Original Research Article

Utility of high-resolution computed tomography in differentiating diffuse parenchymal lung diseases

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Abstract

Background: High resolution computed tomography (HRCT) scanning is currently the most accurate non-invasive modality for evaluating the lungparenchyma. It is particularly helpful in the evaluation of DPLD, as clinical presentation and histopathologic patterns can show significant overlap and there can be significant heterogeneity of disease throughout the lung. **Aim:** To evaluate performance of HRCT to differentiate diffuse parenchymal lung diseases. **Material and Methods:** The study group included a total of 60 patients with suspected clinical diagnoses of diffuse parenchymal lung disease. Contrast enhanced spiral axial computed tomographic scans of the chest were obtained in each patient on Siemens Somatom Emotions 6spiral CT scanner. **Results:** The most commonly identified diffuse parenchymal lung disease was idiopathic pulmonary fibrosis (including chronic interstitialpneumonias) comprising 31.6% of the total cases. The next most common group was of patients with tuberculosis including miliary tuberculosis that comprised 16.67% of the total cases. **Conclusion:** High resolution computed-tomography is an invaluable tool in the diagnosis and characterization of diffuse parenchymal lung disease in an appropriate clinical setting.

Key Words: Diffuse parenchymal lung disease, High resolution computed-tomography, idiopathic pulmonary fibrosis, differentiation.

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INTRODUCTION

Diffuse parenchymal lung disease (DPLD) describes a heterogenous group of disorders of the lower respiratory tract characterized by inflammation and derangement of the interstitium and loss of functional alveolar units. It includes a wide spectrum of diseases comprising more than 200 entities.[1,2] Radiological imaging plays an important role in the evaluation of DPLDs. High resolution computed tomography (HRCT) scanning is currently the most accurate non-invasive modality for evaluating the lungparenchyma. It is capable of imaging the lung parenchyma with excellent patial resolution and providing anatomical detail similar to that seen by gross pathological examination. HRCT is particularly helpful in the evaluation of DPLD, as clinical presentation and histopathologic patterns can show significant overlap and there can be significant heterogeneity of disease throughout the lung.[3] The added value of HRCT scanning in DPLD depends upon its ability to increase confidence of a specific diagnosis, to alter patient management and if possible, to influence outcome. We evaluated the performance of HRCT to differentiate diffuse parenchymal lung diseases.

MATERIAL AND METHODS

The study was conducted in the Department of Radiodiagnosis, SDM hospitals, in association with Department of Medicine and Department of Pathology over a period of one year.

Inclusion Criteria

1. Patients with suspected clinical diagnoses of diffuse parenchymal lung disease.
2. Both the sexes were included in the study
3. Insidious onset of otherwise unexplained dyspnea on exertion
4. Bibasilar inspiratory crackles

Exclusion Criteria

1. Pregnant females

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2. Patients who already had diagnostic work up elsewhere and on treatment.
3. Patients with known cardiovascular morbidities and on treatment.
4. Patients with diagnosed carcinoma lung.

A detailed history was elicited from each patient and findings of general and systemic examination were noted in each patient. Relevant laboratory investigations were recorded in each case. Detailed pulmonary function tests were done in the Department of Medicine in all patients presenting with dyspnea.

HRCT protocol: Contrast enhanced spiral axial computed tomographic scans of the chest were obtained in each patient on Siemens Somatom Emotions 6spiral CT scanner. Patients were instructed to come after overnight fastingon the day of the examination. Images were obtained using helical data acquisition with 6mm sections using a pitch of 1-1.5mm in a caudocranialdirection after giving bolus intravenous contrast agent (60-80ml of iodinated contrast). Non-ionic contrast was used wherever indicated. Patients were asked to inspire fully and hold their breath while the data acquisition was completed. Thinner sections were taken in children. Images were evaluated on both mediastinum and lung windows ettings. Next, non-enhanced high resolution sequential axial scans of the chest with 1mm collimation at a scan interval of 15-20mm in fullinspiration with patient in supine position were obtained. The images were reconstructed using a high spatial frequency or bone algorithm. The exact technique was tailored for individual cases. The aspects of the lung parenchyma evaluated were large bronchi and vessels, secondary pulmonary lobule and its components and lung interstitium. The features of lung involvement by diffuse parenchymal lung diseases were noted. HRCT were retrospectively and independently reviewed by two specialized and experienced radiologists blinded to the clinical data. The findings were recorded in a tabulated manner and a differential diagnosis based on the HRCT findings was made.

