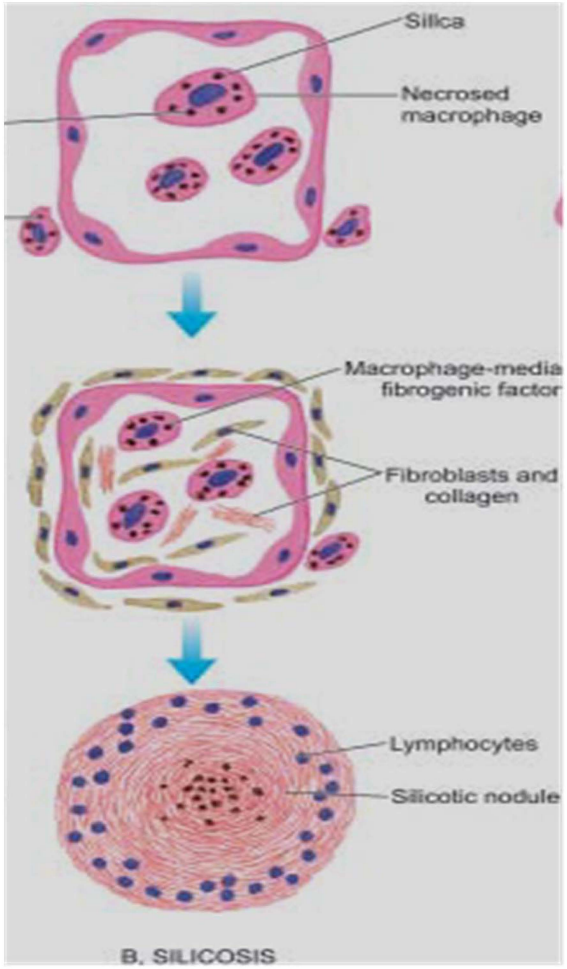
Silicosis

- Caused by prolonged inhalation of silicon dioxide, commonly called silica. Persons at increased risk:
- Miners (e.g. of granite, sandstone, slate, coal, gold, tin and copper), quarry workers, tunnellers, sandblasters, grinders, ceramic workers, foundry workers and those involved in the manufacture of abrasives containing silica.
- Peculiar to India are the occupational exposure to pencil, slate and agate-grinding industry carrying high risk of silicosis (agate = very hard stone containing silica)

Pathogenesis

- Occurs after exposure for decades. Other factors, total dose, duration of exposure, the type of silica inhaled and individual host factors.
- Sequence of events:
- 1. Silica particles between 0.5 to 5 μm size on reaching alveoli taken by the macrophages which undergo necrosis.
- 2. Some silica-laden macrophages carried to respiratory bronchioles, alveoli and in interstitial tissue. Some silica dust transported to subpleural and interlobar lymphatics and into regional lymph nodes

