HRCT Assessment of Interstitial Lung Diseases

Pankaj Badarkhe-Patil[1], Dayanand Kawade[2], Prashant Titare[3], Varsha Rote- Kaginalkar[4]

ABSTRACT

Introduction: Interstitial lung disease (ILD) is a group of diffuse parenchymal lung diseases affecting the pulmonary interstitium. High resolution computed tomography) is the most accurate noninvasive, cross section imaging modality for the diagnosis and follow up monitoring of ILD. Study was done to check the basic HRCT patterns associated with Interstitial Lung Disease and correlation of HRCT patterns with clinical data in differential diagnosis of Interstitial Lung Disease.

Material and methods: Total 50 patients referred from medicine department of our institute having clinical suspicion of ILD were studied during June 2015 to June 2016. HRCT chest was done in all patients on 6 slice Siemens somatom CT scanner in supine position using standard HRCT protocol. Parenchymal abnormalities were detected and categorized for specific diagnosis of ILD.

Result: Majority of the patients (n=25) were between the ages of 60- 80 years (8 males and 17 females). The major complaint was progressive dyspnea (n=48; 96%). The most common interstitial lung disease found in our study was usual interstitial pneumonia (n=18; 36%) followed by nonspecific interstitial pneumonia (n=7; 14%) and acute interstitial pneumonia (n=7; 14%).

Conclusions: UIP was the most common interstitial lung disease observed in our study. Westernisation has changed the disease distribution in Indian population for age. In patients with progressive dyspnea ILD should be ruled out as a cause. Clinical and laboratory finding along with HRCT workup is essential for the diagnosis of specific ILD.

Keywords: High resolution computed tomography, Interstitial lung disease, Usual interstitial pneumonia.

INTRODUCTION

Interstitial lung disease (ILD) is a heterogeneous group of diffuse parenchymal lung diseases, characterize by restrictive physiology, impaired gas exchange, pulmonary inflammation and fibrosis.[1,2] In most cases the pathology of ILD lies in the pulmonary interstitium which consist of connective tissue space between the alveolar epithelial cells and the adjacent capillary endothelial cells. Extensive work up is needed for the diagnosis of ILD.[3] Cigarette smoking, aspiration, certain drugs, radiation therapy, cancer, systemic diseases, environmental and occupational factors had been reported in association with the ILD in one third cases.[4] However two-thirds cases of ILD have no reportable association.[5,6]

Chest radiograph (CXR) may be normal during early in the course of the disease and shows few abnormalities hence unable to identify the specific etiology of ILD.[7] Pulmonary function testing (PFT) cannot diagnose a specific ILD or distinguish between active lung inflammations versus fibrosis.[8] HRCT (High resolution computed tomography) is the most accurate noninvasive, high spatial resolution cross sectional imaging modality for evaluation of lung parenchyma. It assess the presence of disease in lung, type of disease, changes of active lung disease, biopsy site localization, change in disease activity following treatment, characterization of interstitial lung disease (ILD) in appropriate clinical setting. It is more sensitive than the plain radiograph in identifying ILD (sensitivity greater than 90%) and the image pattern of parenchymal abnormalities on HRCT often suggests a particular set of diagnostic possibilities.[9] Present study aimed to study basic HRCT patterns associated with Interstitial Lung Disease and correlation of HRCT patterns with clinical data in differential diagnosis of Interstitial Lung Disease.

MATERIAL AND METHODS

The study was hospital based prospective and descriptive which was conducted during June 2015 to June 2016 in our department of radiology. Total 50 patients were studied based on inclusion exclusion criteria, which were referred from medicine department of our institute having clinical suspicion of ILD. Patients of all age and sex were included in the study. Known cases of infective etiology (Tuberculosis, HIV), chronic obstructive pulmonary disease, congestive cardiac failure, lung malignancy, hemodynamically unstable patients were excluded. After inclusion of the patient in the study, detailed proforma was filled. The proforma included the patient's name, age, address, medical record number, complaints, risk factors, past history, laboratory investigation, and chest radiograph findings. Thereafter HRCT chest was done on 6 slice Siemens somatom CT scanner in supine position using standard HRCT protocol. Prone and expiratory scanning was done wherever needed. Parenchymal abnormalities were categorized into four basic patterns of HRCT with their distribution and predominant involvement. Final possible diagnosis was made as per HRCT findings and clinical information.

