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A Study On Role Of High-Resolution Computed Tomography In The Evaluation Of Interstitial Lung Diseases In Patients Presenting In A Tertiary Care Hospital

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Abstract
Introduction:
Interstitial lung disease (ILD) encompasses a wide variety of disease entities with different clinical presentations, characteristic CT (computed tomography) findings, disease progression, and treatments. With the advancements in imaging, the emphasis on pathologic tissues diagnosis has waned. There are two types of interstitial lung diseases: those with recognised causes and those with unknown origins. Connective tissue disease associated ILD, Pneumoconiosis, Drug-induced, Smoking-related ILD, Radiation-induced, and Toxic inhalation-induced ILD are among those with established causes. Idiopathic pulmonary fibrosis, Sarcoidosis and pulmonary lymphoma are among those with unknown aetiology.
Aims:
HRCT should be used to evaluate the pulmonary interstitium in patients with clinical signs of interstitial lung disease. To assess the accuracies of chest radiography and HRCT in the prediction of specific interstitial lung disease diagnosis.
Materials & Method:
This prospective observational study was conducted at Narayan Medical College & Hospital Jamuhar, Sasaram, Bihar Department of Radiodiagnosis (SIEMENS 16 slice) from January 2021 to June 2022. An informed consent was taken from all the participants, after explaining the main objectives of the study and the procedure.
Result:
2(4.0%) patients were 30 years old, 9(18.0%) patients were 31-40 years old, 15(30.0%) patients were 41-50 years old, 18(36.0%) patients were 51-60 years old, 3(6.0%) patients were 61-70 years old, and 3(6.0%) patients were >70 years old.
Conclusions:
In the case of interstitial lung disorders, HRCT is the most accurate non-invasive imaging method for evaluating lung parenchyma. HRCT outperforms chest radiography due to its cross-sectional perspective and great spatial resolution.

Keywords*: Sarcoidosis; Interstitial Lung Diseases; High Resolution Computed Tomography.*

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I. INTRODUCTION

Interstitial lung disease (ILD) encompasses a wide variety of disease entities with different clinical presentations, characteristic CT (computed tomography) findings, disease progression, and treatments. With the advancements in imaging, the emphasis on pathologic tissues diagnosis has waned. Instead, a thorough history including time course of symptoms, exposure history (occupational, environmental, and smoking for example), personal and family history of auto-immune and connective tissue disease, and findings on high-resolution computed tomography (HRCT) scans of the chest can lead to a definitive diagnosis obviating the need for

biopsy. This in turn can allow for practitioners to discuss with patients the expectations of disease progression, specific treatment regimens aimed at the precise disease, and overall prognosis as each ILD has unique clinical courses. HRCT imaging of the chest, when used in the context of a history and physical, is a vital piece of information in this diagnostic process. Although ILDs are more prevalent in adults, some kinds, such as hypersensitivity pneumonitis and idiopathic interstitial pneumonias, can occur in children[1]. Patients with ILD most commonly present with shortness of breath with exertion, fatigue, weakness, loss of appetite, loss of weight, dry cough and discomfort in chest. These people have a diffuse infiltrative pattern on chest radiograph. This study is aimed at the imaging features of various common interstitial lung diseases so that the diagnosis is made early and irreversible complications avoided. Interstitial lung illnesses appear on radiographs as reticular patterns, nodular patterns, or reticulonodular patterns. Lymphatics and veins are found in interlobular septae. Tissue that connects things together. Diseases that affect these structures cause enlarged interlobular septae and abnormal pleural surface appearances, such as IPF, lymphangitis carcinomatosis, and pulmonary oedema.[2]