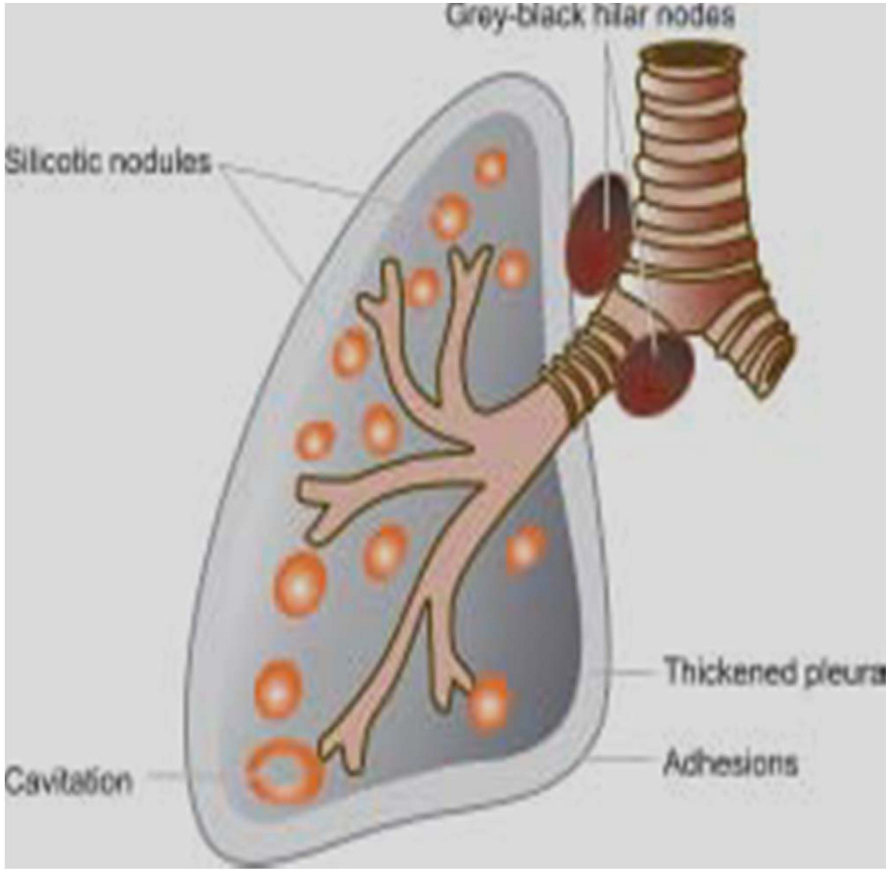
- 3. Silica dust is *fibrogenic. Crystalline form, ie.* quartz, more fibrogenic than non-crystalline silica.
- 4. *Activation of T and B lymphocytes,* results in increased serum levels of immunoglobulins (IgG and IgM), antinuclear antibodies, rheumatoid factor and circulating immune complexes as well as proliferation of T cells.
- 5. Silica is *cytotoxic and kills the macrophages* which engulf it. Released silica dust activates viable macrophages leading to secretion of macrophage derived growth factors as interleukin-1 that favour fibroblast proliferation and collagen synthesis.


Silica
Necrosed macrophage
Macrophage-media
fibrogenic factor
Fibroblasts and collagen
Lymphocytes
Silicotic nodule

