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HIGH RESOLUTION COMPUTERIZED TOMOGRAPHY (HRCT) IMAGING FINDINGS IN CASES OF INTERSTITIAL LUNG DISEASES

Radiodiagnosis

Sharad B. Gadgil Associate Professor, Department of Radio-diagnosis, Dr. VasantraoPawar Medical College Hospital & Research Centre, Nashik, Maharashtra, India.

Rounak R. Bagga* Junior Resident (III), Department of Radio-diagnosis, Dr. VasantraoPawar Medical College Hospital & Research Centre, Nashik, Maharashtra, India.*Corresponding author

Zoya Patni Junior Resident (III), Department of Radio-diagnosis, Dr. VasantraoPawar Medical College Hospital & Research Centre, Nashik, Maharashtra, India.

ABSTRACT

BACKGROUND: High Resolution Computerised Tomography (HRCT) is an effective and non-invasive modality to visualize the various patterns of Interstitial lung diseases. It provides excellent visualization of the lung parenchyma and interstitium.

PURPOSE: The objective of our study was to study the various High resolution computerised tomography imaging findings in cases of interstitial lung diseases (ILD).

MATERIALS & METHODS: HRCT of 60 patients with ILD were studied. All the CT scans were performed on Siemens Somatom Perspective (128 slice) machine.

RESULTS: Of the 60 patients included in the study 25 patients showed features of Usual interstitial pneumonia (UIP),13 showed features of Hypersensitivity pneumonitis (HSP),7 of Nonspecific interstitial pneumonitis (NSIP), 4 of Acute interstitial pneumonia, 6 of Cryptogenic pneumonia, 2 of Respiratory bronchiolitis-ILD (RB-ILD), 2 of Desquamative interstitial pneumonia (DIP) and1 of Sarcoidosis.

CONCLUSION: Accurate analysis of lung pathologies is possible with HRCT. It is an excellent modality to correlate the clinical and imaging findings, helping us to arrive at an accurate diagnosis. Due to the non-invasive nature, short scan time and excellent visualization of the lung interstitium HRCT is a very effective modality for evaluation of various Interstitial lung diseases. It not only helps us to understand the stage of the disease and its prognosis but also helps us to formulate an appropriate treatment plan.

KEYWORDS

High Resolution Computerised Tomography (HRCT), interstitial lung diseases (ILD), Usual interstitial pneumonia (UIP), Hypersensitivity pneumonitis (HSP), Nonspecific interstitial pneumonitis (NSIP).

INTRODUCTION

High-resolution computed tomography (HRCT) of the lung parenchyma is useful in evaluating known or suspected interstitial lung disease[1,2]. HRCT is also performed to evaluate suspected diffuse infiltrative lung disease in patients who have normal, nonspecific, or inconsistent radiographic findings[3]. A HRCT examination performed for a patient with known or suspected ILD, scans are obtained from the level of the aortic arch through the lung bases with the patient in both the supine and prone positions. Obtaining scans in prone position is important in evaluating ILD that tends to involve the subpleural and dependent portions of the lung, such as asbestosis[4].On imaging there are specific patterns and findings which are diagnostic for ILD.

AIMS AND OBJECTIVES

The objective of our study was to study the various High Resolution Computerised Tomography imaging findings in cases of Interstitial lung diseases (ILD).

MATERIALS AND METHODS

This retrospective study was carried out over a period of 6 months (January- June 2017), with due permission from the ethics committee. HRCT thorax of 60 patients was performed, who were referred to the Department of Radiodiagnosis at Dr.VasantraoPawar Medical College, Hospital, Nashik with varied complaints. The clinical and demographic data were recorded after due consent to correlate the findings.

All the scans were done on Siemens Somatom Perspective (128 slice) machine in both supine and prone positions. HRCT scan of thorax with axial and coronal reconstruction was performed for evaluation of ILD.

