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Radiodiagnosis

REVIEW OF LUNG PARENCHYMAL DISEASE BY HRCT CHEST

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ABSTRACT

1.AIM: To look for region specific patterns, extent, progression and treatment response of lung diseases as well as correlation of PFT with HRCT chest findings.

2.METHOD:HRCT chest were performed in symptomatic or CXR positive 100 patients in 1year period. 1 mm slice thickness, 10 mm interval in breath holding, high KV & mAs were kept for acquisition. Expiratory phase in suspected air trapping. 30 patients underwent PFT & few underwent BAL and biopsy.

3.RESULTS: Of the 100 patients, 5 % of were kids. Tuberculosis was the most common cause on HRCT. Air space pathology in 40 %. The most frequent HRCT pattern in ILD was ground glassing in 20 %, followed by a reticular pattern in 7 %. Nodular pattern was randomly distributed in 3 %. Mixed reticulo-nodular pattern of disease seen in 4 %. Symmetrical distribution in 80 % of the patients. Lower zone predominance in 75 %. HRCT was normal in 25 %. 7 % had malignancy. Vasculitis were seen in 6%. Adenopathy was found in 17 %. Out of 30 PFT, 28 patients were positive. 4 patients had restrictive, 1 patient had obstructive pattern and rest showed mixed findings. Post bronchodilator reversibility in 20 patients & 8 were irreversible due to IPF.

4.CONCLUSION:HRCT is most accurate non-invasive gold standard test for evaluating lung parenchyma, diagnosing ILD, detecting the activity, distinguishing types of Pneumonitis, planning treatment, assessing prognosis, scoring of IPF and deciding assisted biopsy.

KEYWORDS : Ground glassing, Nodule, Bronchiectasis, reticulation.

MATERIAL & METHODS

I have studied 100 patients of Kerala population in one-year period between December 2005 to December 2006 during my PG residency. Patient's selection was at random who presenting with cough, expectoration, haemoptysis, dyspnoea, chest pain, wheeze in pulmonology OPD or diffuse lung involvement on CXR in all clinically suspicion of lung diseases.

HRCT chest were performed in a dedicated Radiology department. This study of evaluation of parenchymal lung disease utilizes "GE-high Speed single slice. Spiral Computed Tomography System" (modified third generation machine). It is a sub second spiral CT scan machine having both axial and helical section-functions. Different softwares like MIP, MPR, 3-D, virtual endoscopy and SSD were used to improve the accuracy of the lesion detection when applicable.

HRCT scans were be performed using 1 mm slice thickness at 10 mm interval with proper breath holding, high Kv, and high mAs for acquisition. Wide window width is used during display.

In suspected air trapping, scanning was done in expiratory phase.
In selected patients with questionable pathology at the dependant portion of lungs, CT sections in prone posture were taken.

Out of 100 HRCT scanned patients, only 30 patients underwent pulmonary function tests. These patients were assessed for the functional abnormality and categorized as pure restricted dysfunction, pure obstructive dysfunction and combined dysfunction.

These functional abnormalities were correlated with the HRCT findings and conclusions were drawn from them.

Only few patients underwent BAL (Broncho-alveolar lavage) and lung – biopsy.

On treatment, patients were followed up with repeat HRCT and differences were observed.

RESULTS

Of the 100 patients studied in Kerala population, there were 48 males and 52 females. Only 5 % of these were children. Rests were adults. Majority of the patients presented with fever (30) and dyspnoea (30), of whom exertional dyspnoea was predominant in 10 patients. Cough was the next most common presentation (25). Haemoptysis was noted in 8 patients. Majority had a combination of symptoms at the time of presentation. 30 patients were smokers. Pulmonary function tests (PFT) were performed in 30 patients. Normal PFT was noted in 2 patients (cardiogenic cause of dyspnoea), 4 patients had pure restrictive type and 1 patient had pure obstructive of lung disease. Majority of the patients had a combination of findings (23). Post bronchodilator reversibility was seen in 20 patients (good - 16, fair - 4) and 8 did not show any significant increase of FEV1 (i.e. 12% of predicted) after 2 puffs of bronchodilator (terminal stage of lung disease- fibrosis, BOOP).