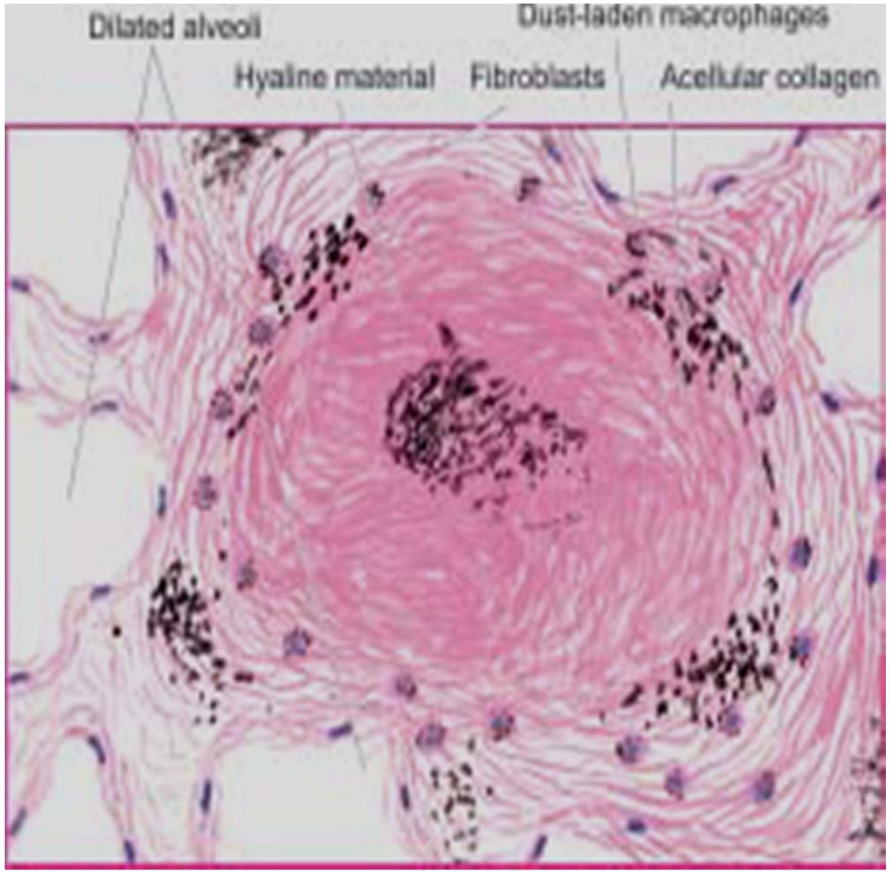
B. SILICOSIS

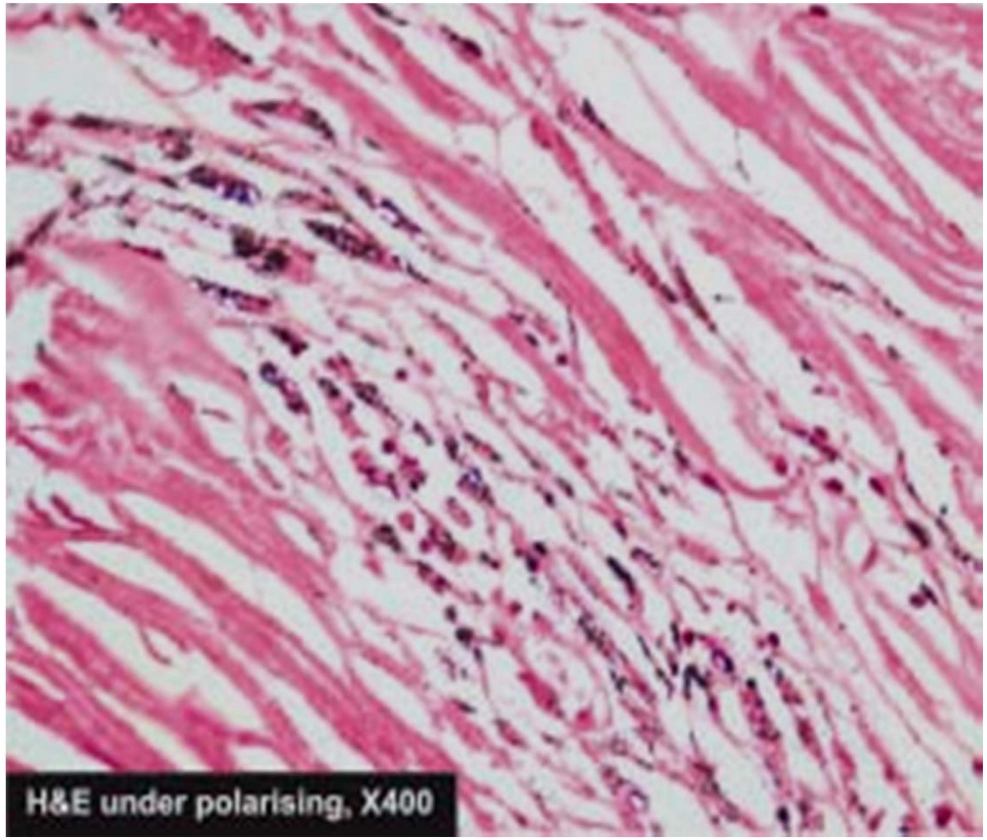
Morphology

- **G/A:**
- lung studded with well-circumscribed, hard, fibrotic nodules, 1 to 5 mm in diameter
- Nodular lesions frequently have simultaneous deposition
- of coal-dust and may develop calcification.
- Pleura grossly thickened, adherent to chest wall.
- Nodular lesions detectable as egg-shell shadows in chest X-rays.
- Lesions may undergo ischaemic necrosis, develop cavitation, or complicated by tuberculosis and rheumatoid pneumoconiosis


Grey-black hilar nodes
Silicotic nodules
Thickened pleura
Adhesions
Cavitation

- **M/E:**
- 1. *Silicotic nodules have central hyalinised* material with scanty cellularity and some amount of dust. Hyalinised centre surrounded by concentric laminations of collagen.
- 2. On polarisation demonstrate numerous birefringent particles of silica.
- 3. Severe and progressive form of disease result in coalescence of adjacent nodules and cause complicated silicosis.
- 4. Intervening lung parenchyma show hyperinflation or emphysema.
- 5. Cavitation, complicated by tuberculosis and rheumatoid pneumoconiosis


Dilated alveoli
Dust-laden macrophages
Hyaline material
Fibroblasts
Acellular collagen


