Occupational Interstitial Lung Diseases

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Occupational Lung Disease

Learning Objectives:

- To understand the presentation of common occupational lung diseases (OLD): established and recently described conditions.
- To review in detail several illustrative common disorders: asbestosis, silicosis, hypersensitivity pneumonitis.

Occupational Burden on Non-malignant Lung Disease

- INCIDENT ASTHMA:
  - PAF (Population Attributable Fraction) 16% (95% CI 10-22%)
- COPD:
  - PAF 14% (95% CI 10-18%)
- *INTERSTITIAL LUNG DISEASE-IPF:*
  - PAF 26% (95% CI 10-41%)
- *GRANULOMATOUS LUNG DISEASE, SARCOIDOSIS*:
  - PAF 30% (95% CI 17-45%)
- *HYPERSENSITIVITY PNEUMONITIS:*
  - PAF 19% (95% CI 12-28%)

BLANC P ET AL. AM J RESPIR CRIT CARE MED 2019;199:1312-1334.

Pneumoconiosis: Definition

Non-neoplastic reaction of the lungs to inhaled mineral or organic dust and the resultant alteration to their structure, but excluding asthma, bronchitis, and emphysema.

Pneumoconiosis = Occupational Interstitial Lung disease

Interstitial Lung Disease: Pneumoconioses

- Asbestosis *
- Silicosis *
- Coal/carbon dust lung fibrosis
- Mixed dust pneumoconiosis
- Talcosis
- Cobalt-induced ILD
- Hypersensitivity Pneumonitis *

ROOF DRAIN

SANITARY

Asbestos-Related Disease

- Fibrosis: Lung Parenchyma(Asbestosis)
- Pathology: virtually identical to IPF but with asbestos bodies present.
- Fibrosis: Pleural
  - Circumscribed Parietal Plaques
  - Diffuse visceral pleural fibrosis

Interstitial Fibrosis (Asbestosis)

- Symptoms:
  - Progressive DOE, out of proportion to CT and sometimes PFT
- Exam:
  - Rales, clubbing - only in advanced cases
  - PFT: classically restrictive defect; may be mixed.
- Exercise Tests:
  - can be useful to evaluate dyspnea/disability assessment
- CXR:
  - Irregular opacities - lower fields
- HRCT:
  - More sensitive at finding early parenchymal lesions, as well as pleural lesions

Radiologic Features

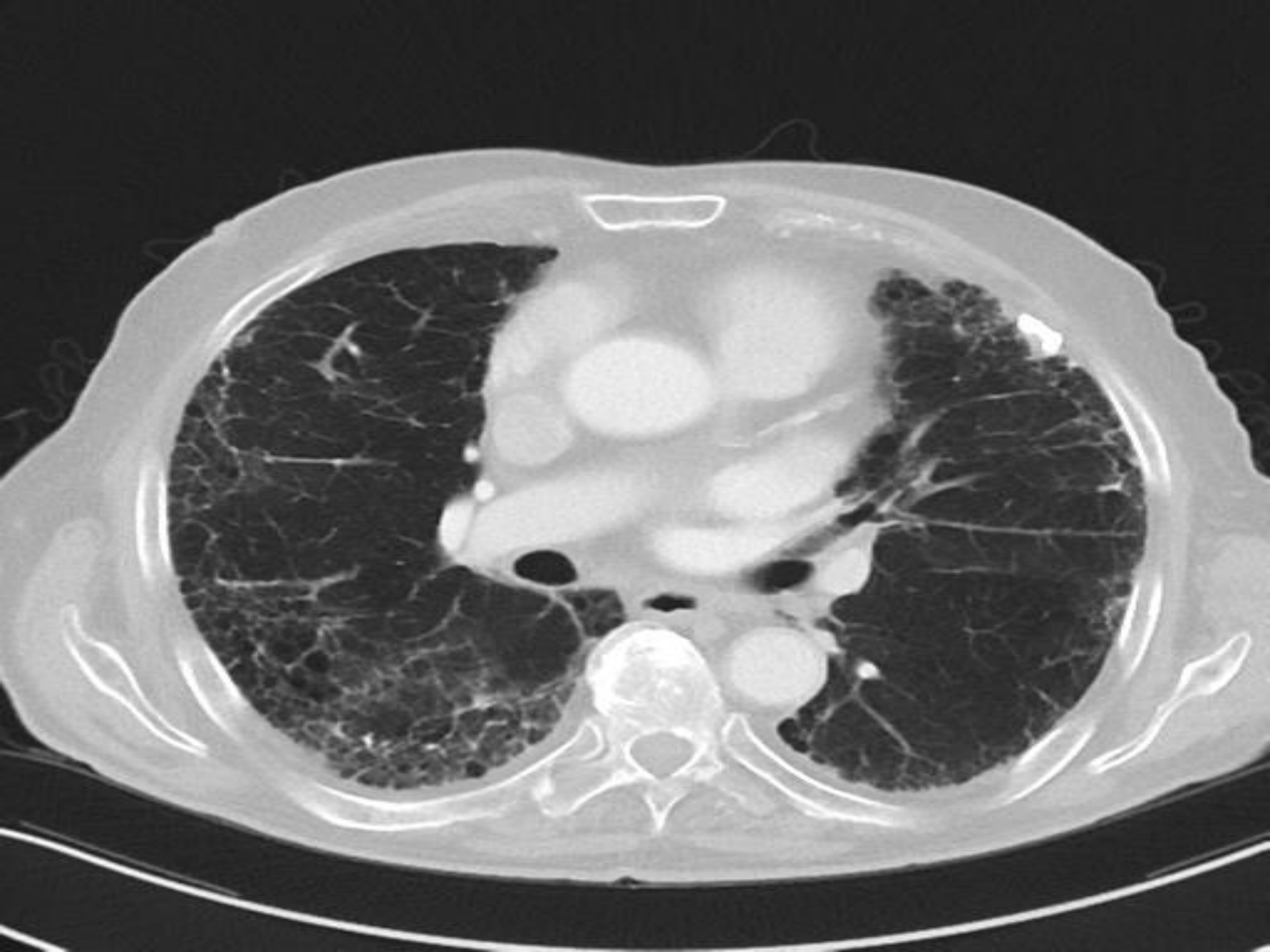
Appearances of asbestosis vary with the duration and severity of the condition. Early manifestations are largely confined to the peripheral region of the lower zones and are subtle. They include:

