OCCUPATIONAL HEALTH

VII

Chemical Hazards

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Pneumoconiosis

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- **Types**
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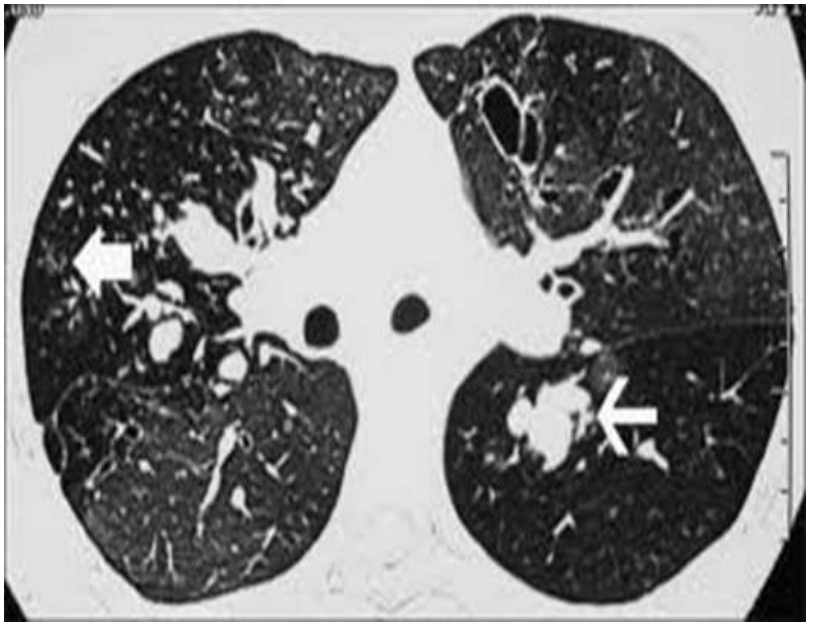

- **Preventive measures**

Asbestosis &Anthracosis

Asbestos Diseases 2

Asbestosis

- Scarring of lung tissue reducing ability to take oxygen.
- Dose related disease ;repeated regular exposures.
- Debilitating disease and can be fatal.
- Latency period 10-20 years

Asbestos fibers

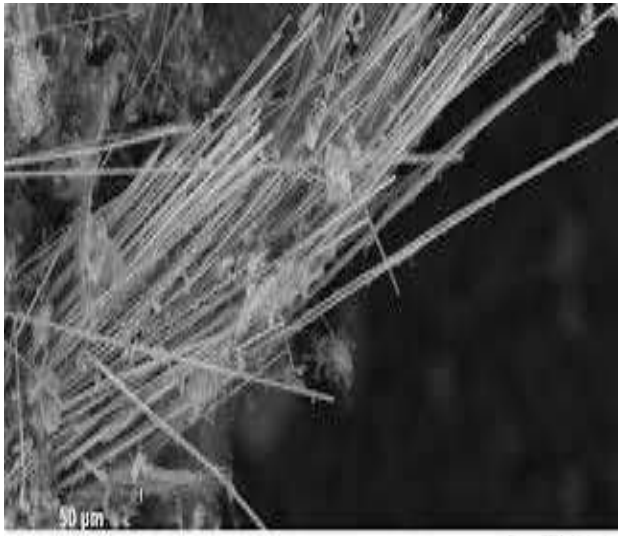

Figure: SEM of Asbestos

ASBESTOSIS

• Asbestosis is **diffuse interstitial pulmonary fibrosis** that occurs secondary to the inhalation of asbestos fibbers.

Asbestos

is the commercial name given to certain types of fibrous materials.

Asbestos is a naturally occurring fibrous silicate mineral

They are silicates of varying composition;

the silica is **combined** with **such bases** as **magnesium, iron, calcium, sodium and** aluminium.

