Original Research Article

Study of different high resolution computed tomography patterns in patients with diffuse interstitial lung diseases

M Deepak[1*], A S Bharranitharan[2], H T Narayana[3], S Senthilnathan[4]

[1]Assistant professor, [4]Professor, Department of Radiodiagnosis, [2]Assistant professor Department of General Medicine, Annapoorna Medical College and Hospital Salem, INDIA.
[3]Consultant, NG Imaging and Diagnostics Bengaluru, INDIA.
Email:deepaktheboss@gmail.com

Abstract

Background: Interstitial lung diseases (ILDs) are a diverse group of diseases which affect the lung interstitium and share similar clinical and radiological manifestations. HRCT is the non-invasive, high spatial resolution cross sectional imaging modality for evaluation of lung parenchyma. It assesses the presence of disease in lung, type of disease, changes of active lung disease, biopsy site localization, change in disease activity following treatment. 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:** Present study was a Cross sectional study, conducted in patients above 20 years, clinically diagnosed as Interstitial Lung Disease, confirmed by HRCT. **Results:** The present cross-sectional study included 51 patients, 21 (41.17%) were in the age group of 41-50 years followed by 18 (35.29%) patients in the age group of 51-60 years. 33 (64.7%) were males and 18 (35.29%) were females. 11 (21.56%) were smokers, all were males. The overall patterns documented on HRCT (n = 51) were ground glass opacities 45 (88.23%), reticular opacities 37 (72.54%), honey-combing 32 (62.74%), nodular opacities 23 (45.09), hilar adenopathy 21 (41.17%), cyst-like 17 (33.33%) and linear opacities 11 (21.56%). In the present study, distribution of cases according to ATS/ERS 2003 Guidelines were studied. IPF was the most common pattern seen in 17 (33.33%) cases, whereas, NSIP, COP, RB-ILD, DIP and AIP patterns were revealed in 12 (23.52%), 8 (15.68%), 6 (11.76%), 3 (5.88%) and 2 (3.92%) cases respectively. **Conclusion:** Rigorous application of an ordered, pattern approach to HRCT abnormalities allows for reproducible and accurate interpretation. The advent of HRCT as an imaging modality has obviated the need for a lung biopsy in many patients. Characteristic findings on HRCT scans are often sufficient to diagnose ILDs.

Keywords: ILD, HRCT patterns, Interstitial Lung Disease, pulmonary fibrosis.

[*]**Address for Correspondence:**
Dr M.Deepak, Assistant professor, Department of Radiodiagnosis, Annapoorna Medical College and Hospital, NH-47 Sankari Main Road Kombadipatty Salem 636308. Tamil Nadu, INDIA.
Email:deepaktheboss@gmail.com.
Received Date: 02/11/2020 Revised Date: 30/12/2020 Accepted Date: 28/01/2021
DOI: https://doi.org/10.26611/101317310

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 27 March 2021

INTRODUCTION

Interstitial lung diseases (ILDs) are a diverse group of diseases which affect the lung interstitium and share similar clinical and radiological manifestations. These are a heterogeneous group of disorders that predominantly affect the lung parenchyma and vary widely in etiology, clinic-radiologic presentation, histopathologic features, and clinical course.[1] ILDs are characterized by infiltration of cellular or non-cellular material into the lung parenchyma. Anatomic distribution of these processes may affect not only the interstitial compartment but also alveolar airspaces, blood vessels, and distal airways.[2] Known causes of ILDs include inhaled organic and

How to cite this article: M Deepak, A S Bharranitharan, H T Narayana, S Senthilnathan. Study of different high resolution computed tomography patterns in patients with diffuse interstitial lung diseases. *MedPulse International Journal of Radiology.* March 2021; 17(3): 85-89. http://www.medpulse.in/Radio%20Diagnosis/

inorganic substances, cigarette smoking, drugs, radiation, and systemic disorders like connective tissue diseases. However, for some ILDs the cause is unknown.[3,4]HRCT is the non-invasive, high spatial resolution cross sectional imaging modality for evaluation of lung parenchyma. It assesses the presence of disease in lung, type of disease, changes of active lung disease, biopsy site localization, change in disease activity following treatment. The advent of HRCT has revolutionized the ability to detect and characterize interstitial lung diseases in vivo.[5] The components of the HRCT findings that are helpful in the diagnosis of ILD include the pattern of parenchymal abnormality (e.g., consolidation, reticular pattern), the anatomic distribution (upper vs lower, central vs peripheral), and associated findings (e.g., mediastinal lymphadenopathy).[6] 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

Present study was a Cross sectional study, conducted in department of radiodiagnosis, Sri Siddhartha Medical College, Tumkur. The study was conducted from November 2014 to November 2016 in patients clinically diagnosed as Interstitial Lung Disease referred for HRCT Chest.

