial lung diseases are a heterogeneous group of many acute and chronic pulmonary disorders. Though individually rare, as a group, they are a common clinical problem. Though they are grouped together, there are great variations in the risk factors for their development, their pathological processes, the relevant therapies and the associated prognosis, making an accurate diagnosis very essential[3].

The last century experienced remarkable advances in the classification, diagnosis, and understanding of the pathogenesis of the interstitial lung diseases. Technological advances, particularly physiologic testing, lung imaging studies, bronchoalveolar lavage, surgical lung biopsy and histopathologic assessment improved our understanding of these entities. In particular, the advent of high-resolution computed tomography, the narrowed pathologic definition of usual interstitial pneumonia, and recognition of the prognostic importance of separating usual interstitial pneumonia from other idiopathic interstitial pneumonia patterns have profoundly changed the approach to these processes[4].

Interstitial lung diseases are characterized by anatomical distortion of peripheral airways and interstitium, determined by a first stage of alveolitis followed by a stage of fibrosis. The natural history of several interstitial lung diseases is characterized by slow and progressive destruction of alveolar-capillary functional units, often with respiratory failure and death. For their smoldering evolution and non-specificity of symptoms (exertional dyspnea and cough), they may remain undiagnosed and not treated for a long time[5-6]. Herein lies the importance of HRCT and other investigations in aiding for an early diagnosis.

Although interstitial lung diseases are more common in adults, certain forms such as hypersensitivity pneumonitis and idiopathic interstitial pneumonias are seen in children as well[7]. In children, common diseases associated with interstitial lung diseases include viral respiratory tract infections (RSV, parainfluenza, etc.), gastroesophageal reflux, idiopathic pulmonary fibrosis, pulmonary hemosiderosis, eosinophilic pneumonia, pneumonitis associated with AIDS, etc[7-8].

In the diagnosis of interstitial lung diseases, clinical, radiological and histological correlation is needed on most occasions. The chest radiogram remains the basic radiological tool in the investigation of these patients[9]. However, chest radiography is relatively insensitive and is normal in 10-20% of patients with histologically proven interstitial lung disease[9]. Many diseases remain occult or are not correctly diagnosed on chest X-ray, appearing as a non specific 'reticulonodular pattern'[2]. It is not specific also in that different interstitial lung diseases can have similar radiographic appearances.

High-resolution computed tomography of the chest has become an invaluable tool in the diagnostic process of interstitial lung diseases. A confident diagnosis can often be made on the basis of high-resolution computed tomographic findings and the clinical context. Serologic testing can be helpful in selected cases[10]. Improvements in CT scanner technology has now made it possible to image the lung parenchyma with excellent anatomic detail[11]. The morphologic characteristics of diffuse parenchymal lung diseases can be demonstrated with very high resolution. HRCT or high resolution computed tomography is more sensitive than conventional chest radiography in the detection of interstitial lung diseases. However, sensitivity is not 100%[11]. The specificity for the characterization of different lung diseases has been documented and appears to be better than conventional radiography. The ability to characterize different disease processes and to provide a specific diagnosis by HRCT is a big advantage in clinical situations.

AIMS AND OBJECTIVES

1. To diagnose interstitial lung diseases using HRCT and Chest X-Ray.
2. To study and compare the different radiographic patterns evident in both conventional chest radiography and HRCT.

MATERIAL AND METHOD

The present study is a prospective and observational (non interventional) type of study. This study aims evaluating patients coming to the radiology department of GMCH, Udaipur. This study comprised of 48 patients during the period of 18 months.

INCLUSION CRITERIA:

1. Patients referred to the radiology department for X-RAY and/or CT scan thorax investigations, and found to have lesion, were

included in this study.
2. Already diagnosed cases of such interstitial lung diseases which need follow up radiological investigations and are referred to our radiology department were included in study.
3. Patients presenting with associated conditions and with symptoms such as rheumatoid arthritis.
4. Patients with known history of industrial exposure or certain drug exposures.
5. Evaluation of diffuse pulmonary disease discovered on chest radiographs, conventional CT of the chest, or other CT examinations that include portions of the chest.
6. Evaluation of the lungs in patients with clinically suspected pulmonary disorders with normal or equivocal chest radiographs.
7. Evaluation of suspected small and/or large airway disease.
8. Quantification of the extent of diffuse lung disease for evaluating effectiveness of treatment.

