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ROLE OF CHEST X-RAY AND HRCT IN EVALUATION OF INTERSTITIAL LUNG DISEASES - AT SBKS MI&RC, VADODARA

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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 SBKS MI & RC,Vadodara. This study comprised of 48 patients during the period of 15 months.

RESULTS: The overall M:F ratio was 1.4:1. The age of the patients ranged from 40 years to 79 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 encompass a diverse array of conditions affecting the lung interstitium, sharing common clinical and radiological features. They represent a heterogeneous spectrum of lower respiratory tract disorders characterized by both acute and chronic inflammation,

leading to irreversible fibrosis within the interstitium and alveolar walls1. The interstitium, located between the capillary endothelium and alveolar epithelium, serves as the primary site of injury.

The term "interstitial" may be misleading as these conditions often involve not only the interstitium but also airway spaces and blood vessels. Nevertheless, primary interstitial involvement distinguishes these diseases2. Although individually rare, collectively, interstitial lung diseases pose a significant clinical challenge due to variations in risk factors, pathogenesis, therapeutic approaches, and prognosis, necessitating precise diagnosis3.

Significant advancements in understanding interstitial lung diseases occurred in the last century, driven by technological innovations such as physiologic testing, lung imaging studies, and histopathologic assessment. High-resolution computed tomography (HRCT) revolutionized diagnostic approaches, offering detailed visualization of lung parenchyma morphology and facilitating more accurate diagnoses. Despite its enhanced sensitivity compared to conventional chest radiography, HRCT is not infallible, yet it offers superior specificity in characterizing different lung diseases, aiding in tailored clinical management4.

In clinical practice, interstitial lung diseases manifest with symptoms like exertional dyspnea and cough, often leading to delayed diagnosis due to their insidious progression5-6. While these conditions predominantly affect adults, certain forms are also observed in children, associated with various underlying diseases7.

In children, typical interstitial lung diseases include viral respiratory tract infections (such as RSV, parainfluenza), gastroesophageal reflux, idiopathic pulmonary fibrosis, pulmonary hemosiderosis, eosinophilic pneumonia, and pneumonitis linked to AIDS7-8.

Diagnosing interstitial lung diseases often requires clinical, radiological, and histological correlation. While chest radiography remains fundamental9, it's relatively insensitive and may appear normal in 10-20% of cases with histologically proven disease9. Many diseases may go undetected or be misdiagnosed on chest X-rays, showing a nonspecific 'reticulonodular pattern.'2 This pattern lacks specificity as various interstitial lung diseases can exhibit similar radiographic appearances.

High-resolution computed tomography (HRCT) has revolutionized the diagnostic process, offering detailed imaging of lung parenchyma and aiding confident diagnoses based on findings and clinical context. Serologic testing can also provide valuable insights in specific cases10. Advancements in CT scanner technology have enhanced imaging capabilities, allowing for precise demonstration of morphological characteristics of diffuse parenchymal lung diseases. HRCT is superior to conventional chest radiography in sensitivity for detecting interstitial lung diseases, although it's not 100%11. However, its specificity in characterizing different lung diseases surpasses that of conventional radiography, enabling accurate diagnoses in clinical practice.

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,SBKS MI & RC,Vadodara. This study comprised of 48 patients during the period of 15 months.

INCLUSION CRITERIA:

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

RESULTS

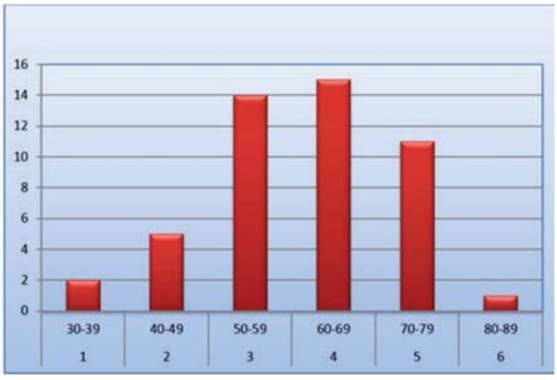
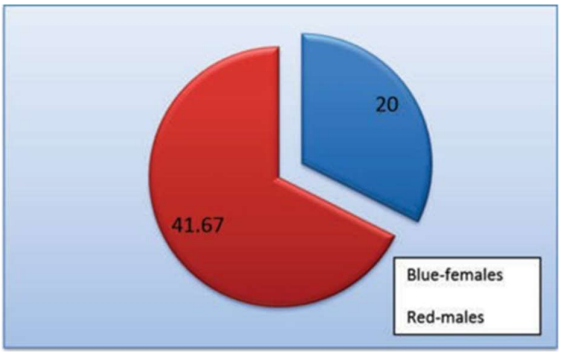


