Volume 2

Manual of Chest X-ray

Rajendra Prasad
Nikhil Gupta
Kiran Vishnu Narayan

Modules 3 and 4

Module 3

- Lung Parenchyma II
  Miliary Lesions, Nodular Lesions
  Mass Lesions, Calcified Lesions
- Pleura

Module 4

- Radiology of Tuberculosis
- Radiology of Bronchiectasis
- Radiology of Chronic Obstructive Pulmonary Disease (COPD)
- Radiology of Allergic Bronchopulmonary Aspergillosis (ABPA)
- Radiology of Lung Cancer
- Radiology of Interstitial Lung Disease (ILD)
- Radiology of Sarcoidosis
- Radiology of COVID-19
- Radiology Quiz

CBSPD Dedicated to Education
CBS Publishers & Distributors Pvt Ltd

CHAPTER

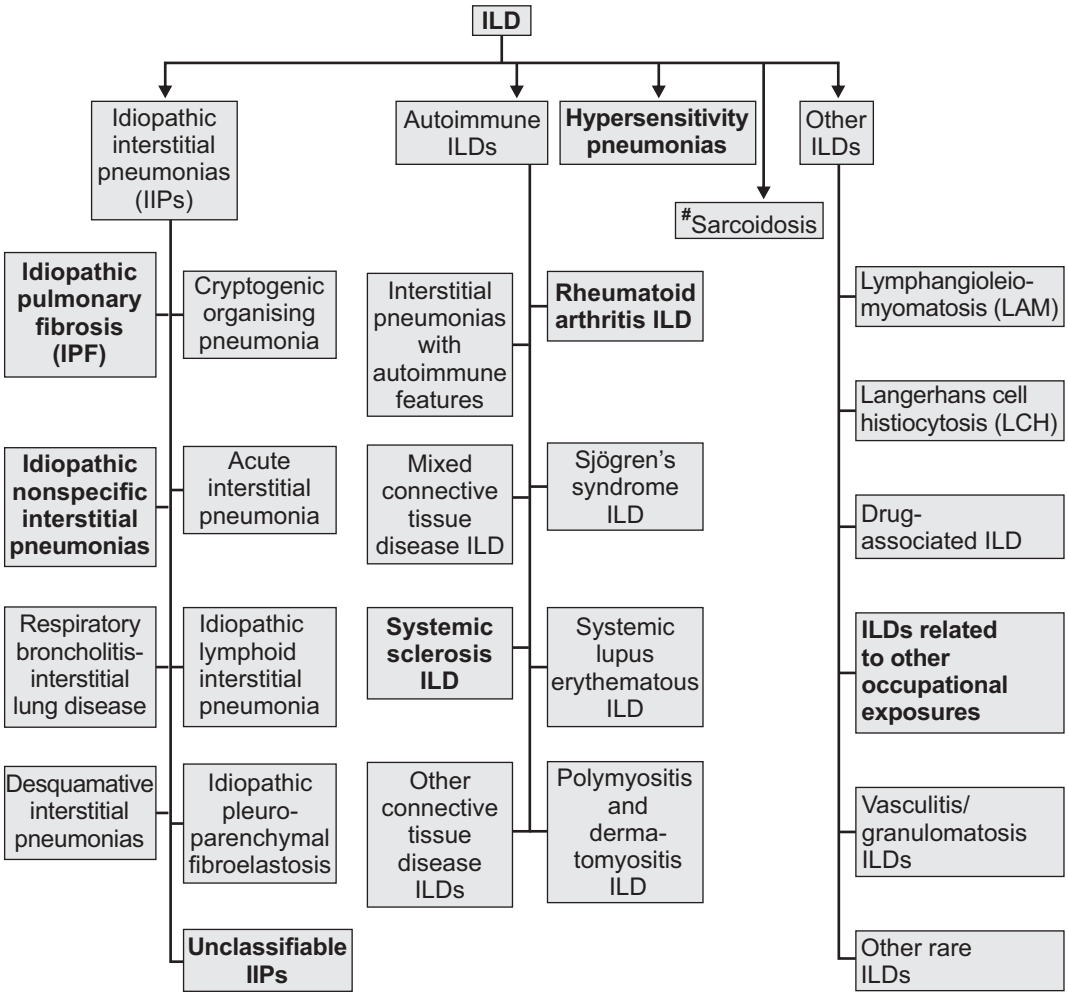
17

Radiology of Interstitial Lung Disease (ILD)

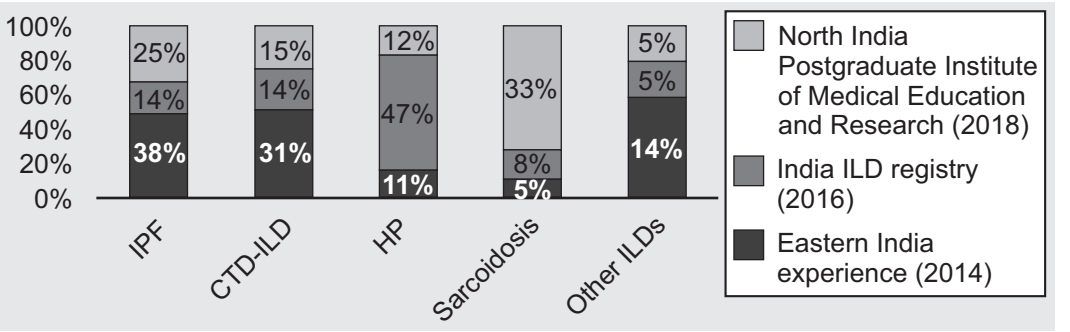
Interstitial Lung Disease (ILD)

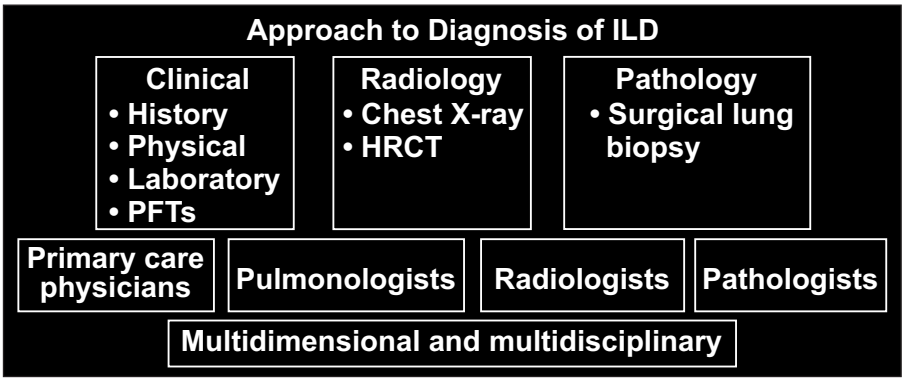
ILD is a heterogenous group of acute and chronic inflammatory and fibrotic lung diseases involving the distal lung parenchyma, of known and unknown causes with different prognosis. It is diverse collection of more than 300 lung disorders

Types of interstitial lung disease (ILD) most likely to have a progressive-fibrosing phenotype (indicated in bold); IIPs: idiopathic interstitial pneumonias. #Stage IV sarcoidosis only



The top 4 ILDs in India are: IPF, CHP, CTD-ILD* and sarcoidosis



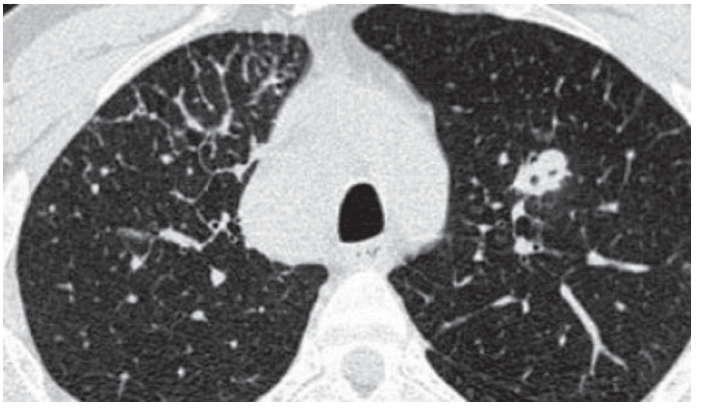


*IPF: Idiopathic pulmonary fibrosis; CHP: Chronic hypersensitivity pneumonitis; CTD-ILD: Connective tissue disorder related ILD

High Resolution Computed Tomography (HRCT) Thorax Common Patterns

Reticular Shadows

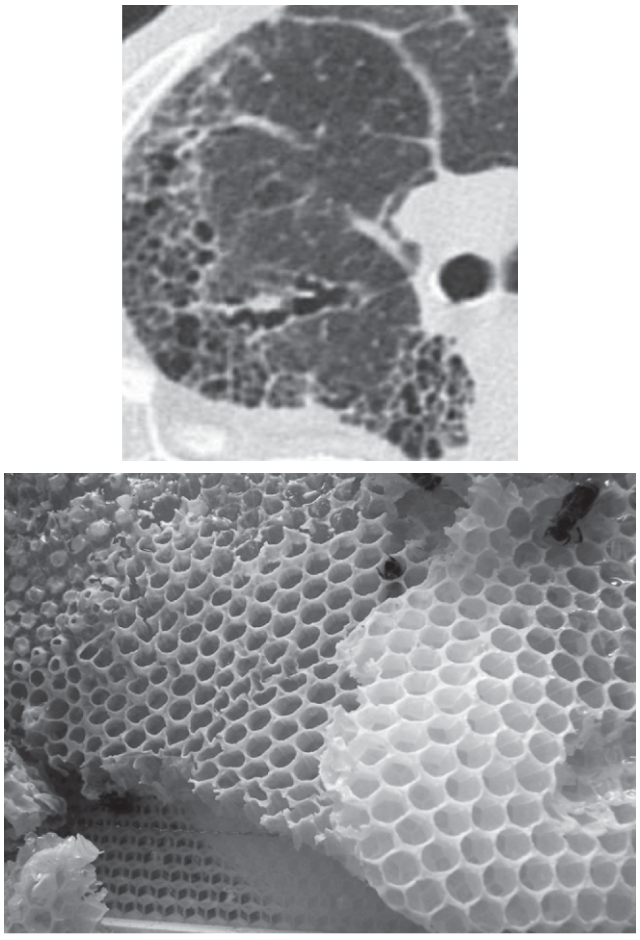
- Caused by thickened interlobular or intralobular septa
- Infiltration by fibrosis, abnormal cells, or fluid
- Interlobular septal thickening is usually described as smooth or irregular
- Manifests as a fine reticular pattern on HRCT
- Late stage—honeycombing, characterized by cystic airspaces surrounded by irregular walls



Focal septal thickening

Honeycombing

- Honeycombing is defined by the presence of small cystic spaces with irregularly thickened walls composed of fibrous tissue
- Predominate in the peripheral and subpleural lung regions
- Subpleural honeycomb cysts occur in several contiguous layers



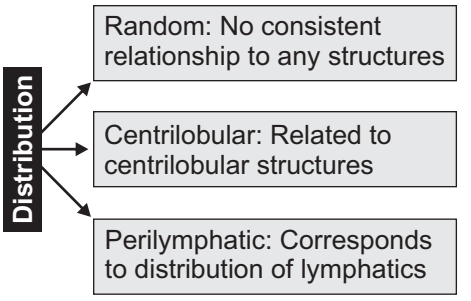
Honeycombing

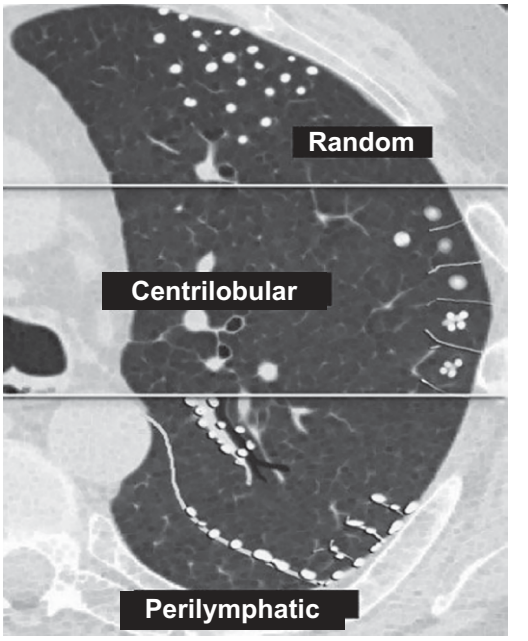
Causes of Honeycombing

Lower lobe predominance
UIP or interstitial fibrosis
Connective tissue disorders
Hypersensitivity pneumonitis
Asbestosis
NSIP (rare)
Upper lobe predominance
End stage sarcoidosis
Radiation
Hypersensitivity pneumonitis
End stage ARDS

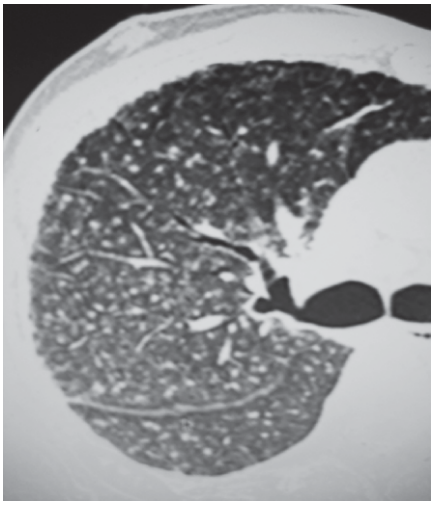
Nodular Shadows

- Feature of both interstitial and airspace disease
- Perilymphatic nodules within the lung interstitium, especially those related to the lymphatic vessels, are seen in the interlobular septa, subpleural and peribronchovascular regions
- Centrilobular nodules
- Random



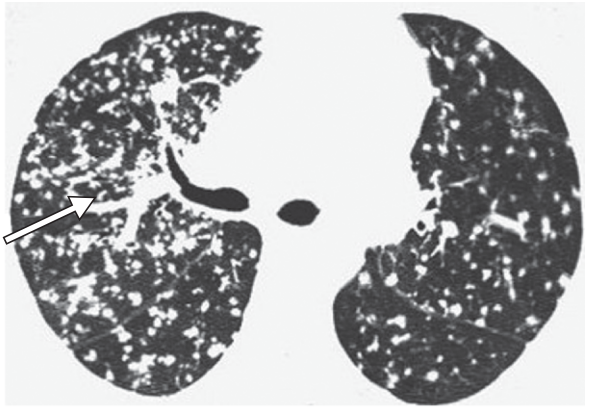


Centriacinar Nodules

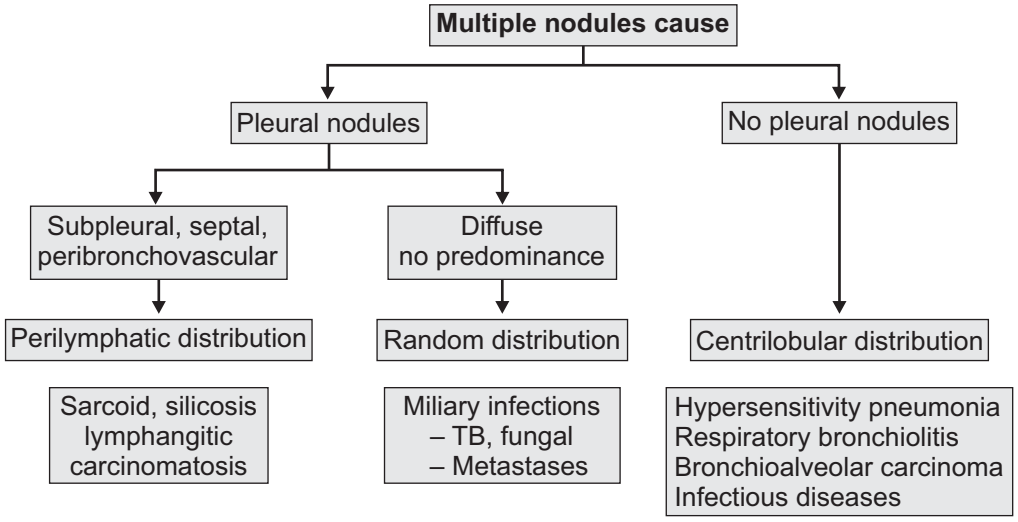


Centrilobular nodules in a patient with subacute hypersensitivity pneumonitis

Perilymphatic Nodules

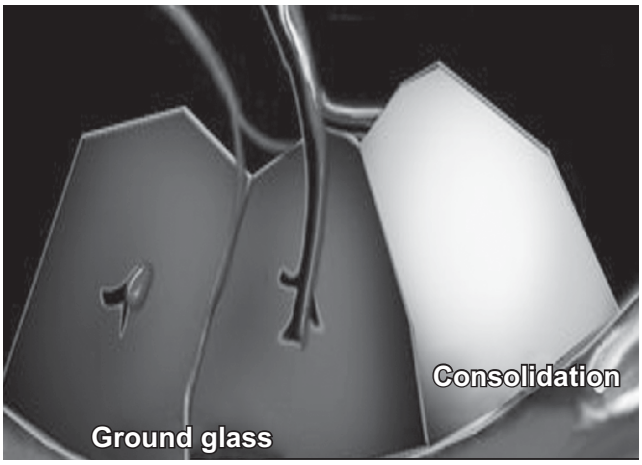


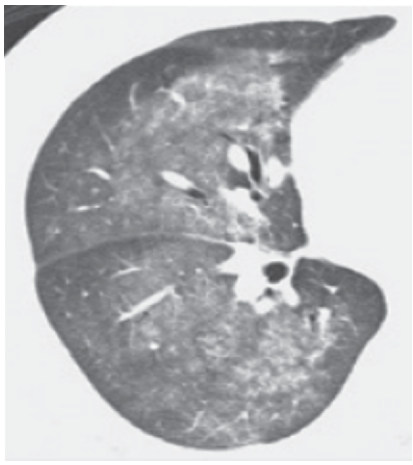
Perilymphatic and random distribution of nodules, seen in sarcoidosis