EXCLUSION CRITERIA:

Pregnant patients and patients unwilling to participate.

PROTOCOL USED TO PERFORM HRCT-

1. Scanogram and 5mm mediastinal window cuts.
2. Full inspiration1.5 mm lung window cuts in axial section
3. Suspended full expiration scans at levels- aortic arch, tracheal bifurcation and above diaphragm
4. Prone scans in lung window 1.5 mm cuts if indicated.

RESULTS

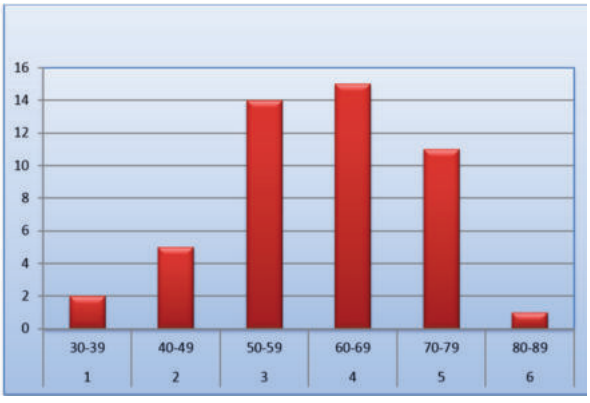
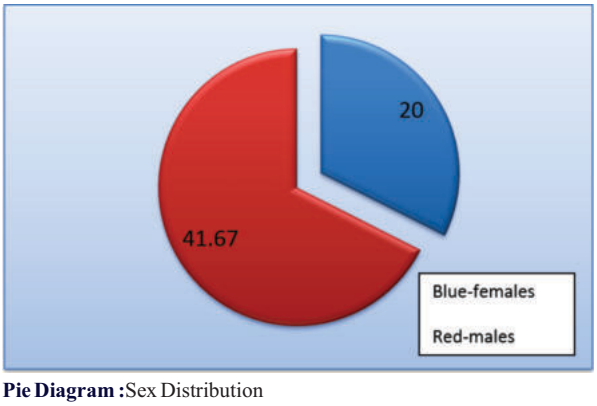


Fig. 1: Age distribution Largest group of patients were in 60-69 years age group.



Pie Diagram : Sex Distribution

The overall sex ratio was M:F = 1.4:1 Of the 48 patients, 28 patients were males(58.33%) and 20(41.67%) were females. The age of the patients ranged from 39 years to 80 years.

Table 1 : Incidence of various patterns in this cross section of population

Sr. No	Pattern	No. of cases	Percentage
1.	Usual interstitial pneumonitis	22	45.8
2.	Non specific interstitial pneumonitis	10	20.8
3	Nodular	02	4.16
4.	Asbestosis	02	4.16
4.	Lymphangitic spread	04	8.33
5.	Desquamative interstitial pneumonia	01	2.08
6.	Lymphangioleiomyomatosis	01	2.08
7.	Cryptogenic organizing pneumonia	02	4.16
8.	Respiratory bronchiolitis-interstitia lung disease	01	2.08
9.	Others	03	6.25

Maximum number of patients i.e. 45.8% had usual interstitial pneumonitis pattern, next most common was non specific interstitial pneumonitis.

Table 2: Results for detection of reticular opacities

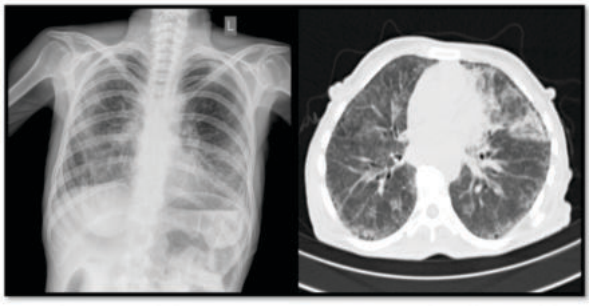
	HRCT		X-ray		
	n	%	n	%	P value
Reticular opacity	47	97.9	43	89.5	0.09
Nodular opacity	11	22.9	04	8.33	0.04
Honeycombing	25	52.08	15	31.25	0.03
Traction Bronchiectasis	26	54.1	13	27.1	0.006
Consolidation	14	29.1	09	18.75	0.217
Emphysema	16	33.3	07	14.58	0.03

HRCT was more sensitive in detecting nodular opacity, honeycombing, traction bronchiectasis and emphysema than x-rays.

