

Original Research Article

Assessment of high resolution computed tomography in the diagnosis of interstitial lung disease

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ABSTRACT

Background: Interstitial lung disease (ILD) are group of pulmonary disorders characterized by inflammation and fibrosis of gas exchanging portion of the lung and diffuse abnormalities on lung radiograph. Conventional computerized tomography plays a limited role in evaluation of interstitial lung disease due to its inability to demonstrate fine parenchymal details. High Resolution Computed Tomography (HRCT) is currently the most accurate non invasive modality for evaluating lung- parenchyma. So, the purpose of the study was to assess high resolution computed tomography in the diagnosis of interstitial lung disease.

Methods: 50 patients with clinical suspicion of interstitial lung disease who were referred to Department of Radio-Diagnosis and Imaging for diagnosis and evaluation were subjected to both conventional radiography and HRCT.

Results: Majority of the cases i.e. 9 (18%) had honeycombing, 8 (16%) cases had crazy paving pattern and mosaic attenuation, 7 (14%) cases had miliary mottling, 6 (12%) cases had normal, 5 (10%) cases had fibrosis and ground glass haze, 2 (4%) cases had ground glass haze with Intralobular reticular opacities and 2 (4%), subpleural nodular opacities and 2 (4%) cases had B/Hilar lymphadenopathy.

Conclusions: Ultimately all patients with clinical suspicion of ILDs should benefit from an HRCT scan of the thorax. High resolution computed tomography (HRCT) chest scans are essential to the diagnostic work-up since each ILD form is characterized by a specific pattern of abnormalities and a confident diagnosis can often be arrived at by HRCT alone or in correlation with the clinical symptoms. When HRCT findings are characteristic in appropriate clinical settings, HRCT may even obviate the need for a lung biopsy.

Keywords: Diagnosis, Interstitial lung disease, High resolution computed tomography

INTRODUCTION

Interstitial lung disease (ILD) are group of pulmonary disorders characterized by inflammation and fibrosis of gas exchanging portion of the lung and diffuse abnormalities on lung radiograph.

Conventional plain film radiography remains the first and foremost imaging modality used in initial assessment and follow up evaluation of virtually all patients. However, a normal chest radiograph does not exclude the presence of

interstitial lung disease.^{1,2} Approximately 4% of patients with dyspnea had normal chest radiograph are limited in sensitivity, specificity and diagnostic accuracy.³ Conventional computerized tomography plays a limited role in evaluation of interstitial lung disease due to its inability to demonstrate fine parenchymal details .First introduced in 1982 High Resolution Computed Tomography (HRCT) is currently the most accurate non invasive modality for evaluating lung- parenchyma.^{4,6}

HRCT findings in patients with ILD include thickened

interlobular septa, reticular, nodular or ground glass area of attenuation, subpleural lines, architectural distortion, and honeycombing. The other uses of HRCT in ILD besides detection and characterization included detecting co-existing diseases, detecting and assessment of complications, providing a guide to the type and site of lung biopsy, follow-up for evaluation for response to therapy.^{7,8}

The diseases currently grouped as “interstitial” also involves the alveolar epithelium, alveolar space, pulmonary vasculature and less commonly the respiratory bronchioles, large airways and even pleura. The predominant findings in these conditions is thickening of interstitium by fluid, cells or fibrosis.

The interstitium of the lung can be divided into two anatomically continuous but conceptually different component i.e. the axial interstitium consisting of the connective tissue around the airway, pulmonary arteries and veins within the pleura and interlobular septa and parenchymal interstitium which is a potential space interposed between the basement membrane of the alveolar lining epithelium and capillary endothelium.^{9,10} So the purpose of the study was to assess high resolution computed tomography in the diagnosis of interstitial lung disease.

METHODS

The study was conducted during a period from July 2012 to September 2014 with a sample size of 50 cases which were collected over a period of 2 years all the scans were performed on the high speed dual scan CT by GE and included non enhanced axial scans with 1 mm collimation at the scan interval of 10mm in suspended inspiration with patient in supine position.

All the patients with clinical suspicion of Interstitial Lung Disease who were referred to Department of Radio-diagnosis and Imaging for diagnosis and evaluation were subjected to both conventional radiography and HRCT. Standard postero-anterior view was taken in all cases. Diagnosis was based on clinical and radiological findings.

The exposure factors used were KVp 140; mA 130-240; mAs 240-400 and a scan time of 2-3 seconds. The Field of View (FOV) matched to the patients size (30-40cms). The Lung window consistently used for scanning was -700 to -800HU. The exact technique was however altered according to the individual.