For many years, the plain chest radiograph was the only imaging modality utilised to diagnose interstitial lung disorders. The introduction of CT provided the first chance to analyse gross lung anatomy. Conventional 8-10 mm collimation scans allowed for a more accurate assessment of lung parenchyma. However, until the emergence of High-Resolution Computed Tomography (HRCT), CT played only a modest role in the identification of interstitial lung disorders. CT enables for a more accurate assessment of the kind, distribution, and severity of parenchymal anomalies by removing superimposition of structures.[3] Since its introduction in the 1980s, HRCT scanning with its greater ability to visualize fine detail within the lung, has replaced conventional chest radiography as the preferred imaging method for the ILDs. The characteristic radiographic features of many ILDs (especially for IPF) and correlations of these features with histopathology have been described. HRCT has been found useful in the evaluation of ILDs in the following areas: Identification of the presence of disease (often being abnormal when other studies are normal or only mildly impaired), evaluation of the extent of disease, characterization of the patterns of the disease, narrowing the differential diagnosis, as a guide to the site of biopsy and assessing the clinical course of the disease and response to therapy. Interstitial lung disease (ILD) is a set of pulmonary illnesses distinguished by inammation and fibrosis of the gas exchanging region of the lung, as well as generalised abnormalities on lung radiographs. Conventional plain film radiography is still the primary imaging modality used in the initial assessment and follow-up evaluation of nearly all patients. A normal chest radiograph, on the other hand, does not rule out the presence of interstitial lung disease. The sensitivity, specificity, and diagnostic accuracy of chest radiographs are reduced in around 4% of patients with dyspnoea. Due to its inability to show significant parenchymal features, conventional computerised tomography has a limited role in the evaluation of interstitial lung disease. High Resolution Computed Tomography (HRCT), first established in 1982, is now the most accurate non-invasive method for examining lung parenchyma.[4]

Thickened interlobular septa, reticular, nodular, or ground glass area of attenuation, subpleural lines, architectural distortion, and honeycombing are all seen on HRCT in patients with ILD. Aside from identification and characterization, other uses of HRCT in ILD included detecting co-existing disorders, detecting and assessing complications, providing a guide to the type and location of lung biopsy, and follow-up for therapy response evaluation.[5]

The lung's interstitium is divided into two anatomically continuous but conceptually distinct components: the axial interstitium, which consists of connective tissue surrounding the airway, pulmonary arteries and veins within the pleura, and interlobular septa, and the parenchymal interstitium, which is a potential space interposed between the basement membrane of the alveolar lining epithelium and capillary endothelium. The study's goal was to evaluate high resolution computed tomography in the identification of interstitial lung disease.[6]

II. OBJECTIVES

1. To utilise HRCT in evaluation of pulmonary interstitium in patients having clinical features of interstitial lung diseases.
2. To categorize the involvement pattern of the pulmonary interstitium with the help of HRCT and then to arrive at a conclusive diagnosis wherever possible.
3. To use HRCT to determine the extent of involvement in case of interstitial lung diseases.
4. To compare the accuracies of chest radiography and HRCT in the prediction of specific diagnosis of interstitial lung disease.

III. MATERIALS & METHODS

This prospective observational study was conducted at Narayan Medical College & Hospital Jamuhar, Sasaram, Bihar from January 2021 to June 2022 in the Department of Radiodiagnosis. An informed consent was

taken from all the parents of the participants. Study population- OPD and indoor patients attending CT section at Dept. Of Radiodiagnosis. Sample size- 50 patients referred to the Department of Radiodiagnosis.

Criteria for patient selection:

Inclusion criteria:

Patients having clinical features and/or pulmonary function test suggestive of interstitial lung disease, irrespective of age and sex.

Exclusion criteria:

Patients diagnosed to have tuberculosis or any malignancy was excluded from the study

IV. Result & Discussion:

In our study, 2(4.0%) patients were 30 years old, 9(18.0%) patients were 31-40 years old, 15(30.0%) patients were 41-50 years old, 18(36.0%) patients were 51-60 years old, 3(6.0%) patients were 61-70 years old, and 3(6.0%) patients were >70 years old. Patients' mean age (mean S.D) was 49.6000 10.6962years. 30 (60.0%) of the patients were female, whereas 20 (40%) were male. Anti-CCP antibodies were found in 6 (12%) of the patients, while ANA was found in 3 (6.0%) of the patients. Biopsy was used to diagnose 7 (14.0%) of the patients. 6(12.0%) of the patients had dyspnea (DYSP), 2(4.0%) had exposure (EXPO), and 3(6.0%) had fever.