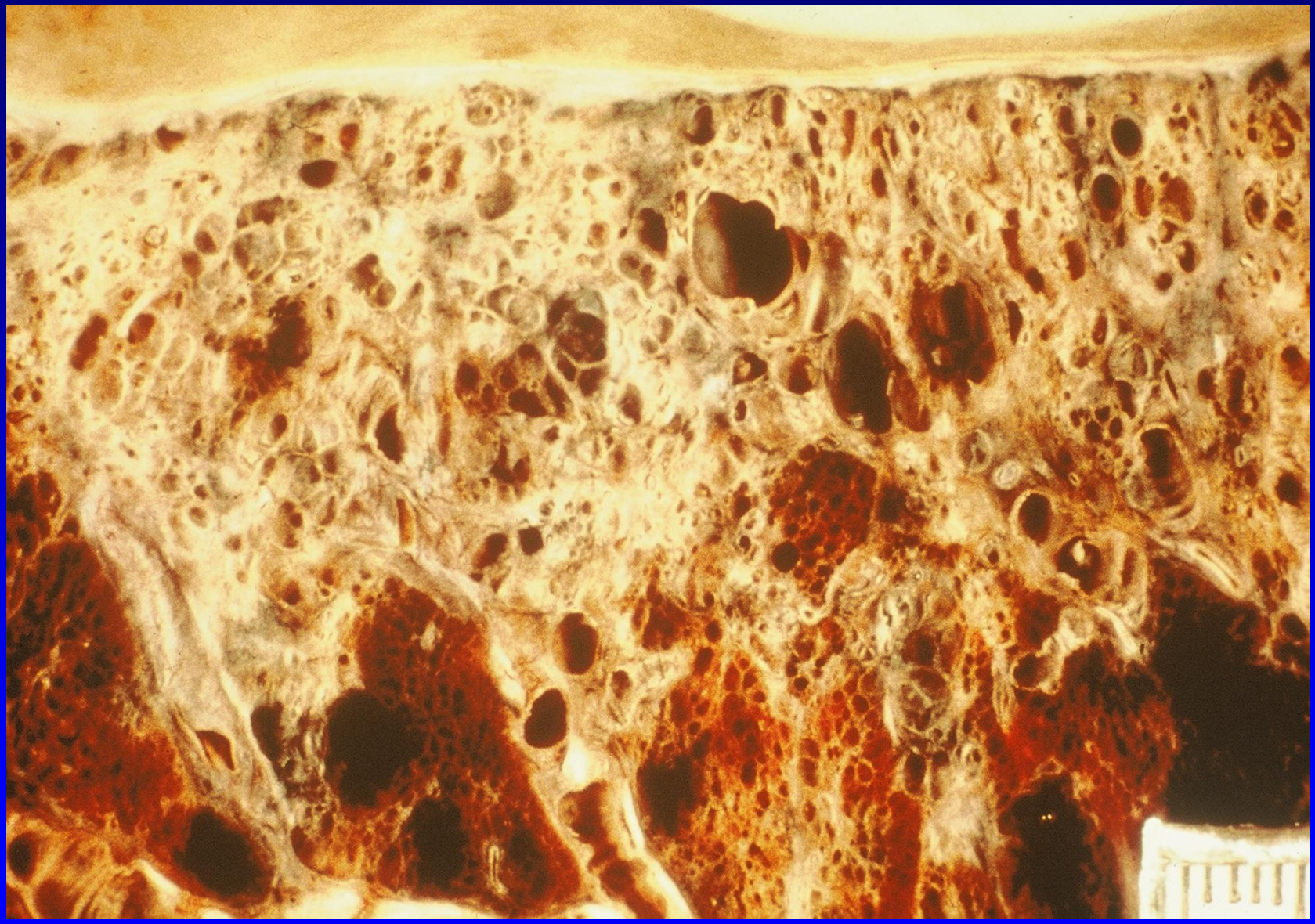
- Centrilobular opacities: peribronchiolar fibrosis intralobular linear opacities and reticulation
- Subpleural lines (often curvilinear)

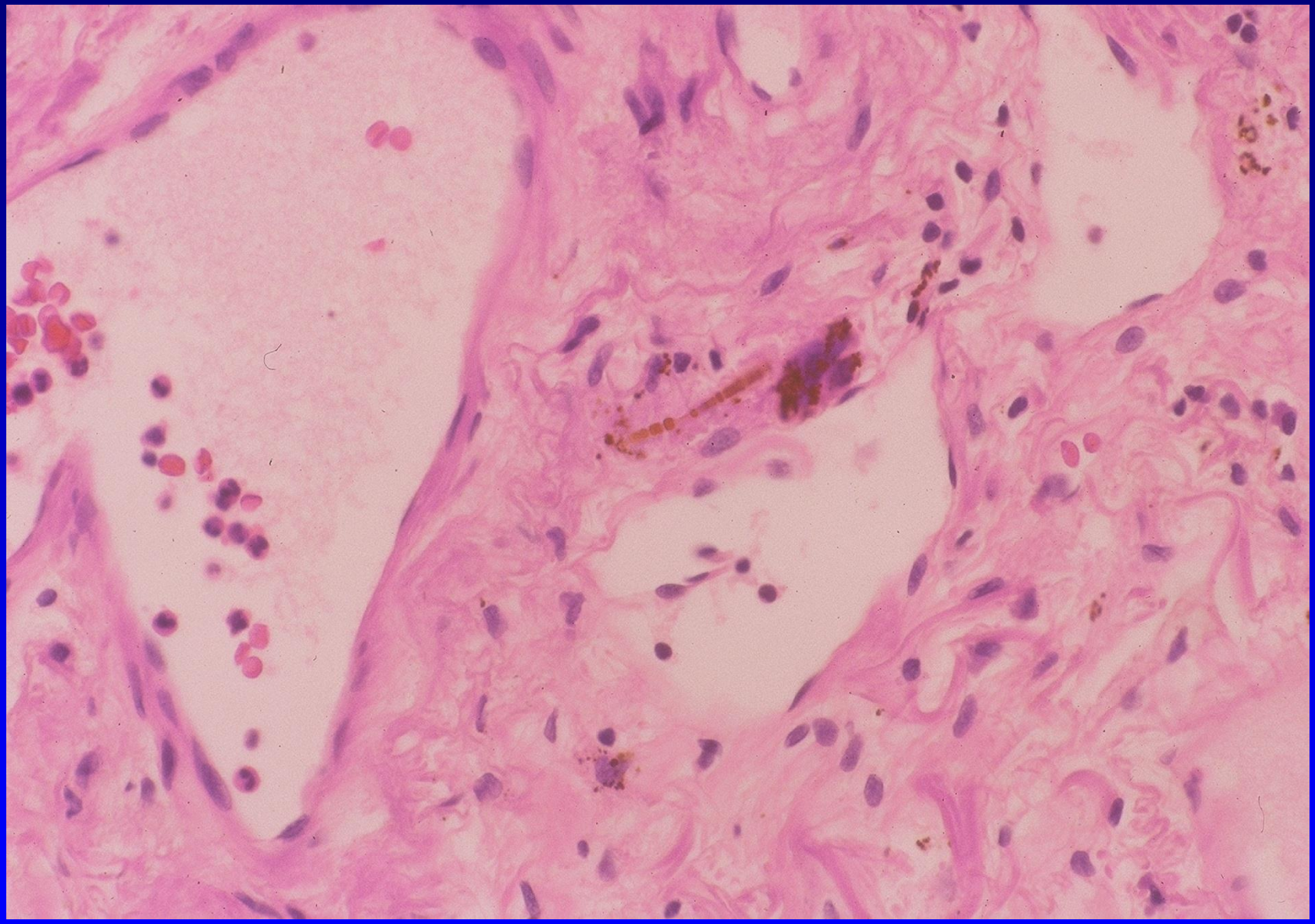
Radiologic Features (Cont.)