STATISTICAL ANALYSIS

Standard statistical analysis was done with the help of Microsoft Excel version 2007. Descriptive statistics like mean (SD) and percentages were used to interpret the results.

RESULT

Majority of the patients (n=25) were between the ages of 60- 80 years, which include 8 males and 17 females. Fifty percent of population included in this study was in between 60 to 80 years of age, the majority of which were females. (Table-1)

[1]Assistant Professor, [2]PG Resident, [3]Associate Professor, [4]Professor and HOD, Department of Radiodiagnosis, Government Medical College and Hospital, Aurangabad, India

Corresponding author: Dr. Pankaj Badarkhe-Patil, Assistant Professor, Department of Radiodiagnosis; Government Medical College and Hospital, Aurangabad, India

How to cite this article: Pankaj Badarkhe-Patil, Dayanand Kawade, Prashant Titare, Varsha Rote- Kaginalkar. HRCT assessment of interstitial lung diseases. International Journal of Contemporary Medical Research 2016;3(8):2426-2430.

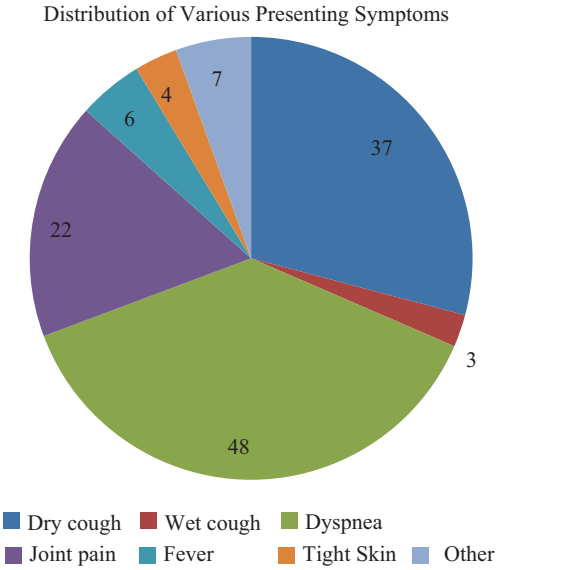
The major complaint was progressive dyspnoea (n=48; 96%), followed by dry cough (n=37, 74%) and joint pain (n=22; 44%) related to connective tissue disorders (Graph-1) Some patients also had varying symptoms like fever, wet cough, tight skin etc. The most common interstitial lung disease found in our study was usual interstitial pneumonia (UIP) / idiopathic pulmonary fibrosis (IPF) (n=18; 36%) followed by nonspecific interstitial pneumonia (NSIP) (n=7; 14%) and acute interstitial pneumonia (AIP) (n=7; 14%) (Graph-2)

Most commonly found associated risk factor with interstitial lung disease was connective tissue disorder (n=19; 38%) followed by smoking (n=9; 18%), allergy (n=8; 16%) and least was exposure history in three cases which include exposure to chemotherapy, radiotherapy and coal dust particles in coal mine.

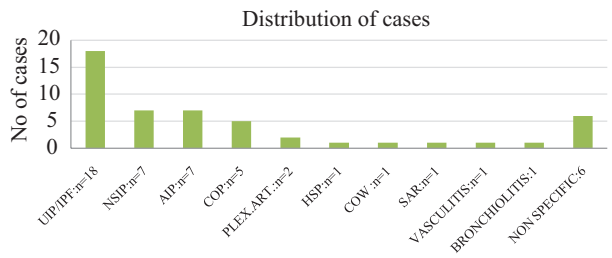
The most commonly found pattern associated with interstitial lung disease was reticular opacity (n=37; 64%) followed by increased opacity (n=29; 58%) and decreased opacity (n=29; 58%) on HRCT. Most common specific HRCT findings in our study population were septal thickening (n=37; 64%) followed by bronchiectasis (n=26; 52%) and ground glass opacity (n=24; 48%). Diffuse distribution of HRCT findings was seen in 24 cases (48%). Lower lobes were predominantly involved in 37 cases (64%).

Sr. No.	Age group	No. of patients	Male		Female	
			No	%	No	%
1	Less than 20 year	1	0	0	1	2
2	20- 40 year	4	2	4	2	4
3	40- 60 year	18	6	12	12	24
4	60-80 year	25	8	16	17	34
5	More than 80 year	2	2	4	0	0
	Total	50	18	36	32	64

Table-1: Showing age and sex distribution in ILD.