H&E under polarising, X400

Asbestos disease

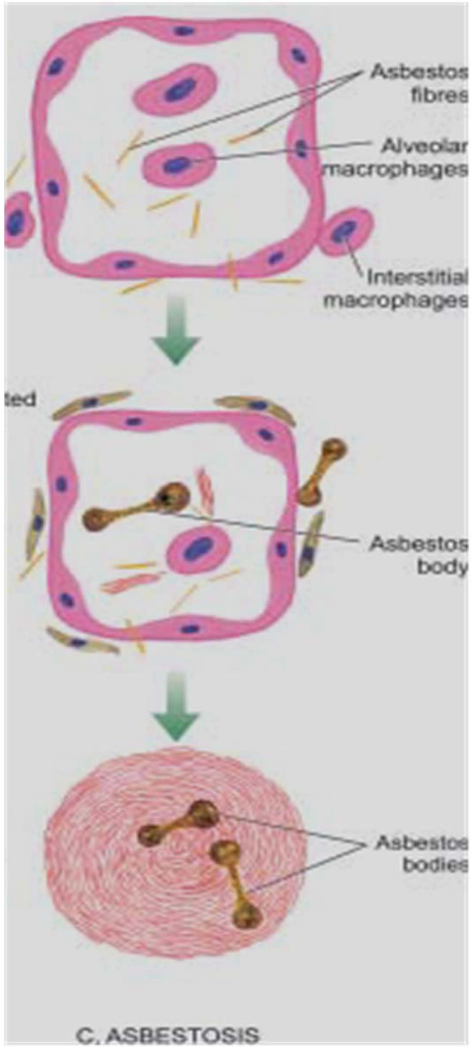
- *Coal is lot of dust and little fibrosis, asbestos is little dust and a lot of fibrosis.*
- **Three types of severe diseases:**
- *Asbestosis of lungs,*
- *Pleural disease*
- *Tumours.*

- In nature, asbestos exists as long thin fibrils which are fire-resistant and can be spun into yarns and fabrics suitable for thermal and electrical insulation and has many applications in industries

- Persons at risk are workers engaged in mining, fabrication and manufacture of a number of products from asbestos eg. Asbestos pipes, tiles, roofs, textiles, insulating boards, sewer and water conduits, brake lining, clutch castings.
- **Two major geometric forms of asbestos:**
- ***Serpentine*** *consisting of curly and flexible fibres is* most common chemical form *chrysotile (white* asbestos) comprising more than 90% of commercially used asbestos.
- ***Amphibole*** *consists of straight, stiff and rigid fibres and include* less common chemical forms *crocidolite (blue* asbestos), *amosite (brown asbestos), tremolite, anthophyllite and actinolyte.* associated with induction of malignant pleural tumours, with crocidolite.