Ground Glass Opacity (GGO)

- Generalized increase in opacity that does not obscure pulmonary vessels
- Include partial filling of the airspaces, considerable thickening of the interstitium, or a combination of the two
- Hazy increased attenuation of lung, with preservation of bronchial and vascular margins
- ***Pathology***: It is caused by partial filling of air spaces, interstitial thickening, partial collapse of alveoli, normal expiration, or increased capillary blood volume



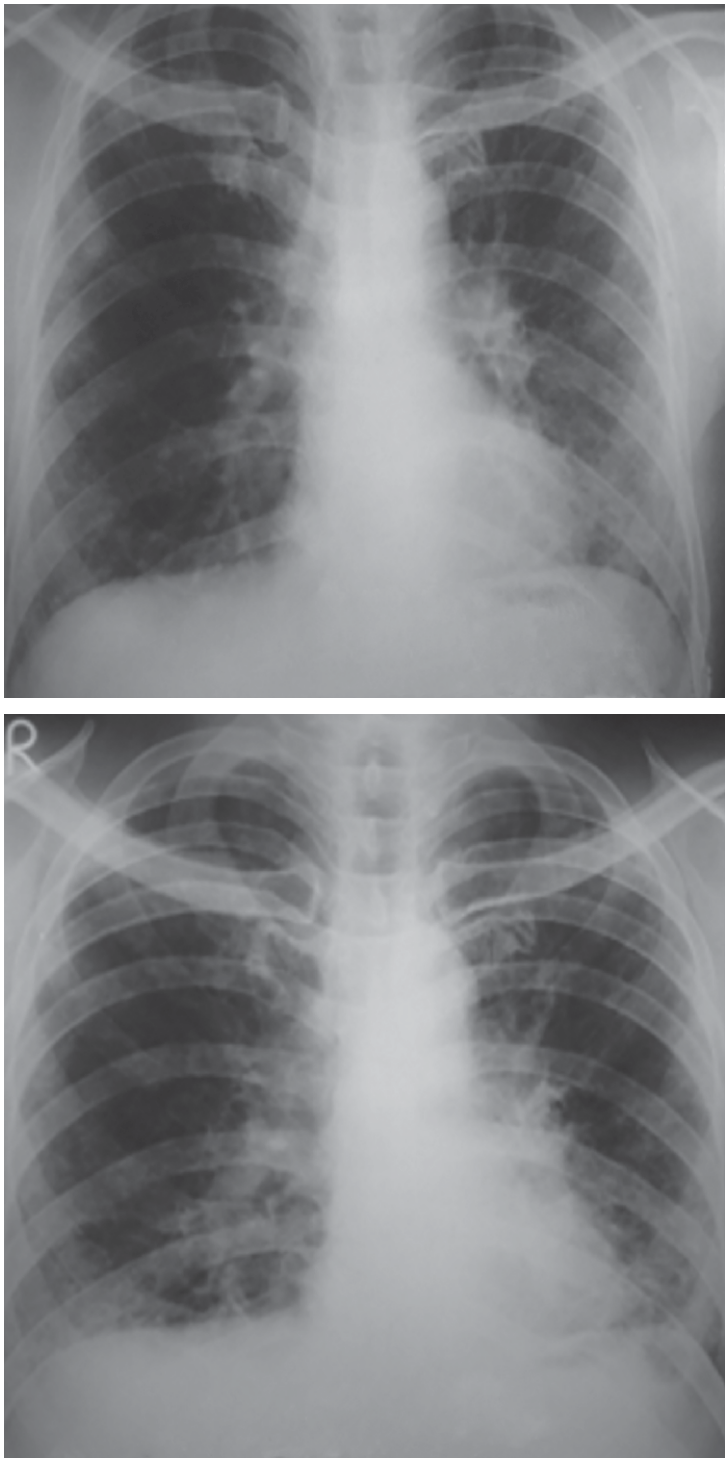


Importance of GGO

- Can represent
  - Microscopic interstitial disease (alveolar interstitium)
  - Microscopic alveolar space disease
  - Combination of both
- In the absence of fibrosis, mostly indicates the presence of an ongoing, active, potentially treatable process

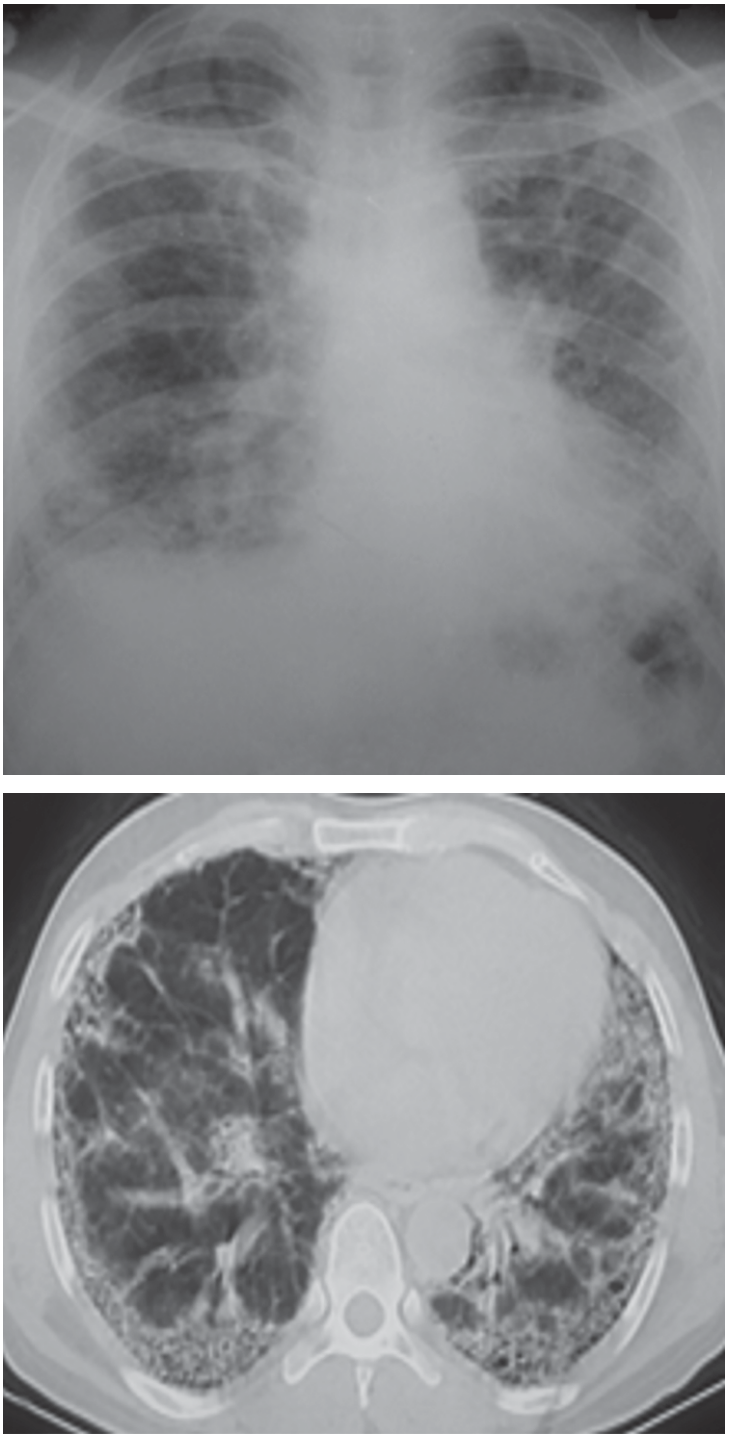
Differential Diagnosis: GGO	
Ground glass opacity	
Acute	**Chronic**
Pulmonary edema • Heart failure • ARDS	Hypersensitivity pneumonitis Organizing pneumonia (BOOP, COP) Chronic eosinophilic pneumonia
Pulmonary hemorrhage pneumonia • Viral • Mycoplasma • *Pneumocystis jiroveci* pneumonia (PJP)	Alveolar proteinosis Lung fibrosis • UIP • NSIP
Acute eosinophilic pneumonia	Bronchoalveolar carcinoma

HRCT Patterns in Idiopathic Pulmonary Fibrosis		
	UIP pattern	Probable UIP pattern
• Level of confidence for UIP histology	• Confident (>90%)	• Provisional high confidence (70–89%)
• Distribution	• Sub-pleural and basal predominant • Often heterogeneous (areas of normal lung interspersed with fibrosis) • Occasionally diffuse • May be asymmetric	• Sub-pleural and basal predominant • Often heterogeneous (areas of normal lung interspersed with reticulation and traction bronchiectasis/ bronchiolectasis)
• CT features	• Honeycombing with or without peripheral traction bronchiectasis/bronchiolectasis • Presence of irregular thickening of interlobular septa • Usually superimposed with a reticular pattern, mild GGO • May have pulmonary ossification	• Reticular pattern with traction bronchiectasis or bronchiolectasis • May have mild GGO • Absence of subpleural sparing
	Indeterminate for UIP	Alternative diagnosis
• Level of confidence for UIP histology	• Provisional low confidence (51–69%)	• Low to very low confidence (<50%)
• Distribution	• Diffuse distribution without subpleural predominance	• Peribronchovascular predominant with subpleural sparing (consider NSIP) • Perilymphatic distribution (consider sarcoidosis) • Upper or mid-lung (consider fibrotic HP, CTD-ILD, and sarcoidosis) • Subpleural sparing (consider NSIP or smoking-related IP)
• CT features	• CT findings of lung fibrosis that do not suggest any specific etiology	• Lung findings ◆ Cysts (consider LAM, PLCH, LIP, and DIP) ◆ Mosaic attenuation or three-density sign (consider HP) ◆ Predominant GGO (consider HP, smoking-related disease, drug toxicity, and acute exacerbation of fibrosis) ◆ Profuse centrilobular nodules (consider HP or smoking-related disease) ◆ Nodules (consider sarcoidosis) ◆ Consolidation (consider organizing pneumonia, etc.) • Mediastinal findings ◆ Pleural plaques (consider asbestosis) ◆ Dilated esophagus (consider CTD)
IPF (an update) and Progressive Pulmonary Fibrosis in Adults, American Journal of Respiratory and Critical Care Medicine, May 1 2022		

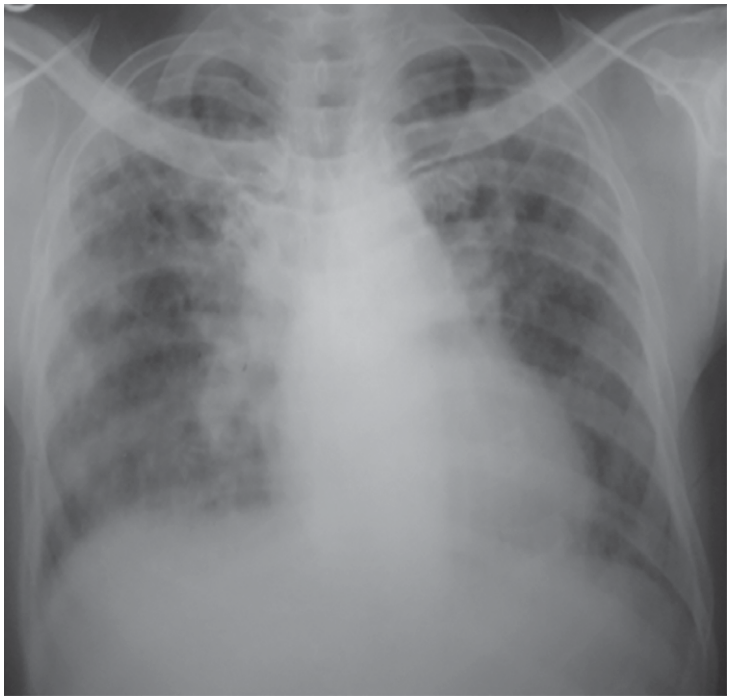


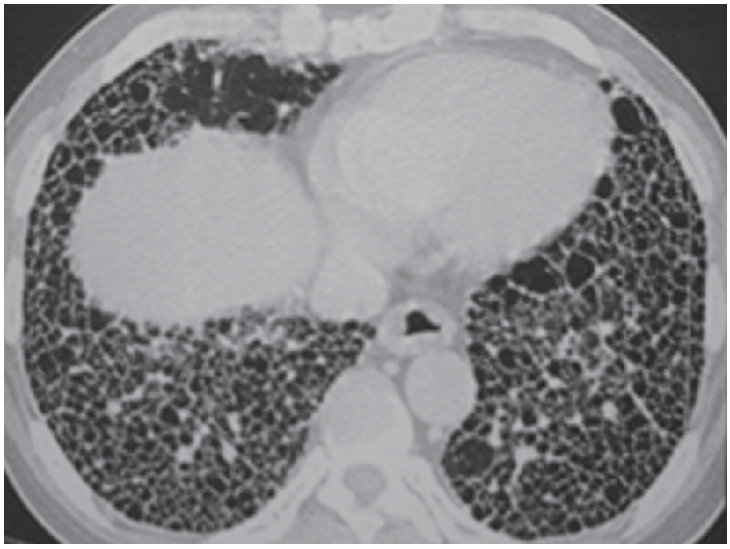
A 63-year-old male presented with breathlessness (exertional) and dry cough for 6 months treated as asthma with inhaled medications for 3 years without any response

What is this?

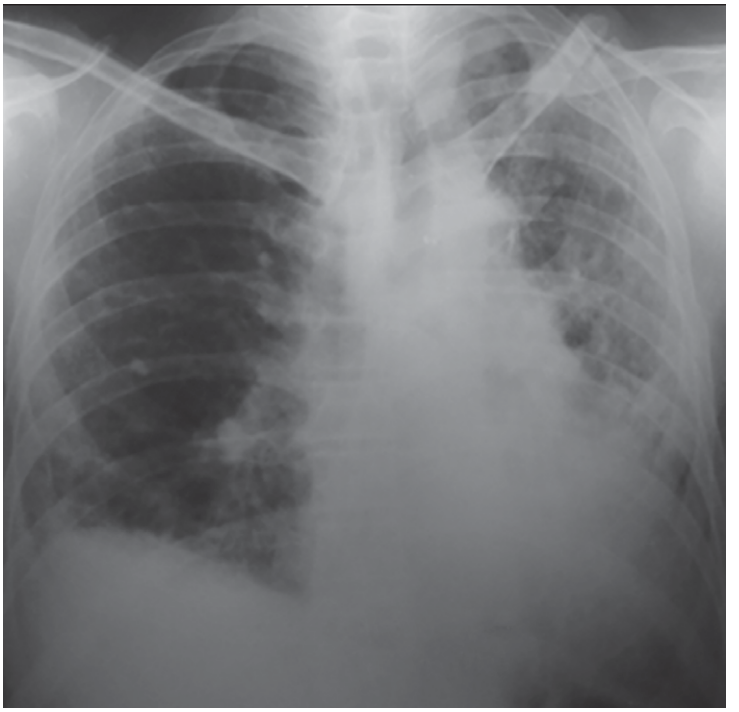


Spirometry shows restrictive disorder (FVC: 1.3 L [48% of predicted value])





Spirometry shows restrictive disorder (FVC: 0.78 L [29% of predicted value])
In spite of adequate treatment patient progressed to extensive honeycombing and died in 2004
Diagnosis: Idiopathic pulmonary fibrosis (IPF)
Please note that typical IPF has poor prognosis and survival rate is like lung cancer



What is this?