RESULTS

The study included 60 patients with a clinically suspected diagnosis of diffuse parenchymal lung disease meeting the inclusion and exclusion criteria and referred for thoracic computed tomography.

Table 1: Distribution of Cases (n=60)

Sr. No.	Pathology	No. of Patients	Percentage
1	Idiopathic pulmonary fibrosis(including chronicinterstitial pneumonias)	19	31.6
2	Sarcoidosis	8	13.3
3	Tuberculosis and post-tubercular disease	7	11.6
4	Connective tissue disorders (includingprogressive systemic sclerosis and otherdiseases)	5	8.3
5	Hypersensitivity pneumonitis	5	8.3
6	Bronchiectasis	5	8.3
7	Miliary tuberculosis	3	5
8	Bronchiolitis obliterans organizing pneumonia	2	3.3
	OTHERS		
1	Radiation induced fibrosis	1	1.6
2	Diffuse metastases	1	1.6
3	Silicosis	1	1.6
4	Histiocytosis X	1	1.6
5	Lymphangioleiomyomatosis	1	1.6
6	Acute interstitial pneumonia	1	1.6

The most commonly identified diffuse parenchymal lung disease was idiopathic pulmonary fibrosis (including chronic interstitialpneumonias) comprising 31.6% of the total cases. The next most common group was of patients with tuberculosis including miliary tuberculosis that comprised 16.67% of the total cases (Table 1).

Table 2: HRCT Findings in patients with DPLDs

HRCT Findings	IPF (n=19)	Sarcoidosis (n=8)	CTD (n=5)	HP (n=5)	Miliary TB (n=3)	TDLD (n=7)	Bronch
			Septal thickening				
Interlobular	18 (94.7%)	4 (50%)	5 (100%)	2 (40%)	2 (66%)	4 (57.1%)	0 (0%)
Centrilobular	8 (42.1%)	5 (62.5%)	1 (20%)	4 (80%)	3 (100%)	3 (42.8%)	0 (0%)
Peribronchovascular	10 (52.6%)	6 (75%)	2 (40%)	2 (40%)	3 (100%)	3 (42.8%)	0 (0%)
Subpleural	14 (73.6%)	4 (50%)	2 (40%)	0 (0%)	1 (33%)	4 (57.1%)	0 (0%)
Intralobular	18 (94.7%)	2 (25%)	4 (80%)	1 (20%)	0	4 (57.1%)	

			Predominant zones involved				
Upper	1 (5.2%)	4 (50%)	1 (20%)	2 (40%)	0	3 (42.8%)	0 (0%)
Mid	3 (15.7%)	3 (37.5%)	2 (40%)	2 (40%)	0	3 (42.8%)	1 (20%)
Lower	6 (31.5%)	0 (0%)	4 (80%)	1 (20%)	0	2 (28.6%)	3 (60%)
Diffuse	9 (47.3%)	4 (50%)	0 (0%)	2 (40%)	3 (100%)	2 (28.6%)	2 (40%)
			Predominant distribution				
Central	0 (0%)	3 (37.5%)	1 (20%)	0	0	0	0 (0%)
Peripheral	8 (42.1%)	0 (0%)	4 (80%)	0	0	0	0 (0%)
Diffuse/random	11 (57.8%)	5 (62.5%)	0 (0%)	5 (100%)	3 (100%)	7 (100%)	5 (100%)
			Predominant pattern				
Reticular	15 (78.9%)	0 (0%)	5 (100%)	1 (20%)	0	2 (28.6%)	5 (100%)
Nodular	0 (0%)	5 (62.5%)	0	3 (60%)	3 (100%)	4 (57.1%)	3 (60%)
Reticulonodular	4 (21%)	3 (37.5%)	0	1 (20%)	0	3 (42.8%)	0 (0%)
Alveolar opacities	0 (0%)	0 (0%)	0	0	0	4 (57.1%)	
Nodules with cavitation	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (33%)	4 (57.1%)	0
Honeycombing	17 (89.4%)	4 (50%)	3 (60%)	1 (20%)	0	4 (57.1%)	0
Ground glass haze	16 (84.2%)	6 (75%)	5 (100%)	5 (100%)	2 (66%)	5 (71.4%)	3 (60%)
Traction bronchiectasis	10 (52.6%)	1 (12.5%)	0	1 (20%)	0	4 (57.1%)	0
Conglomerate fibrosis	7 (36.8%)	2 (25%)	0	1 (20%)	0	2 (28.6%)	0
Pleural thickening	0	5 (62.5%)	3 (60%)	1 (20%)	0	4 (57.1%)	3 (60%)
Cardiomegaly with prominent pulm. art.	0	2 (25%)	3 (60%)	0	0	0	0
Mediastinal / hilar lymphadenopathy	0	7 (87.5%)	3 (60%)	2 (40%)	3 (100%)	6 (85.7%)	4 (80%)