The important factors making it “High Resolution” are use of thin collimation, image reconstruction with high spatial (sharp) algorithm, increased kVp and mAs technique, the use of large matrix size and targeted image reconstruction

Scan was done with 1cm collimation. Volume averaging within the plane of the scan significantly reduces the ability of CT to resolve small structures. Scanning with the thinnest possible collimation is essential if spatial resolution is to be optimized therefore 1mm collimation was used. High resolution techniques in addition to increasing image sharpness also increases the noise in CT images. Thus, increasing the kVp, mA, or the scan time can reduce noise and improve image quality.

RESULTS

The Table 1 shows HRCT finding wise distribution among 50 cases in study group. Majority of the cases i.e. 9 (18%) had honeycombing, 8 (16%) cases had crazy paving pattern and mosaic attenuation, 7 (14%) cases had miliary mottling, 2 (4%) cases were normal, 5 (10%) cases had fibrosis and ground glass haze, 2 (4%) cases had ground glass haze with intralobular reticular opacities and 2(4%), Subpleural nodular opacities and 2(4%) cases had B/IHilar lymphadenopathy.

Table 1: HRCT finding wise distribution of cases in study group.

HRCT finding	No. of cases	%
B/IHilar Lymphadenopathy	2	4
Crazy paving pattern	8	16
Fibrosis	5	10
Ground glass haze	5	10
Miliary mottling	7	14
Honeycombing	9	18
Mosaic attenuation	8	16
Ground glass haze + Reticular opacities	2	4
Subpleural Nodular Opacities	2	4
Normal	2	4
Total	50	100

Table 2: HRCT diagnosis wise distribution of cases in study group.

HRCT diagnosis	No. of cases	%
UIP/IPF	13	26
BOOP	8	16
NSIP	5	10
Hypersensitivity Pneumonitis	6	12
Miliary TB	7	14
Sarcoidosis	2	4
Lymphangitis carcinomatsa	2	4
Fibrosis	1	2
DIP	2	4
Asbestosis	2	4
Normal	2	4
Total	50	100

The Table 2 shows HRCT finding wise distribution among 50 cases in study group. Majority of the cases i.e. 13 (26%) had usual interstitial pneumonia (UIP) and idiopathic pulmonary fibrosis (IPF), 8 (16%) cases had bronchiolitis obliterans organizing pneumonia (BOOP), 6 (12%) cases had hypersensitive pneumonitis, 7(14%) cases had miliary Koch's, 5(10%) cases had nonspecific interstitial pneumonia (NSIP), 2 (4%) cases had desquamative interstitial pneumonia (DIP), 2 (4%) cases had asbestosis and 2 (4%) cases had sarcoidosis and lymphangitis carcinomatosa, 1(2%) cases had fibrosis and 6 (12%) normal.

DISCUSSION

Interstitial lung disease (ILD) are group of pulmonary disorders characterized by inflammation and fibrosis of gas exchanging portion of the lung and diffuse abnormalities on lung radiograph. The diseases currently grouped as "interstitial" also involves the alveolar epithelium, alveolar space, pulmonary vasculature and less commonly the respiratory bronchioles, large airways and even pleura.¹¹⁻¹³ The most common type of interstitial lung disease in our study was usual interstitial lung disease.

HRCT finding wise distribution 4% showed bilateral hilar lymphadenopathy, 16% had crazy paving pattern, 10% had fibrosis and ground glass pattern, 14% had miliary mottling, 18% had honeycombing, 16% had mosaic attenuation. Rest 12% had normal HRCT finding (Table 5). HRCT scan diagnosis showed that 26% cases had UIP/IPF, 16% cases had BOOP, 14% had miliary TB, 12% had hypersensitive pneumonitis, 10% had NSIP, 4% had sarcoidosis and lymphangitis carcinomatosa and 2% had fibrosis.¹⁴⁻¹⁶ 10% cases had normal HRCT scan finding. Muhammad SK et al, assessed the ability of high resolution computed tomography (HRCT) in detecting the early signs of pulmonary involvement in patients with systemic sclerosis. The HRCT findings were distributed among the reticular and nodular structures (70%), decreased attenuation (70%) and other accompanying lesions seen in (60%) of patients. Present study showed that reticulo-nodular opacities are seen in 36% of cases which include honeycombing and miliary mottling.^{17,18}

Decreased opacity is seen in 38% of cases which include Emphysema and Mosaic attenuation. However, areas of Architectural distortion is seen in only 5 % of the cases.¹⁹