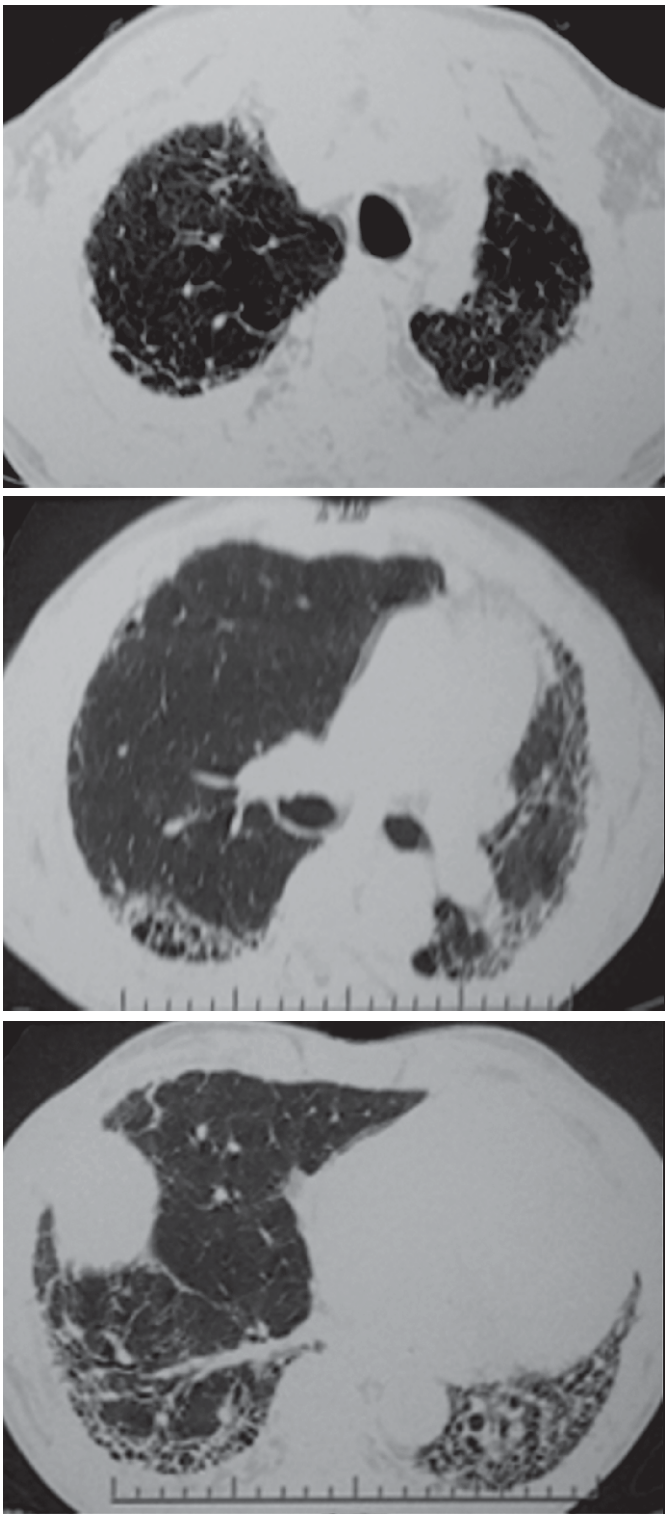
A 56-year-old male, known case of rheumatoid arthritis, smoker 20 bidi/day—35 years presented with fever—1 year, cough with minimal expectoration—1 year, breathlessness—3 months, right-sided chest pain—10 days, decrease appetite—5 days Had taken antitubercular treatment but without any response

Investigations

Serum-rheumatoid factor: 452 IU/ml

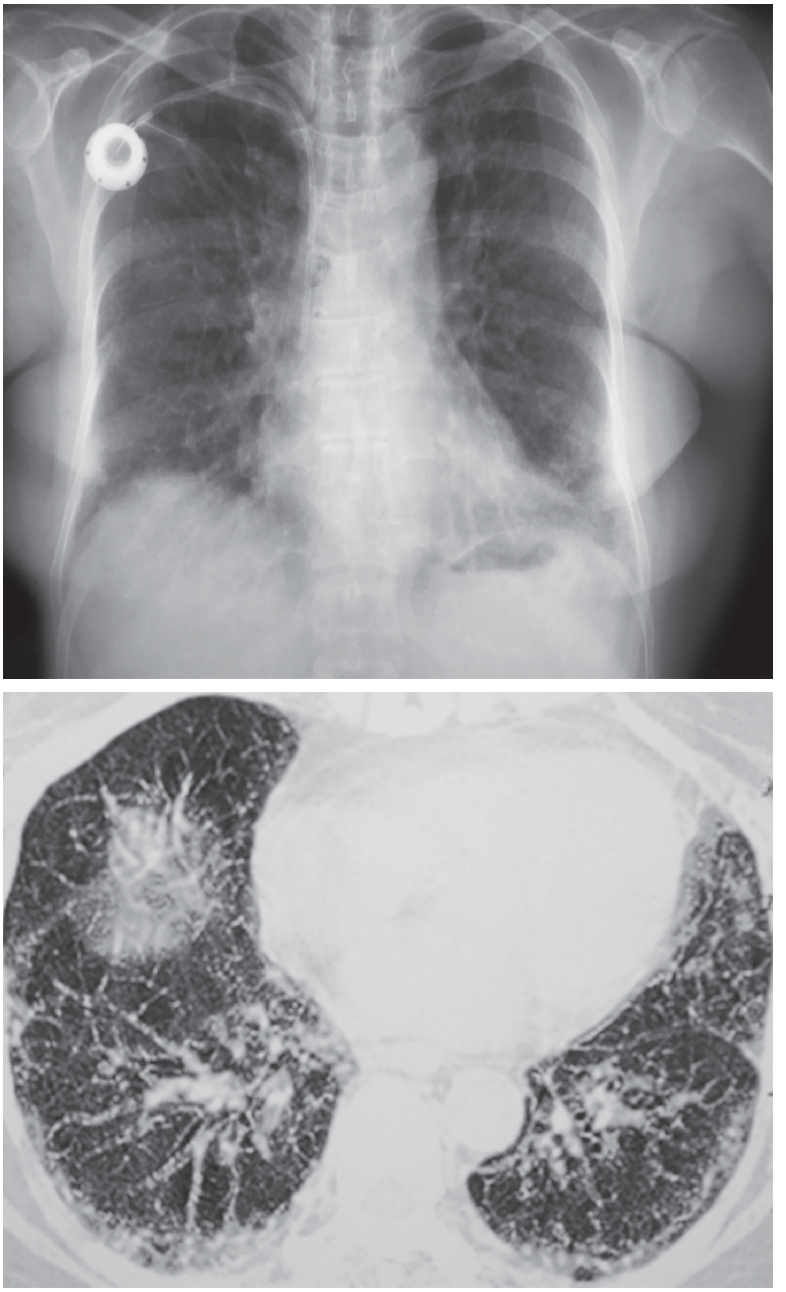
Pleural Fluid

Protein: 4.6 g/dl, sugar: 74 mg/dl
TLC: 1000, DLC-neutrophilic predominant (P84%)
Rheumatoid factor: 49.4 IU/ml
AFB: Negative



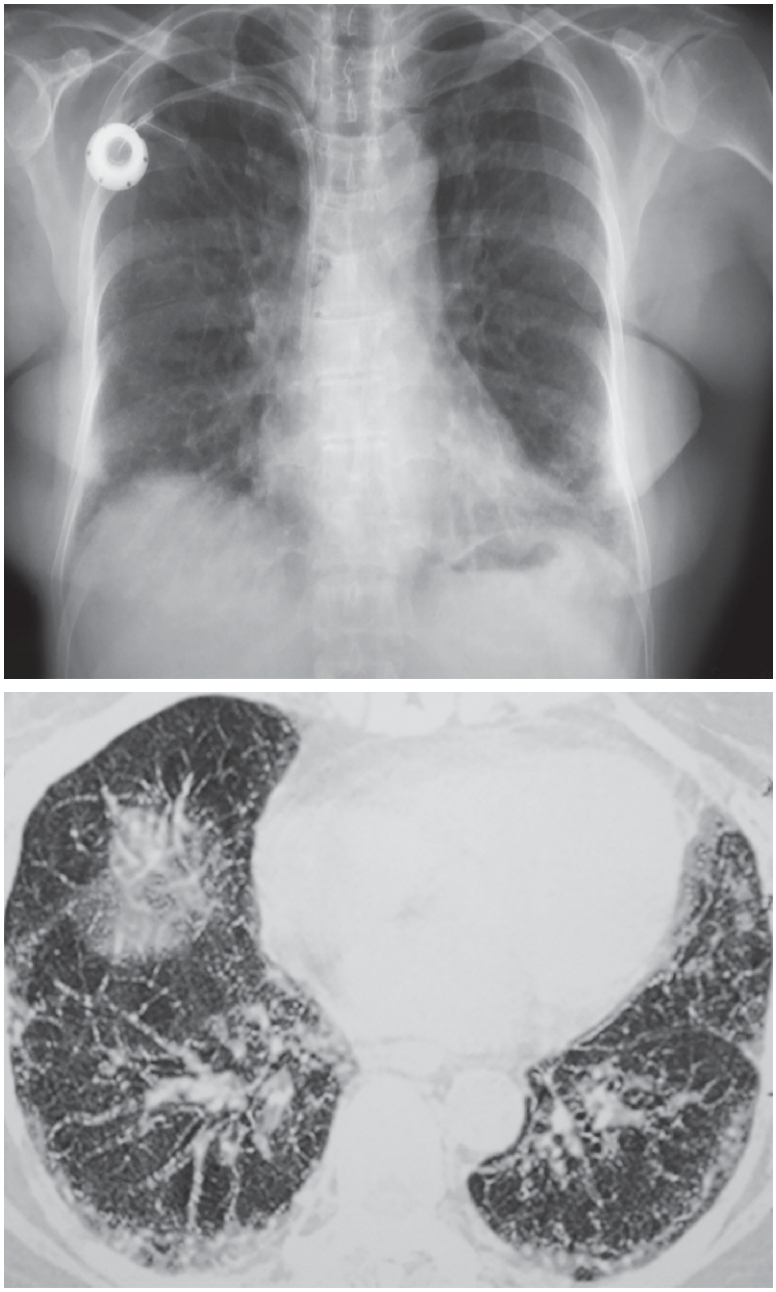
HRCT thorax at different levels

Diagnosis: Interstitial Lung Disease Cause Rheumatoid Arthritis



A 63-year-old female presented with progressive breathlessness and dry cough for 1 month. Patient had past history of adenocarcinoma colon and was given oxaloplatin, 5-FU and leucovorin for six cycles 4 months ago

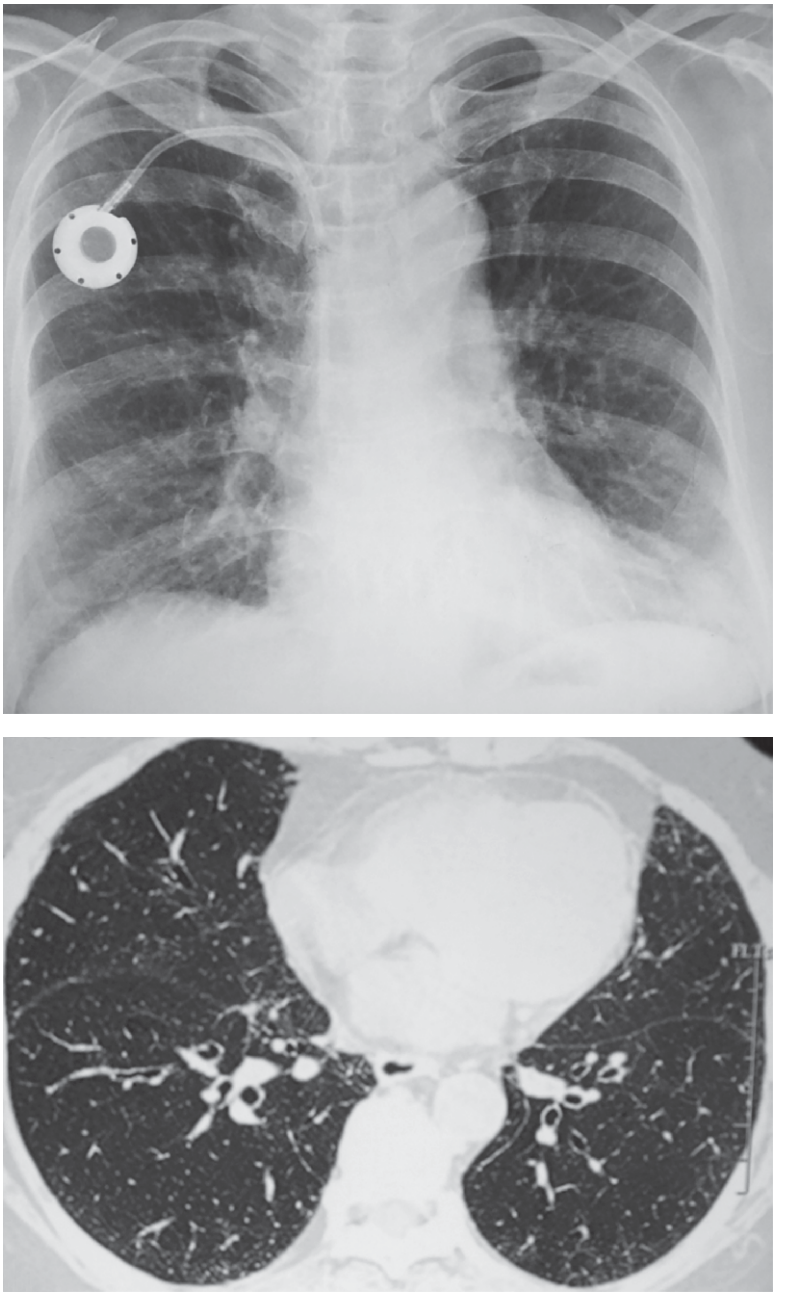
What is this?



Chest X-ray and HRCT thorax

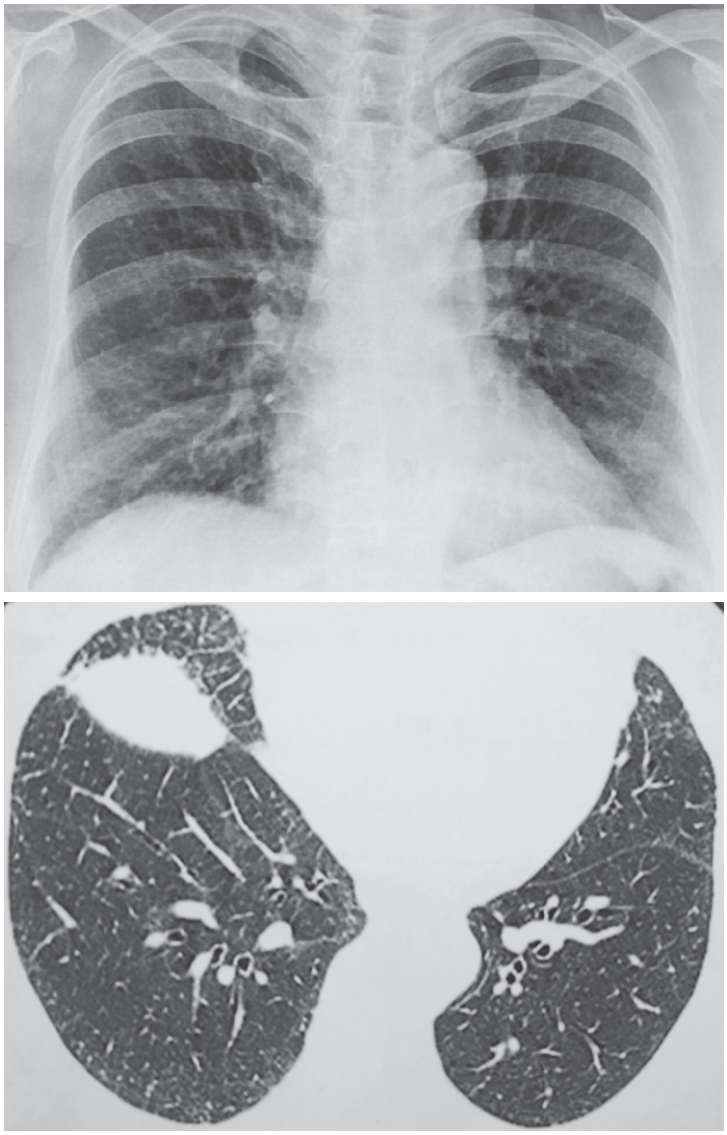
Spirometry and arterial blood gases (ABG)

