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Role of High Resolution Computed Tomography in the Evaluation of Interstitial Lung Diseases: A Hospital Based Study

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ABSTRACT

Background: Interstitial lung diseases are characterized by diffuse thickening of the alveolar walls and the perialveolar tissue with inflammatory cells, exudates, granulomas, hemorrhage and/or fibrosis. Early diagnosis and management of interstitial lung diseases will reduce the morbidity and mortality rates. This study was conducted to find the role of HRCT in the detection of various interstitial lung diseases.

Materials and Methods

This study was conducted in the Department of Radiodiagnosis, Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamilnadu during the period of December 2015 to November 2016. A total of 40 patients were included in the study. This study was approved by Institutional Human Ethics Committee. Informed consent was taken from all the patients included in the study. Patient's demographic data was recorded. They were subjected to HRCT imaging for the evaluation of lung diseases. The data was expressed in number and percentage.

Results

A total of 40 patients were included in the study. 36 patients had interstitial lung disease and 4 were normal. Females were more compared males. Maximum number of cases was in the age group of 50-60 years. Large nodules (>3mm size) were observed in patients with RA and BOOP whereas PSS and Sarcoidosis were having small nodules (<3mm size). IPF and Sarcidosis cases showed more peribronchovascular thickening. RA, PSS, IPF and Koch's showed more interlobular and intralobular septal thickening .All patients with interstitial abnormality showed ground glass opacities. More number of patients with RA showed honeycombing, followed by IPF and PSS.

Conclusion

HRCT is sensitive and specific in the diagnosis of different interstitial lung diseases. From the study observations, it can be concluded that HRCT plays important role in the detection of interstitial lung diseases.

KEYWORDS: High Resolution Computed Tomography, Interstitial lung diseases, ground glass opacities, interlobular septae, intralobular septae, alveoli.

Introduction

The term 'interstitial lung diseases' indicates a heterogeneous group of conditions caused by diffuse thickening of the alveolar walls and the perialveolar tissue with inflammatory cells ,exudates, granulomas, hemorrhage and/or fibrosis [1]. It is otherwise called diffuse infiltrative lung diseases and represents a strikingly heterogeneous group of diseases comprising well over a hundred different causes [2]. In some types of interstitial lung diseases, the causative factors are known, while majority are in idiopathic category. The lung disease may occur in isolation or as part of systemic connective tissue disorders, for example, in rheumatoid arthritis and scleroderma. Interstitial lung diseases may present acutely, as in acute drug reactions, ARDS or the early stages of extrinsic allergic alveolitis, but more often, the natural history is one of slowly progressive loss of alveolar-capillary gas exchange units over months or even years. This relentless progression of increased lung stiffness with disordered matching of ventilation and perfusion and gas transfer defects results in worsening of exertional dyspnoea, which in many cases eventually progress to respiratory failure, pulmonary hypertension, cor pulmonale and eventually death.

The first use of the term "high-resolution" CT has been attributed to Todo et. al., who described the potential use of this technique for assessing lung disease [3]. The epic description of HRCT (High Resolution Computed Tomography) in English date to 1985, including landmark descriptions of pulmonary HRCT findings by Nakata, Naidich and Zerhouni [4,5]. HRCT brought a revolution in pulmonary interstitial imaging where resolution reached the level of secondary pulmonary lobule or the functional unit of lung. Today HRCT images simulate pathological sections of the lung parenchyma. HRCT combines the use of thinly collimated CT slices that are 1 to 2 mm in thickness, with a high spatial frequency algorithm that enhances edge detection [6]. Thin collimation decreases partial volume averaging and improves the ability of the CT to demonstrate small pulmonary lesions [7,8]. With HRCT using high spatial resolution, the lung parenchyma can be evaluated more clearly and more accurately. Since the early involvement of the interstitial lung diseases are very minute, HRCT helps us to arrive at a conclusive diagnosis wherever possible and then save precious pulmonary interstitium [9].

Materials and Methods

This study was conducted in the Department of Radiodiagnosis, Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamilnadu, during the period of December 2015 to November 2016. Patients with lung diseases were included in the study. All the included patients' demographic, clinical and CT data were collected. Consent was taken from all the patients. This study was approved by Institutional Human Ethical Committee. The scheme started with patient's serial number, name, age, sex, address, hospital/MRD number, date of admission and examination details. A thorough clinical history of all patients with clinical presentation and suspicion of interstitial lung diseases were taken, viz. symptoms, duration of symptoms, history of occupational exposure, similar clinical symptoms in family members etc. The

clinical history comprised of cough, dyspnoea, hemoptysis, their duration, whether associated with chest pain, loss of weight, loss of appetite, fever etc. Any relevant laboratory tests previously done were also taken into consideration. The previous biochemical and radiological observations also evaluated for the diagnosis of lung diseases.

