DIAGNOSTIC ACCURACY OF CHEST X-RAY IN INTERSTITIAL LUNG DISEASES, KEEPING HIGH RESOLUTION COMPUTED TOMOGRAPHY SCAN AS GOLD STANDARD

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ABSTRACT

OBJECTIVES

To determine the accuracy of the plain chest radiograph in diagnosing interstitial lung diseases (ILDs), keeping a high-resolution CT scan (HRCT) as the gold standard.

METHODOLOGY

A cross-sectional study was conducted. A total of 75 patients who visited the Department of Radiology department over two years were assessed by prospective analysis of their radiology reports. All the HRCTs and Chest X-ray images were reviewed. Data collected was recorded on a specially designed proforma and entered into Microsoft Excel and SPSS (Version 22.0. IBM Corp., Armonk, NY). Patients with a history of acute exacerbation of symptoms were excluded.

RESULTS

The median age of the patients was 59 years, with SD 12.2. Chest radiographs detected interstitial lung disease (ILD) in 42/75 (56%).). The chest radiograph's sensitivity, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) were 76%, 84%, 86.3% and 76.7%. A plain chest X-ray's positive likelihood ratio (LR+) was 4.75, while the negative likelihood ratio (LR-) was 0.28. The overall accuracy of CXR was calculated as 78.6%.

CONCLUSION

Our study concluded that chest X-ray is the ideal initial investigation for diagnosing Interstitial lung disease (ILDS) with an accuracy of 78.6% compared to HRCT.

KEYWORDS: *Diagnostic Accuracy, Interstitial Lung Diseases, HRCT, Chest Radiograph, CXR*

INTRODUCTION

Interstitial Lung Disease (ILD) is a constellation of clinical conditions that result in progressive scarring of the lung tissue.[1,2] It is primarily present in adults but can also be seen in children, but incidence and mortality increase with age.[3,4] It may be idiopathic, secondary to certain types of drugs, autoimmune-mediated, due to occupational and environmental exposure or because of an old lung infection. Idiopathic and autoimmune varieties have a genetic predisposition as well.[5,6,7,8] Patients usually present with non-specific pulmonary symptoms like dyspnea and cough or with significant respiratory deterioration in case of exacerbation that is associated with higher mortality.[9] Very few studies are devoted to interstitial lung diseases, especially when it comes to their epidemiology, which varies among different geographical locations. Prevalence is estimated to be 81/100000 males and 67/100000 females, while the incidence was 32 and 26 per 100000 person-years in USA.[10] In Turkey, incidence is 24.7/100000 person-years in males and 27/100000 in females.[11] In Greek and Spanish studies, the incidence was much lower, i.e., 4.63 and 7.6/100000 person-years.[12,13] Another study found the prevalence of ILD to be 76% in patients having Chronic Obstructive Pulmonary Disease (COPD).[14] Radiological investigations make the mainstay for diagnosing pulmonary conditions complemented by others, like pulmonary function tests and lung biopsy. The majority of the patients with ILD can be diagnosed with a plain X-ray chest. With time, the quality and ability to interpret plain X-rays have been improved, but still, a sizable proportion of patients with pulmonary fibrosis may go undiagnosed due to poor spatial resolution and superimposition of other structures.[15] Plaichest X-ray is an inexpensive, readily available, low radiation dose, and non-invasive investigation for diagnosing ILD with a reported 47% sensitivity, 77% accuracy, and 82% specificity.[16] High-resolution CT scan (HRCT) has

significantly enhanced our capability to diagnose ILD. Depending on the availability of the modality and expertise, HRCT is indicated in the initial workup of the condition. It has better sensitivity, specificity, and enhanced resolution, which helps to characterize the disease and its progression.[17] However, scarce availability, high doses of radiation, lack of expertise and patient affordability are still a few issues, especially in low-income countries. Hence, a plain radiograph remains the mainstay in diagnosing ILD in such a situation. In this study, we will try to determine the diagnostic accuracy of plain X-ray chest based on the local data where most people are poor and cannot afford expensive investigations like HRCT. We would determine the diagnostic accuracy of chest X-ray (CXR) in diagnosing interstitial lung disease (ILD) in terms of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPPV) and likelihood ratio, keeping HRCT as the gold standard.