Inclusion criteria

Patients above 20 years, clinically diagnosed as Interstitial Lung Disease, confirmed by HRCT.

Exclusion Criteria

Patients with acute dyspnoea. Post traumatic patients with dyspnoea. Acute first episode of lung infections.

HRCT examinations will be conducted to all patients using CT scanners TOSHIBA Aquilion 16. The HRCT scan was conducted in supine position for the axial scanning, prone or supine position with hyper extended neck for coronal scanning. Various patterns of Interstitial lung diseases were studied and ILDs were classified according to the " Revised ATS/ERS classification of Idiopathic Interstitial Pneumonias: multidisciplinary diagnoses 2013 update". The data collected was entered in MS Excel sheet and analysed.

RESULTS

The present cross-sectional study included 51 patients diagnosed with interstitial lung disease on the basis of clinical and radiological characteristics to study the different HRCT patterns of diffuse ILDs. Majority of the patients 21 (41.17%) were in the age group of 41-50 years followed by 18 (35.29%) patients in the age group of 51-60 years. 33 (64.7%) were males and 18 (35.29%) were females. 11 (21.56%) were smokers, all were males.

A total of 16 (31.37%) patients were known cases of ILD diagnosed few years back, whereas, 35 (68.62%) cases were newly diagnosed depending on clinical, radiological and pathological findings. The symptoms were present for than 6 months in 35 (68.62%) cases. Dry cough and breathlessness on exertion were the symptoms present for more than 6 months with mean duration of 3 years.

Table 1: Distribution of study group according to Age (n=51)

	No. of cases	Percentage
Age (yrs.)		
21-30	3	5.88%
31-40	8	15.68%
41-50	21	41.17%
51-60	18	35.29%
>60	1	1.96%
Sex		
Male	33	64.70%
Female	18	35.29%
History of smoking	11	21.56%
Cases of ILD		
Old diagnosed	16	31.37%
Newly diagnosed	35	68.62%
Duration of symptoms (months)		
<1	2	3.92%
2-6	14	27.45%
>6	35	68.62%

Breathlessness on exertion (100%) and cough (84.31%) were the commonest complains among all the patients. Fever (27.45%), chest pain (23.52%), anorexia and weight loss (35.29%) and hemoptysis (5.88%) were the other presenting complaints. On clinical examination, clubbing and cyanosis were recorded in 47.05% and 7.84% cases respectively.

Table 2: Distribution of the study group according to presenting complaints and signs

Presenting complains	Frequency	Percentage
Cough	43	84.31
Dyspnea	51	98.03
Chest pain	12	23.52
Fever	14	27.45
Hemoptysis	3	5.88
Weight loss	18	35.29
Clubbing	24	47.05
Cyanosis	4	7.84

The overall patterns documented on HRCT (n = 51) were ground glass opacities (Fig 1) 45 (88.23%), reticular opacities 37 (72.54%), honey-combing (Fig 2) 32 (62.74%), nodular opacities 23 (45.09), hilar adenopathy 21 (41.17%), cyst-like 17 (33.33%) and linear opacities 11 (21.56%).In the present study, distribution of cases according to ATS/ERS 2003 Guidelines were studied. IPF was the most common pattern seen in 17 (33.33%) cases, whereas, NSIP, COP, RB-ILD, DIP and AIP patterns were revealed in 12 (23.52%), 8 (15.68%), 6 (11.76%), 3 (5.88%) and 2 (3.92%) cases respectively. LIP and Idiopathic pleuroparenchymal-fibroelestosis patterns were observed in one (1.96%) case each.

