DIAGNOSTIC ACCURACY OF X-RAY CHEST IN INTERSTITIAL LUNG DISEASE AS CONFIRMED BY HIGH RESOLUTION COMPUTED TOMOGRAPHY (HRCT) CHEST

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ABSTRACT

Objective: To determine the diagnostic accuracy of x-ray chest in interstitial lung disease as confirmed by high resolution computed tomography (HRCT) chest.
Study Design: A cross-sectional validational study.
Place and Duration of Study: Department of Diagnostic Radiology, Combined Military Hospital Rawalpindi, from Oct 2013 to Apr 2014.
Material and Method: A total of 137 patients with clinical suspicion of interstitial lung disease (ILD) aged 20-50 years of both genders were included in the study. Patients with h/o previous histopathological diagnosis, already taking treatment and pregnant females were excluded. All the patients had chest x-ray and then HRCT. The x-ray and HRCT findings were recorded as presence or absence of the ILD.
Results: Mean age was 40.21 ± 4.29 years. Out of 137 patients, 79 (57.66%) were males and 58 (42.34%) were females with male to female ratio of 1.36:1. Chest x-ray detected ILD in 80 (58.39%) patients, out of which, 72 (true positive) had ILD and 8 (false positive) had no ILD on HRCT. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of chest x-ray in diagnosing ILD was 80.0%, 82.98%, 90.0%, 68.42% and 81.02% respectively.
Conclusion: This study concluded that chest x-ray is simple, non-invasive, economical and readily available alternative to HRCT with an acceptable diagnostic accuracy of 81% in the diagnosis of ILD.

Keywords: Chest x-ray, HRCT, Interstitial lung disease, Non-invasive.

INTRODUCTION

Interstitial lung diseases (ILDs) are a diverse group of pulmonary diseases which differ greatly in causes, presentation, clinical pressentation, imaging, pathologic features and natural history. ILD was once uncommon but now due to various environmental factors it is quite common according to epidemiologic investigations[1].

Diagnosis of ILD can be delayed when clinicians neglect the initial symtoms or attribute them to more commonly encountered lung diseases such as chronic obstructive pulmonary airway disease (COAD). In a study, prevalence of ILD was found to be 76% in all patients presenting with chronic pulmonary disease[2]. Diagnosis of ILD requires thorough workout of clinical presentation, life style, occupational history, exposures, and drug history forming the clinical context[3]. More than 60% of cases are idiopathic[4]. The remaining cases can be due to various parenchymal lung disorders with a wide range of occupational or environmental factors including smoking, drugs, radiation therapy, pulmonary aspiration, neoplasms and systemic diseases with pulmonary involvement[2,4].

Although ILD primarily affects adults, it may be seen in children. Few ILDs are seen in young age e.g., sarcoidosis, pulmonary Langerhan's cell histiocytosis, and autoimmune pulmonary disorders, whereas idiopathic pulmonary fibrosis (IPF) usually presents between 40 to 70 years of age. Familial IPF in which two or more first-degree relatives are involved, the onset of fibrosis appears is in comparatively younger age. Incidence and mortality of interstitial lung disease are directly proportional with age[5,6].

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Chest x-ray is the first line investigation of any pulmonary disease. During the recent years, many advances have been made in interpretation of plain chest radiographs so that interstitial lung disease is diagnosed with more accuracy. However, due to limited spatial resolution and superimposition of various structures confident diagnosis of ILD is hampered by inbuilt limitations of the chest radiographs[7]. Chest radiograph (CXR) is a widely available, in expensive, non invasive investigation but its sensitivity, specificity and accuracy has been shown to be 47%, 82% and 77% respectively in diagnosing interstitial lung disease by Padley SPG et al[8].

The advent of high resolution computed tomography (HRCT) has advanced our ability to detect and characterize ILDs. Structural changes in the lungs can often be detected in patients with a normal chest radiograph. HRCT is indicated during the initial workup of a patient with strong clinical suspicion or CXR features suggestive of ILD[9]. It has higher sensitivity than the plain radiograph in identifying ILD and specific imaging patterns can help in characterization of disease as well as assessment of disease activity[9].

As there is discrepancy between local and international data so this study was planned to generate more local data. This study helped us to determine the diagnostic accuracy of CXR in ILD in our population. Although in previous studies it was found to be very low but we have determined its diagnostic accuracy in our local population where most of the people belong to poor socioeconomic status and they would not be able to afford HRCT. These patients could be provided with simple, non-invasive, economical and readily available alternative to HRCT with the benefit of significant reduction in patient radiation dose and timely diagnosis and treatment.

MATERIAL AND METHODS

This cross sectional vocational study was conducted at Department of Radiology at Combined Military Hospital (CMH), Rawalpindi from October 2013 to April 2014. Sample size was 137 cases with 95% confidence level, 10.5% margin of error for sensitivity and 11% for specificity, expected prevalence of ILD as 76% and taking sensitivity and specificity of x-ray chest in interstitial lung disease as 47% and 82% respectively.