Graph-1: Distribution of various presenting symptoms in ILD.



Graph-2: Distribution of cases in various ILD.

DISCUSSION

Out of 50 cases, Forty four cases (88%) showed specific patterns associated with interstitial lung disease and six cases (12%)

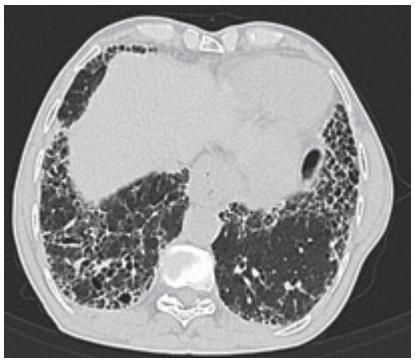


Figure-1: HRCT shows bilateral diffuse extensive fibrosis with septal thickening, honeycombing, traction bronchiectasis predominantly involving bilateral lower lobes in subpleural region and architectural distortion resulting in reduced lung volume. Findings are in favour of usual interstitial pneumonia / idiopathic pulmonary fibrosis.

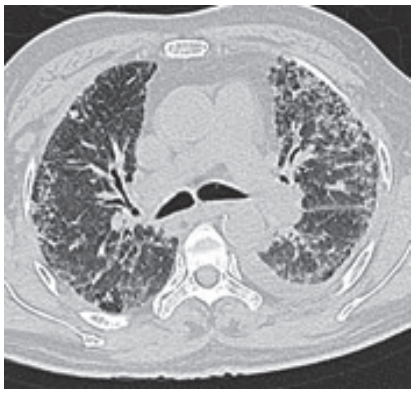


Figure-2: HRCT shows bilateral diffuse interstitial lung disease in the form of interlobular and intralobular septal thickening predominantly in subpleural region with focal areas of tiny honeycombing with left sided pleural effusion. Findings are in favour of idiopathic interstitial pneumonia- nonspecific interstitial pneumonia.

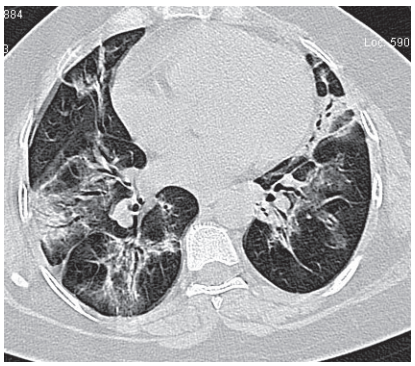


Figure-3: HRCT reveals extensive geographic areas of ground glass attenuation with septal thickening and focal areas of consolidation with air bronchograms. Changes are predominantly distributed in bilateral peribronchovascular, subpleural regions and lower lobes. Findings are in favour of cryptogenic organising pneumonia

showed nonspecific findings. Out of the six cases, three cases showed no involvement of lung parenchyma.

In our study the most common age group at presentation was 60 to 80 years with 25 patients including 17 females and 8 males. Earlier Indian studies of Maheshwari U et al, Muhammed SK et al showed the age of presentation almost two decades earlier (40-60 year) than western study of Aziz ZA, et al. (60-80 years) with predominance of females.[10-13] The age group of our patients is in variance with previously published Indian studies and matches that of western study. This might suggest a change in the Indian life styles towards more westernisation, small sample size and a more urban bias of the study population.

The most common presenting complaint was progressive dyspnea seen in 48 patients (96%) followed by dry cough (74%) and associated joint pain (44%). These findings were in accordance to those reported by Muhammed SK et al in 2011.[11] Joint symptoms were more commonly found as compared to literature. This might happened due to more referral bias towards connective tissue disorder from rheumatologist since the inclusion criteria included patients of connective tissue disorder having pulmonary symptoms.

The most common associated risk factor seen in the present study was connective tissue disorder. A total of 19 patients (38%) were serologically positive for connective tissue disorder. In the study conducted by Muhammed SK et al 29 % of study population tested serologically positive for connective tissue disorder.[11] Other associated risk factors recorded in the present study were smoking (18%), allergy (16%). Three patients had history of exposure which included exposure to chemotherapy, radiotherapy in two patients and coal dust particle in coal mine in one patient. Smoking and exposure history as compared to literature was less common. This might have happened due to more females were included in study population, limited sample size and referral bias.