FVC	FEV1	FEV1/FVC	PaO_2	$PaCO_2$
1.51 (66%)	1.25 (66%)	82%	36 mmHg	28 mmHg



Chest X-ray and HRCT thorax

Drug (oxaloplatin) induced ILD was diagnosed and patient was started on deflazacort 30 mg BD and tapered to 6 mg OD over 6 months



Chest X-ray and HRCT thorax after 6 months of oral steroid treatment

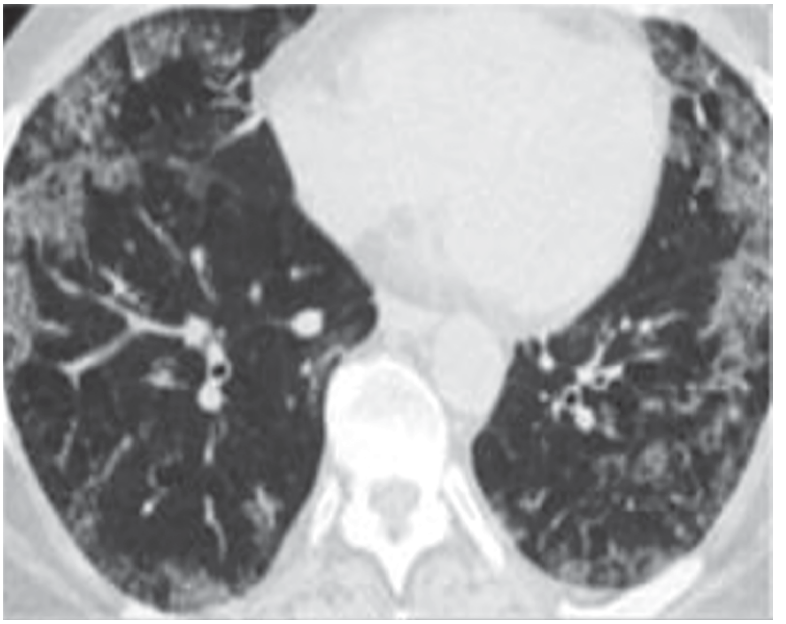
Spirometry and arterial blood gases (ABG) After 6 months of treatment

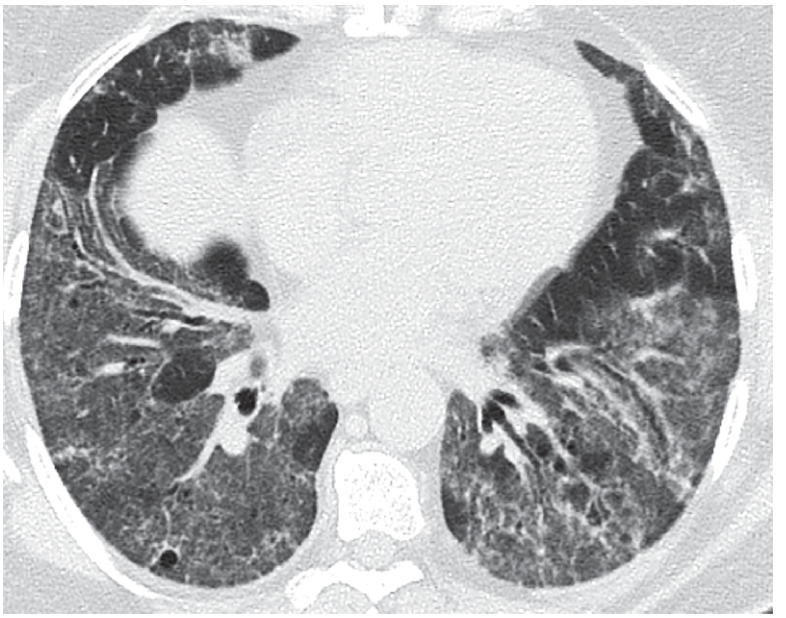
FVC	FEV1	FEV1/FVC	PaO_2	$PaCO_2$
2.28 (99%)	1.77 (93%)	80%	84 mmHg	29 mmHg

Patient improved clinically, radiologically (chest X-ray, HRCT thorax) and in spirometric parameters (FVC 1.51 L to 2.28 L)

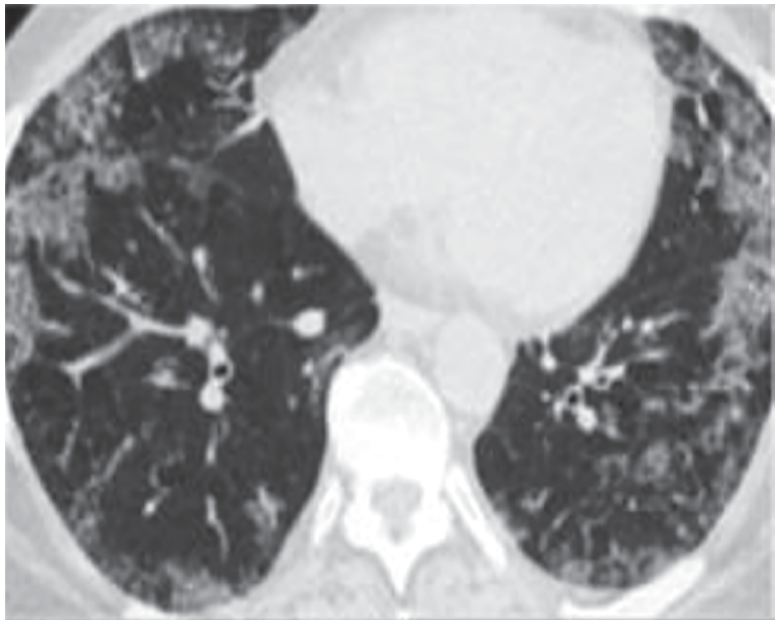
Diagnosis: Drug-induced ILD

Please note that drug-induced ILD is treatable and has better prognosis if detected early and treated

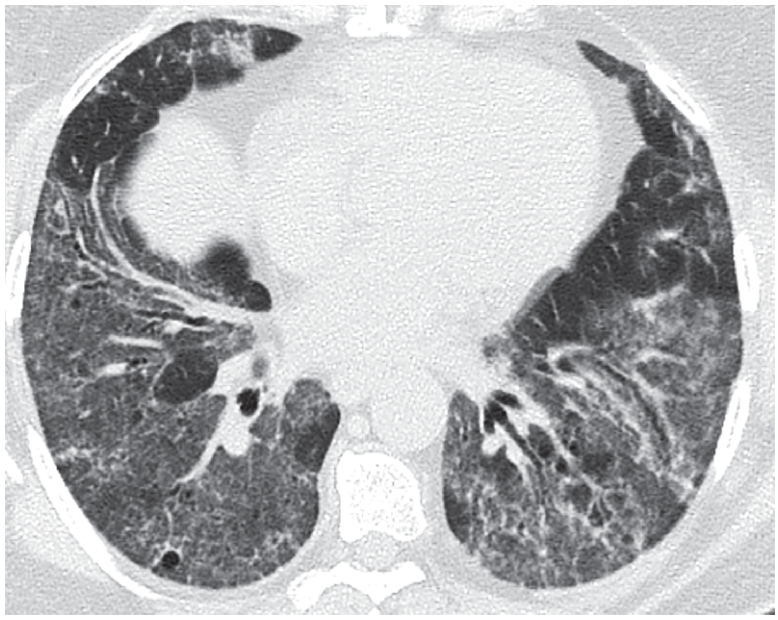




A 50-year-old female presented with cough and breathlessness for last 3 months
What is this?



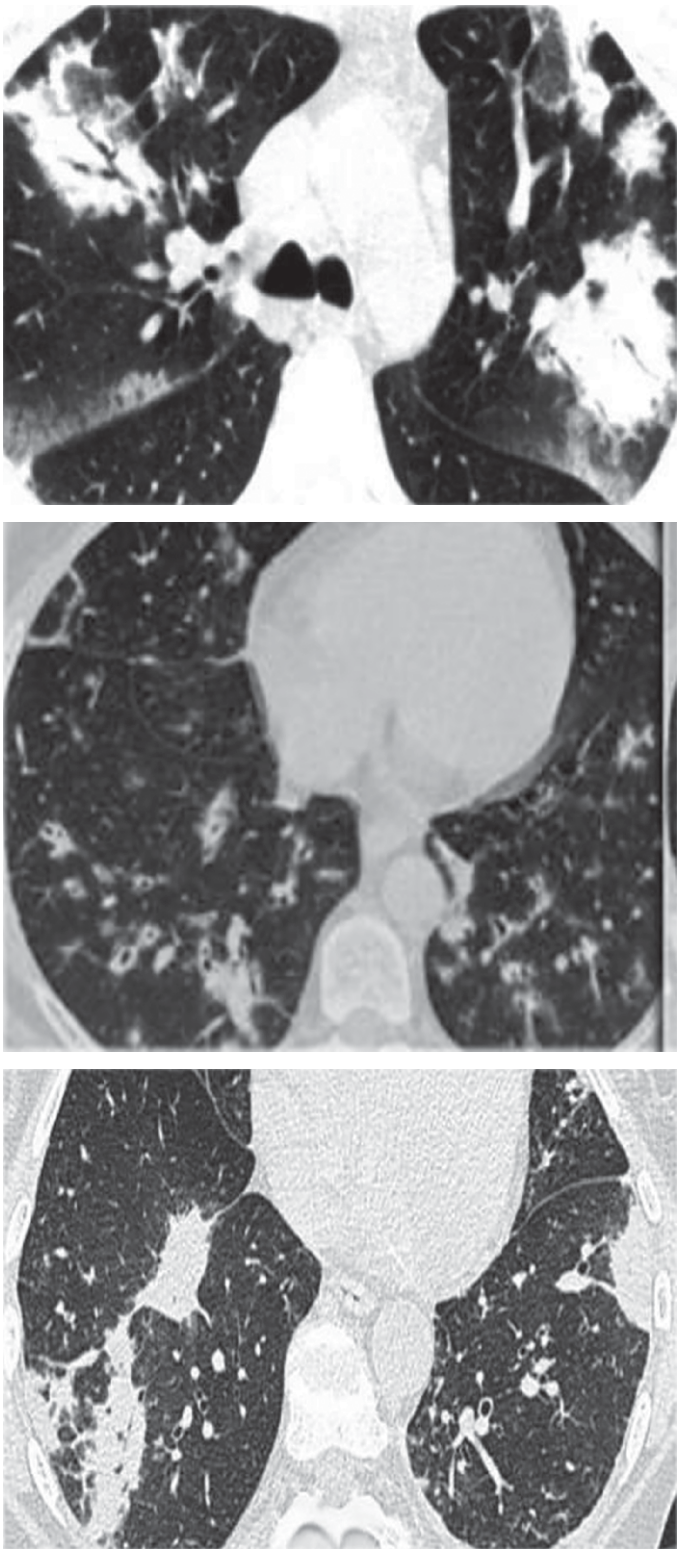
Ground glass opacities with a superimposed fine reticular densities without any honeycombing



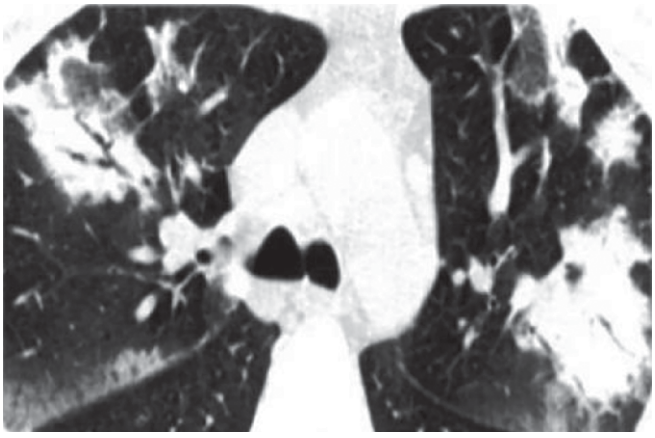
Ground glass opacities with reticulation and traction bronchiectasis without any honeycombing

Diagnosis: Non-specific Interstitial Pneumonia (NSIP)

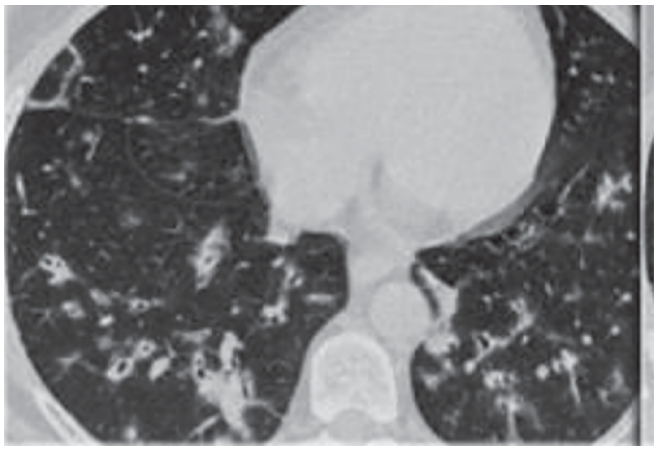
Please note that NSIP has better prognosis if detected early and effectively treated



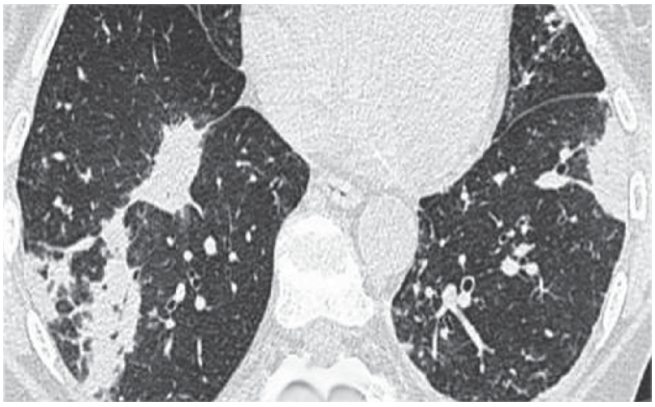
Patient presented with cough and breathlessness for last 4 months
What is this?



Typical bilateral peripheral consolidation



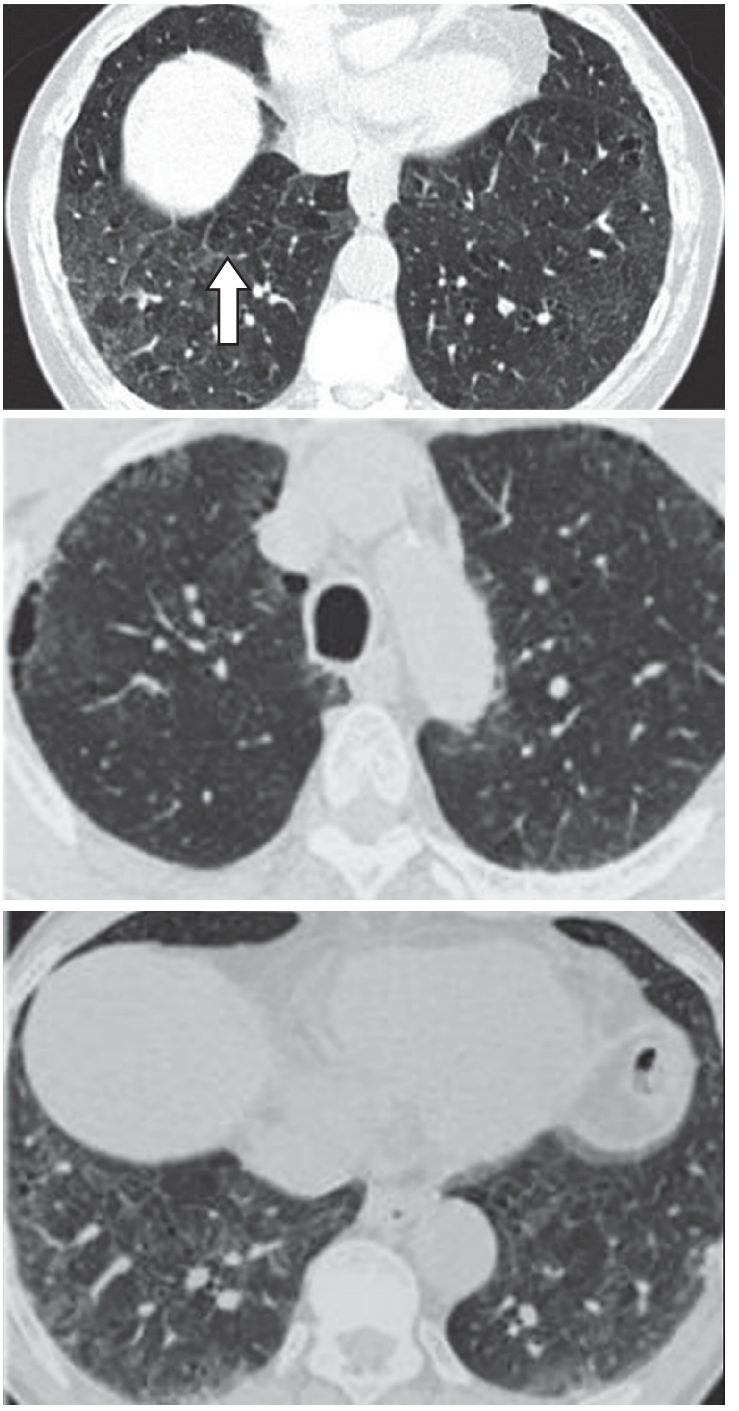
Patient with collagen vascular disease with multiple small bilateral peripheral consolidations