Specifications for High Resolution Computerised Scanning:

- Thickness of section -1 to 2 mm
- High spatial frequency reconstruction
- Target viewing
- Exposure factors: 120 kV and 240 mAs

RESULTS

The present study was carried out at department of Radio diagnosis at a Medical College Hospital & Tertiary centre. A total 60 patients were examined and their HRCT imaging features were studied with the aim of describing interstitial lung disease (ILD). The salient observations are as follows:

- 25 cases(41.6%) were showing a feature of UIP with commonest age group affected was of 51-60years.
- 7 cases(11.6%) were of NSIP with commonest affected age group of 71-80years. One patient was a chronic smoker.
- 13 cases(21.6%) of HSP were studied with commonest age group was 41-50years.
- 6 cases(10%) were diagnosed with COP with 2 patients i.e (33.3%) each in the age group of 31-40years, 41-50years and 61-70years.
- 4 cases(6.6%) were diagnosed with Acute Interstitial Pneumonia (AIP).
- 2 cases(3.3%) of RB-ILD were studied with 1 each in age group of 21-30years and 31- 40years. Both had a history of heavy smoking.
- 2 cases(3.3%) were diagnosed as Desquamative Interstitial Pneumonia (DIP) in this study who were between 31 to 50 years.
- Only 1patient(1.6%) of sarcoidosis was there in this study in age group of 41-50years.
- The Age wise distribution and Sex distribution of ILD are shown in Chart1&Chart2 respectively.
- Table 1 shows various HRCT features among the different types of ILD.

DISCUSSION

Interstitial lung disease (ILD), also known as diffuse parenchymal lung disease (DPLD)[5], is a group of lung diseases affecting the interstitium. It concerns alveolar epithelium, pulmonary capillary endothelium, basement membrane, perivascular and perilymphatic tissues. Since 2001, the idiopathic interstitial pneumonias (IIPs) have been classified in seven different entities according to the American Thoracic Society/European Respiratory Society (ATS/ERS) International Multidisciplinary Consensus Classification of the IIPs[6] and an update of the guidelines was published in 2013[7].UIP is the most common IIPs. NSIP is the next most frequent, followed by COP. DIP, RB-ILD, and AIP are less common, while LIP is rare. Distinction among the IIPs is important largely because of the differences in prognosis associated with these conditions. The HRCT features of

each IIP are distinct, though with some overlap.

Usual Interstitial Pneumonia

By definition, IPF is the term for the clinical syndrome associated with the morphologic pattern of UIP[2].

HRCT features:-h i

- Reticular opacities. They can also be associated with traction bronchiectasis[8,9].
- Honeycombing. Cysts range from 2 to 20 mm and usually enlarge slowly over time[10,11,12].
- Ground-glass opacities(GGOs).
- Architectural distortion, which is indicative of lung fibrosis.
- Lobar volume loss in cases of more advanced fibrosis.
- The distribution of UIP on HRCT images is characteristically basal and peripheral, it is often patchy.
- Definitive histologic diagnosis of UIP requires a surgical lung biopsy when clinical or imaging features are atypical[13,14,15].
- Diagnosis in many cases of UIP is commonly based on clinical and imaging features, without the need for surgical biopsy[16].

Findings in this study-

- The commonest affected region was the subpleural regions of the lower lobes(Fig.1). These findings correlate with the findings of Grenier P etal[17].
- 10 patients had a history of smoking and all were males. These findings correlated well with the findings of Silva CI& Müller NL[10].
- The commonest HRCT feature was Reticular markings which were seen in all the patients(Fig.1). Another common feature was honeycombing seen in 80%cases.These findings correlated with the findings of Nishimura K etal[8].
- Bronchiectasis was seen in 76%cases.
- These features are indicative of fibrosis and advanced stage of the disease.
- Septal thickening was seen in 72%cases.
- GGOs were seen in 36%cases which were suggestive of early stage of UIP.
- Lymph node enlargement was seen 20%cases.

Non specific interstitial pneumonitis (NSIP)

NSIP is a chronic ILD showing homogeneous alveolar wall thickening due to inflammation or fibrosis[10,12].

NSIP represents the second most common IIP[8].

Patients with NSIP are more commonly female & generally are younger than those with UIP[18].

HRCT features

- Ground-glass opacity is the salient HRCT feature of NSIP. It is usually bilateral &symmetric and shows lower lobe predominance. It indicates homogeneous interstitial inflammation, which is an important feature in distinguishing NSIP from UIP[11].
- Can show fibrosis (volume loss, reticular pattern and/or traction bronchiectasis)[15,19].
- Honeycombing is not a dominant feature of NSIP and tends to be mild when present.
- A characteristic imaging feature of NSIP is that the subpleural areas of the dorsal regions of the lower lobes are not generally involved by the disease process.
- Consolidation is not a common feature of NSIP[10,12].
- Mediastinal lymph node enlargement is commonly seen associated with NSIP, which increases with progression of the disease, usually mild, involving one or two nodal stations, usually the right lower paratracheal or subcarinal regions [10].
- HRCT features of NSIP are often variable with time.
- Patients with predominant ground-glass opacities on HRCT improve or resolve with treatment and do not progress to honeycombing[11,12].