PFT finding was positive in 16 (32.0%) of the patients, while Scl70 antibody was positive in 7 (14.0%).

Satija B et al (2013) found that damage to the lungs caused by dusts or fumes or noxious substances inhaled by workers in certain specific occupation is known as occupational lung disease.[7]

Rohatgi PK et al (2011) found that chest radiograph, computed tomography and high- resolution computed tomography (HRCT) is an integral part in the diagnosis and evaluation of diffuse interstitial lung disease (DILD) and are reviewed briefly. Use of two-dimensional HRCT has made it possible to automate identification and quantification of patterns associated with DILD with an overall accuracy of 89%.[8]

Gupta S et al (2017) found that the imaging findings of the common interstitial lung diseases and to assess the severity of the disease and determine the reversibility capability of the pulmonary parenchymal damage in ILD's. This was a prospective, observational study in which we evaluated 50 patients suspected of having interstitial lung diseases based on radiographic or clinical findings, by high resolution computed tomography (HRCT) over a period of one year.[9]

Our study showed that 2(4.0%) patients had COP, 2(4.0%) patients had HP, 13(26.0%) patients had IPS, 13(26.0%) patients had NSIP, 7(14.0%) patients had PSS, 5(10.0%) patients had RA, 5(10.0%) patients had SAR (sarcoidosis) and 3(6.0%) patients had SLE. 8(16.0%) patients had well defined nodule present. 3(6.0%) patients had ill-defined nodule present. 2(4.0%) patients had 3mm size and 39(78.0%) patients had no nodule. In our study, all 5 patient of sarcoidosis shows well defined nodules, which were of both 3 mm in size. 2 patients of RA showed well defined nodules, which were sub pleural in location, showing a size of >3 mm. 2 patient of HP shows ill-defined nodule, showing size of >3mm. out of 2 patient with COP, one showed ill-defined nodules, with size of >3 mm.

It was found that 6(12.0%) patients had centrilobular nodule present. 5(10.0%) patients had peribronchovascular nodule present. In our study, all 5 patient of sarcoidosis shows well defined nodules in peri lymphatic distribution. 2 patients of RA showed well defined nodules in centrilobular distribution. 2 patient of HP shows ill-defined nodule in centrilobular distribution. Out of 2 patients with COP, 1 showed ill-defined nodules in centrilobular distribution. 39(78.0%) patients had interlobular septal thickening. 33(66.0%) patients had intralobular septal thickening. In our study, 28 individuals (56.0%) had peribronchovascular interstitial thickening.The interstitial lung disease was examined in our study by HRCT imaging of peribronchovascular interstitial thickening, interlobular and intralobular interstitial thickening and parenchymal bands. Interlobular septal thickening and intralobular interstitial thickening were seen most commonly in idiopathic pulmonary bronchitis, nonspecific interstitial pneumonia, rheumatoid arthritis, progressive systemic sclerosis, and SLE and were caused by bronchitis and scarring. Peribronchovascular interstitial thickening was found in the majority of instances of IPF and NSIP, as well as in sarcoidosis.

Elicker BM et al (2017) found that HRCT also plays an important role in the follow-up of patients with established DLD. Important roles of HRCT in this context include assisting in determining prognosis, monitoring for the efficacy of treatment, detecting progression of disease or complications, and evaluating patients with worsening or acute symptoms.[10]

Sabri YY et al (2017) found that the role of minimum intensity projection (MinIP) images with that of volumetric high resolution computed tomography (HRCT) images in the diagnosis of interstitial lung diseases (ILD). MinIP is one of the multiplanar techniques of HRCT that proved throughout their study to be an

informative complementary tool increasing the observer confidence and agreement regarding some findings as compared with HRCT alone.[11]

Salaffi F et al (2015) found that the performance of a computerized aided method (CaM) for quantification of interstitial lung disease (ILD) in patients with systemic sclerosis and to determine its correlation with the conventional visual reader-based score (CoVR) and the pulmonary function tests (PFTs). Wells AU et al 49 (2008) found that formal CT scoring is not realistic in routine practice, rapid semi-quantitative estimation of disease extent on CT in combination with a forced vital capacity threshold has been used to stage disease as limited or extensive. The distinction between a higher and lower risk of progression of lung disease, made using this system, has important implications for both routine practice and the enrolment of higher risk patients in therapeutic studies.[12]