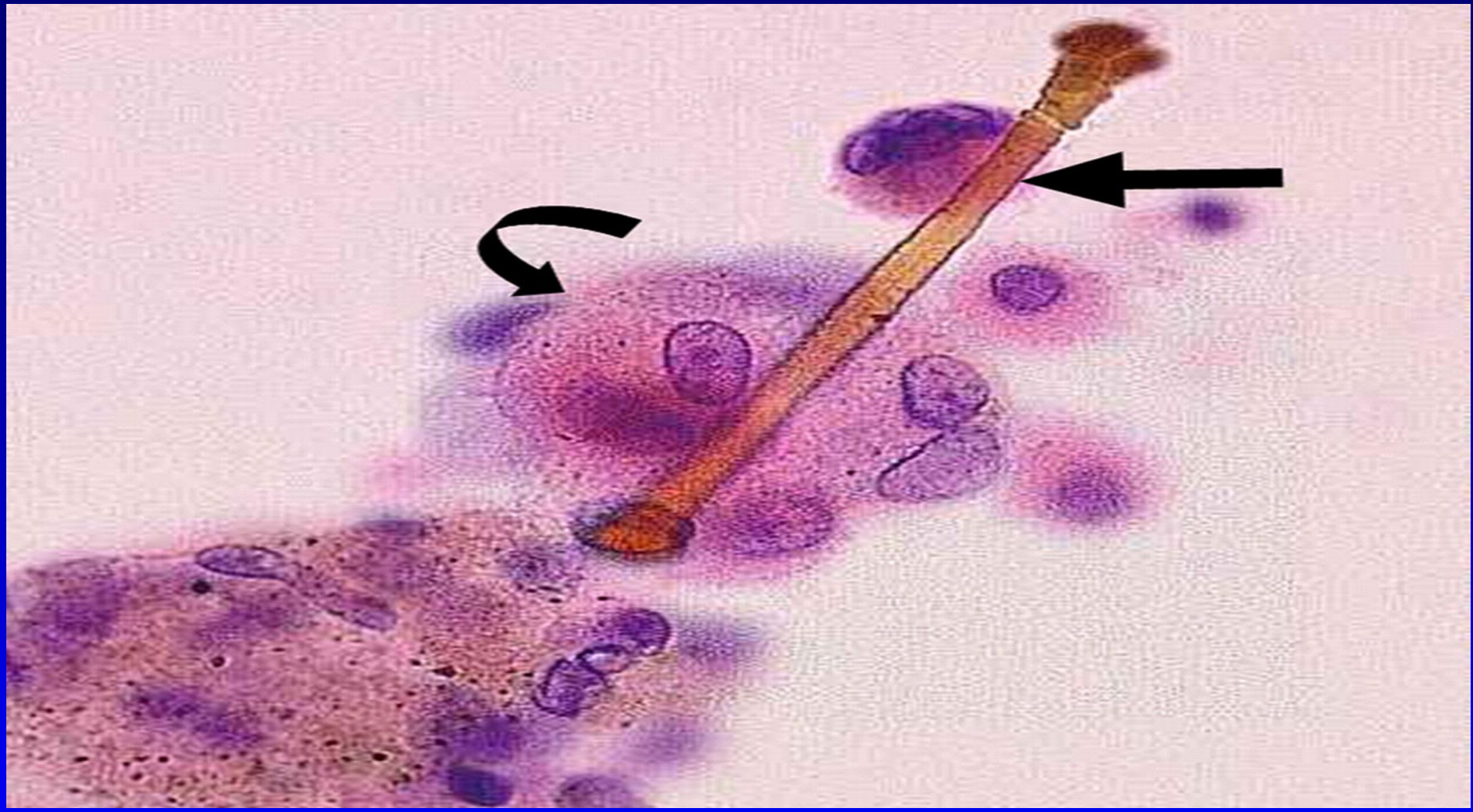
As the fibrosis progresses, a number of more definite findings are seen, which continue to be particularly subpleural and lower lung zone in distribution. They include

- Parenchymal bands
- Traction bronchiectasis
- Honeycombing
- Pleural plaques are common









Asbestos body. Photomicrograph (original magnification, ×1000; hematoxylin-eosin stain) shows a translucent asbestos fiber (straight arrow) surrounded by a segmented protein-iron coat that is much more prominent around the lower part of the fiber, and an alveolar macrophage (curved arrow).

Pleural Fibrosis

Circumscribed (pleural plaque)

- parietal pleura, acelluar, and eosinophillic
- often bilateral and symmetric
- most common between 5th-8th ribs, sparing apices and CPA
- usually asymptomatic - can have chest wall pain
- usually no impairment, though a minority
- has restrictive defect (5%)