Muhammed Shafeeq K et al, determined the clinical and radiological profile and etiology of ILD patients in a tertiary care setting. Exertional dyspnoea was the commonest presenting symptom (97.2%) followed by cough (90%). Commonest HRCT pattern was UIP (42%) followed by NSIP (24%). Connective tissue disease work up was positive in 29% of the study population. Commonest type of ILD was IPF (38.6%) followed by connective tissue associated ILD (24.2%). The findings in our study matched with their study.⁵⁸ Detecting

interstitial lung disease by HRCT and X ray showed sensitivity of 77.27% and specificity of 33.33%. Positive predictive value of detecting interstitial lung disease was 89.47% and negative predictive value is 16.67%. 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. Ranigaet S et al, evaluated the Interstitial Lung Disease (ILD) in the patients with Rheumatoid Arthritis (RA). This study was conducted to evaluate the clinico-spirometric profile and High Resolution Computed Tomography (HRCT) findings with regards to early detection of possible lung involvement in the study group. Authors concluded that HRCT was superior to plain chest radiograph in the evaluation of early interstitial lung changes. Our studies resembled their study.^{20,21}

Kornum JB et al, examined incidence rates (IRs) of ILDs and changes in IRs between 1995 and 2005. The median age of the 12,639 (58%) men was 63 years and that of the 9,126 (42%) women was 64 years.²²

Association between symptoms and interstitial lung diseases showed cases who had Tuberculosis were significantly more associated with interstitial lung diseases as compared to those who smoke, history of occupational exposure and history of cough and fever (Table 9). Fathi M et al, estimated the prevalence and predictors of interstitial lung disease in newly diagnosed polymyositis and dermatomyositis. Interstitial lung disease (ILD), defined as radiological signs on chest X-ray examination/HRCT or restrictive ventilatory defect, were found in 11 (65%) patients and were more common in men than in women. There was no statistically significant association between respiratory symptoms, other serological or laboratory variables and ILD which was similar to our study finding.^{23,24}

The diagnosis of interstitial lung disease (ILD) is frequently delayed because clinical clues are neglected and respiratory symptoms are described to more common pulmonary diagnosis such as chronic obstructive pulmonary disease (COPD) in the primary care setting. While ILD cases ultimately require referral to a pulmonologist, many cases can be diagnosed in the early stages with the help of HRCT.²⁵⁻²⁷ HRCT is able to detect abnormalities in patients when the clinical signs are minimal or even when the chest radiograph appears completely normal.

Chest radiography is a relatively insensitive modality of investigation for the diagnosis of ILDs. Ultimately all patients with clinical suspicion of ILDs should benefit from an HRCT scan of the thorax. High resolution computed tomography (HRCT) chest scans are essential to the diagnostic work-up since each ILD form is characterized by a specific pattern of abnormalities and a

confident diagnosis can often be arrived at by HRCT alone or in correlation with the clinical symptoms. When HRCT findings are characteristic in appropriate clinical settings, HRCT may even obviate the need for a lung biopsy.