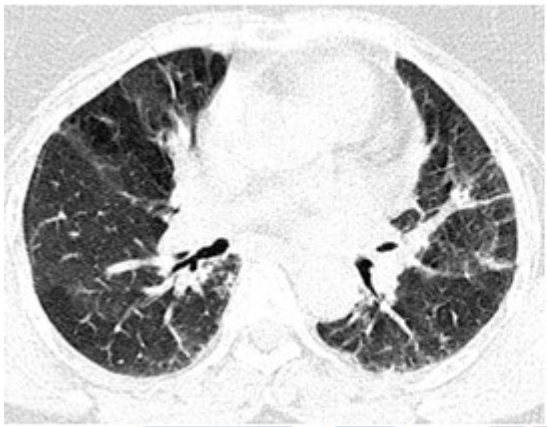

Figure 1

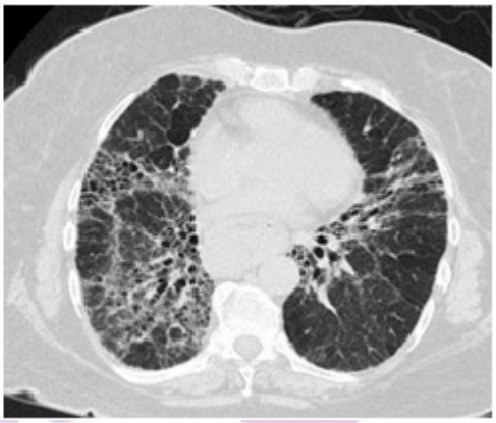

Figure 2

Figure 1: Patchy areas of Ground glass opacities in both lung fields; **Figure 2:** Both lung fields show reticular pattern on posterior segments of both lobes and peripheral honeycombing.

Table 3: Distribution of cases according to Revised ATS/ERS 2013 Guidelines

Findings	No. of cases	%
Idiopathic pulmonary fibrosis (IPF)	17	33.33
Non-specific interstitial pneumonia (NSIP)	12	23.52
Cryptogenic organizing pneumonia (COP)	8	15.68
Respiratory bronchiolitis interstitial lung disease (RB-ILD)	6	11.76
Desquamative interstitial pneumonia (DIP)	3	5.88
Acute interstitial pneumonia (AIP)	2	3.92
Lymphoid interstitial pneumonia (LIP)	1	1.96
Idiopathic pleuroparenchymal fibroelastosis (IPPF)	1	1.96
Unclassifiable	1	1.96

Table 4: HRCT findings in ILD cases

ILD diseases HRCT findings	IPF (n=17)	NSIP (n=12)	COP (n=8)	RBILD (n=6)	DIP (n=3)	AIP (n=2)	LIP (n=1)	IPPF (n=1)	Unclassifiable (n=1)
Ground glass opacities (n=45)	13 (27.65%)	11 (91.66%)	8 (100%)	4 (66.66%)	3 (100%)	2 (100%)	1 (100%)	1 (100%)	1 (100%)
Reticular opacities (n=37)	15 (88.23%)	11 (91.66%)	4 (50%)	2 (33.33%)	2 (66.66%)	0	1 (100%)	1 (100%)	1 (100%)
Honey-combing (n=32)	17 (100%)	8 (66.66%)	3 (37.5%)	0	2 (66.66%)	0	0	0	1 (100%)
Nodular opacities (n=23)	16 (94.11%)	4 (33.33%)	2 (25%)	1 (16.66%)	0	0	0	0	0

Hilar adenopathy (n=21)	3 (17.64%)	12 (100%)	4 (50%)	1 (16.66%)	0	0	1 (100%)	0	0
Linear opacities (n=11)	8 (17.02%)	2 (16.66%)	1 (12.5%)	0	0	0	0	0	0
Cyst-like (n=17)	11 (64.7%)	4 (33.33%)	1 (12.5%)	0	1 (33.33%)	0	0	0	0