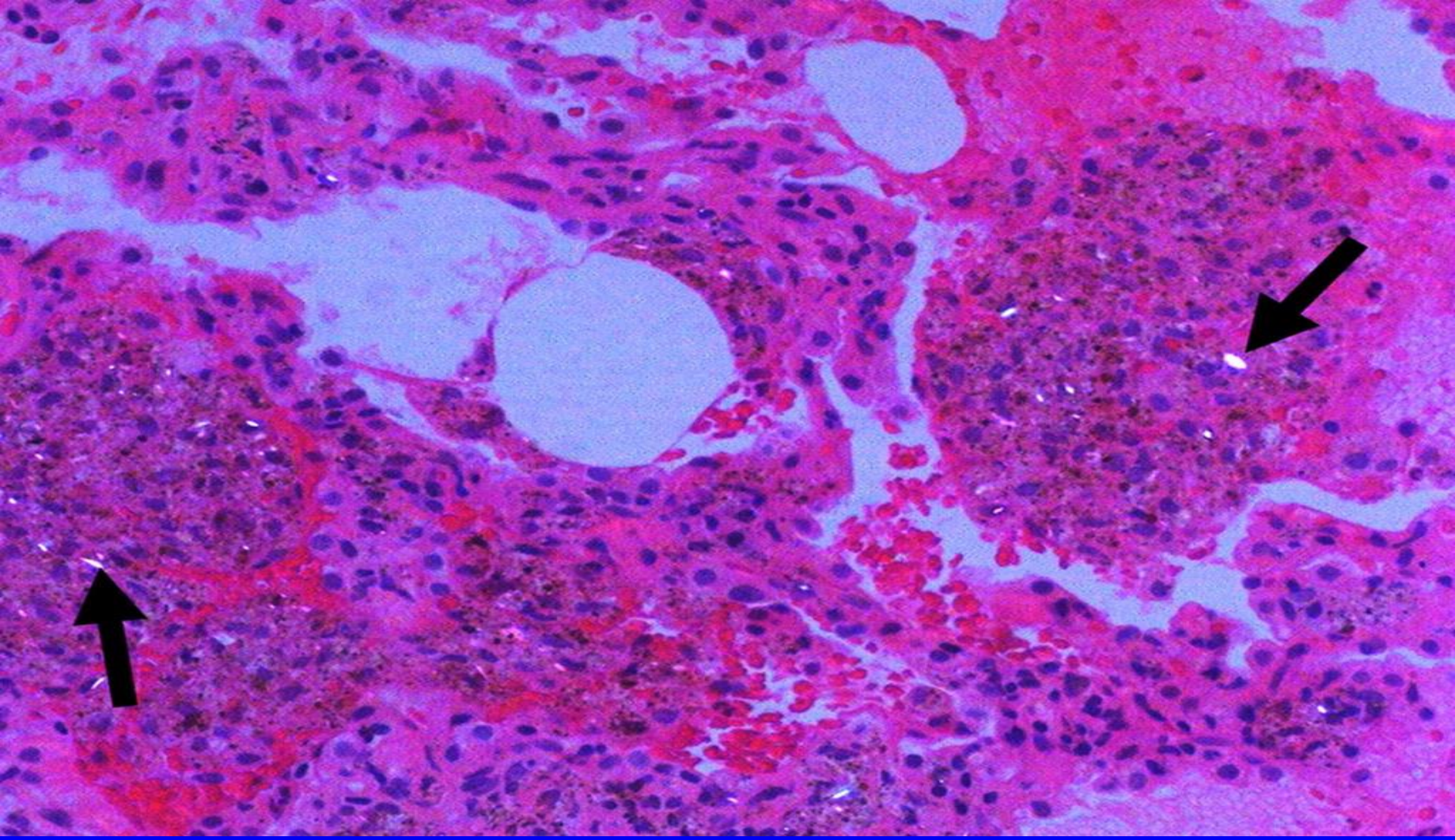
Silicosis

SiO2 (quartz): the toxic agent.

- Sandblasting
- Granite cutting and polishing
- Construction
- Boiler firebrick
- Mining
- *Kitchen Countertops*

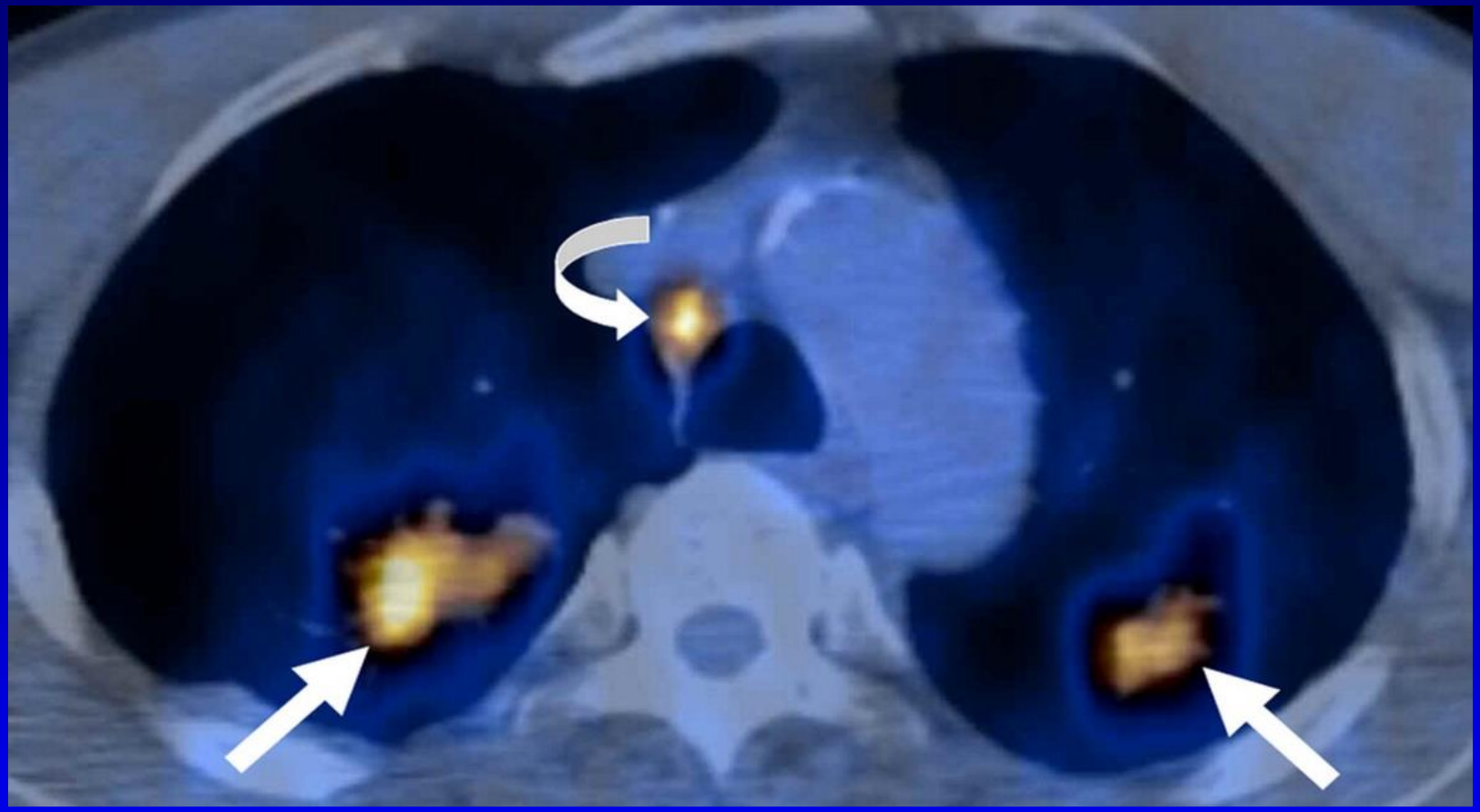
SILICOSIS in a 56-year-old man who worked for 25 years as a stonecutter. **(a)** Chest radiograph shows multiple variable-sized nodular lesions in both lungs, predominantly in the upper and middle zones. **(b)** Axial thin-section CT scan (1.0-mm-thick section) obtained at the level of the azygos arch shows multiple small nodules with a perilymphatic (centrilobular plus subpleural) distribution in the upper lobe of both lungs. Note the tendency toward coalescence of the nodules in the lung periphery (arrows).