The prognosis of NSIP depends on the degree of fibrosis [12].The survival rate for NSIP with fibrotic component though more severe than non-fibrotic type remains better than UIP[20].

Findings in this study-

- In this study NSIP was second common idiopathic interstitial pneumonias which correlated with the findings of Nishimura K etal[8].
- The commonest affected region was the lower lobes of the lung.
- The common HRCT features seen were bronchiectasis and septal thickening , seen in all patients (Fig.2). Reticular opacities were noted in 71.4%cases.Bronchiectasis and reticular opacities were indicative of advanced stage of the disease.
- Ground glass opacities and Nodular opacities were seen in 42.8 %cases each.
- Lymph node enlargement was seen in 57.1%cases.
- In this study the commonest HRCT findings of NSIP were bronchiectasis, septal thickening and reticular opacity(Fig.2).

Hypersensetivity Pneumonitis(HSP)

HSP is a diffuse granulomatous interstitial lung disease caused by inhalation of various antigenic organic particles[21].

HP traditionally has been classified as manifesting in three phases: acute, subacute, and chronic[22].

A high degree of suspicion and meticulous acquisition of an environmental and occupational history are essential to make the diagnosis of HSP as many of the features seen are overlapping with other conditions like NSIP and even IPF[23].

HRCT features:-

The radiological manifestations of acute HP are similar to those of acute pulmonary edema[21].

- Patchy or diffuse bilateral ground-glass opacities,
- Poorly defined small centrilobular nodules
- Lobular areas of decreased attenuation and vascularity on inspiratory images
- Areas air trapping on expiratory images [22,24].
- Chronic HSP is characterized on HRCT by the presence of reticulation and traction bronchiectasis due to fibrosis superimposed on findings of acute or subacute HSP[24].
- The reticulations seen in chronic HSP can be patchy and have a predominantly subpleural and peribronchovascular distribution. It generally tends to spare the lung bases.
- The centrilobular nodules and lobular areas of air trapping typically seen in HSP are uncommon in idiopathic NSIP and idiopathic pulmonary fibrosis[19].

Findings in this study-

- Most of the patients gave a history of exposure to allergens.
- Most common HRCT feature was GGOs which were noted in 92.30%cases(Fig.3).GGOs were visualized in bilateral lung fields which correlated with the findings of Hansell DM etal[24].
- Septal thickening and Bronchiectasis was seen in 53.08%cases each.
- Nodular opacities were seen in 38.4% cases.
- Honeycombing and reticular opacities were noted in 15.3%cases.These findings with bronchiectasis were suggestive of chronic disease.

Cryptogenic Organizing Pneumonia (COP)

COP formerly referred to as bronchiolitis obliterans organizing pneumonia (BOOP) is an interstitial pneumonia with characteristic radiologic features.

Clinically, patients with COP usually present with a nonproductive cough, low grade fever and increasing shortness of breath[25,26]. Most patients are nonsmokers [10,27].

COP can be either idiopathic or is associated with a variety of causes.

When no underlying cause can be identified, the term—cryptogenic organizing pneumonia may be used to refer to the associated idiopathic clinical syndrome[6].

COP affects both men and women equally, with a mean age of onset of 55 years.

HRCT features:-

- Patchy air-space consolidation.
- Nodular or linear opacities[25,26].
- The lung infiltrates show a characteristic peripheral or peribronchial distribution, and the lower lung lobes are more

frequently involved.
- The appearance of the lung opacities varies from ground glass to consolidation which shows air bronchogram and mild cylindrical bronchial dilatation commonly. The opacities tend to migrate, changing the location and sizes, even without treatment. They are of variable size, ranging from a few centimeters to involve the entire lobe of the lung [28].
- Pulmonary nodules may be seen in patients with organizing pneumonia usually small in about half of cases along the bronchovascular bundles.