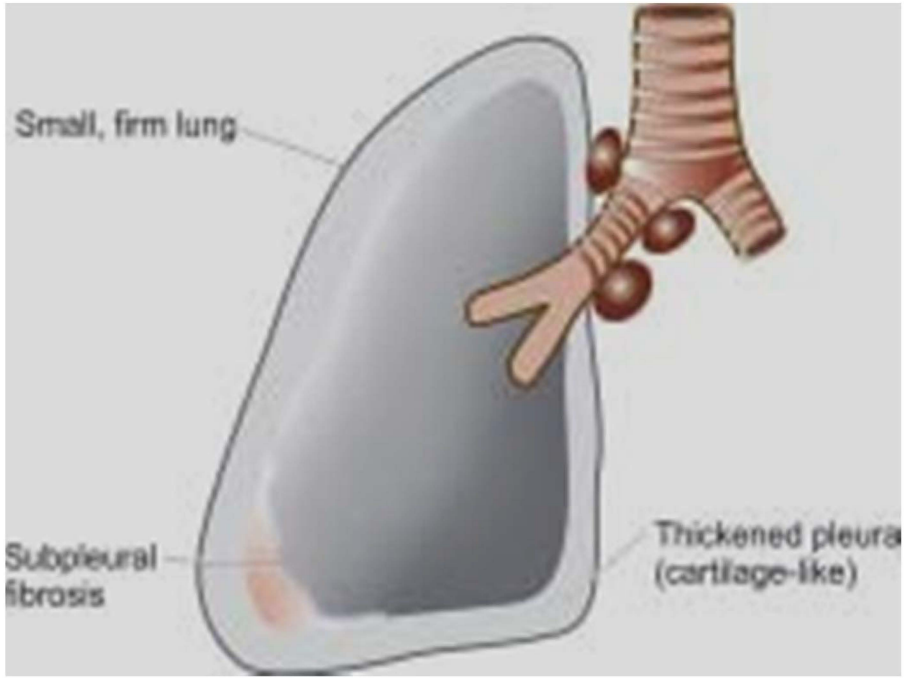
Pathogenesis

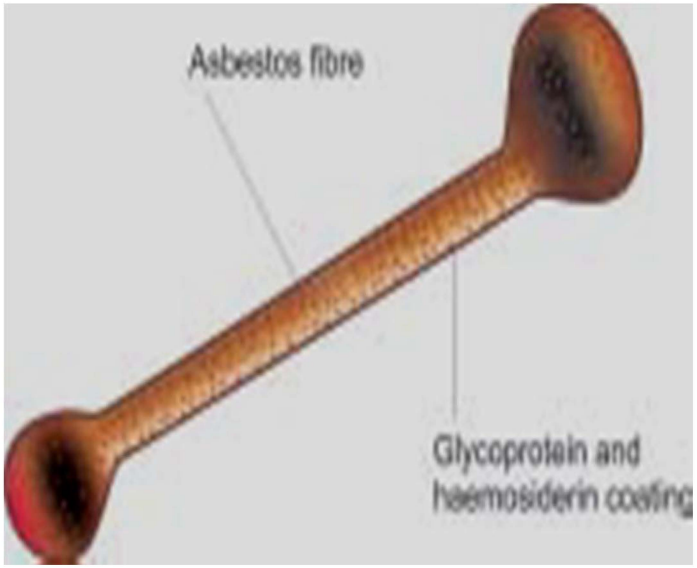
- 1. Inhaled asbestos fibres *phagocytosed by alveolar macrophages from where they reach the interstitium.*
- 2. Asbestos-laden macrophages release *chemo-attractants* for neutrophils and for more macrophages, inciting cellular reaction around them.
- 3. Asbestos fibres coated with glycoprotein and endogenous haemosiderin; beaded or dumbbell-shaped *asbestos bodies.*
- 4. All types of asbestos, *fibrogenic result in interstitial* fibrosis.
- 5. Few *immunological abnormalities as ANA* and rheumatoid factor have been found, their role in the genesis of disease is not clear.
- 6. Asbestos fibres are *carcinogenic cause mesothelioma*


Asbestos fibres
Alveolar macrophages
Interstitial macrophages
ted
Asbestos body
Asbestos bodies
C. ASBESTOSIS

Morphology

- **G/A:**
- Lungs small and firm with cartilage-like thickening of the pleura. C/S: Variable degree of pulmonary fibrosis, in subpleural areas and in bases of lungs.
- **M/E:**
- 1. Non-specific interstitial fibrosis.
- 2. Presence of characteristic *asbestos bodies in* involved areas, coating stains positively for Prussian blue reaction.
- 3. May be changes of emphysema in pulmonary parenchyma between the areas of interstitial fibrosis.


Small, firm lung
Subpleural fibrosis
Thickened pleura (cartilage-like)


Asbestos fibre
Glycoprotein and
haemosiderin coating

- **Pleural Disease:**
- 3 types of lesions: Pleural effusion, Visceral pleural fibrosis, Pleural plaques
- **G/A:**
- Circumscribed, flat, small (upto 1 cm in diameter), firm or hard, bilateral nodules
- **M/E:**
- Hyalinised collagenous tissue may calcify so that they are visible on chest X-ray. Asbestos bodies generally not found within the plaques.

- **Tumors:**
- Number of cancers, most importantly bronchogenic carcinoma and malignant mesothelioma, others are: carcinomas of oesophagus, stomach, colon, kidneys and larynx and various lymphoid malignancies.
- **Bronchogenic carcinoma:** Incidence is 5 times higher in non-smoker asbestos workers, 10 times higher in smoker asbestos workers.
- **Malignant mesothelioma:** Association with asbestos exposure is present in 30 to 80% of cases with mesothelioma