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REFERENCES

- Zerhouni EA, Naidich DP, Stitik FP, Khouri NF, Siegelman SS. Computed tomography of the pulmonary parenchyma. Part 2: Interstitial disease. *Journal of thoracic imaging.* 1985 Dec;1(1):54-64.
- Zerhouni EA. Computed tomography of the pulmonary parenchyma an overview. *Chest.* 1989;95:901-7.
- Gotway MB, Reddy GP, Webb WR, Elicker BM, Leung JW. High-resolution CT of the lung: patterns of disease and differential diagnoses. *Radiologic Clinics.* 2005 May 1;43(3):513-42.
- Webb WR. High-resolution CT of the lung parenchyma. *Radiol Clin North Am.* 1989;27:1085-97.
- Murata K, Itoh H, Todo G, Kanaoka M, Noma S, Itoh T, et al. Centrilobular lesions of the lung: demonstration by high-resolution CT and pathologic correlation. *Radiology.* 1986 Dec;161(3):641-5.
- Itoh H, Murata K, Konishi J, Nishimura K, Kitaichi M, Izumi T. Diffuse lung disease: pathologic basis for the high-resolution computed tomography. *J Thorac Imaging.* 1993;8:176-188.
- Murata K, Itoh H, Todo G, Kanaoka M, Noma S, Itoh T, et al. Centrilobular lesions of the lung: demonstration by high-resolution CT and pathologic correlation. *Radiology.* 1986 Dec;161(3):641-5.
- Gulatia M. Diagnostic assessment of patients with interstitial lung disease. *Prim Care Respir J.* 2011;20(2):120-7.
- American Thoracic Society. European respiratory society. American thoracic society/European respiratory society international multidisciplinary consensus classification of the idiopathic interstitial pneumonias. *Am J Respir Crit Care Med.* 2002;165(2):277-304.
- Nishimura K, Kitaichi M, Izumi T, Nagai S, Kanaoka M, Itoh H. Usual interstitial pneumonia: histologic correlation with high resolution CT. *Radiology.* 1992;182:337-42.
- Johkoh T, Müller NL, Cartier Y, Kavanagh PV, Hartman TE, Akira M, et al. Idiopathic interstitial pneumonias: diagnostic accuracy of thin-section CT in 129 patients. *Radiology.* 1999 May;211(2):555-60.
- Terriff B, Kwan S, Chan-Yeung M, Muller N. Fibrosing alveolitis: chest radiography and CT as predictors of clinical and functional impairment at follow-up in 26 patients. *Radiology.* 1992;184:445-449.
- Akira M, Sakatani M, Ueda E. Idiopathic pulmonary fibrosis: progression of honeycombing at thin-section CT. *Radiology.* 1993;189:687-91.
- Park JS, Lee KS, Kim JS, Park CS, Suh YL, Choi DL, et al. Nonspecific interstitial pneumonia with fibrosis: radiographic and CT findings in seven patients. *Radiology.* 1995 Jun;195(3):645-8.
- Nishiyama O, Kondoh Y, Taniguchi H, Yamaki K, Suzuki R, Yokoi T, et al. Serial high resolution CT findings in nonspecific interstitial pneumonia/fibrosis. *J Computer Assisted Tomo.* 2000;24(1):41-6.
- Ryu JH, Colby TV, Hartman TE, Vassallo R. Smoking-related interstitial lung diseases: a concise review. *Eur Respir J.* 2001;17:122-32.
- Hartman TE, Primack SL, Swensen SJ, Hansell D, McGuinness G, Muller NL. Desquamative interstitial pneumonia: thin-section CT findings in 22 patients. *Radiology.* 1993;187:787-90.
- Koyama M, Johkoh T, Honda O, Tsubamoto M, Kozuka T, Tomiyama N, et al. Chronic cystic lung disease: diagnostic accuracy of high-resolution CT in 92 patients. *American J Roentgenology.* 2003 Mar;180(3):827-35.
- Johkoh T, Müller NL, Pickford HA, Hartman TE, Ichikado K, Akira M, et al. Lymphocytic interstitial pneumonia: thin-section CT findings in 22 patients. *Radiology.* 1999 Aug;212(2):567-72.
- McDonagh J, Greaves M, Wright AR, Heycock C, Owen JP, Kelly C. High resolution computed tomography of the lungs in patients with rheumatoid arthritis and interstitial lung disease. *Br J Rheumatol.* 1994 Feb;33(2):118-22.
- Grenier PH, Valeyre D, Cluzel P, Brauner MW, Lenoir S, Chastang C. Chronic diffuse interstitial lung disease: diagnostic value of chest radiography and high-resolution CT. *Radiology.* 1991 Apr;179(1):123-32.
- Murata K, Itoh H, Todo G, Kanaoka M, Noma S, Itoh T, et al. Centrilobular lesions of the lung: demonstration by high-resolution CT and pathologic correlation. *Radiology.* 1986 Dec;161(3):641-5.
- Palat P, Parmar HD. Recent trends in interstitial lung disease: Study of 25 cases. *Int J Med Sci Public Health.* 2013; 2(1): 52-55.
- Elliot TL, Lynch DA, Newell Jr JD, Cool C, Tuder R, Markopoulou K, et al. High-resolution computed tomography features of nonspecific interstitial pneumonia and usual interstitial pneumonia. *J computer assisted tomography.* 2005 May 1;29(3):339-45.
- Gagiya AK, Patel AS, Bhagat GR, Bhadiyadra VR, Patel KS, Patel P. Spirometry and x-ray findings in cases of interstitial lung diseases. *Natl J Community Med.* 2012;3(4):700-2.
- Raniga S, Sharma P, Kaur G, Arora A, Khalasi Y, Vohra PV. Interstitial Lung disease (ILD) in

Rheumatoid arthritis (Ra)-a study of thirty cases. *Indian J Radiology Imaging.* 2006 Oct 1;16(4):835.

27. Fathi M, Dastmalchi M, Rasmussen E, Lundberg IE, Tornling G. Interstitial lung disease, a common manifestation of newly diagnosed polymyositis and dermatomyositis. *Annals of the rheumatic diseases.* 2004 Mar 1;63(3):297-301.

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