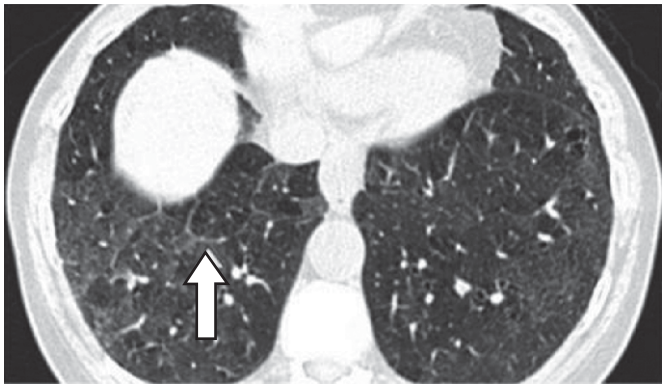
Patient with rheumatoid arthritis and bilateral peripheral consolidations

Diagnosis: Cryptogenic Organizing Pneumonia

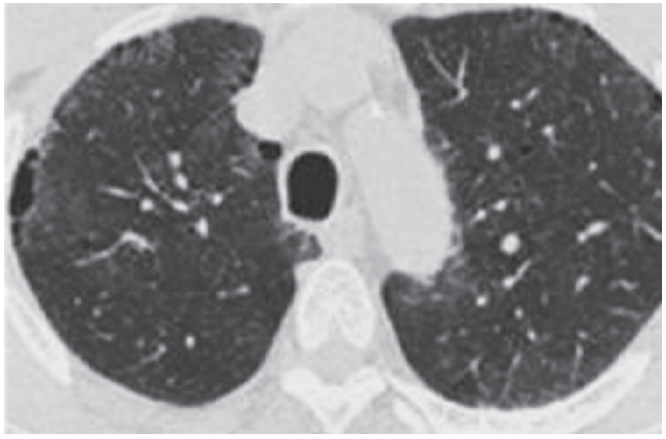
Cryptogenic organizing pneumonia (COP) used to describe as bronchiolitis obliterans with organizing pneumonia (BOOP) in an earlier version of the classification of idiopathic interstitial pneumonias. It is an inflammatory process in which the healing process is characterized by organization of the exudate rather than by resorption



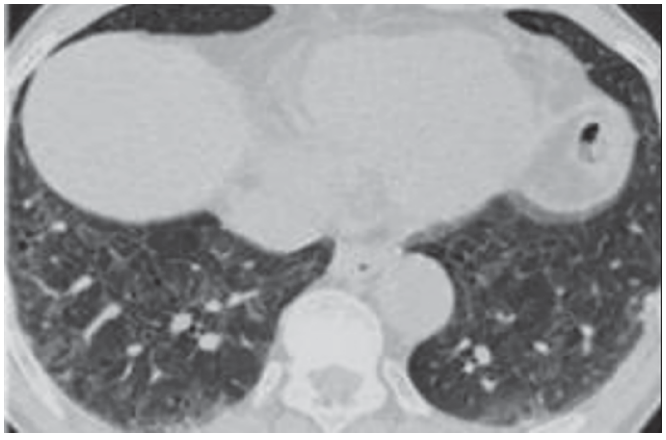
Chronic smoker presented with breathlessness
What is this?



Ground glass opacification with thickened interlobular septa (arrow)



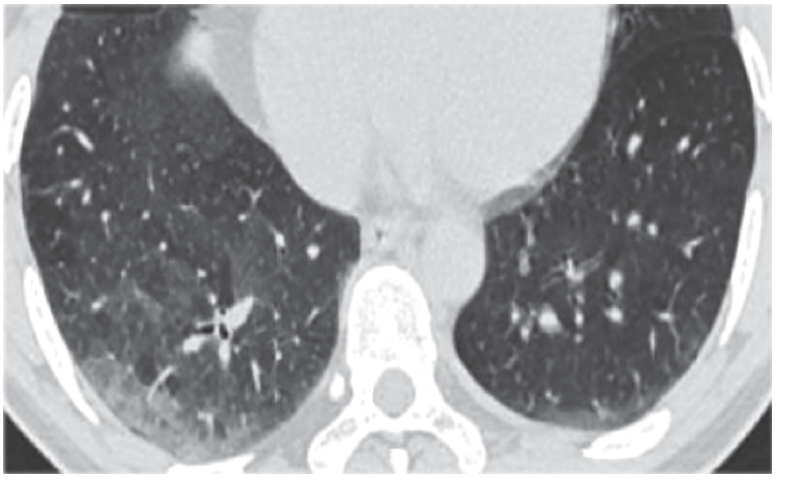
Ground glass opacification with paraseptal emphysema in the upper lobes



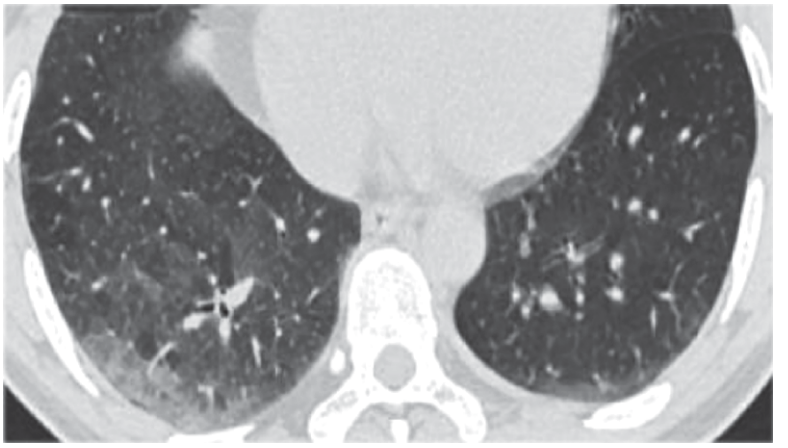
Multiple bilateral ground glass opacifications with some septal thickening

Diagnosis: Respiratory Bronchiolitis-associated Interstitial Lung Disease (RB-ILD)

RB-ILD is a treatable condition and has better prognosis if detected early. It is mandatory to stop smoking



What is this?

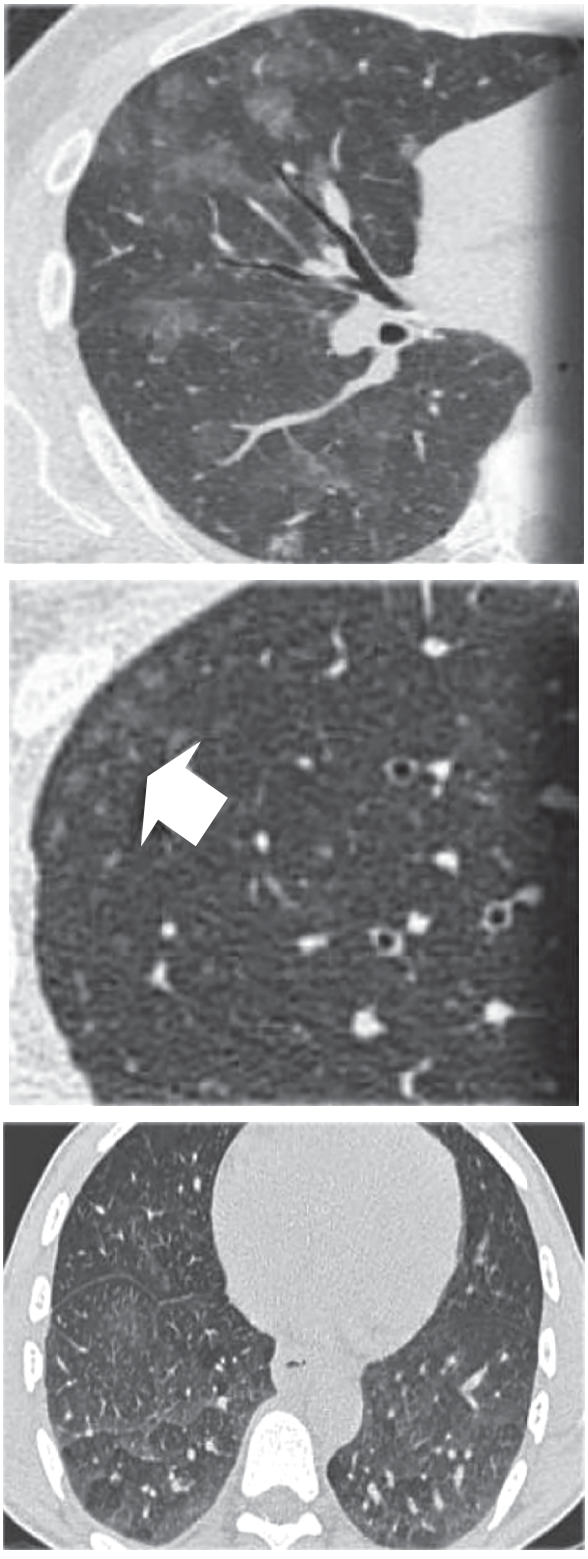


HRCT shows diffuse areas of ground-glass opacification in the lower lobes and some mosaic pattern as the sole abnormality

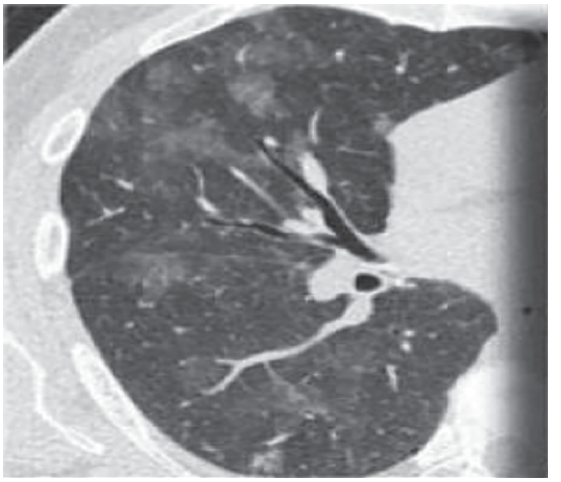
Diagnosis: Desquamative Interstitial Pneumonia (DIP)

Respiratory Bronchiolitis-associated Interstitial Lung Disease (RB-ILD), and Desquamative Interstitial Pneumonia (DIP)

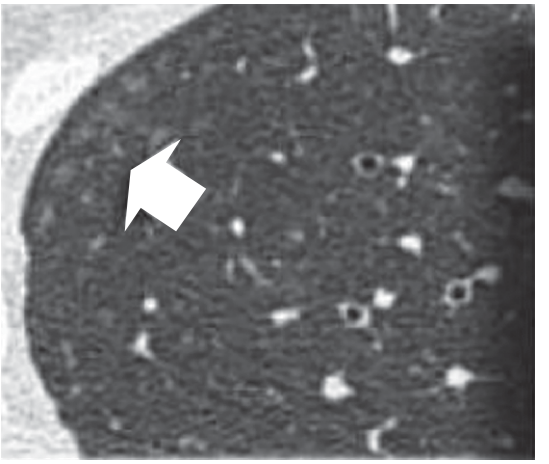
- Respiratory bronchiolitis (RB), respiratory bronchiolitis-associated interstitial lung disease (RB-ILD), and desquamative interstitial pneumonia (DIP) represent different degrees of severity of small airway and parenchymal reaction to cigarette smoke
- All smokers have various degrees of respiratory bronchiolitis, but it is usually asymptomatic
- HRCT findings in RB-ILD: Centrilobular nodules of ground glass opacity with upper lobe predominance, bronchial wall thickening and secondary lobule with decreased attenuation (air trapping)



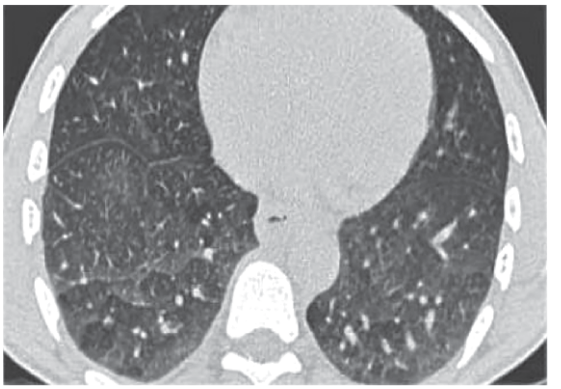
Patient presented with breathlessness
What is this?



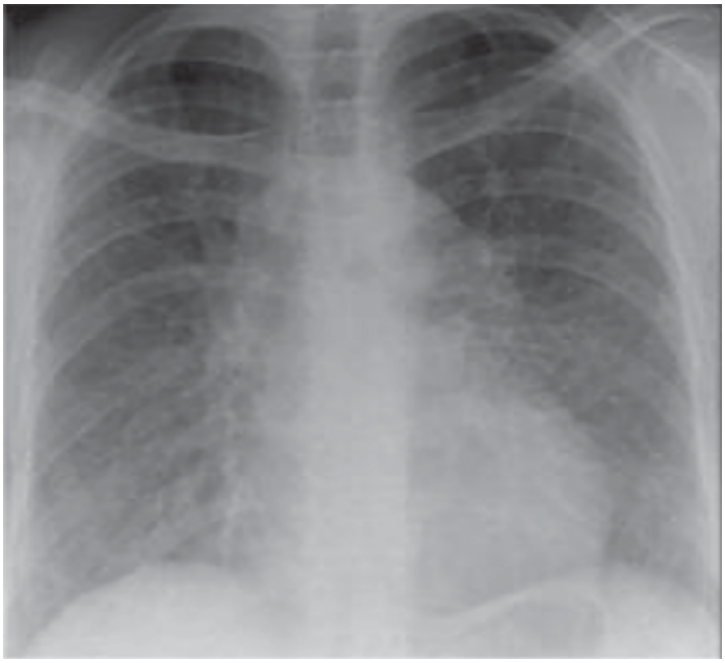
HRCT shows lobular areas of ground glass attenuation
Acute hypersensitivity pneumonitis



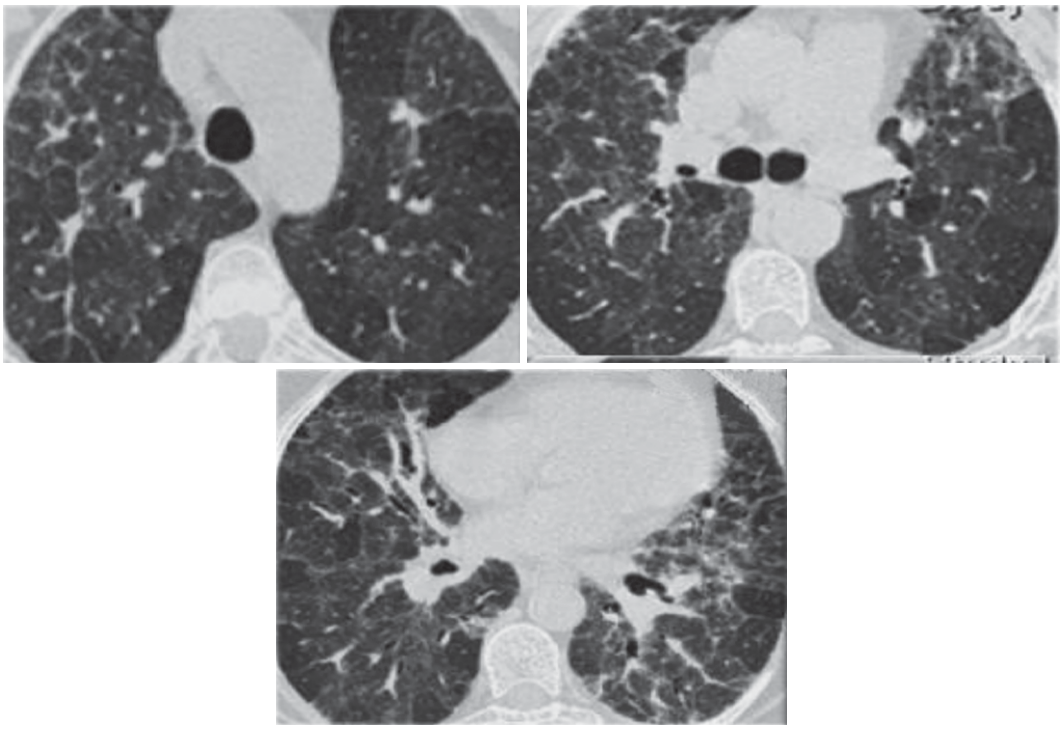
HRCT shows ill-defined centrilobular nodules



HRCT shows ill-defined centrilobular nodules with mosaic pattern
Subacute hypersensitivity pneumonitis



Patient presented with breathlessness
What is this?

