



ROLE OF HIGH RESOLUTION COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF INTERSTITIAL DISEASES OF THE LUNGS

Pathology

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ABSTRACT

Background: Interstitial lung diseases are a diverse group of diseases that predominantly affect the lung interstitium and share similar clinical and radiological manifestations. Most patients have nonspecific respiratory complaints and the first suggestion of the disease is usually by a chest radiograph. However many patients of interstitial lung disease can have a normal chest radiogram; in these patients HRCT can detect abnormalities not visualized on the chest radiogram.

Aims: This study attempts to highlight the role of HRCT in the diagnosis of interstitial lung disease.

Material and Methods: The present study included 30 patients. After a detailed clinical work up, all the patients underwent both conventional chest radiography and HRCT. The images were evaluated and the findings compared between chest radiography and HRCT. The results were tabulated, statistically analysed and compared with previous studies.

Results: The main result of the study was that HRCT was able to detect many abnormalities in interstitial lung diseases compared to conventional radiographs.

Conclusion: HRCT appears to be a better modality of investigation than conventional chest radiography in the diagnosis of interstitial lung diseases. HRCT was able to detect abnormalities even in cases when the chest radiogram was normal. Clinicians should therefore give patients the benefit of an HRCT examination even when the chest radiogram appears normal.

KEYWORDS:

Interstitial lung disease, HRCT, Sensitivity

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 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].

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 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^[4]. Herein lies the importance of HRCT and other investigations in aiding for an early diagnosis.

Idiopathic pulmonary fibrosis is the most common interstitial lung disease in adults and generally has a poor prognosis^[5]. Around 15% of patients with interstitial lung disease have an underlying connective tissue disorder^[6]. 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].

For the physician, the distinctive sign of interstitial lung disease is the evidence of diffuse pulmonary opacities on chest X rays or a suggestive pattern on pulmonary function tests. The diagnosis of chronic ILD depends on epidemiologic data, clinical and radiological findings which make it possible to consider a diagnosis of high probability in at least 60% of cases and reduce the gamut of hypothesis in the remaining^[8].

In the diagnosis of interstitial lung diseases, clinical, radiological and histological correlation is needed in 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 nonspecific '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. Improvements in CT scanner technology has now made it possible to image the lung parenchyma with excellent anatomic detail^[10].

The morphologic characteristics of diffuse parenchymal lung diseases can be demonstrated with very high resolution. However, sensitivity is not 100%^[10]. 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 evaluate if HRCT can detect pulmonary abnormalities in patients with suspected interstitial lung diseases but with a normal chest radiograph
2. To highlight the importance of HRCT in early diagnosis of various interstitial lung diseases.

METHODS AND MATERIALS:

This is a prospective study done in Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar over a period of 1 year (December 2015 to November 2016).

All the patients with clinical suspicion of interstitial lung disease who were referred to the department of Radiodiagnosis, CAIMS for diagnosis were subjected to both conventional chest radiograph and HRCT. Diagnosis was based on clinical and radiographic findings.

HRCT scans were performed in supine position in a GE LIGHTSPEED XTRA 16 Slice CT machine in suspended inspiration using a kVp of 130 and mAs of 60-70. The window width was set between 1200-1500 and the window level at -600 to -700. The matrix used was 512 x 512 while the pitch was set at 1:1.

The patients also underwent chest radiography postero-anterior view at 60kVp and 5-8 mAs in a SIEMENS HELIPHOS-D 500mA x-ray machine.

A cross sectional study was performed. All ages and both sexes were included in the study. Total of 30 patients were included in the study. Duration of the study was 1 year.

RESULTS

The study was carried out in the Department of Radiology, Chalmeda AnandRao Institute of Medical Sciences, Karimnagar. A total of 30 patients were selected for the study between the time period of December 2015 and December 2016.

The 30 patients were subjected to both conventional chest radiograph and HRCT scan thorax and a detailed work up of these patients was performed; their clinical history, relevant past and occupational history and any laboratory data recorded.

Of the 30 patients, 18 patients were males (60%) and 12(40%) were females. The age of the patients ranged from 24 years to 74 years.