Fig. 1: Age distribution largest group of patients were in 60-69 years age group.



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 40 years to 79 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
5.	Lymphangitic spread	04	8.33
6.	Desquamative interstitial pneumonia	01	2.08
7.	Lymphangioleiomyomatosis	01	2.08
8.	Cryptogenic organizing pneumonia	02	4.16
9.	Respiratory bronchiolitis-interstitia lung disease	01	2.08
10.	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.

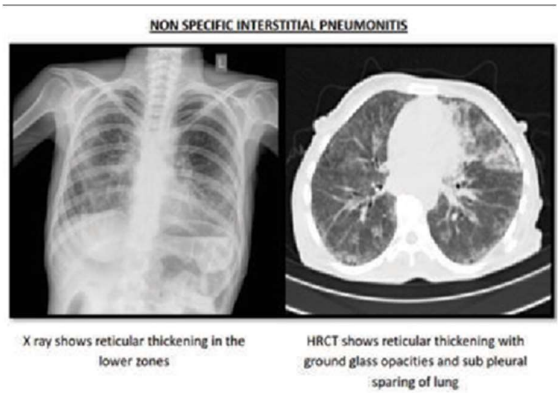
Table 2: Results for detection of reticular opacities

	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

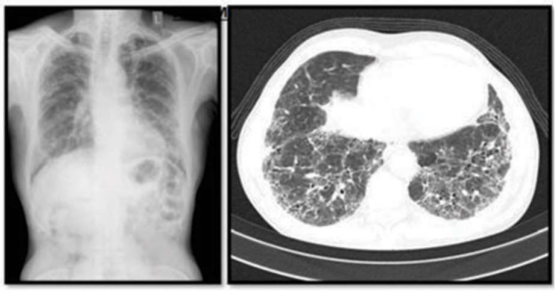
HRCT was more sensitive in detecting nodular opacity, honeycombing, traction bronchiectasis and emphysema than x-rays.

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

S.No	Etiology	No. of cases	Upper Lobe	Middle /Lingul ar 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	Lymphangioleiomyo matosis-tuberous sclerosis	01	-	-	-	1
12	Allergic bronchopulmonaryas pergillosis	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)	-	-	-

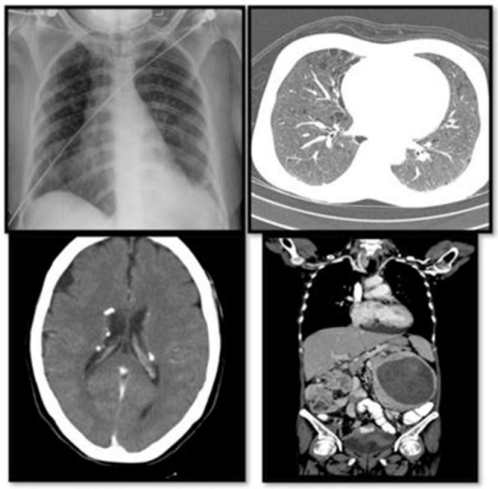


CHRONIC HYPERSENSITIVITY



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

In our study, we found that HRCT detected more abnormalities compared to conventional radiography, and it was better at characterizing and locating them accurately. Conventional chest radiography often fails to detect interstitial lung disease, with 4.16% of patients showing no abnormalities on radiographs but abnormalities found on HRCT. HRCT also showed greater sensitivity in detecting reticular opacities, with 98% detection compared to 89% on chest radiographs.