Findings in this study-
- The commonest HRCT finding were areas of consolidation which correlated well with the findings of Epler GR etal[25].
- GGOs were noted in 4 patients.
- The location of the areas of lung opacification was classically the subpleural and peribronchial areas in the lower lung, seen in all 6 patients(Fig.4). These findings correlated well with the findings of Izumi T etal[29].
- Nodular opacities were noted in 2 patients and bronchiectasis was seen in 1.

Acute Interstitial Pneumonia (AIP)

Acute interstitial pneumonia (AIP) is an idiopathic lung disease characterized by rapidly progressive respiratory failure occurring in patients without pre-existing systemic or lung diseases with diffuse alveolar damage histologically[30,31].

AIP is the only entity among the IIPs with acute onset of symptoms. Patients who present with AIP have a mean age of 50 years[6].

Men and women are equally affected, and cigarette smoking does not seem to increase the risk for development of AIP.

HRCT features:-
- The HRCT features of AIP are similar to those of acute respiratory distress syndrome but these patients are more likely to have symmetric, bilateral distribution with lower lobe predominance [32].
- The most common HRCT findings are diffuse ground-glass attenuation with a mosaic pattern and consolidation (often in the dependent regions of the lungs)[33].
- In the late phase of AIP, architectural distortion, traction bronchiectasis, and honeycombing are the most striking CT features and are more severe in the nondependent areas of the lung.

Findings in this study-
- The commonest HRCT feature was GGOs which was noted in all patients.
- Consolidation was noted in 75%cases(Fig.5). These findings are suggestive of the early or acute phase of alveolar damage.
- The above mentioned findings are correlated well with the findings in the study of Wittram C etal[33].
- Septal thickening was seen in 75%cases.Bronchiectasis was seen in 1patient.It is suggestive of chronic phase of the disease.

Respiratory Bronchiolitis (RB-ILD)

Respiratory bronchiolitis (RB) is also called smoker's bronchiolitis, is characterized by the accumulation of golden brown-pigmented macrophages within respiratory bronchioles.

Men are affected twice often and present with mild dyspnea and cough. Smoking cessation is the most important component in the therapeutic management of RB-ILD.

The clinical differentiation of RB-ILD from hypersensitivity pneumonitis is facilitated by exposure history and by the fact that most patients with hypersensitivity pneumonitis are nonsmokers.

HRCT features:-
- Centrilobular nodules in combination with GGOs and bronchial wall thickening[34].
- Coexisting moderate centrilobular emphysema is common, given that most patients have a smoking history.
- The HRCT features of RB-ILD may be similar to those of hypersensitivity pneumonitis and NSIP.

Findings in this study-
- The commonest HRCT features were GGOs and nodular opacities (Fig.6) which were seen in both the patients. These correlated well with the findings of Heyneman LE etal[34].
- 1 patient showed septal thickening and bronchiectasis as well.

Desquamative Interstitial Pneumonia (DIP)

DIP is an uncommon condition that primarily affects cigarette smokers in their 4th or 5th decades of life[35].DIP is more common in men than in women.

HRCT features:-
- Diffuse ground-glass opacities.
- Peripheral and lower lung lobe predominance [36].
- Spatially limited irregular linear opacities and small cystic spaces, which are indicative of fibrotic changes[6].
- Honeycombing is not commonly seen.
- Well-defined cysts may occur within the areas of ground-glass opacification . The cysts are usually round, thin-walled, and less than 2cm in diameter.

Findings in this study-
- Both the patients were chronic smokers for more than 10 years.
- GGOs were seen in both the patients predominantly in the lower lobes(Fig.7).These findings correlated well with the findings of Akira M etal[36].
- Bronchiectasis was seen in 1 patient suggestive of changes of early fibrosis.

Sarcoidosis

Sarcoidosis is a multisystem chronic inflammatory condition of unknown etiology. It is characterized by noncaseous epithelioid cell granulomas, which may affect almost any organ.

Involvement of the lung and the mediastinal and hilar lymph nodes is most common, being seen in majority of the patients.

Sarcoidosis typically affects adults less than 40 years old, and the incidence peaks in the 3rd decade of life.

In most studies, incidence has been found to be greater among women.