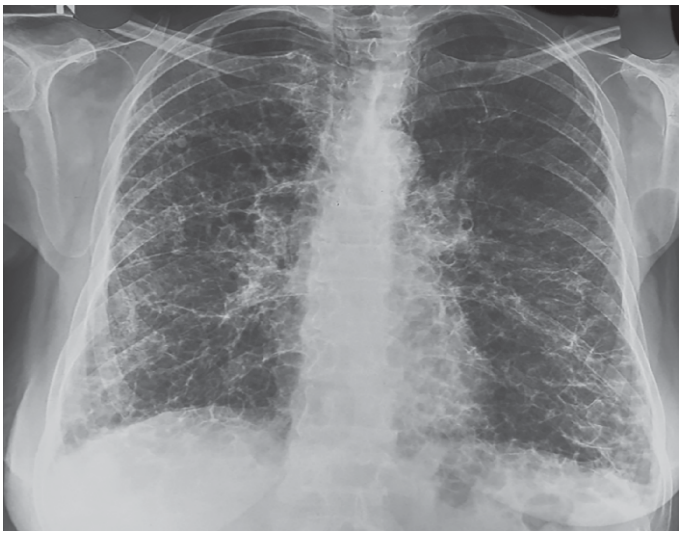


HRCT thorax at different levels

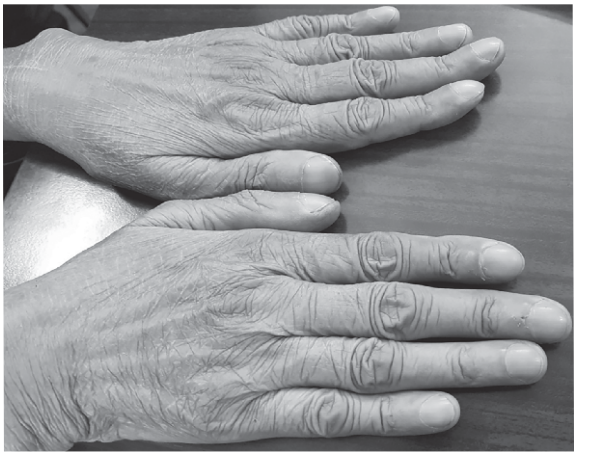
Diagnosis: Chronic Hypersensitivity Pneumonitis

Hypersensitivity Pneumonitis

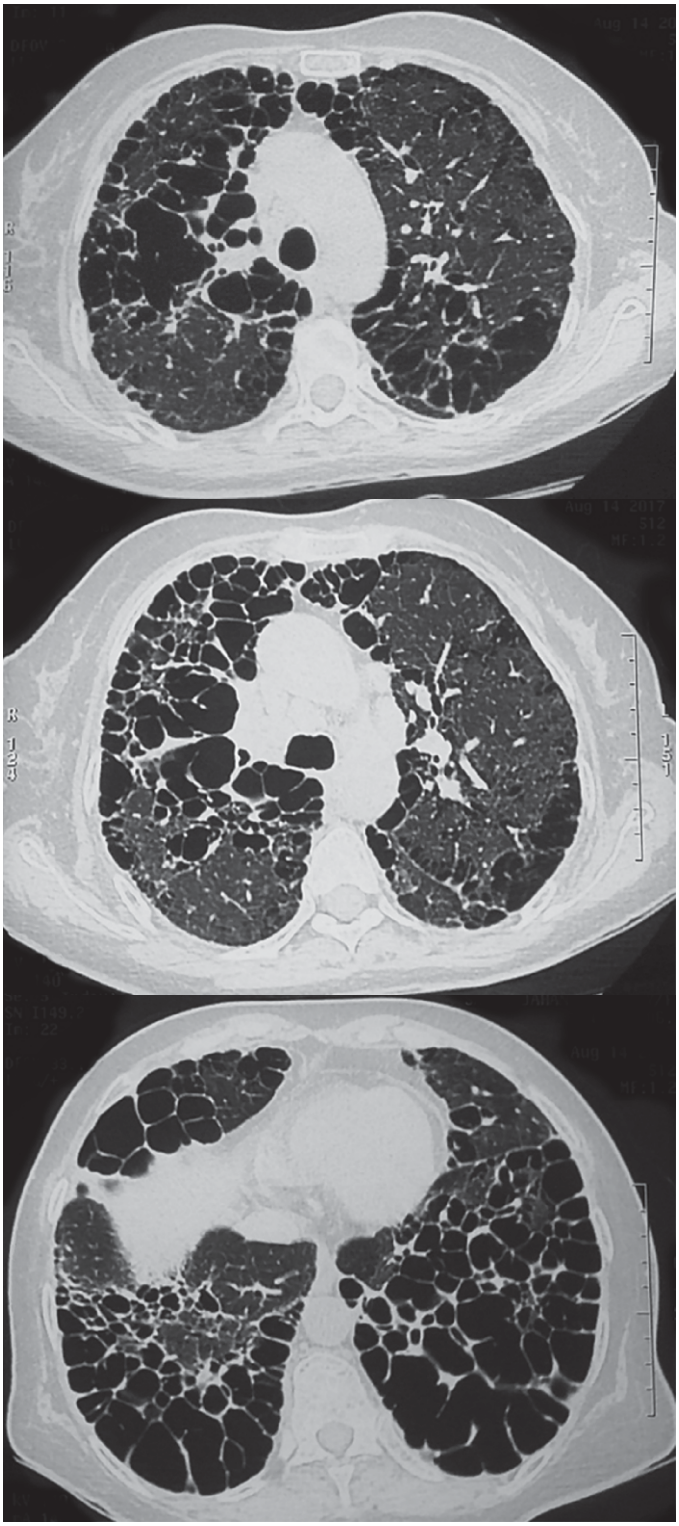
- Hypersensitivity pneumonitis (HP) is also known as extrinsic allergic alveolitis (EAA)
- The radiographic and pathologic abnormalities in patients can be classified into acute, sub-acute, and chronic stages. Recently hypersensitivity pneumonitis is classified as fibrotic or nonfibrotic based on presence or absence of fibrosis on high resolution CT thorax
- Mostly HRCT is performed in the sub-acute stage of HP, weeks to months following the first exposure to the antigen or in the chronic phase
- HRCT shows a mosaic pattern with hyperaerated secondary nodules of increased attenuation, additionally there is a septal and interlobular reticular thickening, indicating already existing irreversible fibrosis



A 50-year-old female presented with breathlessness
What is this?

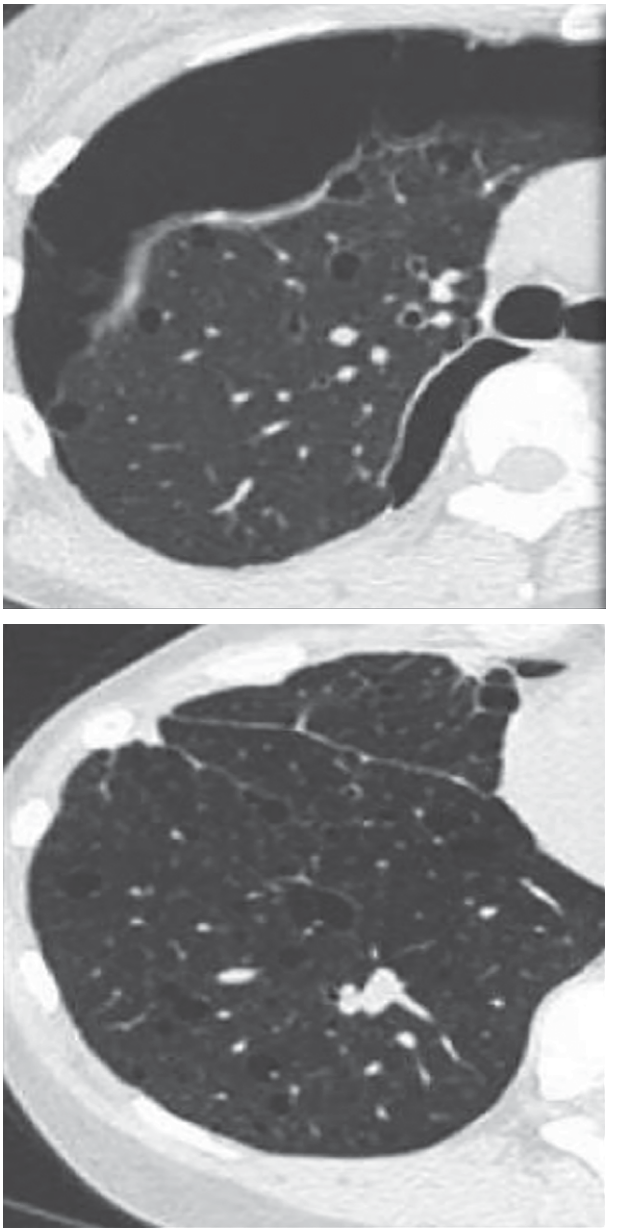


Clubbing



HRCT thorax at different level showing numerous thin-walled cysts

Diagnosis: Lymphangioleiomyomatosis (LAM)

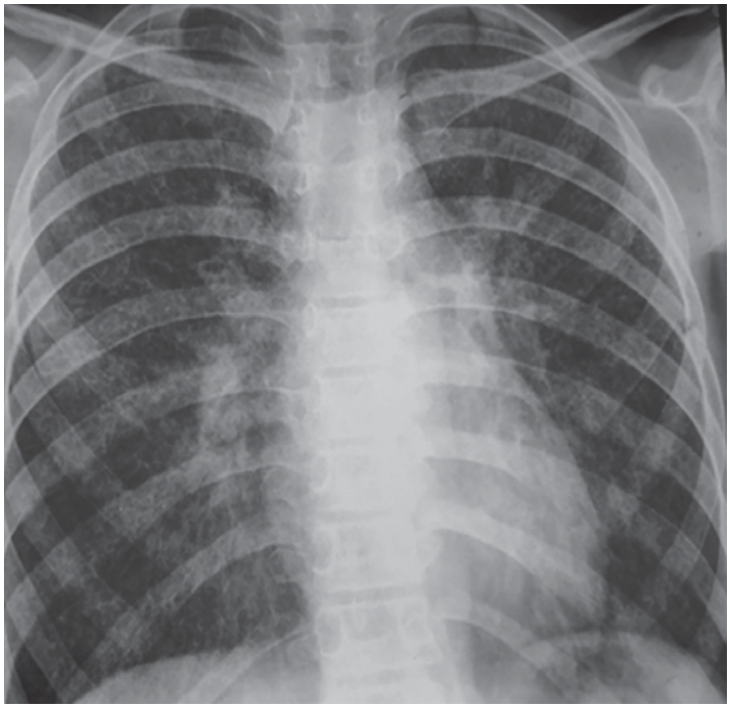


Multiple evenly spread thin-walled cysts complicated by a pneumothorax

Diagnosis: Lymphangioleiomyomatosis (LAM)

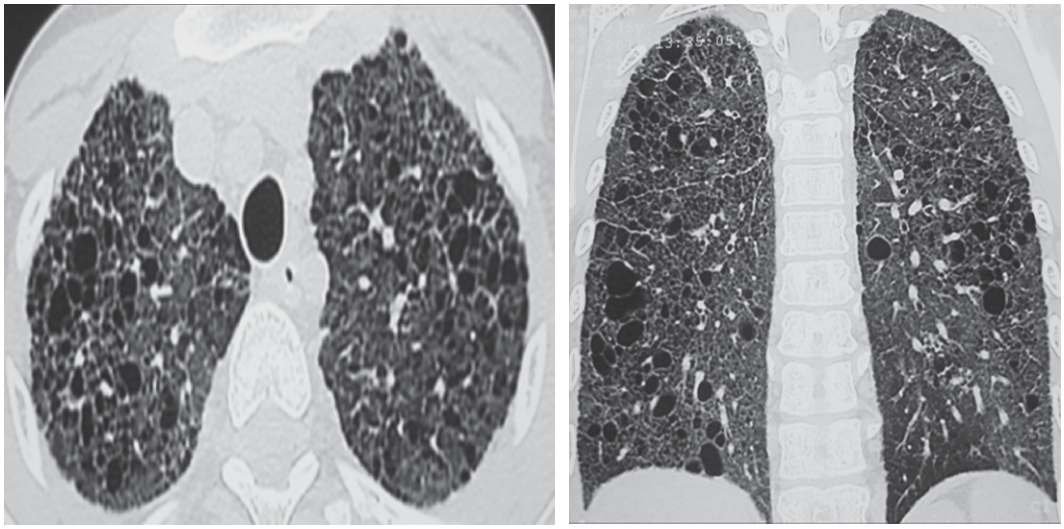
Lymphangioleiomyomatosis (LAM)

- Rare disease, that occurs only in premenopausal women
- Numerous thin-walled cysts, surrounded by normal parenchyma
- Cysts range from 2 mm to 5 cm in diameter, are round in shape and more or less uniform
- Cysts are distributed diffusely throughout the lungs and upper and lower lobes are involved to a similar degree



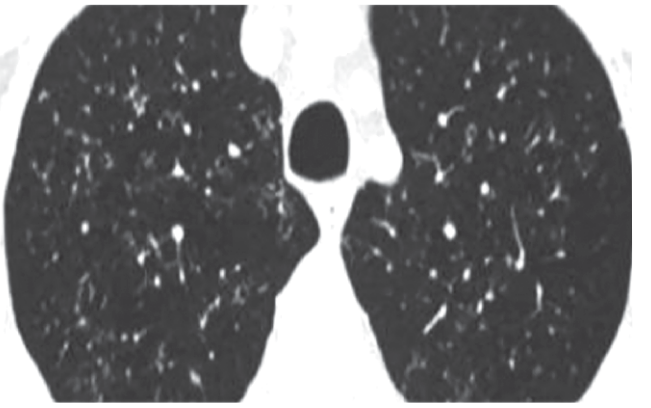
A 15-year-old male, nonsmoker, nonalcoholic, came with cough since 10 years and shortness of breath since 3 years with history of antitubercular treatment two years back without improvement. Grade IV clubbing with bilateral end inspiratory crepts

What is this?