After approval from ethical review committee, 137 patients admitted in other departments of CMH, Rawalpindi and referred to the radiology department for HRCT scan with clinical suspicion of ILD between the ages of 20-50 years of both genders were enrolled in the study through non-probability convenience sampling technique. After taking written, informed consent and relevant history including h/o occupation, any drug intake and smoking, patients had their CXR on Shimadzu x-ray system run at 800mA, prior to HRCT examination.

Assessment of CXR and HRCT was double blinded. Each CXR was assessed by consultant radiologist for presence or absence of interstitial lung disease. Then the patients underwent HRCT imaging on whole body by Toshiba Astieon 16-slice CT scan system. Each HRCT was reviewed by consultant radiologist (at least 10 years of experience) unaware of the x-ray findings. Data collected was recorded on a specially designed proforma containing two parts. The 1st part included the demographic features of the patients while 2nd part included the study variables.

Collected data was analyzed through computer software SPSS version 16.0. Mean and standard deviation was calculated for quantitative variables i.e. age and duration of disease. Frequency and percentage were calculated for qualitative variables i.e. gender, CXR and HRCT results i.e. presence or absence of ILD. A 2×2 contingency table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of x-ray chest in diagnosing interstitial lung disease taking HRCT as a gold standard.

RESULTS

Total number of subjects was 137. Age range in this study was from 20-50 years with mean age of 40.21 ± 4.29 years. Majority of the patients (48.17%) were between 41 to 50 years of age. A total of 21.17% were between 21 to 30 years and 30.66% between 31 to 40 years. Out of these 59.85% had symptoms for 1 to 3 months while 40.15% had it for more than 3 months. Out of 137 patients, 79 (57.66%) were males and 58 (42.34%) were females with male to female ratio of 1.36:1. All the patients were subjected to CXR and ILD was detected in 80 (58.39%) patients. HRCT confirmed interstitial lung disease in 90 (65.69%) cases where as 47 (34.31%) patients revealed no interstitial lung disease (table-I). In X-ray positive patients, 72 (true positive) had ILD and 8 (false positive) had no ILD on HRCT. Among 57, X-ray negative patients, 18 (false negative) had ILD on HRCT where as 39 (true negative) had no ILD on HRCT (p=0.213) (table-II). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of X-ray in diagnosing ILD was 80.0%, 82.98%, 90.0%, 68.42% and 81.02% respectively (table-III) (figure).

Table-I: Summary of results.

	Positive result on X-Ray	Negative result on X-Ray	*p*-value
Positive result on HRCT	72 (TP)*	18 (FN)***	0.213
Negative result on HRCT	08 (FP)**	39 (TN)****	

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

Table II: Stratification of male gender (n=79).

	Positive result on X-Ray	Negative result on X-Ray
Positive result on HRCT	39 (TP)	11 (FN)
Negative result on HRCT	03 (FP)	26 (TN)

Table III: Stratification of female gender (n=58).

	Positive result on X-Ray	Negative result on X-Ray
Positive result on HRCT	33 (TP)	07 (FN)
Negative result on HRCT	05 (FP)	13 (TN)

DISCUSSION

During the recent years, many advances have been made in interpretation of plain chest radiographs so that interstitial lung disease is diagnosed with more accuracy. However, due to limited spatial resolution and superimposition of various structures confident diagnosis of ILD is hampered by inbuilt limitations of the chest radiographs. Though there are quite a few studies comparing plain chest radiography and HRCT in specific interstitial diseases like systemic sclerosis, ankylosing spondylitis and silicosis, the whole gamut of interstitial lung diseases has not been studied as a group frequently enough[10].

A study conducted on progressive systemic sclerosis inferred that HRCT was more sensitive than chest radiography when assessing minimal interstitial lung involvement in this group of patients[11]. HRCT was reported to be superior to other imaging modalities with improved clarity of parenchymal abnormalities, enabling a better and more confident characterization of pathologic processes in interstitial lung diseases[12]. A study on patients of idiopathic pulmonary fibrosis concluded that investigation by HRCT can lead to earlier detection and treatment as compared to conventional radiography[13]. It was also reported that conventional radiography is not perfect in detecting early parenchymal changes and small opacities in patients of silicosis as compared to HRCT[14].

Plain CXR is considered a baseline investigation in patients with respiratory symptoms. Imaging features of early ILD are often subtle and can be missed by less

experienced radiologists. In cases of clinical suspicion of ILD, HRCT chest scans should be ordered, if available without specialist referral. HRCT uses thin section CT images and high spatial frequency algorithm so it has superior spatial and contrast resolution compared to routine CT[15]. In our study, we have determined the diagnostic accuracy of CXR in diagnosing ILD taking HRCT as gold standard.