DISCUSSION

The principal causes of diffuse interstitial lung disease are fibrosing alveolitis, inhalation disorders (asbestos, silica), drug induced lung disorders, interstitial pneumonias, hypersensitivity pneumonitis and connective tissue disorders/ collagen vascular diseases. These abnormalities can lead to impaired V/Q (ventilation/perfusion) mismatching, decreased diffusion and decreased lung compliance.[7] A basic understanding of the anatomy of the interstitium and the secondary pulmonary lobule is essential for understanding the pathologic processes that take place in interstitial lung diseases and their subsequent radiologic manifestations.[8]ILD is commonly seen in the middle-aged patients, and the incidence advances with increasing age. In present study peak incidence was found between 41- 60 years age group. Other studies also correlate with this study with peak incidence between 40 to 59 years.[9,10] Male predominance was noted in present study, raises possibility of occupational factor in etiology.21.56% were smokers. It has been appreciated that cigarette smoking is related to the development of several ILDs including desquamative interstitial pneumonia (DIP), respiratory bronchiolitis-associated interstitial lung disease (RBILD), pulmonary Langerhans cell histiocytosis (PLCH) and IPF.[11,12]Idiopathic pulmonary fibrosis (IPF) was the most common entity of the ILDs (33.33%). Patients with IPF present with progressively worsening dyspnea and nonproductive cough. A history of cigarette smoking seems to be a risk factor for the development of IPF. Ground-glass opacities are present in the majority of patients with IPF.[13]In the present study, ground-glass opacity on HRCT was seen in 88.23% ILD patients. Majority (68.62%) of the patients included in this study were newly diagnosed with active infection. Ground-glass opacity is a nonspecific finding that may reflect volume averaging of abnormalities that cannot be completely resolved with HRCT technique, a purely interstitial abnormality, a purely alveolar abnormality, or a disease process that involves both the pulmonary interstitium and the air spaces. The significance of ground-glass opacity depends on the patients symptoms (acute versus chronic, and the actual presenting symptoms); the distribution of the ground- glass opacity on HRCT; and the presence or absence of other findings on the HRCT study. Remy-Jardin *et al.*[14] showed that ground-glass opacity on HRCT corresponded to active, reversible pulmonary inflammation in 65% of patients undergoing biopsy. In the study by Leung *et al.*82% of patients with ground-glass opacity on HRCT had reversible disease shown on lung biopsy.[15] Reticular opacities pattern was observed in 37 (72.54%) cases. The most important form of reticular opacity encountered on HRCT imaging is intralobular interstitial thickening. Intralobular interstitial thickening is a common finding in patients with usual interstitial pneumonia– idiopathic pulmonary fibrosis, and may be the pre- dominant finding before honeycombing is evident. Non-specific interstitial pneumonia (NSIP) was found to be less than IPF (33.33% Vs 23.52%). NSIP is less common than IPF.[16] The typical patient with NSIP is between 40 and 50 years old and is usually about a decade younger than the patient with IPF. Symptoms of NSIP are similar to those of IPF but usually milder.[17] Patients present with gradually worsening dyspnea over several months, and they often experience fatigue and weight loss. On high-resolution CT, common manifestation consists of patchy ground-glass opacities combined with irregular linear or reticular opacities and scattered micronodules. The end stage of interstitial lung disease is characterized by honeycombing. It reflects extensive lung fibrosis with alveolar destruction, thereby resulting in a characteristic reticular appearance.[18] On HRCT, it is associated with gross distortion of lung architecture, where individual lobules are no longer visible. In our study, such honey-combing was seen in 32 (62.74%) of the cases. On HRCT, honeycombing was much more accurately diagnosed by the presence of thick walled, air filled cysts, usually measuring 3mm to 1cm in diameter, typically occurring in several layers at the pleural surface. Nodular opacities are another common manifestation of interstitial lung diseases. In our study 23 (45.09) had nodular opacities on HRCT. The appearance of the nodules themselves can be an indicator as to whether they are interstitial or air space nodules. Interstitial nodules tend to be sharply marginated while air space nodules poorly defined.[18] Nodules were classified as peri lymphatic, random and centrilobular based on their distribution on HRCT. This distinction of nodules was much better appreciated on HRCT scans. The scenario in which there is a high clinical suspicion of lung disease but with normal chest radiograph is a common reason for requesting HRCT. HRCT allows earlier diagnosis of IPF, helps to narrow the differential diagnosis based on the CT patterns. HRCT of the chest

can be performed as stand-alone study or as an adjunct to conventional CT,[19] there are two key differences between HRCT and conventional CT images. First beam collimation is narrower (1-3 mm). By reducing slice thickness to improves the spatial resolution and hence reduces partial volume averaging effect.[20] Secondly specialized algorithm is used to reconstruct the data (high frequency) and take advantage of the intrinsically high contrast milieu of the lungs.[21] The scans are performed during breath holding at the end inspiration and image slices will be inter-spaced (usually a gap of 10mm). Expiratory HRCT scan may be performed to identify air trapping.[22]In suspected interstitial fibrosis, where CT abnormalities are subtle, limited number of images with patient prone may be performed to distinguish established disease rather than gravitational induced atelectasis. Compared to conventional (10 mm collimation) sections HRCT improves the detection of subtle parenchymal abnormalities, ground-glass opacification, small cystic air spaces.[23]

CONCLUSION

Rigorous application of an ordered, pattern approach to HRCT abnormalities allows for reproducible and accurate interpretation. The advent of HRCT as an imaging modality has obviated the need for a lung biopsy in many patients. Characteristic findings on HRCT scans are often sufficient to diagnose ILDs.