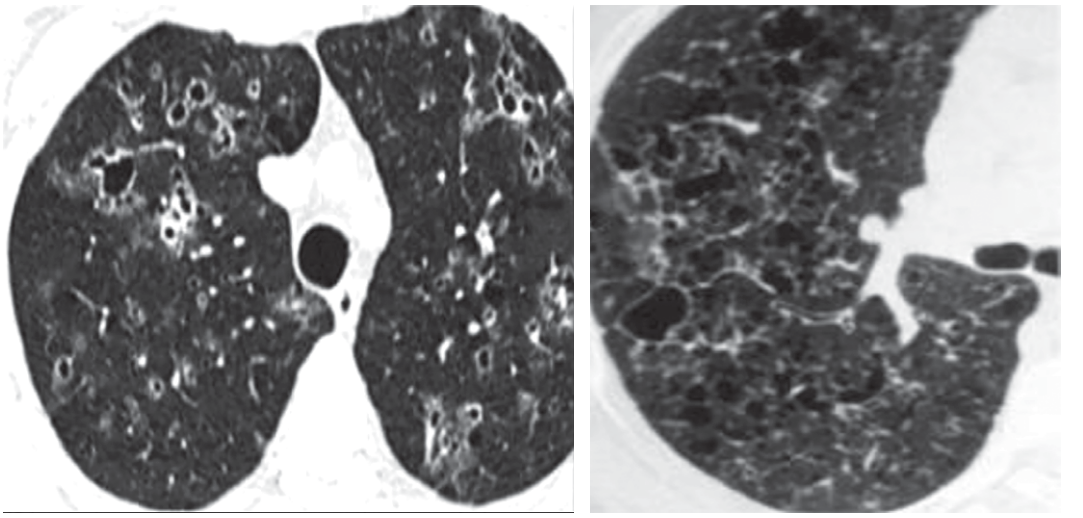


HRCT thorax showing cystic air spaces with bizarre shapes

Diagnosis: Pulmonary Langerhans Cell Histiocytosis (PLCH)



Early stage Langerhans cell histiocytosis with small nodules



Late stage Langerhans' cell histiocytosis.
Cysts progress to typical bizarre-shaped cysts

Diagnosis: Pulmonary Langerhans Cell Histiocytosis (PLCH)

Pulmonary Langerhans Cell Histiocytosis (PLCH)

Also known as pulmonary histiocytosis X or eosinophilic granuloma

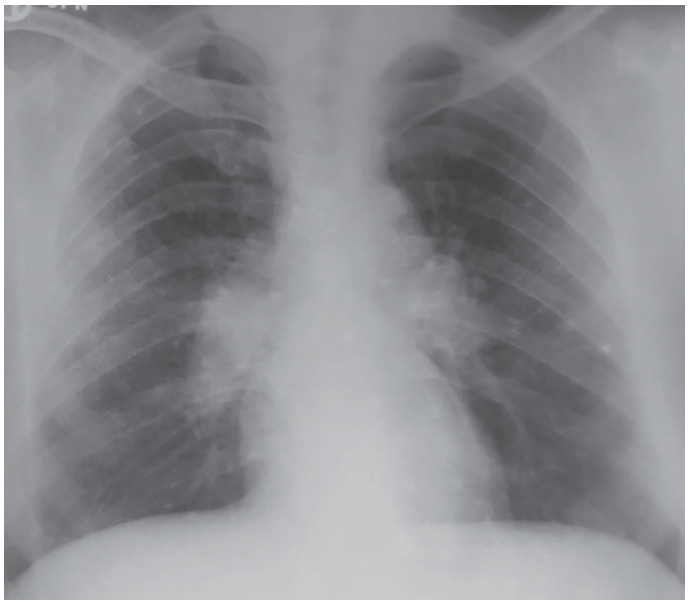
HRCT findings

- Early stage: Small irregular or stellate nodules in centrilobular location
- Late stage (more commonly seen): Cystic airspaces cysts have bizarre shapes, they may coalesce and then become larger, upper and midlobe predominance and recurrent pneumothorax

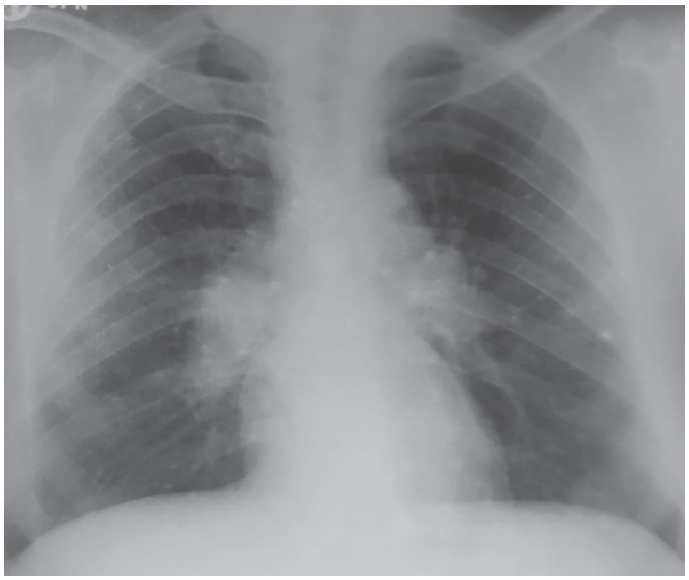
CHAPTER

18

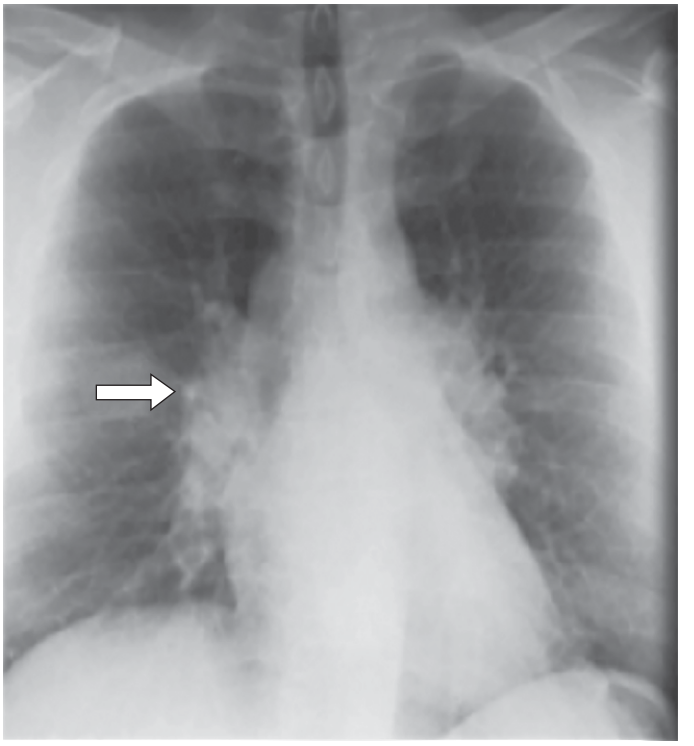
Radiology of Sarcoidosis

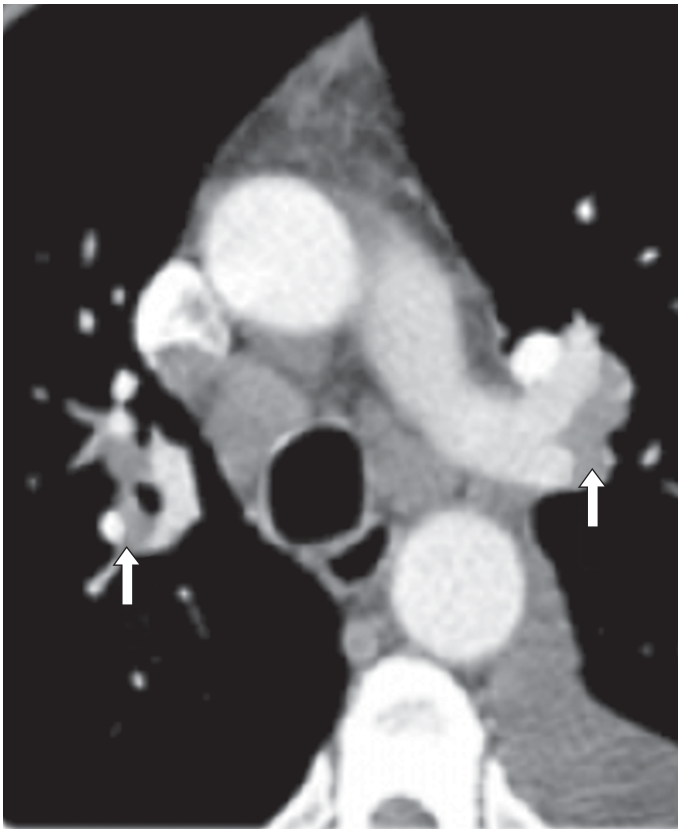


What is this?

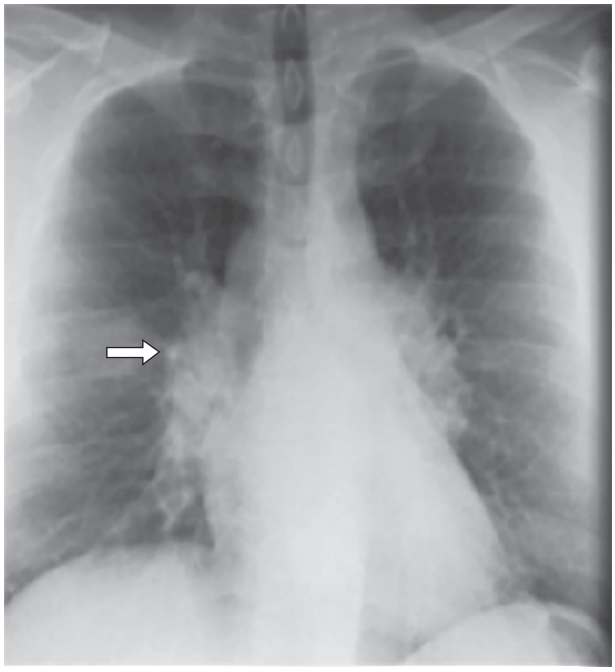


Bilateral hilar lymph node enlargement cause sarcoidosis stage 1

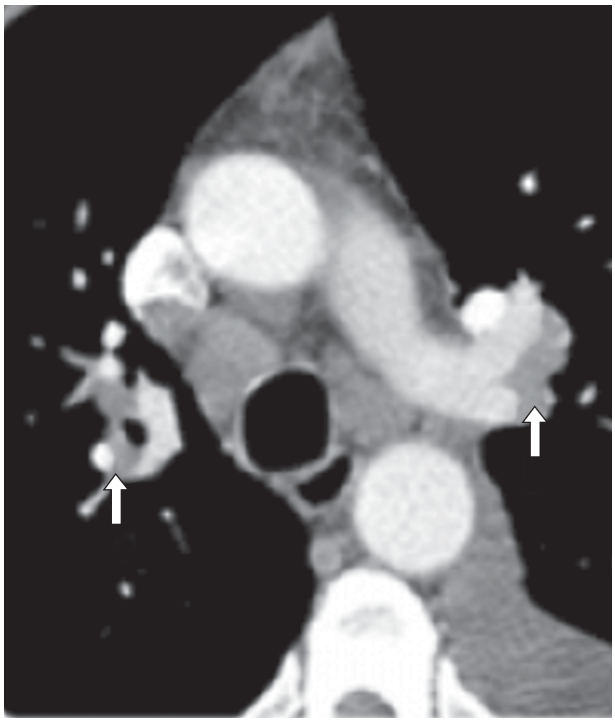




What is this?

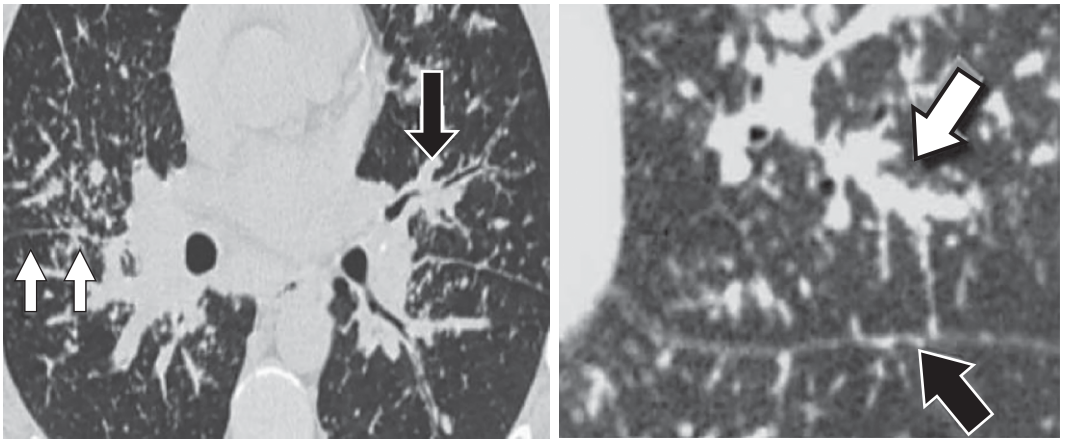


Left and right hilar adenopathy

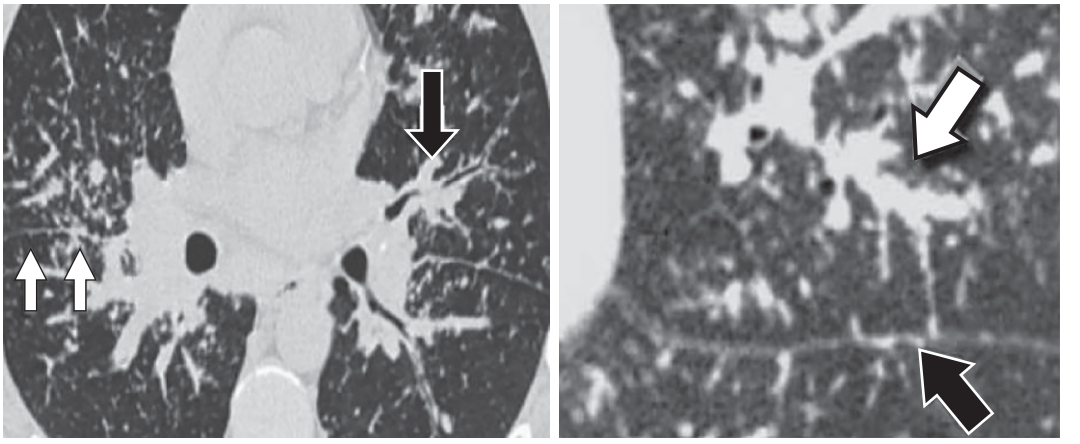


Left and right hilar and paratracheal adenopathy (1-2-3 sign)

Diagnosis: Sarcoidosis Stage I



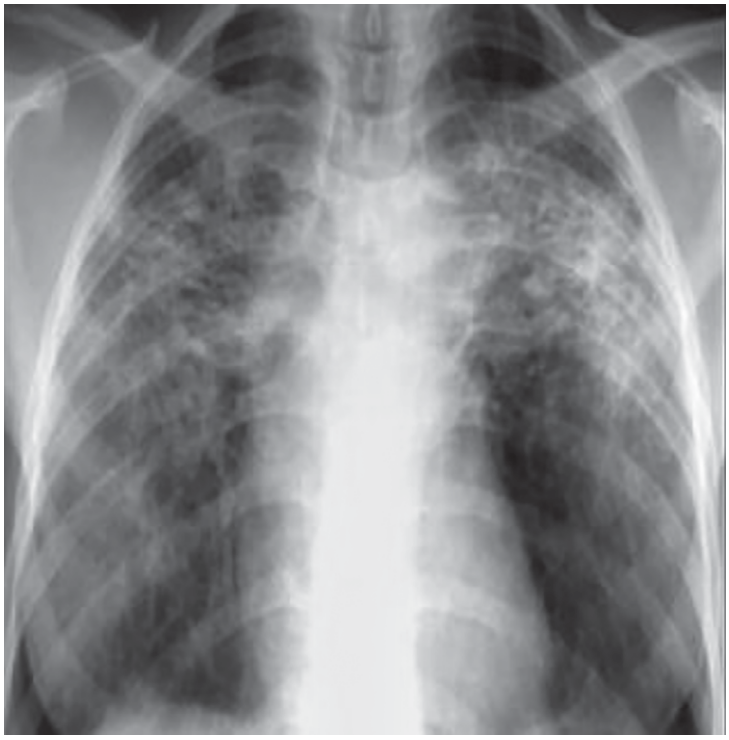
What is this?

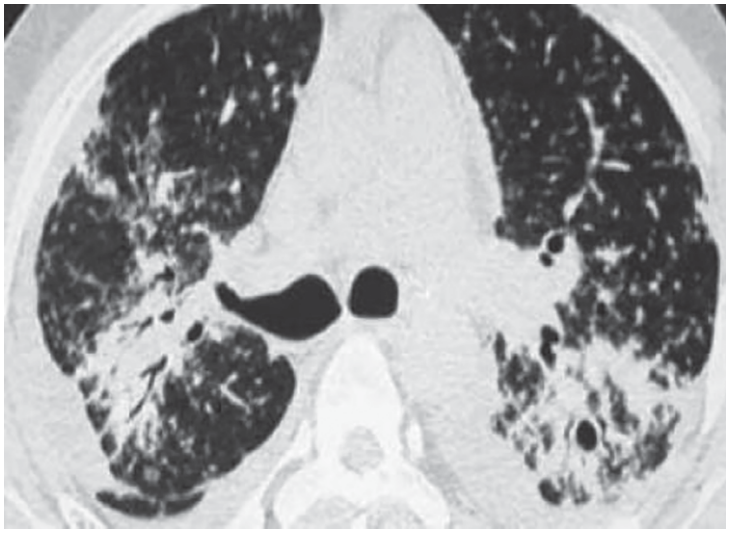


CT picture shows nodules along the bronchovascular bundle and fissures

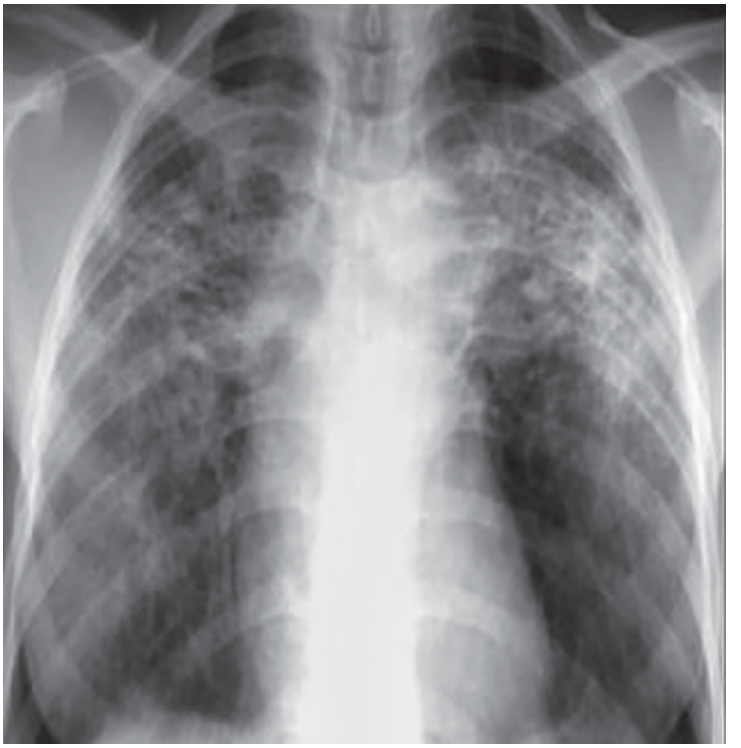
HRCT shows nodules along bronchovascular bundle (white arrow) and fissures (black arrow), this is the typical perilymphatic distribution of the nodules

Diagnosis: Sarcoidosis Stage III

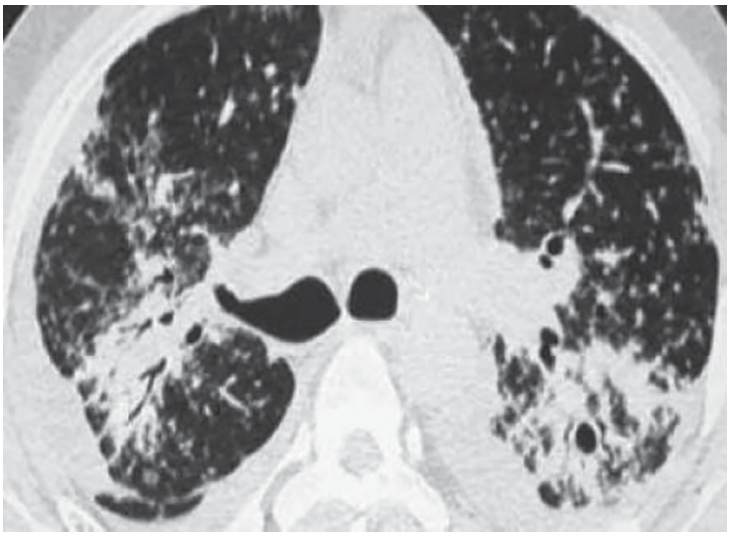




What is this?