(IPF=Idiopathic pulmonary fibrosis; CTD=Connective tissue disorders; HP=Hypersensitivity pneumonitis; TDLD=Tubercular Diffuse Lung diseases; Bronch=Bronchiactasis)

Table 2 and 3 shows the HRCT findings in patients with DPLDs and in the rest of the diffuse lung diseases.

Table 3: HRCT findings in the rest of the diffuse lung diseases

HRCT Findings	Silicosis (n=1)	Diffuse meta (n=1)	Hx (n=1)	LAM (n=1)	RIF (n=1)	BOOP (n=2)	AIP (n=1)
Septal thickening							
	1	0	1	1	1	0	0
Interlobular Centrilobular Peribronchovascular SubpleuralIntralobular	1	1	1	0	1	0	0
	1	1	1	0	1	1	0
	1	1	0	1	1	1	0
	0	0	0	1	1	0	0
Predominant zones involved							
Upper	1	0	1	0	0	0	0
Mid	1	0	1	0	0	0	0
Lower	0	0	0	0	0	0	0
Diffuse	0	1	0	1	1	2	1
Predominant distribution							
Central	0	0	0	0	0	0	0
Peripheral	0	0	0	0	0	1	0
Diffuse/random	1	1	1	1	1	0	1
Predominant pattern							
	0	0	0	0	1	0	0
Reticular	1	1	1	0	0	0	0
Nodular Reticulonodular Alveolar opacities	0	0	0	0	0	0	0
Cystic lucencies	0	0	0	0	0	2	0
	0	0	1	1	0	0	0
Honeycombing	1	0	0	1	1	0	0
Ground glass haze	1	0	1	1	1	2	1

(Hx=Histiocytosis X; LAM=Lymphangioleiomyomatosis; RIF=Radiation induced fibrosis; BOOP=Bronchiolitis obliterans organizing pneumonia; AIP=Acute Interstitial Pneumonia)

DISCUSSION

The present study was undertaken to differentiate DPLDs using HRCT in our hospital set up. Sixty patients with suspected clinical diagnosis of DPLD and referred for thoracic CT were included in the study. The most common diffuse parenchymal lung disease encountered in our study group was idiopathic pulmonary fibrosis (IPF) including chronic interstitial pneumonias accounting for 31.6% of cases. Coultas *et al* reported that IPF accounts for 25-50% of total DPLDs.[2]Tuberculosis formed the second major group constituting 10 cases. Miliary tuberculosis accounted for 30% of these cases and the rest were other forms of active tuberculosis or sequelae of old disease. Eight cases of sarcoidosis accounting for 13.3% of cases were also seen.

Idiopathic pulmonary fibrosis

Our study included 19 patients with idiopathic pulmonary fibrosis, comprising 31.6% of total cases. On HRCT scans, the predominant features observed were interlobular and intralobular septal thickening (94.7% cases) in a reticular pattern throughout the lung fields. Nishimura *et al* reported the incidence of septal thickening in 94% of cases.[4] Though a diffuse pattern of disease was observed in 54% of cases, the lower zones and the peripheral lung fields were more commonly involved. Austin *et al* reported similar findings.[5] Honeycombing was present in 89.4% of cases, more commonly present in the subpleural and peripheral location. Staples *et al* reported 90% incidence of honeycombing in cases of IPF identified on HRCT.[6]Traction bronchiectasis and conglomerate fibrosis were associated with the presence of honeycombing. Ground glass opacities were present in 84.2% of cases with IPF. Similar findings were reported by Remy-Jardin *et al*.[7] Patchy ground glass opacities were the only finding in 1 case, suggestive of early disease. Ground glass haze was more frequently present in patients, with lesser degrees of fibrosis. These findings suggest the presence of active reversible disease as suggested by Leung *et al*.[8] Histopathological examination was done in one case; it showed findings of peribronchiolar fibrosis and small honeycomb cysts.