HRCT features:-
- Anatomic distribution abnormalities (eg, upper lobe predominance) may point to a highly specific diagnosis[37].
- HRCT shows nodular and reticular opacities, thickened interlobular septa, and faint ground-glass opacities, making the technique especially useful for identifying and managing sarcoidosis [38].
- Linear reticular opacities are observed in almost half of patients with sarcoidosis.
- Bilateral hilar lymph node enlargement, alone or in combination with mediastinal lymph node enlargement, occurs in an estimated 95% of patients affected with sarcoidosis[39].
- The calcifications may have an amorphous, punctate, popcornlike, or eggshell-like appearance. Eggshell-like calcifications also may be seen in silicosis.

Findings in this study-
- The patient gave no history of smoking.
- Reticular opacities and centrinodular opacities were seen in the upper lobes.
- Honeycombing, bronchiectasis and septal thickening were also seen in the upper lobes(Fig.8).
- Above findings are suggestive of fibrosis, architectural distortion and advanced stage of the disease.
- Pretracheal, paratracheal, subcarinal and hilar calcified lymph nodes were seen in the patient.

CONCLUSION

High Resolution Computerised Tomography(HRCT) is an effective and non-invasive modality to visualize the various patterns of Interstitial lung diseases in the lung parenchyma and/or interstitium. Accurate analysis of the pathology of lung is possible with HRCT. It is an excellent modality for correlating the clinical and HRCT features in order to arrive at an accurate diagnosis in many interstitial pathologies. Due to its non-invasive nature, short scan time and excellent visualization of the interstitium of the lung it is a very effective modality for evaluation of various Interstitial lung diseases.

CHART :1 AGE WISE DISTRIBUTION OF ILD

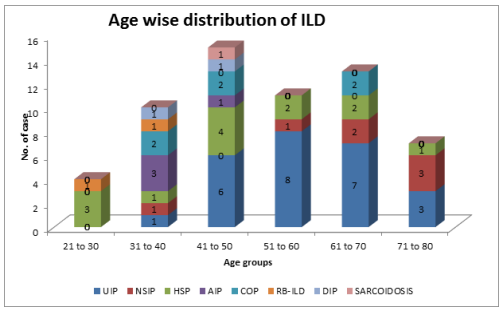


CHART 2: SEX WISE DISTRIBUTION OF ILD

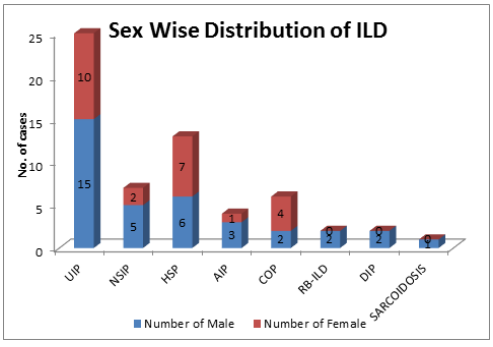


Table 1 :HRCT features

Sr. No	Disease	Reticular	Nodular	GGOs	Consolidation	Honeycombing	Bronchiectasis	Septal thickening	Lymph nodes
1	UIP	25	1	9	3	20	19	18	3
2	NSIP	5	3	3			7	7	4
3	HYP PNEUMON- IA	2	5	12	1	2	7	7	
4	AIP			4	3		1	3	
5	DIP			2			1		
6	RB-ILD		2	2			1	1	
7	COP		2	4	6		1		
8	SARCOID	1	1			1	1	1	1

1. Figure 1- USUAL INTERSTITIAL PNEUMONIA

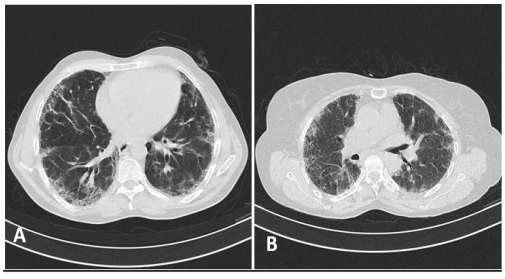


Fig 1A & 1B: Axial sections of HRCT showing features of reticular opacities and areas of Fibrosis s/o features of usual interstitial pneumonia.

Figure 2- NON SPECIFIC INTERSTITIAL PNEUMONIA-

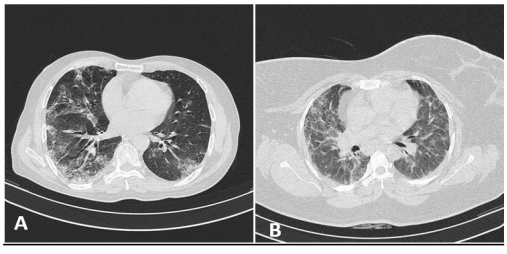


Fig 2A & 2B: Axial sections of HRCT showing features of bronchiectasis, septal thickening and ground-glass opacities s/o non-specific interstitial pneumonia.