TABLE I : SEX DISTRIBUTION

Gender	n	%
Male	18	60%
Female	12	40%
Total	30	100%

The spectrum of diseases included in the study were: Sarcoidosis (23.3%), systemic lupus erythematosus (10%), rheumatoid arthritis(10%), idiopathic pulmonary fibrosis(13.3%), silicosis (16.7%), disseminated tuberculosis(6.7%), hypersensitivity pneumonitis(6.7%), allergic bronchopulmonary aspergillosis(6.7%) and lymphangitis carcinomatosa(6.7%).

The comparative tables between X-ray and HRCT in the detection of different findings are given below.

TABLE II : COMPARATIVE FINDINGS IN XRAY AND HRCT

	Plain radiograph	HRCT
1 Air space consolidation	14	19
2 Septal thickening	12	19
3 Reticular opacities	13	29
4 Reticular opacities – Medium	11	16
5 Reticular opacities – Coarse	2	6
6 Peribronchial cuffing	7	13
7 Honeycombing	4	6
8 Nodular opacities	13	18
9 Distribution of nodules (perilymphatic, centrilobular or random)	NA	A
10 Ground glass opacity	5	12
11 Traction bronchiectasis	4	11
12 Air trapping	2	6
13 Hilar and mediastinal lymphadenopathy	6	16

A-A applicable, NA- Not applicable

The results of our investigation were evaluated using proportions and chi square test. The level of significance was 0.05.

Decision Criterion: We compared the P-Value with the level of significance. If P<0.05, we reject the null hypothesis and accept the alternate hypothesis. If P≥0.05, we accept the null hypothesis.

Results for the detection of reticular opacity: Higher no. of samples with reticular opacity were detected in HRCT method compared to X-ray method but the difference between the two methods was not statistically significant (P>0.05).

TABLE III : NODULAR OPACITY

Nodular Opacity	HRCT		Xray		Total	χ^2	Total
	N	%	n	%			
Present	19	63%	11	37%	30	4.267	0.039*
Absent	11	37%	19	63%	30		
Total	30	100%	30	100%	60		

Higher no. of samples with nodular opacity were detected in HRCT method compared to X-ray method and this difference between the two methods was found to be statistically significant (P<0.05).

TABLE IV : SEPTAL THICKENING

Septal thickening	HRCT		Xray		Total	χ^2	Total
	N	%	n	%			
Present	15	50%	6	20%	21	5.934	0.015*
Absent	15	50%	24	80%	39		
Total	30	100%	30	100%	60		

Results for the detection of septal thickening: Higher no. of samples with septal thickening were detected in HRCT method compared to X-ray method and this difference between the two methods was found to be statistically significant (P<0.05).

TABLE V : HONEYCOMBING

Honeycombing	HRCT		Xray		Total	χ^2	Total
	N	%	n	%			
Present	10	33%	6	20%	16	1.364	0.243
Absent	20	67%	24	80%	44		
Total	30	100%	30	100%	60		

Higher no. of samples with honeycombing were detected in HRCT method compared to X-ray method but the difference between the two methods was not statistically significant (P>0.05).

TABLE VI : CONSOLIDATION

Consolidation	HRCT		Xray		Total	χ^2	Total
	N	%	n	%			
Present	13	43%	13	43%	26	—	—
Absent	17	57%	17	57%	34		
Total	30	100%	30	100%	60		

No significant difference was seen between conventional radiography and HRCT.

TABLE VII : LYMPHADENOPATHY

Lymphadenopathy	HRCT		Xray		Total	χ^2	Total
	n	%	N	%			
Present	16	53%	10	33%	26	2.443	0.118
Absent	14	47%	20	67%	34		
Total	30	100%	30	100%	60		

No significant difference was seen between conventional radiography and HRCT.

TABLE VII : LYMPHADENOPATHY

Lymphadenopathy	HRCT		Xray		Total	χ^2	Total
	n	%	N	%			
Present	16	53%	10	33%	26	2.443	0.118
Absent	14	47%	20	67%	34		
Total	30	100%	30	100%	60		

Higher no. of samples with lymphadenopathy were detected in HRCT method compared to X-ray method but the difference between the two methods was not statistically significant (P>0.05)

DISCUSSION

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 30 patients (6.7%) had no abnormalities in their chest radiographs. However HRCT was able to show reticular changes in these patients.