Formed of fibrous ***magnesium silicate.***

Asbestos fibers

- **Asbestos Posses thermal ,noise , water and chemical resistance,**
- **flexible and high tensile strength**

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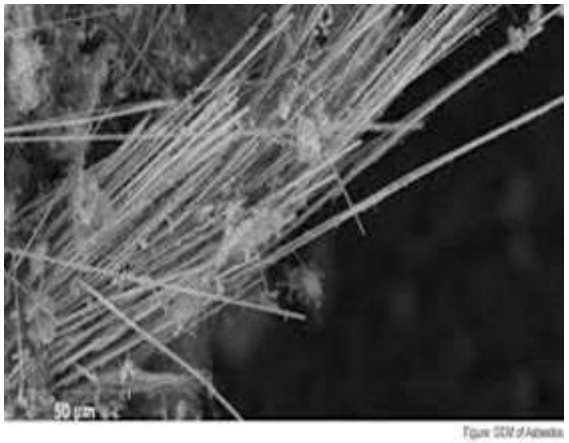
  - **flexible and high tensile strength**
- **Asbestos** fibres are usually from
  20 to 500 μ in length and
  0.5 to 50 μ in diameter.

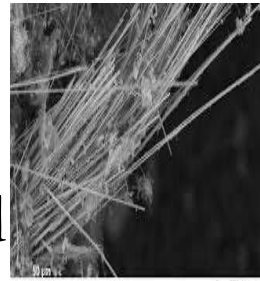


- **Uses:**
- **Due to its physical properties, it is used in manufacture** of:
- **fire proof textile,**
- **wire insulation,**
- **friction materials (break lining),**
- **roofing and floor products,**
- **ship construction** and
- **paints.**

Asbestos is used

- **in the manufacture of asbestos cement,**
- **brake lining** بطانة الفرامل,
- **gaskets and**
- **several other items.**

Asbestos fibers



- **Asbestos is classified into two groups:**
- **Serpentine (93% of commercial use)** which is hydrated magnesium silicate

Chrysotile fibers have **curved appearance (white asbestos)**.

- **Amphibole**. (**7%** of commercial use) **contains little magnesium**. **chain silicate with straight line**, This type occurs in different varieties, e.g.
- **Chrysolite Actinolite, Amosite** (**brown asbestos**), Anthophyllite, Crocidolite (**blue asbestos**), Richterite, TremRichterite, Tremolite

ASBESTOSIS

Serpentine (93% of commercial use)	Amphibole (7% of commercial use)
Chrysolite	Actinolite, Amosite, Anthophyllite, Crocidolite, Richterite, Tremolite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❑ Types of exposures:

1) Direct:

primary → miners and millers

Secondary → manufacturing plants

2) Indirect:

bystander (observer) exposure تعرض المتفرجين and household contact

❑ At risk groups:

- plumbers, السباكين،
- insulation workers، عمال العزل,
- carpenters، لنجارين,
- welders، الحام,
- Miners and millers of asbestos.

❑ **Prevalence increase** with length of employment (dose response)

❖ **Smokers and x smokers carry greater risk and higher mortality**

- **Asbestos enters** the body by **inhalation**, and the fine dust may be deposited in the alveoli.
- The fibbers are **insoluble**.
- The dust deposited in the lungs causes **pulmonary fibrosis**

➢ **leading to respiratory insufficiency** and **death;**

❖ **The fibrosis in asbestosis** is due to **mechanical irritation**, and is

➢ **peribronchial, diffuse in character**, and **basal in location** interstitium (peribronchial, diffuse and basal fibrosis).