REFERENCES

1. Antoniou KM, Margaritopoulos GA, Tomassetti S, Bonella F, Costabel U, Poletti V. Interstitial lung disease. EurRespir Rev 2014; 23: 40–54.
2. Hansell DM, Bankier AA, MacMahon H, McLoud TC, Müller NL, Remy J. Fleischner Society: Glossary of Terms for Thoracic Imaging. Radiology2008; 246:3, 697-722.
3. Caminati A, Cavazza A, Sverzellati N, Harari S. An integrated approach in the diagnosis of smoking-related interstitial lung diseases. EurRespir Rev 2012; 21(125):207-17.
4. Glazer CS, Newman LS. Occupational interstitial lung disease. Clin Chest Med. 2004; 25(3):467-78, vi.
5. David Sutton. Textbook of Radiology and Imaging. 2002; Vol1.Seventh edition, chapter 7, page 187. Elsevier India.
6. American Thoracic Society / European Respiratory Society international multidisciplinary consensus classification of the idiopathic interstitial pneumonias. Am J RespirCrit Care Med 2002; 165:277–304.
7. Interstitial lung disease: Clinical evaluation and keys to an accurate diagnosis. Clin Chest Med 2004;25:409-419.
8. John R. Haaga, Vikram S Dogra, Michael Forsting, Robert C Gilkeson, Hyun Kwon Ha, Murali Sundaram. CT and MRI of the whole body, Fifth edition,Vol 1;chapter 22;877-879.
9. Sen T, Udwadia ZF. Retrospective study of interstitial lung disease in a tertiary care centre in India. Indian J Chest Dis Allied Sci2010;52:207-11.
10. Kundu S, Mitra S, Ganguly J, Mukherjee S, Ray S, Mitra R. Spectrum of diffuse parenchymal lung diseases with special reference to idiopathic pulmonary fibrosis and connective tissue disease: An eastern India experience. Lung India 2014;31:354-60.
11. Murin S, Hilbert J, Reilly SJ. Cigarette smoking and the lung. Clin Rev All Immunol 1997; 15: 307-336.
12. J.H. Ryu, T.V. Colby, T.E. Hartman, R. Vassallo. Smoking-related interstitial lung diseases: a concise review. EurRespir J 2001; 17: 122-132.
13. MacDonald SL, Rubens MB, Hansell DM, *et al...* Nonspecific interstitial pneumonia and usual interstitial pneumonia: comparative appearances at and diagnostic accuracy of thin-section CT. Radiology 2001;221:600 – 605.
14. Remy-Jardin M, Giraud F, Remy J, *et al...* Importance of ground-glass attenuation in chronic diffuse infiltrative lung disease: pathologic-CT correlation. Radiology 1993;189:693 – 8.
15. Leung AN, Miller RR, Muller NL. Parenchymal opacification in chronic infiltrative lung diseases: CT-pathologic correlation. Radiology 1993;188:209– 14.
16. Leslie KO. Pulmonary pathology for the clinician. Clin Chest Med. 2006; Mar;27(1 Suppl 1): S1-10.
17. Cushley MJ, Davison AG, du Bois RM, Egan JJ, Flower CD, Gibson GJ, Greening AP, Ibrahim NB, Johnston ID, Mitchell DM, Pickering CA. The diagnosis, assessment and treatment of diffuse parenchymal lung disease in adults: British Thoracic Society recommendations. Thorax 1999; 54: s1-s30
18. Webb WR, Muller NL, Naidich DP. HRCT findings of lung disease. In: Webb WR, Muller NL, Naidich DP (eds). HRCT of the lung 2nd(ed). Philadelphia: Lippincott, Raven, 1996; 41-108.
19. Wells AU. Clinical usefulness of HRCT in cryptogenic fibrosing alveolitis. Thorax 1998; 53: 1080 -1087.
20. Sieglman SS, Zerhouni EA, Leo FP, *et al...* CT of the solitary pulmonary nodule. AJR 1980; 135: 1-13.
21. Mayo JR, Webb WR, Gould R, *et al...* HRCT of the lungs: an optimal approach. Radiol 1987; 163: 507 -510.
22. Remy JM, Remy J, *et al...* HRCT pathologic correlation in chronic diffuse infiltrative lung disease. Eur Radio 1999; (supp 2): 579-587.
23. Remy JM, Remy J, Deffontaines C, eta l. Assessment of diffuse infilterative lung disease, comparison of convential CT and high-resolution CT. Radiol 1991; 181: 157 -162.

Source of Support: None Declared
Conflict of Interest: None Declared