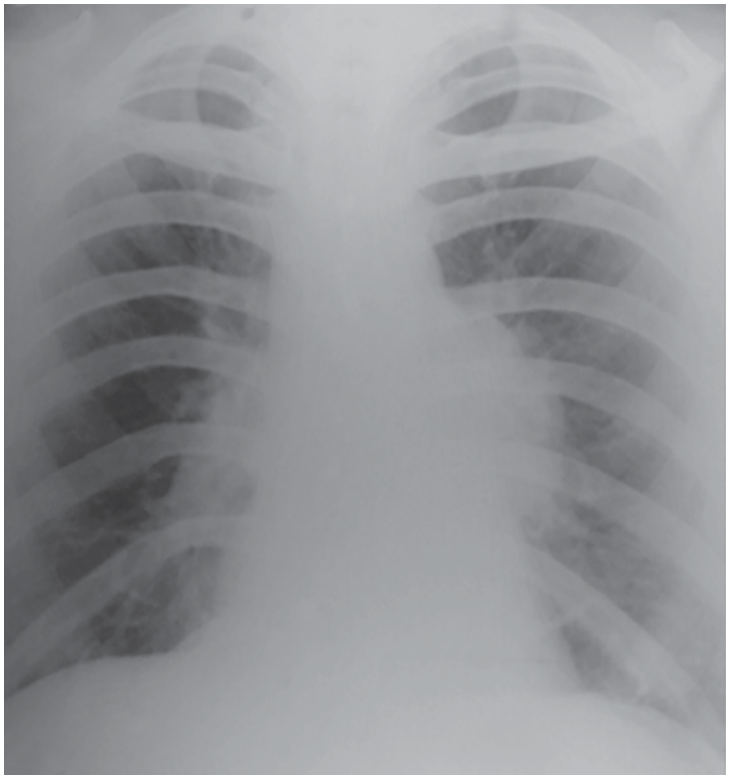


Long standing sarcoidosis with fibrosis in upper zones

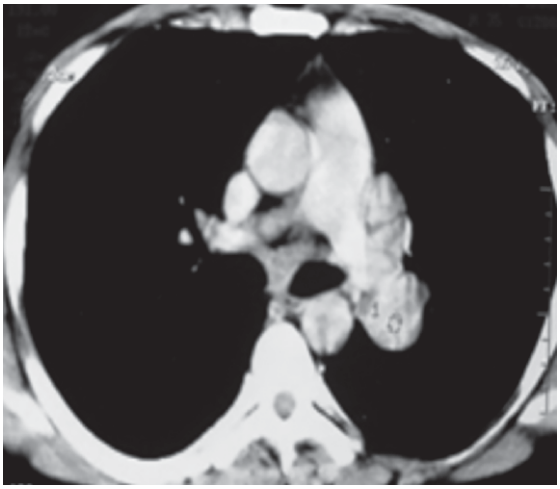


CT shows conglomerate masses of fibrosis in posterior part of lungs with multiple small well-defined nodules with subpleural distribution

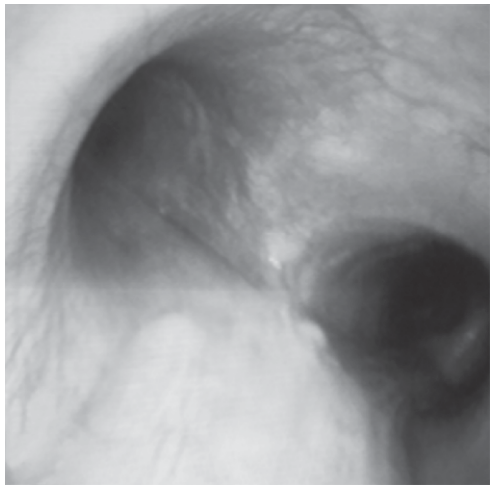
Diagnosis: Sarcoidosis with Fibrosis Stage IV



What is this?

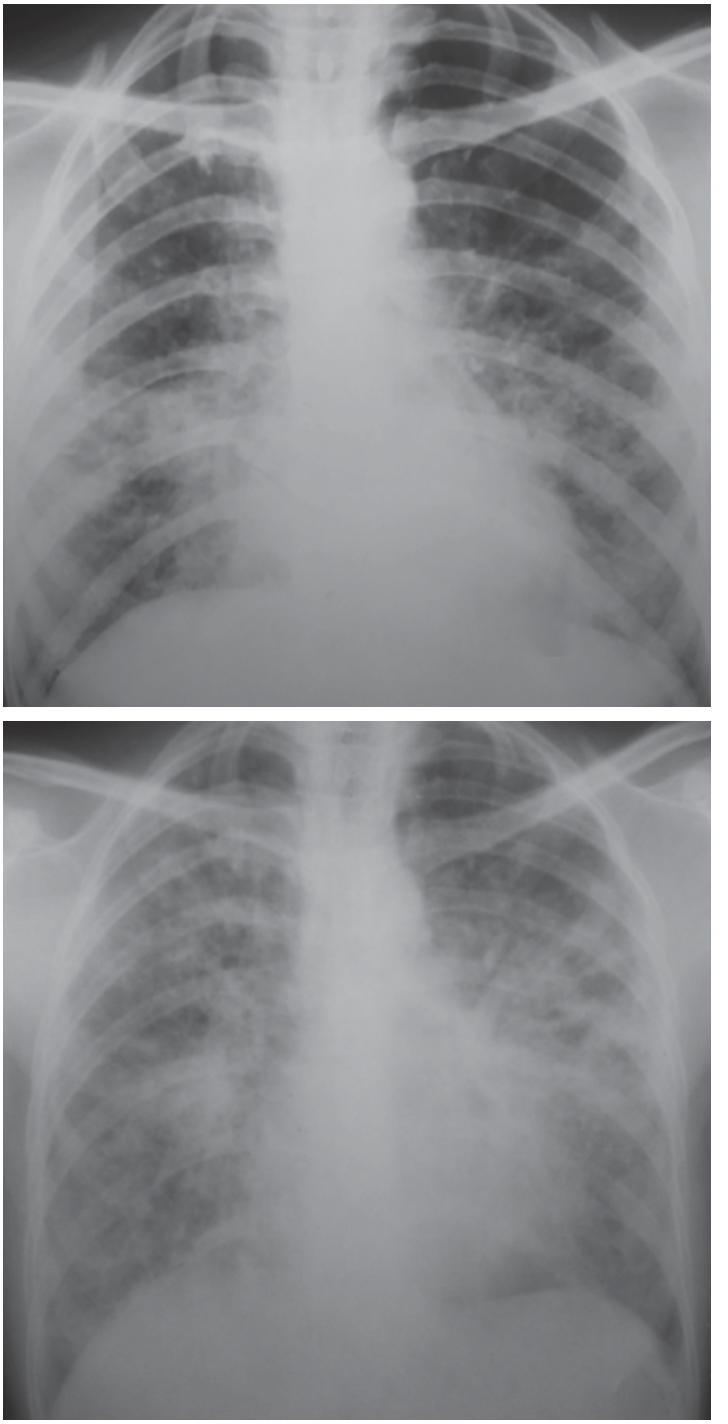


CT thorax left hilar lymphadenopathy



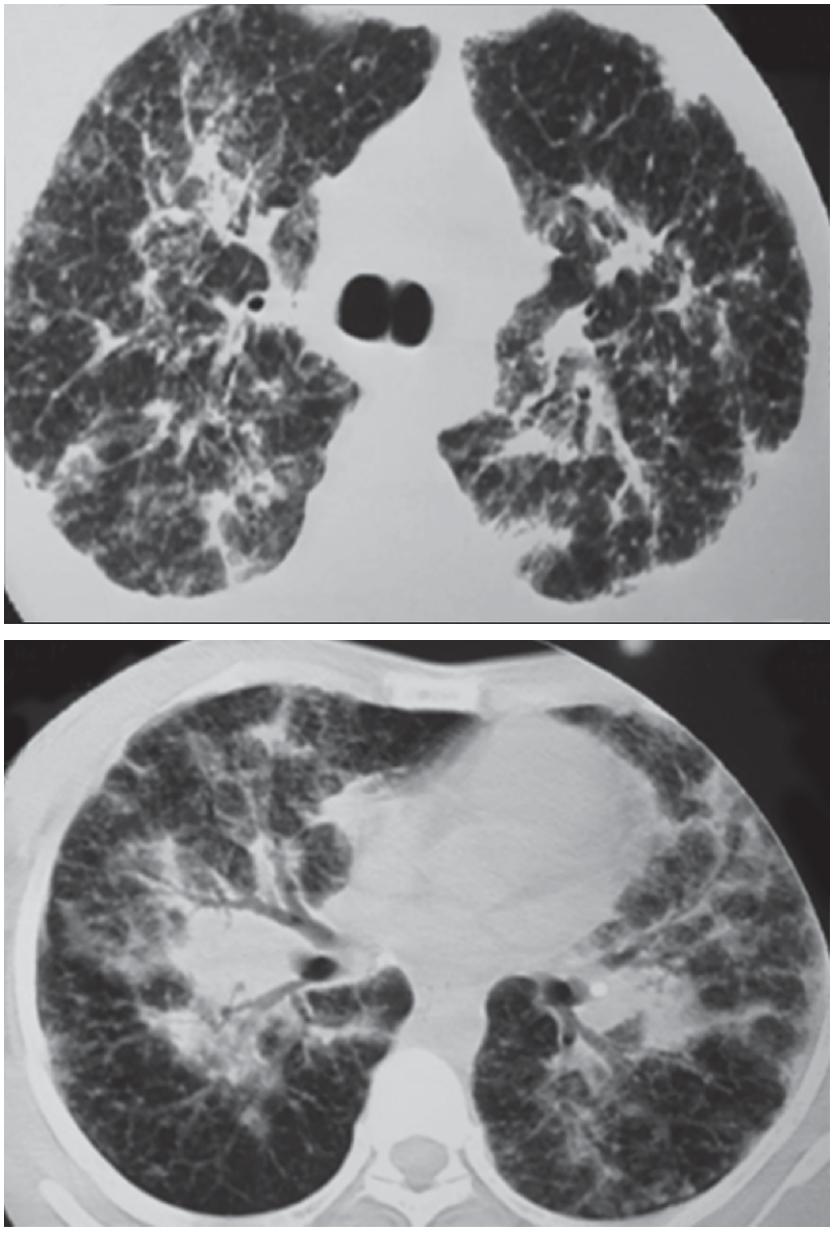
Fiberoptic bronchoscopy shows multiple nodules at lower end of trachea and main carina (Colour Plate IV)

Diagnosis: Sarcoidosis Stage II



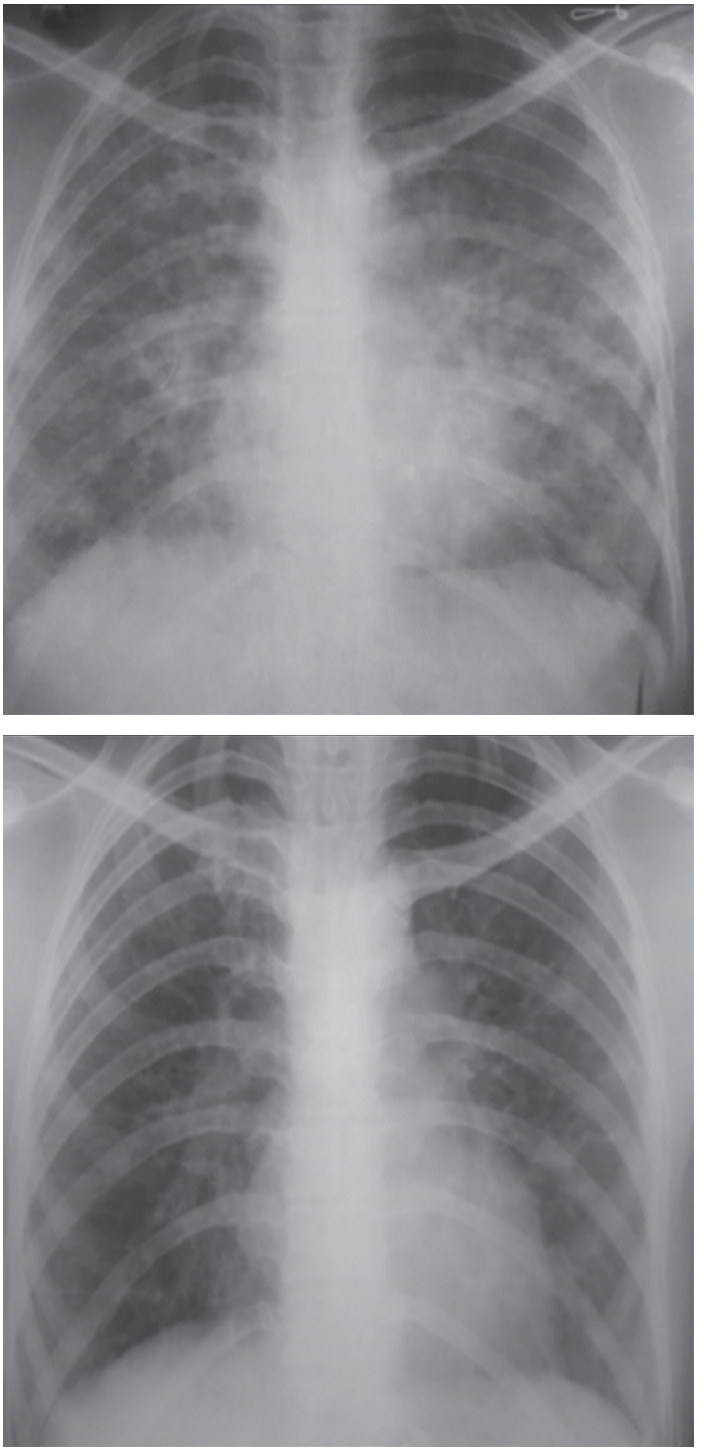
A 38-year-old female presented with dry cough—1 year, breathlessness—10 months, PPD and sputum for AFB negative. 5 years back patient had supraclavicular lymph node, histopathology showed epitheloid granuloma with caseous necrosis, had antitubercular treatment for 8 months with good response patient received antitubercular treatment again for 10 months with no response

What is this?



HRCT thorax

Serum ACE-144 IU/L transbronchial lung biopsy (TBLB) showed evidence of epitheloid ganuloma without caseous necrosis



Clinical and radiological improvement after 6 months of steroid treatment

Diagnosis: Sarcoidosis Stage III

Please note that this was a rare case in which tuberculosis and sarcoidosis diagnosed in same patient at different time