Chong S. Published Online: *January 01, 2006*



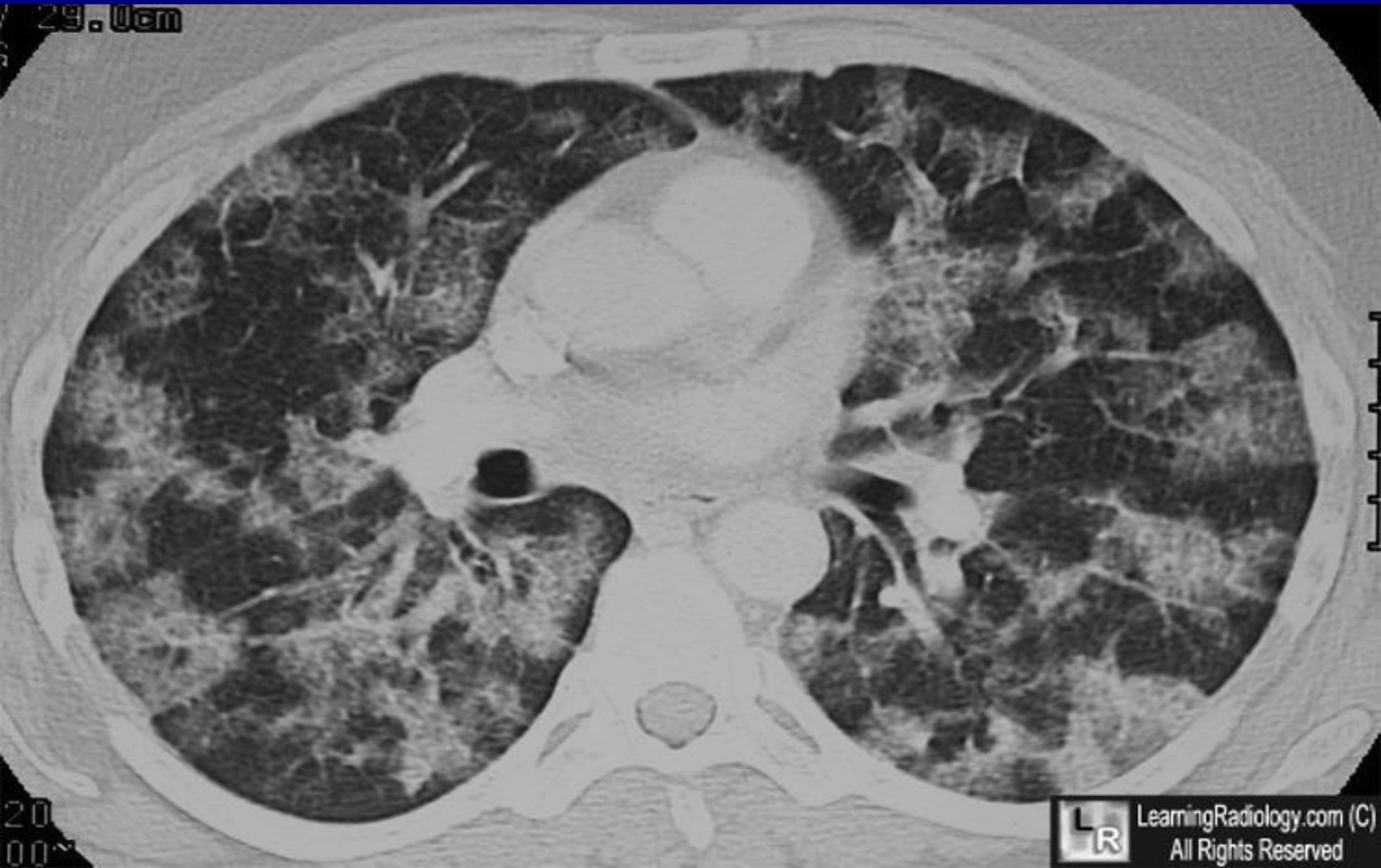
Classic silicosis in a 53-year-old man who worked for 12 years in sandblasting. Photomicrographs (original magnification, ×100; hematoxylin-eosin stain) show a transbronchial lung biopsy specimen. Image obtained with polarized light shows scattered interstitial silica particles (arrows).

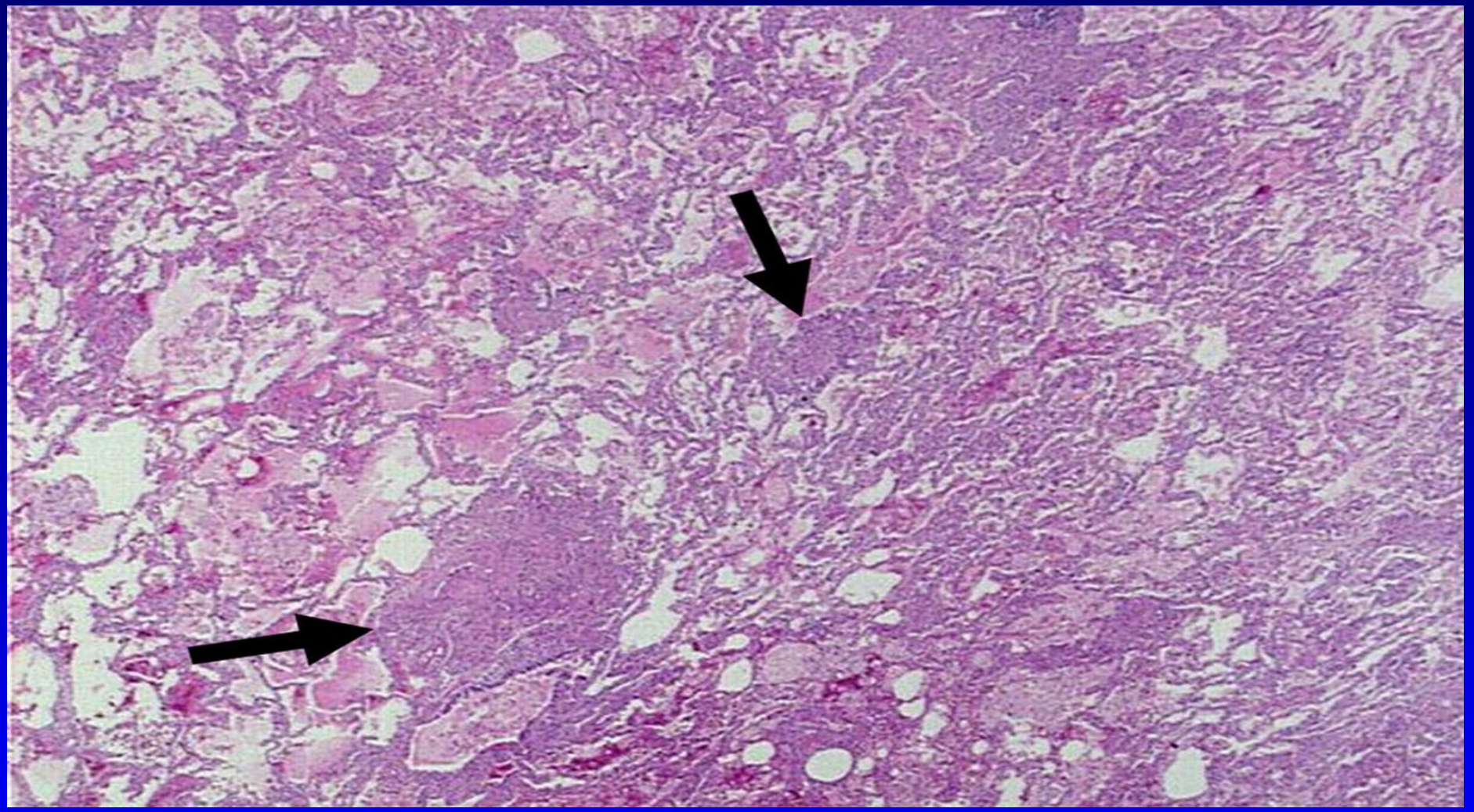
Silicotuberculosis in a 52-year-old man who worked for 30 years as a stoneworker. **(a)** Axial thin-section CT scan (1.0-mm-thick section) obtained at the level of the great vessels shows an irregular thick-walled cavitary lesion (arrow) in the upper lobe of the left lung, a finding suggestive of pulmonary tuberculosis, as well as subpleural nodular lesions in both lungs.