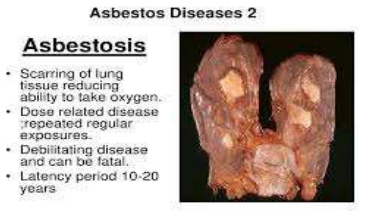
➢ **in contrast to silicosis in which the fibrosis is nodular in character and present in the upper part of the lungs.**

➢ The **lung architecture** is changed leading to **honeycomb** changes and intense **peribronchial cellular reaction** may cause

➢ narrowing or **obstruction of airway lumen.**

Average latency period is

Cont. ..ASBESTOSIS



- Average latency period **is 20-30 years**
- **Carcinoma of the bronchus;**
- The **risk of bronchial cancer** is reported to **be high** if occupational **exposure to asbestos is combined with cigarette smoking**
- **mesothelioma** of the pleura or peritoneum;
- **In Great Britain, an association was reported between mesothelioma and living within 1 km of an asbestos factory**
- **Mesothelioma, a rare form of cancer of the pleura and peritoneum,**
- has been shown to have a strong **association with the crocidolite (blue asbestos)** variety of asbestos .
- The disease does not usually appear until **after 5 to 10 years** of exposure and
- Cancer of the **gastro-intestinal tract.**

❑ Clinically the disease is characterized by

- ➢ Dyspnoea gradually increases
- ➢ Cough Chest pain
- ➢ .Bilateral late **inspiratory crepitation** on posterior Lung bases

❖ **In advanced cases**, there may be

- **Clubbing of fingers,**
- **cardiac distress and**
- **cyanosis.**

❑ **The sputum shows "asbestos bodies"** which are asbestos fibres coated with fibrin

❖ **Lung function change:**

Restrictive impairment with ↓ lung volumes (FVC, TLC)
FEV1/FVC ratio is usually preserved.

❖ **X-ray picture:**

Bilateral diffuse nodular & or irregular **oval opacities**

❖ X-ray picture:

Bilateral diffuse nodular & or irregular **oval opacities** predominant in **lower lung zones**, Interstitial fibrosis and "**Shaggy heart sign**

❑ **At histopathologic analysis,**

asbestos bodies, which may consist of a single asbestos fibre surrounded by a segmented protein-iron coat, **can be identified in intraalveolar macrophages**

❑ **Diagnosis:**

1- History of **exposure**: exposure **over (10-20)** years is usually necessary.

2- **Clinical** picture: particularly **dyspnea** and **clubbing** of fingers.

3- **X-ray** picture: **irregular basal opacities** (**ground glass**) .

4- Pulmonary **function**: restrictive abnormality.

5- Broncho-alveolar lavage (BAL): **Contain Asbestos bodies**

D.D:

Serpentine (95% of commercial use)	Amphibole (7% of commercial use)
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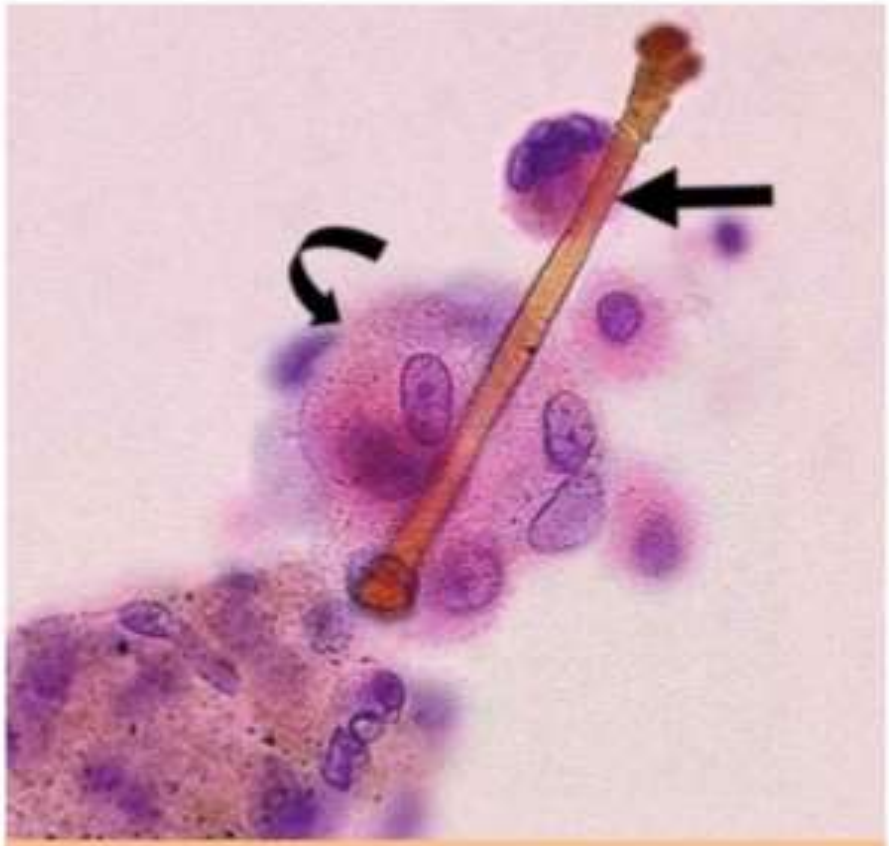
ASBESTOSIS