The procedure and objectives of performing the high-resolution scans were explained to the patients and written consent from patient or the attendant were taken, as the images were to be produced in print. The patient was explained and demonstrated the procedure of holding of breath in deep inspiration during acquisition of the HRCT scans. HRCT imaging was done with the Siemens Somatom Scope 16 machine of Department of Radiodiagnosis. Scans were obtained with patient at supine position, with maximum inspiration, using 2mm collimation, voltage of 130 kV, tube current of 50mA, at 1cm interval. In few patients, additional images were taken at maximum expiration.
Patients' images were vividly evaluated under the following criteria. 1. Nodules and nodular opacities, 2. Linear and reticular opacities, 3. Increased lung opacities, 4. Decreased lung opacities, cysts and airway abnormalities [10,12].

Results

A total of 40 cases of clinically suspected interstitial lung diseases were studied using the HRCT scans. By analyzing the involvement pattern of the pulmonary interstitium in various disease entities with the help of HRCT, present study arrived at a conclusive diagnosis wherever possible. HRCT images were used to determine the extent of pulmonary involvement in every case included in the study. Maximum number of patients was in age group of 50-60 years (Table-1). Females were more compared to males in this study (Graph-1). Out of 40 patients undergone HRCT study, a total 36 patients showed lesions and 4 were normal. In patients with RA and BOOP, nodules of size >3 mm were observed. PSS and Sarcoidosis were having nodules < 3mm size. In patients with Koch's, both ill defined and well defined nodules of size < 3mm and >3mm were observed. PSS and Koch's showed centrilobular distribution of nodules compared to random distribution (Table-2). Majority of patients with Koch's showed 'tree in bud' appearance of nodules in the lung. IPF and Sarcidosis casea showed more peribronchovascular thickening. RA, PSS, IPF and Koch's showed more interlobular and intralobular septal thickening compared to other lung diseases (Table-3). All patients with interstitial abnormality showed ground glass opacities (Table-4).Patchy areas of consolidation were seen in BOOP. Maximum number of patients with bronchiectasis and emphysema was observed in Koch's disease compared to other lung diseases (Table-5). More number of patients with RA showed honeycombing compared other lung diseases (Graph-2).

Discussion

Chest radiography and HRCT are the investigations used in suspected cases of interstitial lung diseases. HRCT is used to evaluate` the abnormalities of lung in detail and to arrive at a diagnosis in such cases [13,14]. The present study conducted in 40 patients with the aim to evaluate the role of HRCT in the detection of interstitial lung diseases. Out of 40 patients, 4 were not showing any abnormalities in HRCT images of lungs. Maximum number of cases with abnormalities was in the age group of 40-60 years. Muller NL et.al study also observed lung diseases were more common between ages of 40-60 years [15]. Lympany PA et.al study showed females were more prone to various interstitial lung diseases. In our study also, female patients were more compared to male patients [16]. Im JG et.al showed nodule size 3-5 mm in the Koch's and Sarcoidosis [17]. Similar results were observed in present study .Interlobular interstitial thickening is seen in HRCT scans in the presence of interstitial fluid, cellular infiltration or fibrosis. Septal thickening can be smooth, nodular or irregular. In our study, 53% of the cases of Koch's infection had nodular /irregular interlobular septal thickening, which correlated well with the findings of study conducted by Chung et.al [18]. Ground glass opacities were seen in 75% of our cases of PSS. This correlates well with the findings of a study by Seely et al in 1998, where ground glass opacities were seen in 8 out of 11 cases of PSS [19]. Another study by Munk PI et al showed 81% of cases of PSS were having ground glass opacities [20]. Determining the lung abnormalities with HRCT technique provides more insight in the underlying disease pathophysiology and disease progression.

Conclusion

Interstitial lung diseases are characterized by diffuse thickening of alveolar walls and the perialveolar tissue of lung with inflammatory cells, exudates, granulomas, hemorrhage and/or fibrosis. HRCT imaging helps us to have detailed and precise evaluation of lung abnormalities to reach a specific diagnosis. Since HRCT scans can reveal abnormalities up to the level of the secondary pulmonary lobule, it can match with pathological counterparts. HRCT is the best non invasive diagnostic modality in evaluation of interstitial lung diseases

Table-1: Distribution of patients based on age

Age (Years)	Number	Percentage (%)
0-10	0	0.00
11-20	0	0.00
21-30	6	15.00
31-40	6	15.00
41-50	8	20.00
51-60	15	37.50
61-70	2	5.00
Above 70 Y	3	7.50
Total	**40**	**100.00**

Graph-1: Distribution of patients based on gender

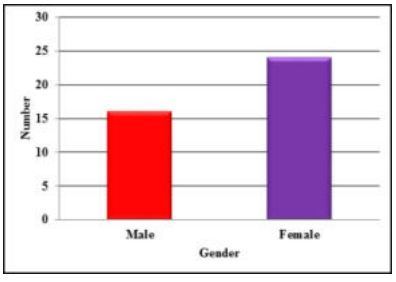


Table-2: Appearance and size and distribution of nodules in interstitial lung disease

Nodules	RA	PSS	BOOP	Sarcoidosis	Koch's
Ill defined	0	0	0	0	7
Well defined	2	4	1	1	4
Size of nodule	>3 mm	>3 mm	>3 mm	>3 mm	>3 mm
Centilobular	2	3	2	1	3
Random	0	1	0	0	8