While chest radiography could differentiate between medium and coarse opacities, it struggled to detect fine reticular densities, which HRCT successfully identified. Additionally, while 10% of patients had nodular opacities on chest radiographs, HRCT revealed nodules in 16.5% of cases, showing better visualization and distribution of nodules.

Honeycombing, indicative of extensive lung fibrosis, was seen in 52% of cases on HRCT compared to 31% on chest radiographs. HRCT accurately diagnosed honeycombing through thick-walled, air-filled cysts, a feature less visible on chest radiographs.
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, associated with lung fibrosis, was visible in 27% of cases on chest radiography, but HRCT detected it in 54% of cases, with better visualization of associated features such as absence of mucous plugging.

HRCT also showed superior detection of associated air trapping and lymphadenopathy. Additionally, HRCT abnormalities were strongly linked to functional impairment, especially abnormal gas exchange, suggesting its greater sensitivity in assessing respiratory disability compared to chest radiographs.

In a study by Sumikawa et al. in 2006, signs of interstitial fibrosis were more common in idiopathic pulmonary fibrosis (IPF) compared to extrinsic allergic alveolitis/hypersensitivity pneumonitis (25% versus 6.25%)15. Fibrosis with basal and peripheral distribution was characteristic of IPF, with 75% sensitivity and specificity. However, in chronic extrinsic allergic alveolitis, fibrosis areas often had irregular and heterogeneous distribution, seen in 91.6% of cases. Similarly, in our study, HRCT clearly depicted basal and subpleural honeycombing in IPF, which was challenging to appreciate on conventional chest radiography.

Another study in 2005 found that HRCT detected significantly more small nodular opacities compared to radiography in all lung zones. HRCT was particularly sensitive in detecting small opacities in mid-out zones, while there was no statistical difference in detecting small opacities in lower lung zones. HRCT also showed higher detectability of bulla, emphysema, and pleural, mediastinal, and hilar changes, potentially indicating silicosis11,17. Our study similarly showed HRCT's ability to detect nodular opacity in 16.5% of cases compared to 10% detected by chest radiography. The profusion of opacities on HRCT correlated with functional impairment, and the presence of branching centrilobular structures could aid in early recognition of silicosis18.

Pulmonary function tests were conducted in 40 out of 48 patients, revealing a restrictive pattern with normal FEV1/FVC values. Total lung capacity was mildly restricted (<65%) in 15 patients, moderately restricted (50-65%) in 11 patients, and severely restricted (<50%) in 14 patients.

High-resolution computed tomography (HRCT) is preferred for assessing lung parenchyma due to its ability to detect small interstitial changes not visible on plain chest radiographs. HRCT allows evaluation at the level of the lung lobule10. In lymphangitic spread of carcinoma, nodular thickening of the peribronchovascular interstitium and interlobular septa are typical, while smooth peribronchovascular and septal thickenings are typical in sarcoidosis. Differentiating between lymphangitis carcinomatosa and sarcoidosis is possible as lung architecture remains unchanged in the former12. Our study also observed various types of septal thickening in different diseases, though detailed statistical analysis was not conducted.

In our study of rheumatoid arthritis patients, five out of seven showed a usual interstitial pneumonitis pattern, while the remaining two exhibited a specific interstitial pneumonitis pattern.

Our study concludes that HRCT is more sensitive than conventional chest radiography for assessing and diagnosing interstitial lung diseases. Therefore, HRCT is the preferred investigation for evaluating parenchymal abnormalities in these diseases and making a specific and accurate diagnosis19.

Lymphangioleiomyomatosis (LAM) is a rare interstitial lung disease primarily affecting women during their reproductive years. Some women with LAM also have tuberous sclerosis complex (TSC). LAM is characterized by abnormal smooth muscle cell proliferation in the lungs and thoracic and retroperitoneal lymphatics. Computed tomography (CT) and HRCT reveal bilateral diffuse thin-walled cysts surrounded by normal lung parenchyma. Additionally, CT may show associated pleural effusion, pneumothorax, thoracic or abdominal lymphadenopathy, and other abdominal abnormalities such as angiomyolipomas, lymphangioleiomyomas, and ascites20.

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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