Progressive massive fibrosis in a 59-year-old man who worked for 20 years in a coal mine Integrated PET-CT scan shows increased uptake of FDG in both nodules (straight arrows) and in a right paratracheal lymph node (curved arrow).

Acute Silicosis (Proteinosis)





Acute silicosis in a 52-year-old man who worked for 10 years as a crystal craftsman. Photomicrograph (original magnification, ×40; hematoxylin-eosin stain) of a specimen obtained with video-assisted thoracoscopic biopsy in the lingula shows a fine granular eosinophilic material that fills the alveolar space. Note the pigment-laden perivascular and interstitial macrophages and giant cells (arrows).

Artificially-engineered stone

- Method of manufacture: finely Crushed rock, mixed with polymeric resins, then molded into slabs and heat cured.
- Can contain up to 95% (!) quartz (silica).
- 1986: First became commercially available
- 2010: first reported case of countertop silicosis.
- 2011-present: reports of cases increase

Hoy et. Al., *OCCUP ENVIRON MED.* 2018;75:3-5.

Hypersensitivity Pneumonitis

Hypersensitivity Pneumonitis (also referred to as “extrinsic allergic alveolitis”) is an immunologic-induced, non-IgE mediated inflammatory pulmonary disease. It affects primarily the interstitium, alveoli, and terminal airways, and is caused by prolonged, repeated inhalation of organic dusts or certain chemicals.

Hypersensitivity Pneumonitis

Originally described as an occupational disease affecting farmers and other agricultural workers, and later chemical workers.

And later as “bird fanciers) disease, then populations exposed to contaminated HVAC systems, hot tubs and other environments.

Clinical Features of HP

Three forms, defined by nature and intensity of symptoms, intensity, and duration of exposure:

- Acute
- Subacute
- Chronic

Acute

- Dry cough, dyspnea, chest tightness, *PLUS* fever (up to 40ºC), chills, sweating, myalgia, headache, fatigue
- Symptoms occur with hours of antigen exposure and resolve spontaneously within 24 hours
- Bibasilar rales

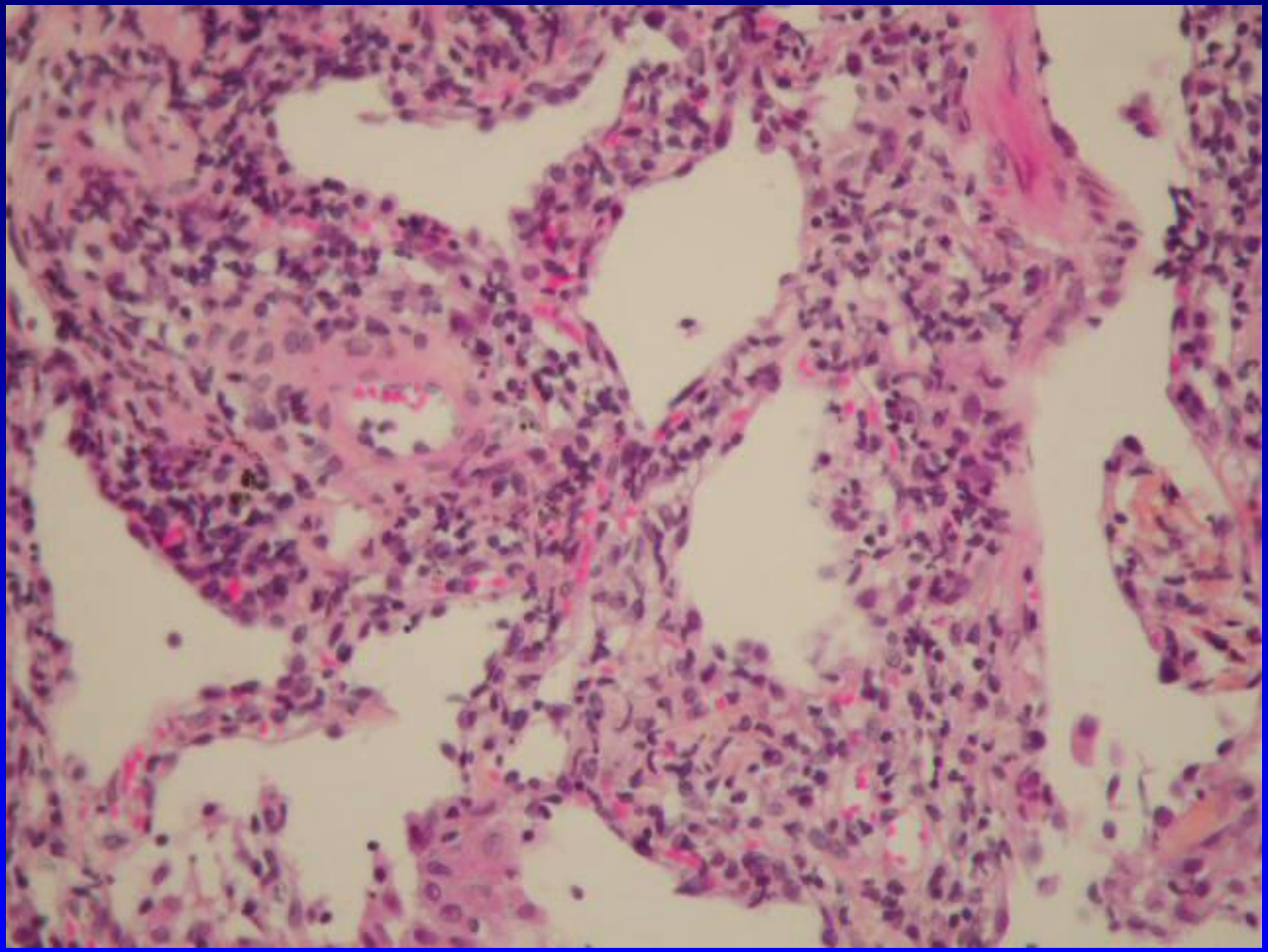
Acute (Cont.)