METHODOLOGY

From December 2020 to November 2022, we evaluated 75 patients who visited the Department of Radiology, Rehman Medical Institute Peshawar, Pakistan. These patients had clinically been assessed and were sent to Radiology to assess the presence of ILD. Both male and female patients with no age restriction were included based on symptoms, professional exposure, smoking history, medical evidence, or previous radiological records in the form of X-rays. No unnecessary new X-rays were performed to minimize radiation exposure. Patients underwent digital radiography, and only a PA view was obtained. All the HRCTs were performed using multidetector CT (Toshiba, 16 slicer). Only X-rays performed within 3 months of the HRCT were included. HRCT was performed shortly after an X-ray based on X-ray findings or clinical suspicion of ILD. Patients presenting with acute exacerbation were excluded. Consultant radiologists evaluated all the X-rays and HRCTs with a minimum of five years of experience in the field. Ethical approval was obtained from the hospital's ethical committee, and written informed consent was obtained from the patients included in the study. Data collected was recorded on a specially designed proforma and entered into Microsoft Excel and SPSS (Version 22.0. IBM Corp., Armonk, NY). The continuous variables, such as age, duration and size of the lesion, were calculated as mean ± standard deviation, while categorical variables, such as the conclusion of CXR and HRCT reports, were presented as frequencies and percentages. A 2x2 table was generated to calculate sensitivity, specificity, positive and negative predictive values, and chest X-ray accuracy in diagnosing ILD, taking HRCT findings as the gold standard.

RESULTS

A total of 75 subjects comprised 49 (65.33%) males and 26 (34.66%) females. The age range was set at 25-75 years. Most patients did not know the duration of their symptoms and called it "since long". Median age was 59 years with ±12.2 SD. All the patients underwent CXR and HRCT except those having CXR less than 3 months old. The majority of the patients presented with non-specific symptoms like cough and dyspnea. In our study, the different radiographic findings encountered are shown in Tables.1 and 2

Table 1: Radiographic Findings on CXR

Septal lines	29.3%
Reticular shadows	25.3%
Ground glass opacities	6.6%
Consolidation	11%
Honeycombing	14.6%
Pleural effusion	2.6%
Enlarged Lymph nodes	00

Table 2: Imaging Findings on HRCT

Reticular/linear striations	61%
Ground glass opacity	13.3%
Consolidation	17.3%
Interlobular septal thickening	58.6%
Honeycombing	46.6%
Traction bronchiectasis	40%
Enlarged Lymph nodes	00

CXR of those having ILD (later confirmed by HRCT) showed mainly interstitial septal thickening, with few having reticular shadowing or patchy reticulations, while HRCT showed Septal thickening, honeycombing, sub pleural cysts and traction bronchiectasis. HRCT confirmed the presence of ILD in 50 patients (66.6%), while 25 (34.4%) were found disease-free on HRCT. Plain CXR showed the disease in 42 (56%), of which 38 were true positive and 4 false positive, later confirmed by HRCT. Thirty-three subjects were found negative for ILD on plain chest X-ray (12 false negatives, 21 true negatives, later confirmed by HRCT). Sensitivity, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) are 76%, 84%, 86.3% and 76.7%. (Table 3 summary)

Table 3: Imaging Findings on HRCT

	Positive on HRCT	**Negative on HRCT**	**Total**
Positive on CXR	38 a (TP)	4 b (FP)	42
Negative on CXR	12 c (FN)	21 d (TN)	33
Total	50	25	75 (n)

TP=True positive FP=False positive FN=False negative TN=True negative

A plain chest X-ray's positive likelihood ratio (LR+) was 4.75, while the negative likelihood ratio (LR-) was 0.28. The overall accuracy of CXR was calculated as 78.6%

Table 4: Calculation of Likelihood Ratio

	Positive on HRCT	Negative on HRCT	Total	Likelihood Ratio (LR)
Positive on CXR	38 a (TP)	4 b (FP)	44	4.75
Negative on CXR	12 c (FN)	21 d (TN)	31	0.28
Total	50	25	75 (n)	