The most common abnormality seen on chest radiographs was reticular opacities which was observed in 73% of the cases. However HRCT managed to detect reticular opacities in 90% 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.

Nodular opacities are another very common manifestation of interstitial lung diseases. In our study 37% had nodular opacities in their chest radiographs, while HRCT showed evidence of nodular opacities in 63% 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 margined while air space nodules poorly

Defined^[11]. This distinction of nodules is much better appreciated on HRCT scans.

Perilymphatic nodules occur in relation to lung lymphatics and in clinical practice are usually the result of sarcoidosis^[12]. Similarly, random nodules are most typical of military 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 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^[11]. 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 can avoid it^[13].

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

Findings on HRCT in disseminated TB in a study done in 2005 included miliary nodularity, alveolar lesions such as ground glass attenuation and/or consolidation, lymphadenopathy, peribroncho vascular interstitial thickening, emphysema, pleural pathology, and pericardial effusion^[14]. In our study also, we were able to detect nodularity, consolidation, interstitial thickening, fibrosis and traction bronchiectasis.

Sumikawa H, et al in 2006 found signs of interstitial fibrosis more frequently in IPF than in extrinsic allergic alveolitis (91.6% versus 33.3%)^[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. However, 25% of extrinsic allergic alveolitis cases had a distribution mimicking idiopathic pulmonary fibrosis. The presence of areas with increased ground- glass opacity is more common in EAA than in IPF (66.6% versus 33.3%)^[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.

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^[16]. The findings in our study also revealed similar results with HRCT being able to detect nodular opacity in 19 of the 30 cases (63%) while chest radiography could detect the same in only 11 of the 30 cases (37%).

HRCT enables the evaluation of small interstitial changes, invisible on plain chest radiographs, and their assessment at the level of the lung lobule^[12]. Nodular thickening of the peribronchovascular interstitium and interlobular septa are typical in lymphangitic spread of carcinoma.

In our study also, we were able to appreciate the different types of septal thickening evident in different diseases.

A study on rheumatoid arthritis in 2007 showed that interstitial involvement was the most common finding on HRCT (36%) and followed by air trapping (20%).

Bronchiectasis, pulmonary nodule, and pleural disease were seen in 16%, 12%, and 12% of patients, respectively. None of patients had emphysema and honeycomb pattern. There was no statistically significant correlation between HRCT findings and disease activity criteria. In our study in the identification of pleural disease, reticular opacities and ground glass haziness, HRCT could detect more number of cases.

In another study, HRCT in rheumatoid arthritis revealed air trapping in 69%, bronchiectasis in 58%, bronchial wall thickening in 52% and ground glass opacities (GGOs) in 35% of the patients. Pleural thickening and effusion were observed in 11%. Chest radiogram was abnormal in only one patient revealing a single pulmonary nodule.

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 diseases.

CONCLUSION

HRCT is able to detect abnormalities in patients when the clinical signs are minimal or even when the chest radiograph appears completely normal.

Ultimately all patients with clinical suspicion of ILDs should benefit from an HRCT scan of the thorax.

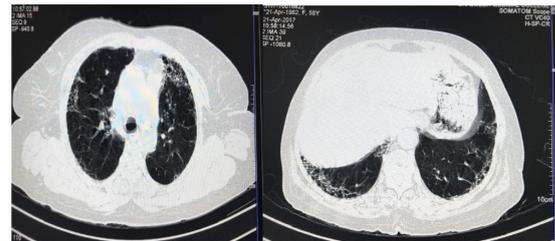


Figure 1 and 2 : HRCT showing subpleural honey-combing.



Figure 3: HRCT showing traction bronchiectasis.

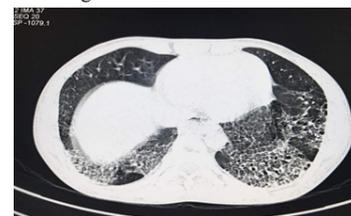


Figure 4: HRCT showing fibrosis and ground glass opacities in bilateral lung fields.



Figure 5: HRCT showing air trapping.

Figure 6: HRCT showing ground glass opacities in bilateral lung fields.



Figure 7: HRCT showing reticulonodular opacities.

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