- Chest X-Ray: patchy infiltrates, reticulonodular pattern, sparing apices
- Exam and CXR may be normal between attacks
- Pleural effusions, calcification, cavitation, and solitary nodules are NOT present

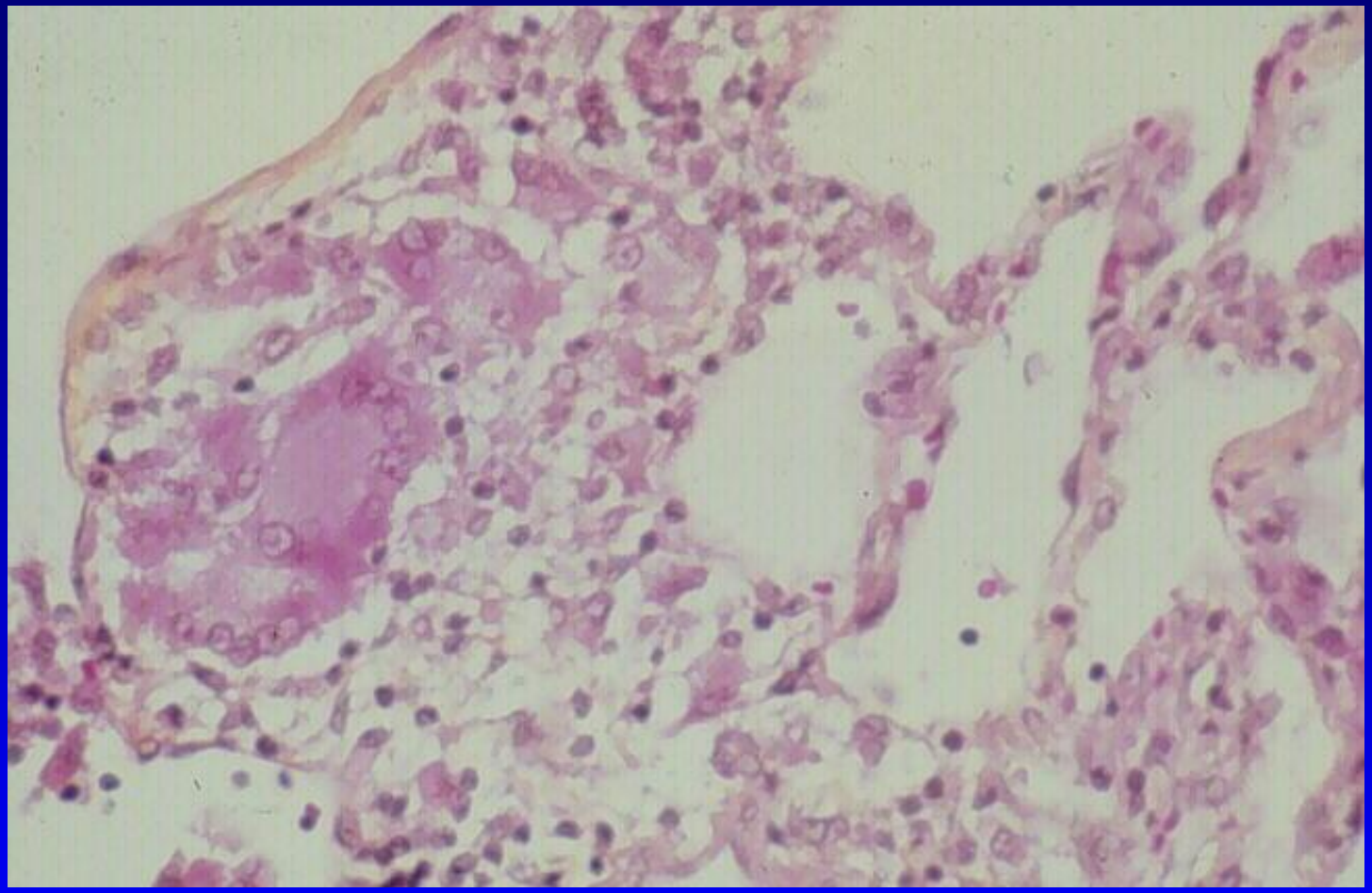
Ground-glass opacification in acute hypersensitivity pneumonitis

Acute HP (continued)

- Pulmonary Function Tests : usually restrictive pattern, with decreased DLCO, and desaturation of P_aO_2 on exercise
- High wbc, with PMN↑, mild ↓ lymphocytes
- Eosinophilia and ↑IgE are UNCOMMON
- Differential: acute pneumonia, organic dust toxic syndrome, chemical pneumonitis, occupational asthma.