DISCUSSION

The diagnostic accuracy of chest X-ray (CXR) has been promising in diagnosing lobar pneumonia and the extent of pneumonic consolidation. However, its role in the diagnosis of ILD has been questioned. Our study found that CXR has sensitivity, specificity, and accuracy of 76%,84% and 78.6% compared to HRCT scan. A similar study conducted by Akram et al. in 2022 showed that the sensitivity, specificity and Diagnostic Accuracy of CXR for the diagnosis of ILD as compared to HRCT was calculated to be 65.5%, 20% and 61.66%, respectively. One reason for our study results' high specificity compared to this study is the more than 20 years of experience of our radiologist reporting the CXR. Another study published in 2017 by Afzal and fellows on the diagnostic accuracy of CXR compared to HRCT showed overall sensitivity, specificity and diagnostic accuracy of CXR in diagnosing ILD was found to be 80.0%, 82.98% and 81.02%, respectively. These results are more similar to ours and can be comparable to our study's sensitivity, specificity, and accuracy of 76%,84% and 78.6%, respectively. This shows that CXR can be used as a screening tool for suspected established ILD cases. Our study also shows the characteristic radiographic findings assessed independently on CXR, like the presence of septal line consolidations. Findings on HRCT were also independently assessed. We found that no patients had enlarged mediastinal lymph nodes in our study. Pleural effusion was seen only in a few cases, with aetiology unrelated to ILD. The most common finding on CXR and HRCT was septal thickening and reticulations seen in 29.3% of cases of CXR and 61% of cases of HRCT. A study done by Ankit Kumar in 2020 showed ILD-related septal thickening in 80% of cases on CXR as well as on HRCT. This is not comparable to our results. One reason can be that the sample population in their study had an extreme suspicion of ILD, whereas our sample population included all patients. CXR is one of the baseline investigations in diagnosing chest conditions. It is readily available, cheap, non-invasive and has a low radiation dose, and these properties make it the ideal first-line investigation for lung conditions. Although this modality has improved in terms of quality with time, due to its lower spatial and contrast resolution, it cannot be interpreted with certainty with lower inter-rater agreement, especially in cases with early ILD changes. Plain radiographs cannot differentiate among different types of ILDs. Moreover, it cannot detect the early stages of the disease, and sensitivity increases as the disease progresses. On the other hand, HRCT (Fig.1) has higher spatial and contrast resolution with higher inter-rater agreement, but it is expensive, not readily available and has a higher radiation dose. Its resolution capabilities make it the gold standard for many lung conditions, including interstitial lung disease. It has a higher sensitivity and specificity and can detect ILD early.[18]

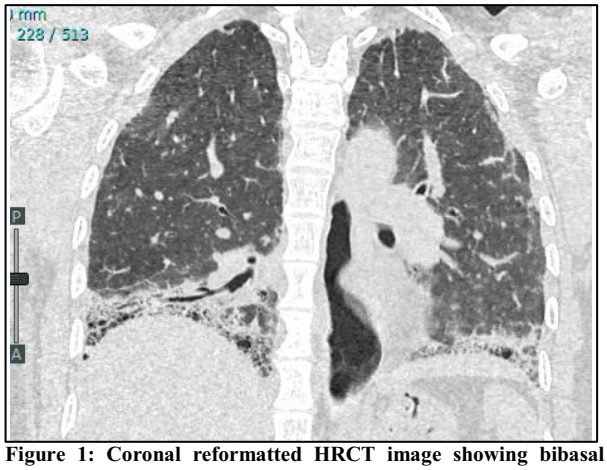

Figure 1: Coronal reformatted HRCT image showing bibasal septal thickening, honeycombing and tractional bronchiectasis in a patient with Interstitial lung disease (ILD UIP pattern). Note the dilated oesophagus. This was a patient of scleroderma.

In our study, the sensitivity, specificity, and accuracy of CXR have been compared to HRCT under local circumstances in which the patient's age is usually higher with a relatively advanced stage of the disease. Since most of the subjects in our study have had their symptoms for a long time, they had advanced stages of the disease. This makes CXR relatively more sensitive to our study's condition than others.[16] With a sensitivity and specificity of 76% and 84%, CXR may be seen as an ideal initial test for diagnosing lung conditions, but it significantly delays the diagnosis of ILD if it is normal in cases of early-onset ILD or contains findings not suggestive of ILD.

LIMITATIONS

Our study was single-centered. Most patients with chest X-ray findings of ILD did not go for HRCT. As data was collected from private sector hospitals, high scan

expenses led to a small sample size.

CONCLUSIONS

Our study concludes that CXR has sensitivity, specificity, and accuracy of 76%, 84% and 78.6% compared to HRCT.

CONFLICT OF INTEREST: None

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