Table 3: Distribution Of Various Pathologies On X-Ray And HRCT

S.No	Etiology	No. of cases	Upper Lobe	Middle /Lingular Lobe	Lower Lobe	Both Lungs (All Lobes)
1	Idiopathic UIP-interstitial pulmonary fibrosis	12	-	2	5	5
2	Idiopathic NSIP	08	-	2	4	2
3	Rheumatoid arthritis associated ILD	07	-	3(M+L)	4	-
4	Asbestoses	03	2(U+M)	-	1(M+L)	-
5	Silicosis	01	-	-	-	1
6	Cryptogenic organizing pneumonia	01	-	-	-	1
7	Hypersensitivity pneumonitis (chronic and sub acute)	3	1(U+M)	-	-	2
8	Smoking related ILD	03	2	-	-	1
9	Lymphangitic spread	04	1	1(M+L)	2	-
10	Post infection (atypical mycobacterial)	01	-	-	-	1
11	Lymphangioleiomyomatosis-tuberous sclerosis	01	-	-	-	1
12	Allergic bronchopulmonaryaspergillosis	01	-	-	-	1(MORE IN UPPER LOBE)
13	Sarcoidosis	01	1(U+M)	-	-	-
14	Drug induced ILD	01	-	-	-	1
15	Atypical UIP	01	1(U+L)	-	-	-

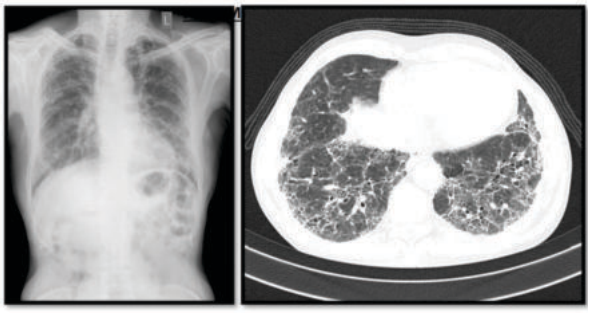
NON SPECIFIC INTERSTITIAL PNEUMONITIS



X ray shows reticular thickening in the lower zones

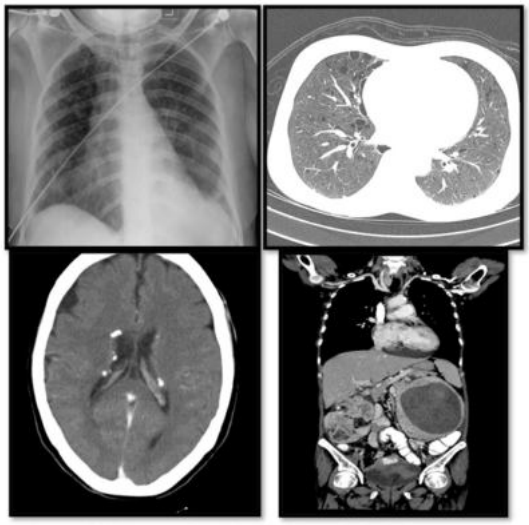
HRCT shows reticular thickening with ground glass opacities and sub pleural sparing of lung

CHRONIC HYPERSENSITIVITY



X ray shows reticular thickening at bases and HRCT shows fibrosis. Reticulation involving entire section of lung both central and sub pleural region

TUBEROUS SCLEROSIS-LYMPHANGIOLEIOMYOMATOSIS



HRCT shows multiple intra parenchymal cysts with ground glass haziness.

CT BRAIN shows multiple calcified sub ependymal lesions-sub ependymal glial astrocytomas

Coronal section of abdomen shows a large angiomyolipoma in left kidney, there were multiple angiomyolipomas in both the kidneys,

DISCUSSION

The study was carried out in the Department of Radiology, GMCH, Udaipur. A total of 48 patients were selected for the study. All the patients were subjected to both conventional chest radiograph and HRCT scan thorax was performed.