Sarcoidosis: Patients with sarcoidosis comprised of 13.3% of cases in our study group. On HRCT, a nodular pattern of interstitial thickening was the predominant finding present in 62% of cases. Grenier *et al* reported a similar incidence of nodular septal thickening in patients with sarcoidosis.[9] A predominant central distribution of the nodules was seen in 37.5% cases with more common involvement of the upper and mid zones of the lungs (50% cases). Brauner *et al* reported an upper, and mid zonal predominance in two-thirds of the cases of sarcoidosis.[10] A perilymphatic distribution of nodules along the peribronchovascular (75%), centrilobular (62.5%) and the subpleural interstitium was found in majority of cases. Muller *et al* and various other authors described similar findings.[11] Conglomerate nodules measuring more than 1cm in diameter were present in 2 cases (25%). Various authors reported similar incidence of conglomerate nodules.[11-13]Honeycombing was seen in 50% of cases, more commonly in the upper and mid zones in a subpleural location. These cases represent advanced disease with progressive fibrosis. Mediastinal and hilar lymphadenopathy was apparent on CT in 87.5% of the cases of sarcoidosis. The predominant groups involved were right paratracheal (100%), right hilar (87%), subcarinal and precarinal regions. Large anterior mediastinal nodes were also seen in two of the cases. Sider *et al* reported a similar frequency of lymph nodal involvement.[14]

Hypersensitivity Pneumonitis: Patients with hypersensitivity pneumonitis comprised of 8.3% of the total cases. On HRCT, diffuse ground glass haze was present in all the patients. Ill-defined centrilobular nodules were seen in 60% of cases. Hansell and Maskovic reviewed HRCT findings in 15 patients with subacute hypersensitivity pneumonitis. They found that the most common abnormality was the presence of ground glass haze seen in 73% of patients with poorly defined nodules measuring upto 4mm in diameter seen in 40% cases.[15]

Connective Tissue Disorders: Our study group included 5 patients with connective tissue disorders. Three of these cases were diagnosed cases of progressive systemic sclerosis (PSS) by skin biopsy. One patient was a known case of mixed connective tissue disease. On HRCT, a typical pattern of peripherally distributed (80%) reticular opacities (100%) with lower zone predominance was seen in 4 out of the 5 cases. These reflect the occurrence of chronic interstitial fibrosis in these patients. Schurawitzki *et al* reported similar findings in patients with PSS.[16] Honeycombing was present in 60% cases mostly in a subpleural location. Schurawitzki *et al* found honeycombing in 43% of cases. Ground glass haze was present in all the cases. In 2 cases with Progressive systemic sclerosis, evidence of esophageal dilatation was seen in the mediastinal window scans. Grenier *et al* reported the incidence of esophageal dilatation as 40-80% in PSS.[17] Enlarged mediastinal nodes were seen in 60% of the cases. Similar findings were found by Bhalla *et al*.[18]

Tuberculosis and Miliary TB: Patients with diffuse tubercular lung disease comprised 10 cases with three patients showing a miliary pattern of disease. A previous

history of pulmonary tuberculosis was elicited in 5 of the 10 patients. On HRCT scans, randomly distributed fine nodular lesions measuring 1 to 3mm scattered throughout both lung fields were seen in all the cases. Similar findings were described by Hong *et al*.[19] Nodules were seen along bronchovascular bundles and centrilobular interstitium in all the cases. The random distribution of the nodules is due to massive lymphohematogenous dissemination of tubercle bacilli. Patchy ground glass haze was seen in 66% cases.