Translucent asbestos fiber (straight arrow) surrounded by a protein-iron coat and an alveolar macrophage (curved arrow)

Chest x-ray showing Small, irregular oval opacities Interstitial fibrosis and "Shaggy heart sign"

❑ D.D:

- Idiopathic pulmonary fibrosis (I.P.F): the patient **is younger**, clinically and physiological impairment is more sever and progress **rapidly.**
- (pseudo asbestos bodies) such as silica, kaolinite, silicates or **man-made mineral fibers**. They **contain no asbestos core.**

❑ Treatment Strategy:

❑ Once established, the disease is progressive even after removal of the worker from contact

- Stopping additional exposure
- Careful **monitoring** to facilitate **early diagnosis**
- **Smoking cessation**
- Regular **influenza and pneumococcal vaccines**
- **Disability assessment**
- Pulmonary **rehabilitation** as needed
- Aggressive treatment of **respiratory infections**
- Health education to patient

Control Measures Of Asbestos

- PEL 0.1 fiber/CM^3 (TWA8). Permissible Exposure Limit (PEL) for asbestos is 0.1 fiber per cubic centimeter of air as an **eight-hour time-weighted average** (TWA),

❖ - Switch to alternate material, **man-made fibers (MMF)** are considered . Man-made vitreous fibers الألياف الزجاجية, MMVF (MM mineral fibers):

- **Constitute 3 main species**:

a. - **Glass fibers** (glass wool, continuous glass filaments)

b. - **Mineral wool** (rock wool and slag wool)

c. Ceramic fiber.

- **They used as a substitute** for asbestos since the latter were banned due to its bad health effects.
- They posses high **tensile strength**, perfect elasticity, **thermal and electrical properties** and moist and corrosion resistance.
- They have a toxic effect on peritoneal and pulmonary macrophages and structure chromosome alteration in mammalian cells.
- **TWA8 should keep below 1 fiber /CM^3 as asbestos.**

- Engineering controls include enclosure, increased ventilation,
- wet manufacturing.

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- wet manufacturing.
- **Use of personal respirators.**
- **Stop tobacco smoking**

Significant occupational exposure to asbestos occurs mainly in

– Asbestos cement factories
– Asbestos textile industry and
– Asbestos mining and milling.