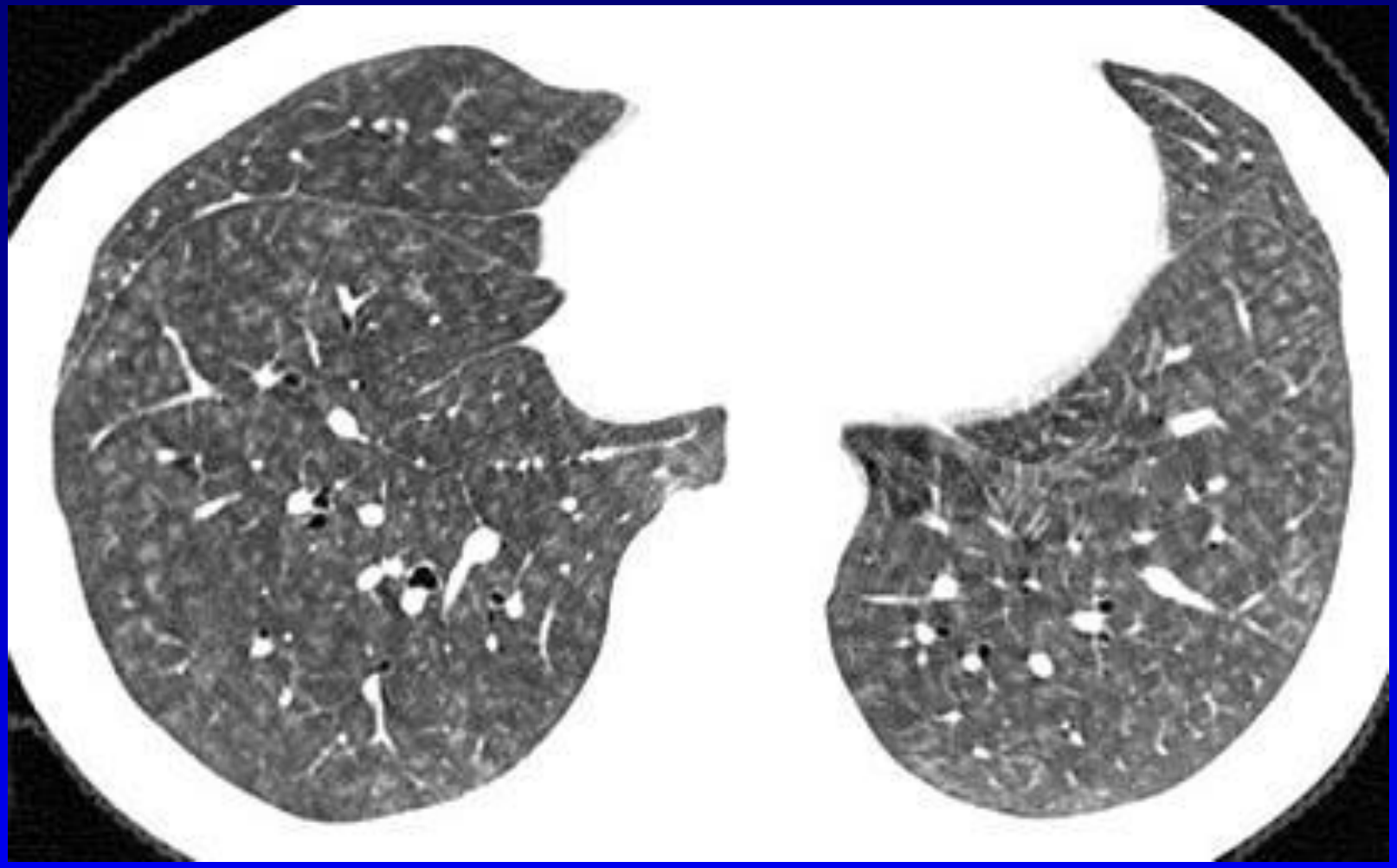
Marked interstitial inflammation



Granulomas in the interstitium

Subacute HP

- Cough, dyspnea, fatigue that progress over days to weeks
- May culminate in severe respiratory distress
- Systemic symptoms may be minimal
- Physical exam and chest x-ray similar to acute form
- PFT : restrictive, obstructive or mixed
- Methacholine may be positive



Subacute hypersensitivity pneumonitis

Scattered ground-glass opacities

More well-defined centrilobular nodules

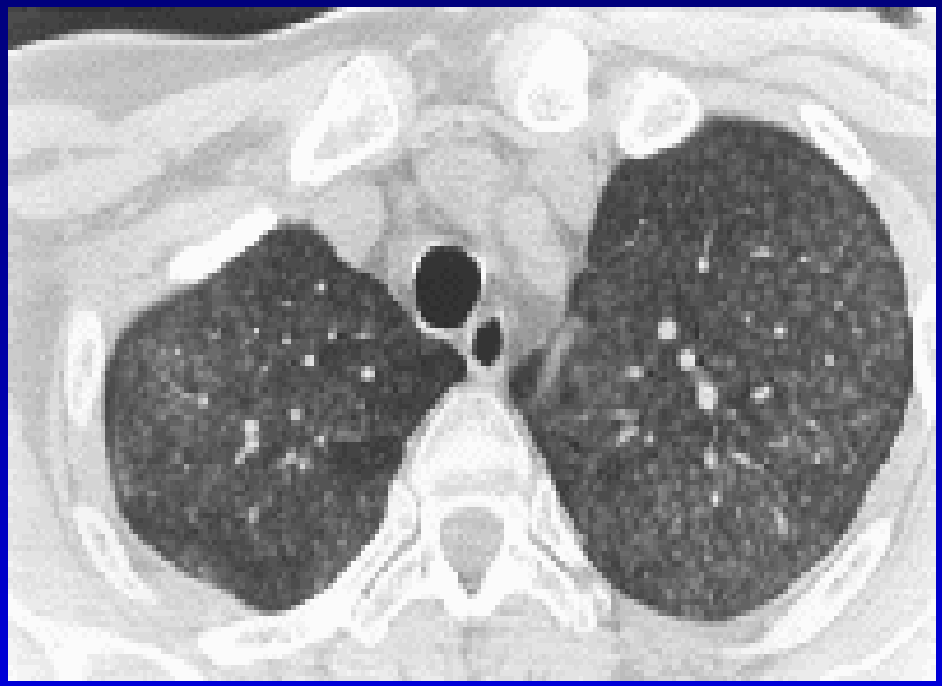
Chronic HP

- Insidious – difficult to diagnose
- Weakness, anorexia, weight loss, dyspnea
- Acute symptoms lacking unless high-intensity exposures occur
- Physical exam – unspecific, may have rales
- Chest x-ray: linear fibrotic markings

HP - Diagnosis

- History
- Chest x-ray; HRCT
- Serology (precipitins): sensitization
- Pulmonary Function : specific challenges
- BAL : High CD8 +
- Absence of low CD4/CD8 ratio does not exclude diagnosis

Honeycombing and traction bronchiectasis



Centrilobular nodules

Chronic hypersensitivity pneumonitis

Machining Workers Lung

- Mycobacteria related HP late 20th cent.
- The first outbreak was in auto parts plant in Ohio, with 3 workers hospitalized in 4 week period
- Environmental assessment showed non-tuberculous mycobacteria aerosolized when using non-petroleum based machining fluid

Management

- Avoidance (strict) of antigen exposure
- Oxygen as indicated
- Oral steroids (prednisone 40-60 mg/day) for short interval (10 days), usually with dramatic response
- Evaluation studies with anti-fibrotics are underway (esp. subacute and chronic forms).
- If airway obstruction is present, inhalers

Final Words

- Primary approach to disease reduction is reducing or eliminating exposures
- Occupational lung diseases are rarely treatable, but are ***preventable***.