In this study, mean age was 40.21 ± 4.29 years with majority of the patients (48.17%) between 41 to 50 years of age. These findings are very much comparable to the study of Gagiya et al[16] and Shabbier et al[17] who had found mean age of 43 & 41 years respectively. As majority of the ILDs have a long natural history that is why they usually present in older adults in the sixth or greater decade of life. Some types of ILDs eg sarcoidosis, connective-tissue disease–associated lung disease, and inherited forms of lung disease present in younger adults[18,19]. Few ILDs show sexual predilections. IPF mostly affects men (ratio of 1.5:1), whereas lymphangioleiomyomatosis (LAM) and pulmonary tuberous sclerosis exclusively affect women[20]. The Bernalillo County study estimated an incidence of 31.5 cases per 100,000/year in men and 26.1 cases per 100,000/year in women[21]. Similarly, in our study, 79 (57.66%) were males and 58 (42.34%) were females with male to female ratio of 1.36:1. This male predominance was also reported in other previous publications[16-18,22,23].

CXR is a widely available, inexpensive, non invasive investigation but it misses abnormalities in 20% of patients[4]. It can be normal in early disease and may be unable to characterize ILD. It cannot be used as sole diagnostic investigation in such patients but is used as baseline investigation in cases of clinical suspicion of ILD. Padley et al[8] in his study has shown the sensitivity, specificity and accuracy of chest x-ray as 47%, 82% and 77% respectively in diagnosing ILD. In another study by Coutinho et al[2], sensitivity, specificity, positive and negative predictive values for the x-ray diagnosis of interstitial lung disease was found to be 70%, 90%, 62.3% and 93% respectively.

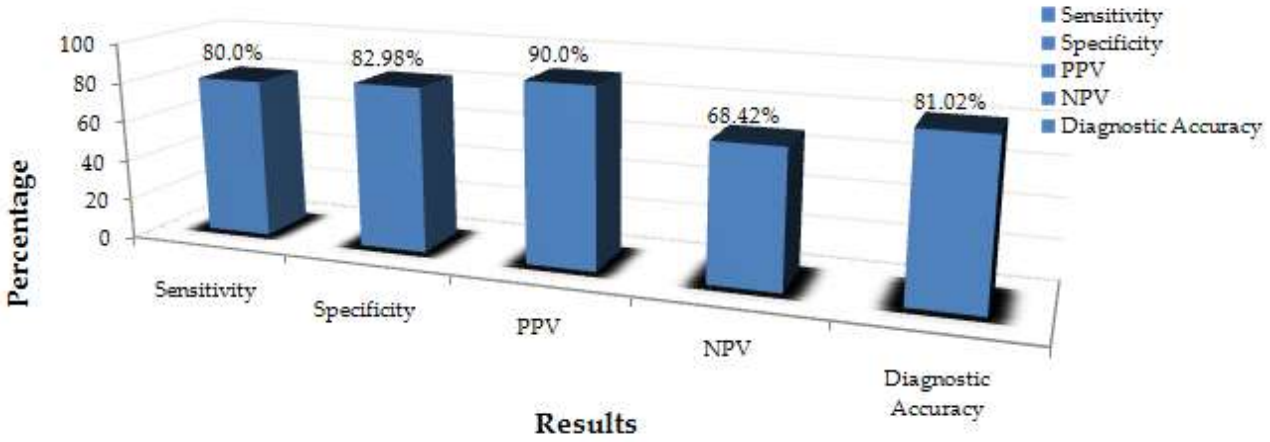

Figure: Diagnostic accuracy of X-ray chest in diagnosing interstitial lung disease.

Chest radiography usually demonstrates any of the following patterns: a reticular and netlike appearance of linear or curvilinear densities or diffuse opacities with a predilection to the lower lobes. In advanced disease, the presence of a coarse reticular pattern or multiple cystic or honeycombed areas, and coarse reticular pattern with translucencies are associated with poor prognosis. Pleural involvement is uncommon and its presence suggests another diagnosis[24]. Tahbaz et al[25] in a study on 49 patients found only 3 patients (6.1%) with reticulonodular involvement on chest x-ray while HRCT showed pulmonary parenchymal involvement in 32 cases (65.3%). He reported only 3 true positive, 29 false

negative, 0 false positive and 17 true negative cases. On the whole he concluded very low sensitivity of chest x-ray of only 9.5% but in his study specificity was found to be 100%.

CXR is a baseline invesitgaion of pulmonary diseases. But due to inbuilt limitation such as poor spatial resolution and superimpostion of structures, subtle imaging features may not be visualized[26]. Grenier et al[27] assessed the diagnostic value of chest radiography and high-resolution computed tomography (CT) in chronic diffuse interstitial lung disease in 140 consecutive patients with diffuse infiltration of the lung visible at radiography. Radiographs and CT scans were separately read by three independent observers without knowledge of clinical and pathologic data. First-choice diagnoses of all three observers that were made with a high level of confidence (probability, greater than or equal to 75%) were more accurate with CT than with radiography (p<0.001). The interobserver agreement for the proposed diagnosis was significantly better with high-resolution CT (p<0.001).

CONCLUSION

This study concluded that chest x-ray is simple, non-invasive, economical and readily available alternative to HRCT with an acceptable diagnostic accuracy of 81% in the diagnosis of ILD.

RECOMMENDATION

We recommend that chest x-ray could be used alone in our general practice for ILD diagnosis in our society where majority of people belong to poor socioeconomic status and can't afford the HRCT which results in their incomplete treatment as well as increase in their morbidity and mortality.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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