15 patients out of 100 had cardiac disorder in the form of mitral valve disease, myocardial infarction, dilated cardiomyopathy or pulmonary hypertension. Tuberculosis was the most common known pulmonary cause of parenchymal changes on HRCT. Cavitatory, infiltrative or old healed tuberculous focuses were found in these patients. Other bacterial or fungal infections were seen in 12 patients in whom we found scattered areas of nodular air space densities or Tree-in-Bud patterns of airspace and airway combination. 7 patients were diagnosed to have malignancy, either primary in lung (Bronchogenic carcinoma) or secondaries in lung from breast, thyroid and unknown primary sites. Vasculitis as a cause of parenchymal lung changes was seen in 6 patients. In those, pulmonary hemorrhages, Centrilobular nodules and emphysema were found. Interstitial changes like septal thickening with honeycombing were found associated with collagen vascular disease in 5 patients. Few patient was Rh. factor positive. 3 patients had asthma and showed air trapping with emphysema. Foreign body was also found to be one of the causes of lobar emphysema in 2 patients. However, in 12 patients, no obvious causes of the parenchymal changes were found. Of which, few had Idiopathic Pulmonary fibrosis (IPF).

HRCT did not show any abnormality in 25 % of patients. The most frequent HRCT pattern in ILD was ground glass pattern in 20 % without any zonal predominance, followed by a reticular pattern in 7 %. These were noted mainly in the middle and lower lung zones. Nodular pattern was randomly distributed in 3 subjects. Mixed reticulo-nodular pattern of disease was seen in 4 % of patients. Nodular and infiltration type of air space accounted for 40 %. 15 % patients had airway disease in the form of bronchiectasis and tree in bud appearance. Associated features such as emphysema, bronchiectasis, mosaic perfusion, pleural thickening or effusion and honeycombing are shown in Table 2. Symmetrical distribution of the lesions was noted in 80 % of the patients. Lower zone was predominantly involved in 75 % while segmental distribution was observed with equal frequency in all the patients.

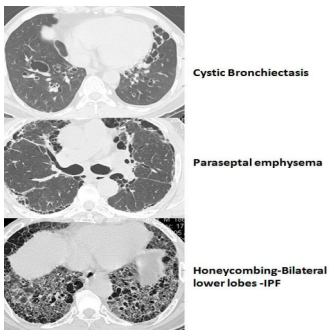


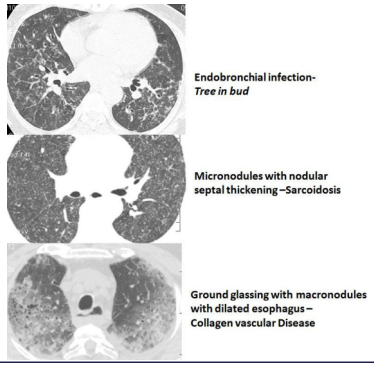
Figure1: Lung Cysts

Bronchiectasis was seen in 34 patients, in whom true dilatation were seen in 14 patients. 20 patients had dilated stretched bronchi secondary to fibrotic changes and honey combing especially in terminal stage of lung disease.

Out of 28 positive PFT patients, following were the predominant findings on HRCT chest: Bronchiectasis - 5, Nodules (air space) - 4, Honeycombing - 3, Emphysema - 3, Ground glassing - 3, Collapse-consolidation - 2, Mass - 2, 1 each of Tree in bud, Reticulonodular and pleural thickening. Of these, 12 patients had pathology involving < 5 segments, 10 patients between 5-10 segments and only 6 patients > 10 segments. Reversibility was poor or absent if > 10 segments were involved. Fair reversibility was seen between 5-10 segments involved.