In the present study the most common interstitial lung disease reported on HRCT was usual interstitial pneumonia / idiopathic pulmonary fibrosis (36%) (Table-2). Nonspecific interstitial pneumonia and acute interstitial pneumonia were reported in 7 cases (14%) each. These findings like those reported by Muhammed SK et al, Maheshwari U et al and Sen T Udwadia ZF et al.[10,11,13] As compared to literature, more patients of COP (Cryptogenic organising pneumonia) and AIP (Acute intestitial pneumonia) were noted in our study and which might be due to sampling error. As opposed to this less patient of hypersensitivity pneumonitis (HSP), coal worker pneumoconiosis (CWP) and sarcoidosis were noted and this might be due to a small sample size.

The various patterns found to be associated with interstitial lung disease in our study population, on HRCT were reticular opacities (n= 37; 64%) followed by increased opacity (n=29; 58%) and decreased opacity (n=29; 58%).These findings were well correlated with the findings of Indian study done by Muhammed SK et al which was very similar to our study, except decreased opacity which were not separately described in that study.[11] Decreased opacity was mainly contributed by traction bronchiectasis and in most conditions it was part of reticular opacity.

Most common pattern seen on HRCT is reticular opacities. These findings correlated with findings of Muhammed SK et al.[11] HRCT was superior to chest radiograph in detection of all basic patterns and their distribution associated with ILD. Chest radiograph is a nonspecific investigation and can be utilized as initial investigation in work up of ILD. However, HRCT of lungs along with clinical data is essential for the diagnosis of ILD as reported by Potente G et al, Grenier P et al, Aziz ZA et al, Raniga S et al and Ghulam Shabbier et al.[14-18]

Septal thickening, honeycombing and traction bronchiectasis were commonest findings observed in almost all cases of UIP seen predominantly in basal and subpleural region corrosponding to the findings of the studies done by Maheshwari U et al, Akira M et al, Nishiyama O et al and Misumi S et al.[11,19-21] (Figure-1) In NSIP, HRCT findings predominantly involved the lower lobes and subpleural regions like IPF but the distribution was patchy in contradictory to IPF which showed diffuse distribution of all findings. Honeycombing was also less common than IPF/UIP. These findings are like those reported by TS Kim et al and Elliot TL et al.[22,23] (Figure-2) In AIP, HRCT showed patchy areas of ground glass opacity with discrete areas of alveolar consolidation involving both lungs with predominant involvement of upper lobes (4 cases) and subpleural regions which were consistent with the findings of Primack SL et al and Bonaccorsi A et al.[24,25] High-resolution CT findings consist of ground glass opacities (80%) and/or consolidative areas (80%) distributed along the bronchovascular bundles and along the subpleural lungs. These findings suggestive of COP were as per study done by Ju Won Lee et al.[26] (Figure-3) Diffuse involvement was noted on HRCT in HSP which include tiny centrilobular nodules with groundglass haziness and predominance in upper lobes. These findings were correlated with study done by DA lynch et al.[27]

In sarcoidosis, HRCT revealed patchy distribution of septal thickening, peripheral and random nodules.These findings correlated with study done by Nishimura K et al and Mimori Y et al.[28,29] HRCT findings of plexogenic arteriopathy observed were mosaic perfusion without air trapping in 2 cases, suggestive of basic pathology in vessels rather than bronchial pathology.[30] Additional findings were dilated main pulmonary artery,

HRCT Diagnosis	Muhammed SK et.al[11]	Sen T Udwadia ZF et.al[13]	Present study
UIP/IPF	39%	43%	36%
NSIP	24%	18%	14%
Connective Tissue Disease Related ILD	24%	18.6%	30%
COP	4%	2%	10%
AIP	0%	1%	14%
HSP	17%	6%	2%
COW /Silicosis	4%	1%	2%
Sarcoidosis	13%	22%	2%

Table-2: Distribution of interstitial lung diseases and literature comparison

centrilobular nodules and consolidation. HRCT showed patchy areas of ground glass opacity, consolidation, centrilobular nodule, septal thickening and traction bronchiectasis with collapse of apical segment of left lower lobe in a case of pulmonary vasculitis.[31]