Other forms of pulmonary tuberculosis: Random or diffuse involvement of the lung by pulmonary tuberculosis and its sequelae were seen in 7 patients. A previous history of tuberculosis was elicited in 5 patients. The predominant findings on HRCT in all the patients with active tuberculosis (57.1% cases) included patchy air space consolidation of varying degrees, fibrotic opacities, poorly defined nodular opacities few of them showing cavitation (seen in 57.1% cases) and interlobular septal thickening (57% of cases). An ill-defined aggregation of centrilobular nodules suggestive of endobronchial spread was seen in 3 patients. Honeycombing with bronchovascular distortion and fibrosis were identified in 57% of cases. Pleural thickening or effusion was identified in 4 cases. Im *et al* reported the prevalence of HRCT findings in tuberculosis.[20] The findings in active tuberculosis included patchy air-space consolidation (52%), cavitory nodules (69%), interlobular septal thickening (34%), bronchovascular distortion (17%) and fibrotic bands (17%) and scattered centrilobular branching structures or tree-in-bud pattern. Fibrosis, honeycombing and bronchiectasis occurred in advanced cases. Mediastinal lymphadenopathy was seen in 6 patients, most commonly the right paratracheal group. Two of these showed evidence of calcification. The present study concludes that High resolution computed-tomography is an invaluable tool in the diagnosis and characterization of diffuse parenchymal lung disease in an appropriate clinical setting.

REFERENCES

1. Bergin CJ, Muller NL. CT of interstitial lung diseases - adiagnostic approach. AJR Am J Roentgenol 1987; 148: 9-15.
2. Coultas DB, Zumwalt RE, Black WC etal.Theepidemiology of interstitial lung diseases. Am J RespCritCare Med 1994; 150: 967-72.
3. Hansell DM, Kerr IH. The role of high resolution computed tomography in the diagnosis of interstitial lung disease. Thorax 1991; 46.2:77-84.
4. Nishimura K, Kitaichi M, Izumi T, et al. UIP - histologic correlation with high resolution computed tomography. Radiology 1992; 182:337-42.
5. Austin JHM, Muller NL, Friedman PJ, et al. Glossary for terms for CT of lungs: Recommendations of Nomenclature Committee of Fleishner society. Radiology 1996; 200:32.
6. Staples CA, Muller NC, Vedal S, et al. UIP- correlation of CT with clinical, functional and radiologic findings. Radiology 1987; 162:377-381.
7. Remy-Jardin M, Remy J, et al. Pulmonary involvement in progressive systemic sclerosis: sequential evaluation with CT, Pulmonary function tests and bronchioalveolar lavage. Radiology 1993;188:499-506.
8. Leung AN, Miller RR, Muller NL. Parenchymal opacities in chronic infiltrative lung diseases: CT-pathologic correlation. Radiology 1993; 188:209-214.
9. Grenier P, Valeyre D, Cluzel P, et al. Chronic diffuse infiltrative lung disease: Diagnostic value of chest radiography and HRCT. Radiology 1991; 179:123-132.
10. Brauner MW, Grenier P, Mompoint D, et al. Pulmonary sarcoidosis - evaluation with HRCT. Radiology 1989; 172(2):467-71.
11. Muller NL, Kullnig P, et al. CT findings of pulmonary sarcoidosis: analysis of 25 patients. AJR 1989; 152.6:1179-1182.
12. Nishimura K, Itoh H, Kitaichi M, et al. Pulmonary sarcoidosis - correlation of CT and histologic findings. Radiology 1993; 189:105-109.
13. Bergin CJ, Bell DY, Coblentz CL, et al. Sarcoidosis: correlation of pulmonary parenchymal patterns at CT with results of pulmonary function tests. Radiology 1989; 171:619-624.
14. Sider L, Horton ES Jr. Hilar and mediastinal adenopathy in sarcoidosis as detected by CT. J Thoracic Imaging 1990; 5:77-80.
15. Hansell DM, Moskovic E. HRCT in extrinsic allergic alveolitis. Clin Rad 1991; 43:8-12.
16. Schurawitzki H, Stiglbauer R, et al. Interstitial lung disease in progressive systemic sclerosis: HRCT versus radiography. Radiology 1990; 176:755-59.
17. Grenier P, Chevret S, Beigelman C, et al. Chronic diffuse infiltrative lung disease: Determination of diagnostic value of clinical data, chest radiography and CT with Bayesian analysis. Radiology 1994; 191:383-90.
18. Bhalla M, Silver RM, Shephard JD, et al. Chest CT in patients with scleroderma - prevalence of asymptomatic esophageal dilatation and mediastinal lymphadepopathy. AJR 1993;161:269-72.
19. Hong SH, Im JG, Lee SS, et al. HRCT study of miliary tuberculosis Journal of Comput Assist Tomograph 1998; 22:220-24.
20. Im JG, Itoh H, Shim YS, et al. Pulmonary tuberculosis - CT findings -early disease and sequential change with anti- tubercular therapy. Radiology 1993;186:653-60.

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