HRCT findings in positive PFT patients:

HRCT findings (Predominant)	Segments	N	Reversibility PFT
Bronchiectasis	<5 5-10 >10	2 1 2	+ + +
Nodules	<5 5-10 >10	3 0 1	- -
Honey combing	<5 5-10 >10	0 1 2	- -
Emphysema	<5 5-10 >10	1 2 0	+ +
Ground glass	<5 5-10 >10	2 1 0	+ +
Consolidation / collapse	<5 5-10 >10	1 1 0	+ +
Mass	<5 5-10 >10	2 0 0	+
Tree in bud	5-10	1	+
Military nodules	5-10	1	+
Reticulo-nodular	5-10	1	+
Pleural Thickening / effusion	<5 5-10 >10	1 1 1	+ - -



Features of interstitial Pneumonia

AIP	1. Predominantly LINEAR opacities. INTRALOBULAR. 2.Subpleural, patchy, reticular, 3. Irregular interfaces between pulm.vessels, lung tissue, bronchi & pleural surfaces. 4.Traction bronchiectasis / bronchiectasis 5. Groundglass attenuation. 6.Mediastinal nodes 70-90 % 7.LATE STAGE: Honeycombing – patchy	IRREGULAR LINEAR OPACITIES & HONEYCOMBING
DIP	1. Predominantly GROUNDGLASS attenuation. 2.Middle & lower lobes 3.Peripheral location 4. MINIMAL Irregular LINEAR PERIPHERAL opacities. 5.EXCLUSIVELY SMOKERS	EXCLUSIVELY SMOKERS GROUNDGLASS OPACITIES
RB ILD	1. ILL-DEFINED CENTRILOBULAR NODULES. 2.Upper lobe predilection	EXCLUSIVELY SMOKERS
AIP (Hamman-Rich Syndrome)	1.DIFFUSELY UNIFORM pattern 2.GROUNDGLASS opacities 3.Patchy consolidations	UNCOMMON ANY AGE GROUP
NSIP	1.Patchy or diffuse GROUND-GLASS ATTENUATION 2.Consolidations in lower lobes 3. Irregular linear opacities	RELATIVELY COMMON NEXT TO UIP MIDDLE AGE GROUP

Malignancy, either primary or secondary in lung was next common finding with features of peribronchial mass lesion having spiculations and mediastinal lymphadenopathy with or without encasing the bronchi and great vessels. Haematogeneous metastasis on HRCT typically show multiple, small, peripheral and basal nodules. It is not related to any lobule or segment. However at times they are visible in relation to vessels or pleural surfaces.

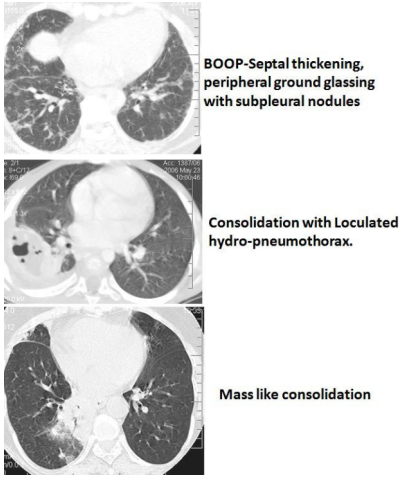


Figure 3: Air space Pathology

Adenopathy was found in 17 patients. In some patients, they were associated with other changes of tuberculosis. Few were calcified. Commonest locations in these patients were carinal. Hilar adenopathy were found in malignancy. Usually they were unilateral, ipsilateral to the site of malignancy. Hilar and bronchial lymph nodes were seen in sarcoidosis in 2 patients. They were discrete rounded; homogeneous and associated with other changes like septal thickening and fibrosis. Random adenopathy were seen in patients with unknown etiology.