Eleven (22%) cases which were serologically positive for rheumatoid arthritis were reported in our study. Out of eleven, one was (9%) male and ten (91%) were females showing a clear female preponderance. Most common pattern found with rheumatoid arthritis was reticular opacity associated with UIP / fibrosing alveolitis (3 cases 27%) in our study. These findings correlated with J K Dawson et al and Kinoshita F et al.[32,33] Out of two cases of systemic lupus erythematous (SLE), one case showed features of acute interstitial pneumonia and another case showed focal involvement of ground glass opacity in left lower lobe which may represent early changes of inflammation associated with SLE. The findings in the first patient correlate with lung involvement in SLE as reported by Fenlon HM et al and Ooi GC et al.[34,35] The findings in the second patient are nonspecific in nature. Out of four cases of progressive systemic sclerosis, three (75%) cases showed NSIP pattern and remaining one case showed UIP pattern with preserved lung volume. Few of these findings and association with interstitial lung disease correlated with studies done by Chan TY et al and JmSeely et al.[36,37] In our study we found a strong correlation between scleroderma and NSIP pattern.

CONCLUSION

UIP was the most common interstital lung disease observed in our study. It is also most common pattern seen in rheumatoid arthritis. Westernisation has changed the disease distribution in indian population with respect to age. In patients with progressive dyspnoea ILD should be ruled out as this is the most common complaint in ILD patients. HRCT lung is a noninvasive investigation of choice in clinically suspected cases of interstitial lung disease as it is very effective in visualizing the distorted architecture of lung parenchyma. HRCT along with clinical data and relevant laboratory investigations helps in arriving at the closest differential diagnosis in interstitial lung disease.

REFERENCES

1. Behr J, Ryu JH. Pulmonary hypertension in interstitial lung disease. Eur Respir J. 2008;31:1357-67.
2. American Thoracic Society. Idiopathic pulmonary fibrosis: diagnosis and treatment. International consensus statement. American Thoracic Society (ATS),and the European Respiratory Society (ERS). Am J Respir Crit Care Med. 2000;161:646-64.
3. Ryu J, Daniels C, Hartman T, ES Yi. Diagnosis of interstitial lung diseases. Mayo Clin Proc. 2007;82:976-86.
4. British Thoracic Society and Standards of Care Committee. The diagnosis, assessment and treatment of diffuse parenchymal lung disease in adults. Introduction. Thorax. 1999;54:1-14.
5. Raghu G, Nyberg F, Morgan G.The epidemiology of interstitial lung disease and its association with lung cancer. Br J Cancer. 2004;91:3-10.
6. Selman M, Chapela R, Raghu G. Hypersensitivity pneumonitis: clinical manifestations, diagnostic and therapeutic strategies. Semin Respir Med. 1993;14:353-64.
7. Sharma RP, Kaur G, Arora A, Khalasi Y, Vohra PV. Interstitial lung disease in rheumatoid arthritis: a study of thirty cases. Chest. 2006;16:835-9.
8. Raghu G, Brown KK. Interstitial lung disease: clinical evaluation and keys to an accurate diagnosis. Clin Chest Med. 2004;25:409-19.
9. Lynch D. Imaging of diffuse parenchymal lung disease. In: Schwarz MI, King TE, editors. Interstitial lung disease. 4th ed. Hamilton (Ontario): BC Decker, Inc; 2003.
10. Maheshwari U, Gupta D, Aggarwal AN, Jindal SK. Spectrum and Diagnosis of Idiopathic Pulmonary Fibrosis. Indian J Chest Dis Allied Sci. 2004;46:23-26.
11. Muhammed SK, Anithkumari K, Fathahudeen A, Jayprakash B, et al. Aetiology And Clinic-Radiological Profile Of Interstitial Lung Disease In A Tertiary Care Centre. J Pulmon. 2011;13:12-15.
12. AzizZA, Wells AU, Hansell DM, Bain GA, et al. HRCT Diagnosis Of Diffuse Parenchymal Lung Disease: Interobserver Variation, Thorax. 2004;59:506–511.
13. Sen T, Udwadia ZF. Retrospective Study of Interstitial Lung Disease in a Tertiary Care Centre in India.Indian J Chest Dis Allied Sci. 2010;52:207-211.
14. Potente G, Bellelli A, Nardis P. Specific diagnosis by CT and HRCT in six chronic lung diseases. Comput Med Imaging Graph. 1992;16:277-282.
15. Grenier P, Chevret S, Beijelman C et al. Chronic diffuse infiltrative lung disease: Determination of the diagnostic value of clinical data. Chest radiography and CT with Bayesian Analysis. Radiology. 1994;191:383-390.
16. Aziz ZA, Wells AU, BatemanED, CopleySJ,et al. Interstitial Lung Disease: Effects of Thin-Section CT on Clinical Decision Making Radiology. 2006:238(2).
17. Raniga S, Sharma P, Kaur G, Arora A, et al. Interstitial Lung Disease (IId) in Rheumatoid Arthritis (RA). IJRI. 16:835-839.
18. Shabbier G, Amin S, Ullah F, Rehman S, Khan S. Role of high resolution Computed Tomographic Scan in diagnosis of Interstitial Lung Diseases in local population. J Postgrad Med Inst. 2012;26:149-52.
19. Akira M, Sakatani M et al. Idiopathic pulmonary fibrosis: Progression of honeycombing at thin section CT: Radiology. 1993;189:687-691.
20. Nishiyama O, Taniguchi H, Kondoh Y, Kimura T, Katoh T, Oishi T, Matsumoto S, Yokoi T, Takagi K et al. Familial idiopathic pulmonary fibrosis: Serial high resolution computed tomographic findings in 9 patients: J Comput Assist Tomogr. 2004;28:443-448.
21. Misumi S, Lynch DA. Idiopathic pulmonary fibrosis/Usual interstitial pneumonia: Imaging diagnosis, spectrum of abnormalities and temporal progression: Proc Am Thorac Soc. 2006;3:307-314.
22. TS Kim, Lee KS et al. Nonspecific interstitial pneumonia with fibrosis: high resolution CT and pathologic findings. AJR Am J Roentgenol. 1998;171:1645-1650.
23. Elliot TL, Lynch DA et al. High-resolution computed tomography features of nonspecific interstitial pneumonia and usual interstitial pneumonia. J Comput Assist Tomogr. 2005;29:339-345.
24. Primack SL, Hartman TE et al.Acute interstitial pneumonia: radiographic and CT findings in nine patients. Radiology. 1992;188:817-820.
25. Bonaccorsi A, CancellieriA et al. Acute interstitial pneumonia: Report of series. Eur Respir J. 2003;21:187-191.
26. Ju Won Lee, Kyung Soo Lee, Ho Yun Lee, Man Pyo Chung