Assayag D et al (2012) found that interstitial lung disease commonly develops in patients with Systemic sclerosis (Ssc). High resolution computed tomography (HRCT) has become the gold standard for detection and evaluation of lung involvement in SSc. Several HRCT scoring methods have been described and used to characterize and quantify the disease.[13]

In our study, 41 (82.0%) of the patients had ground glass opacity. Ground glass opacity was observed in all disease entities in our analysis. All examples in NSIP, HP, and COP had ground glass opacity. In the majority of patients with idiopathic pulmonary fibrosis, rheumatoid arthritis, and progressive systemic sclerosis had ground glass opacities. Ground glass opacity was widespread in the majority of NSIP cases, but less so in idiopathic pulmonary fibrosis, rheumatoid arthritis, and progressive systemic sclerosis. Crazy paving opacity was absent in 50 (100%) subjects. Consolidation was found in 13 patients (26.0%). Bronchiectasis was present in 33 (66.0%) of the patients. Air trapping was detected in 8 (16.0%) of the patients. Mosaic perfusion occurred in two patients (4.0%). Emphysema was detected in 9 (18.0%) of the patients. In our investigation, we looked at air trapping, mosaic perfusion, bronchiectatic alterations, and emphysema. In our analysis, the most patients with bronchiectatic alterations were found in IPF, NSIP, and PSS. We discovered evidence of air trapping in two cases of HP, one case of RA, and three cases of IPF. Mosaic perfusion was discovered in both HP instances. Emphysema was most common in IPF, PSS, and RA patients.

Honeycombing was found in 21 (42.0%) of the patients. Honeycombing was identified in abundance in cases of IPF, RA, and PSS in our investigation. The honeycombing was predominantly seen in the posterior, basal area and at sub pleural location. The connection between X-ray and HRCT was shown to be statistically significant. 40 individuals had both abnormal Chest Radiographs and HRCTs, while 2 patients had both normal Chest Radiographs and normal HRCTs. 7 individuals had an abnormal HRCT but a normal Chest Radiograph, and 1 patient had an abnormal HRCT but a normal Chest Radiograph. In three patients (clinically diagnosed, one RA, one PSS, and one SLE), HRCT did not show any distinctive findings of interstitial lung disease. One case of SLE showed false positive findings in HRCT due to motion artefact and gravity dependent opacity.

Mathur M et al (2017) found that HRCT severity had strong and significant negative correlation with spirometry indices, especially Forced Vital Capacity (FVC), followed by Vital Capacity (VC) and least with forced expiratory volume in first second (FEV1). HRCT and spirometry are two simple and reliable non-invasive modalities for the diagnosis.[14]

Jo HE et al (2016) found that multidisciplinary meetings (MDM) are the current "gold standard" in interstitial lung disease (ILD) diagnosis and comprise inter-disciplinary discussion of multiple forms of information to provide diagnostic and management outputs.[15]

Nurmi HM et al (2018) found that HRCTs from 60 RA-ILD patients were independently evaluated and re-categorized into usual interstitial pneumonia (UIP), nonspecific interstitial pneumonia (NSIP), organizing pneumonia (OP), diffuse alveolar damage (DAD) and unclassified subtypes by two radiologists. The presence and extent, which was reported using a semi-quantitative scoring system, of e.g. reticulation, ground-glass opacity, honeycombing, emphysema, traction bronchiectasis and architectural distortion were further evaluated and compared between the subtypes.[16]

V. Conclusion:

The following findings can be derived from the study:

HRCT is the most accurate non-invasive imaging technique for evaluating lung parenchyma in cases of interstitial lung disorders.

HRCT outperforms chest radiography due to its cross-sectional perspective and great spatial resolution.

HRCT aids in categorising the involvement pattern of the pulmonary interstitium in order to get a definite diagnosis.

HRCT also assesses the degree of illness in relation to prognosis and therapy.

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