HRCT features of common ILD

	DISTRIBUTION	PATTERN
Sarcoidosis	Upper lobe	Nodules (Lymphatic), Fibrosis
Langerhans	Upper lobe	Nodules (Respiratory), Cysts (Bizarre)

IPF	Lower lobe (Periphery)	Reticular, Honeycombing
Lymphangitic tumour	Spares lobe or lung	Irregular septal
Chronic oedema	Batwing (Dependent)	Smooth septal
Asbestosis	Lower lobe (Periphery)	Reticular, Honeycombing
Collagen vascular disease	Lower lobe (Periphery)	Reticular, Honeycombing
Environmental disease	Farmer's lung	Nodules (Respiratory)
	Silicosis	Nodules (Lymphatic)
Drugs	Any pattern	Any pattern

DISCUSSION

Among ILD, ground glassing was the most common pattern found without any zonal predominance, followed by a reticular pattern in 7 %..These were noted mainly in the middle and lower lung zones, in comparison to the findings by the study Nishimura K et al. [2]

Usually, the UIP, NSIP, DIP are indistinguishable, but requires adequate history to differentiate since they represent different phase or stage of abnormalities caused by lung injury or diseases state Like UIP, DIP was seen in smokers and predominantly seen in the subpleural peripheral basal segment, which is consistent with the findings given by the study Remy-Jardin M et al [3].

Nodular and infiltration type of air space accounted for 40 %. These findings were comparable with those of Remy-Jardin M et al [3]...

Mixed reticulo-nodular pattern of disease was seen in 4 % of patients. One patient had systemic sclerosis but with normal pulmonary function which is comparable to study Webb R et al [1] which reveals 75 % of patients with systemic sclerosis having positive HRCT findings but only 1 % with symptoms of pulmonary dysfunction.

HRCT scanning clearly differentiated old fibrotic lesions from new active lesions and demonstrated early bronchogenic spread. These findings may be of value in decisions on treatment in comparison to the studies on Hatipoglu et al. and Santiago Enrique Ross**i** et al [6].

On HRCT, fibrosis with irregular septal thickening and irregular interfaces, irregular septal thickening, visible intralobular bronchioles, honeycombing and traction bronchiectasis were seen in comparison to the study *Webb R et al.[1]*

One case of Alveolar proteinosis had areas of ground glassing with smooth septal thickening. Combination of these gives the classical *crazy paving appearance*, strongly suggestive of alveolar proteinosis. One patient with history of renal transplant on immunosuppressants had nonspecific ground glassing and consolidation, which was diagnosed as Cytomegaloviral pneumonia. This type of presentation is the commonest according to the study *Webb R et al [1].* CMV is well recognized as most common viral organism to be identified in patients with AIDS.

In our study 1/3rd of patients underwent PFT. Majority of patients had a combination of obstructive and restrictive forms. Good reversibility was observed in milder involvement. Wells et al found that changes like regression of ground-glass pattern and reticular pattern in serial HRCT scans were reflected as improvement in pulmonary function tests. Hence, it was possible to predict the prognosis and duration of the disease.

Ground glassing is reversible while fibrosis is not. It helps in determining the prognosis since ground glassing has better prognosis as compared to the reticular or honeycombing pattern.

SUMMARY AND CONCLUSION

HRCT is particularly valuable in assessing patients with a normal chest radiograph but having significant clinical symptoms and/ or abnormal lung function indicating diffuse infiltrative lung disease. The most frequent HRCT pattern observed in ILD was ground glass pattern in 20% without any zonal predominance. Symmetrical distribution of the lesions was noted in 80 % of the patients. Lower zone was predominantly involved in 75 % while segmental distribution was observed with equal frequency in all the patients. Micronodules and ground glassing were signs of active disease. So HRCT helped to detect activity of the disease and helps in the management and triage. PFT is a good bedside test to assess the severity of lung disease and also to see for the progression. However, the gold standard in detecting and scoring lung parenchymal involvement in IPF is HRCT. To summarise, HRCT is the most accurate non-invasive available imaging method for evaluating lung parenchyma due to its ability to scan rapidly and acquire very thin slices.

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