ASBESTOSIS

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Asbestos cement factories

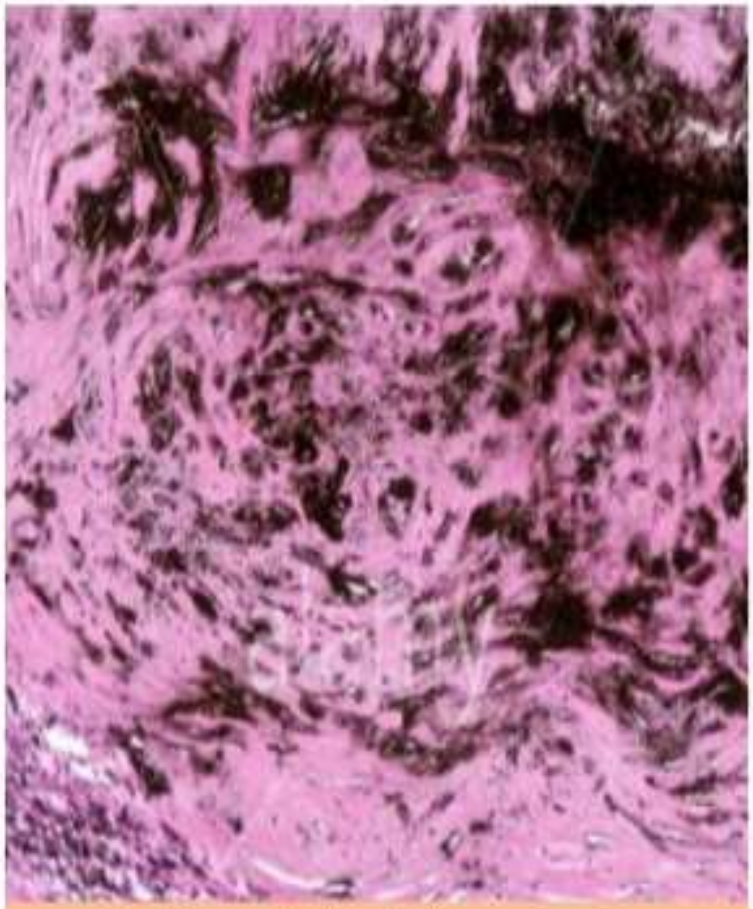

Asbestos textile industry


Asbestos mining

Cut section of lungs in anthracosis On histopathological examination

Anthracosis

Cut section of lungs in anthracosis



On histopathological examination

Anthracosis

Anthracosis:

Coal Worker's Pneumoconiosis (CWP) / **Black lung disease:**

- **Accumulation of coal dust in the lungs and the tissue's reaction** to its presence.
- **Associated with coal mining industry**
- Takes **one or two decades to cause symptoms**
- **The disease is divided into 2 categories:**

I. **Simple CWP** and
II. **Complicated CWP** or **Progressive Massive Fibrosis** (**PMF**).

I. Simple Coal Worker's Pneumoconiosis:

- **the presence of radiological opacities < 1cm in diameter.**
- **Benign disease** if no complications.
- **is associated with little respiratory impairment.**
- This phase may require **about 12 years of work exposure** for its development

- **I Common symptoms:**
  - cough,
  - expectoration (black in colour) and
  - dyspnea.
  - – Slight decrease in FVC and FEV1/FVC
- Once a background of simple pneumoconiosis has been attained in the coal worker, a progressive massive fibrosis may develop out of it without further exposure to it.

- From the epidemiology point of view
- the risk of death among coal miners has been nearly twice that of the general population .

- **II. Complicated Coal Worker's Pneumoconiosis**

or **Progressive Massive Fibrosis (PMF).**

II. Complicated Coal Worker's Pneumoconiosis or Progressive Massive Fibrosis (PMF).

- Is diagnosed when **large opacity** of **1cm or more** in diameter is observed in the CXR
- **Pathologically it is characterized by large masses of black colour fibrous tissue.**
- **Symptoms are similar but more severe**
- **The large lesions may cavitate as a result of ischemic necrosis or infection (T.B).**
- **Recurrent pulmonary infection**
- PFT (Pulmonary function test) reveals **decreased FVC, FEV1/FVC and increased residual volume.**
- **The Second phase is characterised by**
- ***progressive massive fibrosis*** (PMF) **this causes**
- **severe respiratory disability and frequently results in**
- **premature death**

- **Special type of PMF associated with rheumatoid disease**

- **Special type of PMF associated** with **rheumatoid disease** (rheumatoid pneumoconiosis or **Caplan syndrome**) occur and **is characterized by:**
- **typically smooth rounded nodule 1-5 cm in** diameter with **concentric internal lamination and relatively little coal dust** compared with other PMF lesions.