et.al.Cryptogenic Organizing Pneumonia:Serial High-Resolution CT Findingsin 22 Patients. AJR. 2010;195:916-922.
27. DA Lynch, CS Rose, D Way, TE King Jr et al. Hypersensitivity pneumonitis: Sensitivity of high resolution CT in a population based study: American Journal of Roentgenology. 1992;159:469-472.
28. Nishimura K, Itoh H, Kitaichi M et al. pulmonary sarcoidosis: Correlation of CT and histopathologic findings. Radiology. 1993;189:105-109.
29. Mimori Y et al. Sarcoidosis correlation of HRCT findings with results of pulmonary function tests and serum angiotensin - converting enzyme assay. Kurume med J. 1998;45:247-256.
30. Webb WR, Higgins CB. Thoracic Imaging. Lippincott Williams and Wilkins. 2010.
31. Chung MP, Yi CA, Lee HY et-al. Imaging of pulmonary vasculitis. Radiology. 2010;255:322-41.
32. JK Dawson, HE Feuins, J Desmond, MP Lynch, DR Graham. Fibrosing alveolitis in patients with rheumatoid arthritis as assessed by high resolution computed tomography, chest radiography and pulmonary function tests. Thorax. 2001;56:622-627.
33. Kinoshita F, Hamano H, Haroda H, Kinoshita T, Igishi T, Hagino H et al. Role of KL - 6 in evaluating the disease severity of rheumatoid lung disease: comparison with HRCT. Respir Med. 2004;98:1131-1137.
34. Fenlon HM, Dran M et al. High resolution chest CT in systemic lupus erythematosus. AJR Am J Roentgenol. 1996;166:301-307.
35. Ooi GC, Ngan H, Peh WC, Mok MY, Ipm et al. Systemic lupus erythematosus patients with respiratory symptoms: the value of HRCT. Clin Radiol. 1997;52:775-781.
36. Chan TY, Hansell DM et al. Cryptogenic fibrosing alveolitis and the fibrosing alveolitis of systemic sclerosis: Morphologic differences on computed tomographic scan. Thorax. 1997;52:265-270.
37. JM Seely, Jones LT, Wallace et al. Systemic sclerosis: using high resolution CT to detect lung disease in children. AJR Am J Roentgenol. 1998; 170:691-697.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 20-06-2016; **Published online**: 31-07-2016