Table-3: Pattern of reticular /linear opacities in different diseases

Type	Peribronchovascular	Interlobular	Intralobular
RA	1	7	4
PSS	4	7	6
SLE	2	4	1
IPE	5	5	5
BOOP	2	0	0
DIP	0	1	0
Sarcoidosis	0	1	0
Koch's	8	7	2

Table-4: Distribution of patients showing ground glass opacities (GGO) in different ILDs

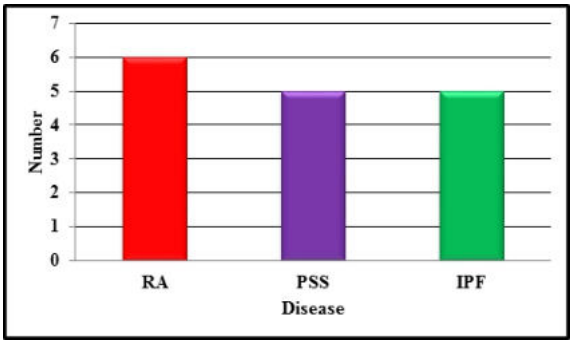
Type	Ground glass opacities (GGO)
RA	2
PSS	6

SLE	4
IPE	4
BOOP	2
DIP	2
Sarcoidosis	1
Koch's	4

Table-5: Distribution of patients decreased lung attenuation in different diseases

Disease	Air trapping	Bronchiectasis	Emphysema
RA	2	2	1
PSS	0	5	2
SLE	0	1	0
IPE	0	5	1
BOOP	2	1	2
DIP	1	0	0
Sarcoidosis	0	2	0
Koch's	2	6	3

Graph-2: Distribution of patients showing honeycombing in different ILDs



References

1. Coultas DB, Zumwalt RE, Black WC. The epidemiology of interstitial lung diseases. Am J Respir Crit Care Med 1994;150:967-72.
2. De Remee RA. Diffuse interstitial pulmonary disease from the perspective of the clinician. Chest 1987;92:1068-73.
3. Todo G, Itoh H, Nakano Y. High-resolution CT for the evaluation of pulmonary peripheral disorders. J pn J Clin Radiol 1982;27:1319-32.
4. Nakata H, Kimoto T, Nakayama T. Diffuse peripheral lung disease: Evaluation by high-resolution computed tomography. Radiology 1985;157:181-85.
5. Zerhouni EA, Naidich DP, Siegelman SS. Computed tomography of the pulmonary parenchyma. Part 2: interstitial disease. J Thoracic imaging 1985;1(1):54-64.
6. Mayo JR. High resolution computed tomography: technical aspects. Radiol Clin North Am 1991;29:1043-49.
7. Muller NL, Miller RR. Computed tomography of chronic diffuse infiltrative lung disease: part 1. Am Rev Respir Dis 1990;142:1440-48.
8. Zerhouni E. Computed tomography of the pulmonary parenchyma: an overview. Chest 1989;95:901-07.
9. Mayo JR, Webb WR, Gould R. High-resolution CT of the lungs: an optimal approach. Radiology 1987;163:507-10.
10. Heitzman ER. The role of computed tomography in the diagnosis of pulmonary nodules: Results of large scale observer test. Radiology 1999;213:23-726.
11. Baron RL, Levitt RG, Sagel SS, White MJ, Roper CL, Marberger JP. Computed tomography in the preoperative evaluation of bronchogenic carcinoma. Radiology 1982;145:727-32.
12. Fishman NH, Brostein MH. Is mediastinoscopy necessary in the evaluation of lung cancer. Ann Thorac Sung 1975;20:678-86.
13. Reich SB, Treasure RL, Knumpe PE, Carson JW, Samson PJ. Oblique hilar tomograms in preoperative stagning of carcinoma if the lung. Chest 1981;79:370-71.
14. Finkelstein SE, Schrumo DS, Nguyen DM, Hewitt SM, Kunst TF, Summers RM. Comparative evaluation of tracheobronchial malgnancies, Chest 2003;124:1834-40.
15. Muller NL, Staples CA, Miller RR. Disease activity in idiopathic pulmonary fibrosis: CT and pathologic correlation. Radiology 1987;165:731-34.
16. Lympany PA, du Bois RM. Interstitial Lung Disease: Pathophysiology and Genetic Predisposition. Medscape Pulmonary Medicine e-Journal 200;4(1):1-4.
17. Im JG, Itoh H, Shim YS. Pulmonary tuberculosis: CT findings-early active disease and sequential change with anti-tuberculosis therapy. Radiology 1993;186:653-60.
18. Chung MJ, Lee KS, Koh WJ. Drug-sensitive tuberculosis, multidrug-resistant tuberculosis, and nontuberculous mycobacterial pulmonary disease in non AIDS adults: comparisons of thin-section CT findings. European Radiology 2006;16:1934-41 .
19. Seely JM, Jones LT, Wallace C. Systemic sclerosis: using high- resolution CT to detect lung disease in children. Am J Roentgenol 1998:170:691-97.
20. Munk PL, Muller NL, Miller RR. Pulmonary lymphangitic carcinomatosis: CT and pathologic findings. Radiology 1988;166:705-09.