Figure 3- HYPERSENSETIVITY PNEUMONITIS

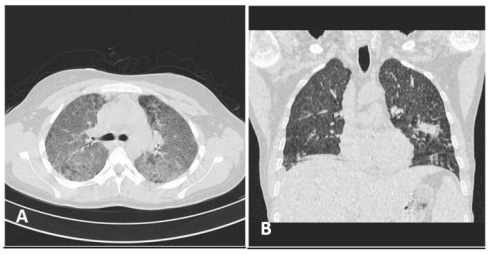


Fig 3A & 3B Axial sections of HRCT showing bilateral ground-glass opacities s/o hypersensitivity pneumonia.

Figure 4- CRYPTOGENIC ORGANIZING PNEUMONIA (COP)

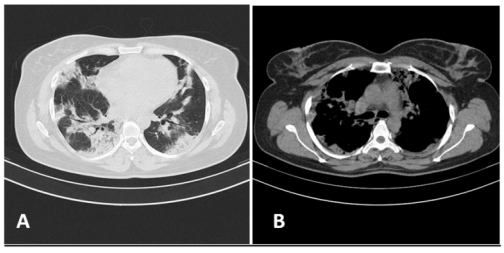


Fig 4A & 4B Axial sections of HRCT showing areas of bilateral consolidation in peripheral and peribronchial distribution s/o COP.

Figure 5- ACUTE INTERSTITIAL PNEUMONIA

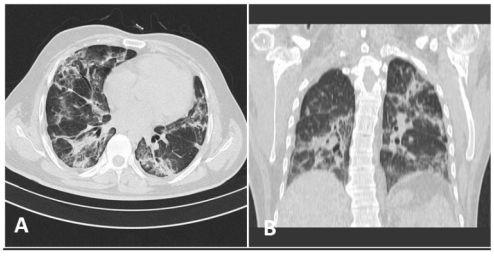
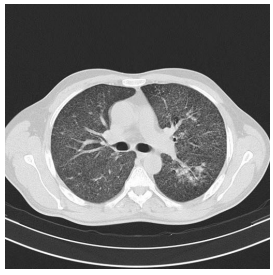


Fig 5A & 5B Axial and coronal sections of HRCT showing areas of bilateral consolidation and GGOs in peripheral and peribronchial distribution s/o AIP.

FIGURE 6- RESPIRATORY BRONCHIOLITIS -ILD



Axial section of HRCT showing nodular opacities and GGOs in a smoker s/o features of RB-ILD.

FIGURE 7 - DESQUAMATIVE INTERSTITIAL PNEUMONIA

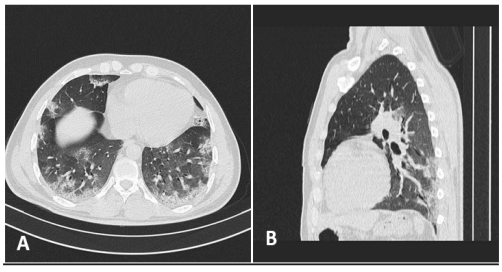


Fig 7A & 7B: Axial and sagittal sections of HRCT showing GGOs having a lower lobe predominance in a smoker s/o features of DIP.

FIGURE 8- SARCOIDOSIS

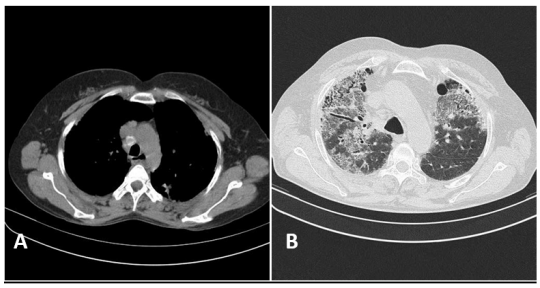


Fig 8A & 8B Axial sections of HRCT showing calcified mediastinal lymph nodes and areas of honeycombing, bronchiectasis in bilateral upper zones s/o features of Sarcoidosis

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