Of the 48 patients, 28 were males (58.33%) and 20(41.67%) were females. The age of the patients ranged from 39 years to 80 years.

The main observation in our study was that higher number of samples with findings were detected by HRCT as compared to conventional radiography. Even when both modalities were able to detect the findings, HRCT could characterize the abnormality and specify its location much more accurately.

The chest radiogram can appear completely normal in patients suffering from interstitial lung diseases. Therein lies the inherent lack of sensitivity of conventional chest radiography in the diagnosis of the conditions. In our study, 2 of the 48 patients (4.16%) had no abnormalities in their chest radiographs. However HRCT was able to show changes in these patients.

The most common abnormality seen on chest radiographs was reticular opacities which was observed in 89% of the cases. However HRCT managed to detect reticular opacities in 98% of the cases, thereby implying a much greater sensitivity in the identification of these densities.

Furthermore, in the detection of these reticular opacities, although conventional chest radiography was able to differentiate between medium and coarse opacities, their detection of fine reticular densities was a cause of concern. HRCT detected fine reticular opacities in the lungs when the chest radiograph revealed no such abnormalities.

In our study 10% had nodular opacities in their chest radiographs. While HRCT showed evidence of nodular opacities in 16.5% of the cases. The appearance of the nodules themselves can be an indicator as to whether they are interstitial or air space nodules. Interstitial nodules tend to be sharply marginated while air space nodules poorly defined[12]. This distinction of nodules is much better appreciated on HRCT scans than on chest radiograms.

Furthermore, the location and distribution of nodules in relation to lung structures is a key determinant in narrowing down the differential diagnosis. Nodules can be classified as perilympahtic, random and centrilobular based on their distribution on HRCT. Perilympahtic nodules occur in relation to lung lymphatics and in clinical practice are usually the result of sarcoidosis[10]. In our study this perilymphatic distribution of nodules in sarcoidosis was well appreciated. Similarly, random nodules are most typical of miliary tuberculosis, fungal infections or hematogenous metastases. Such narrowing down of the differential diagnosis based on the nodule distribution was possible only on HRCT and not on chest radiography. The maximum that chest radiography could offer in this context was to show a subpleural distribution of the nodule. This highlights the increased specificity of HRCT over conventional radiography.

The end stage of interstitial lung disease is characterized by honeycombing. It reflects extensive lung fibrosis with alveolar destruction, thereby resulting in a characteristic reticular appearance[12]. On HRCT, it is associated with gross distortion of lung architecture, where individual lobules are no longer visible. In our study, such honeycombing was seen in 52% of the cases on HRCT while chest radiography could detect them in only 31%. On HRCT, honeycombing was much more accurately diagnosed by the presence of thick walled, air filled cysts, usually measuring 3mm to 1cm in diameter, typically occurring in several layers at the pleural surface.

Detection of honeycombing has great clinical significance as its presence strongly suggest the diagnosis of usual interstitial pneumonia. It also indicates end stage disease, whereby the patient will gain little from a lung biopsy and hence avoid it [14]. In this context also, HRCT definitely scores over conventional radiography.

Traction bronchiectasis or bronchial dilatation resulting from lung fibrosis was visible in 27% of the cases on chest radiography. They were typically associated with reticular opacities and in some cases with honeycombing. HRCT however managed to detect traction bronchiectasis in 54%. The bronchiectasis in these cases was typically associated with an absence of mucous plugging or fluid within the bronchi. This finding or the absence of it was much better appreciated on HRCT than conventional radiography.

The detection of associated air trapping and lymphadenopathy was also greater with HRCT than with conventional radiography.

HRCT abnormalities, but not the chest radiographic stage, were strongly associated with functional parameters. Abnormal changes of lung parenchyma, established by HRCT features, were associated with respiratory functional impairment in sarcoidosis. Moreover, compared with the radiographic stages, HRCT findings appeared to be much more sensitive in depicting respiratory disability, especially abnormal gas exchange.

Sumikawa H, et al in 2006 found signs of interstitial fibrosis more frequently in IPF than in extrinsic allergic alveolitis/hypersensitivity pneumonitis (25% versus 6.25%)[15]. The presence of fibrosis with basal and peripheral distribution was characteristic of idiopathic pulmonary fibrosis, with good sensitivity and specificity (75%), whereas in chronic extrinsic allergic alveolitis the areas of fibrosis often presented an irregular and heterogeneous distribution, in 91.6% of cases[15]. In our study also, the basal and subpleural distribution of honeycombing in IPF was well appreciated on HRCT. However appreciation of the same on conventional chest radiography was difficult.

Another study in 2005 found that the numbers of small nodular opacities in HRCT scans were significantly higher than those seen in radiography in all lung zones ($p<0.01$). HRCT was more sensitive than radiography in detecting small opacities of mid-out zones of the lung, but no statistical significance was found between the two methods in the detection of small opacities of lower zones of the lung. A statistically significant increase in the detectability of bulla, emphysema, pleural, mediastinal and hilar changes was observed

($p<0.05$). HRCT might also be more sensitive than radiography in detecting lung parenchymal changes suggestive of silicosis[11,17]. The findings in our study also revealed similar results with HRCT being able to detect nodular opacity in 11 of the 48 cases (16.5%) while chest radiography could detect the same in only 04 of the 48 cases (10%). Profusion of opacities on HRCT correlates with functional impairment. The presence of branching centrilobular structures may be helpful in early recognition of silicosis[18].

Pulmonary function test was performed in 40 out of 48 patients.it was restrictive in nature with FEV1/FVC values are normal while total lung capacity was less than 65%(mild restriction) in 15 out of 40 patients and was 50-65% (moderate restriction) in 11 patients and severe restriction of <50% was seen in 14 patients.

High resolution computed tomography is a diagnostic method of choice in the evaluation of lung parenchyma. HRCT enables the evaluation of small interstitial changes, invisible on plain chest radiographs, and their assessment at the level of the lung lobule[10]. Nodular thickening of the peribronchovascular interstitium and interlobular septa are typical in lymphangitic spread of carcinoma. Smooth peribronchovascular and septal thickenings are typical in sarcoidosis, and are only seen in some patients in the lymphangitic spread of carcinoma. In lymphangitis carcinomatosa lung architecture remains unchanged, which allows differentiating from sarcoidosis[12]. In our study also, we were able to appreciate the different types of septal thickening evident in different diseases; although detailed statistical analysis in this regard was not performed.

In our study, out of 7 patients of rheumatoid arthritis,5 patients show usual interstitial pneumonitis pattern and the rest two shown on specific interstitial pneumonitis pattern.

The inference that we draw from this study is that HRCT is much more sensitive than conventional chest radiography in the assessment and diagnosis of patients with interstitial lung diseases. Hence, HRCT seems to be the investigation of choice for the evaluation of the parenchymal abnormalities in interstitial lung diseases and thereby make a more specific and accurate diagnosis of the particular disease[19].

Lymphangioleiomyomatosis (LAM) is a rare interstitial lung disease that affects women exclusively, typically during their reproductive years. A small percentage of patients, also typically women, have LAM in association with tuberous sclerosis complex (TSC). LAM is characterized by the abnormal proliferation of smooth muscle cells (LAM cells) in the lungs and in the thoracic and retroperitoneal lymphatics. Computed tomography (CT) and high-resolution CT demonstrate bilateral diffuse thin-walled cysts surrounded by normal lung parenchyma. CT may also demonstrate associated pleural effusion or pneumothorax; thoracic or abdominal lymphadenopathy; and other abdominal abnormalities including angiomyolipomas, lymphangioleiomyomas, and ascites[20].

In our case of tuberous sclerosis. The patient demonstrated normal lung fields on chest X-ray but on HRCT, there is ground glass opacity and intra parenchymal cysts seen with septal thickening.

CONCLUSION

Chest X ray is a modality for preliminary diagnosis and screening of patients and HRCT proves to be a ultimate modality for near to accurate diagnosis of the pathology. Hence any case with suspected interstitial lung disease should always be subjected to HRCT to reach to the final diagnosis.

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