❖ **Pulmonary function changes: obstructive or mixed lesion.**

- decrease in FEV 1 and FEV1/FVC ratio

❖ **X-ray picture:**

❖ **Simple CWP**

➢ frequently **mixed nodular and irregular** and

➢ **occasionally exclusively irregular opacities** was noted

➢ first in **upper and middle lung zone**.

➢ **irregular opacities** raises the possibility of previous exposure to asbestos.

❖ PMF appear radiologically as

❖ PMF appear radiologically as:

➢ **nodular opacity 1cm or larger**

➢ usually **found posteriorly in upper lung zone**.

- **D.D of small opacities in x-ray picture includes**:

Miliary T.B and viral pneumonia

Other pneumoconiosis, metastatic carcinoma, chronic T.B

❖ PMF should be differentiated from malignancy,

❖ **Diagnosis and clinical assessment:**

➢ **History of present** and past exposure .

➢ Look for **previous chest X-** ray and lung function tests.

➢ S. & S. including cough, sputum, dyspnea or cardiovascular symptoms

❖ **Treatment and clinical care:**

Symptomatic, for dyspnea , ch. bronchitis and congestive H.F

Silicosis, Anthracosis & asbestosis X-ray findings

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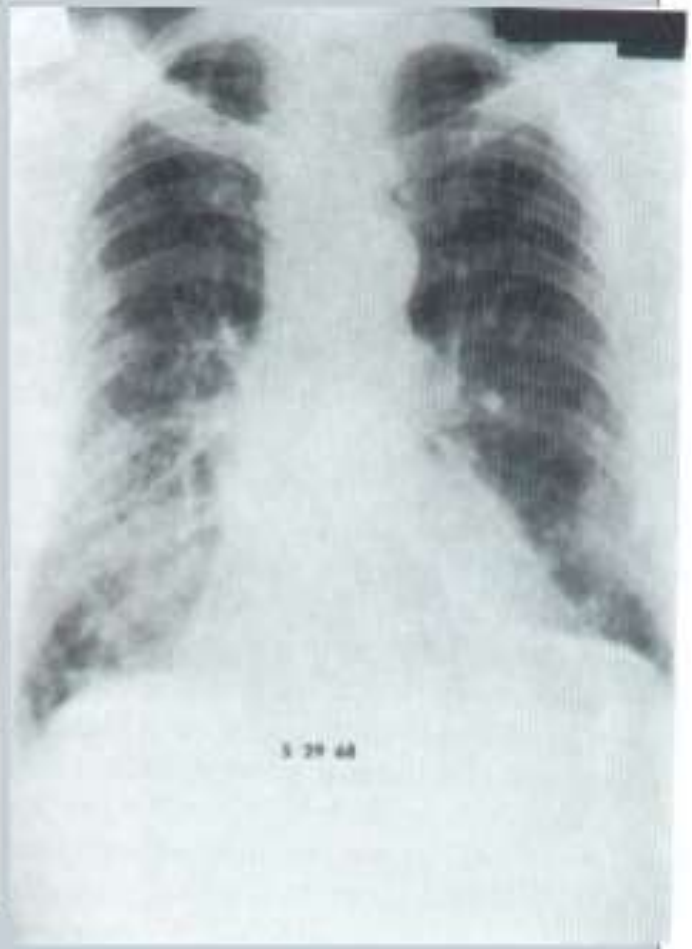

Caplan's syndrome (Caplan disease or (Rheumatoid pneumoconiosis)

- **is a combination of rheumatoid arthritis** (RA) & **pneumoconiosis**
- **manifests as intrapulmonary nodules**,
- **which appear homogenous and well-defined** on **chest X ray**
- The nodules in the lung **typically occur bilaterally and peripherally**, on *a background of simple coal worker's* **pneumoconiosis**
- **There are usually multiple nodules,** varying in **size** from **0.5 to 5.0 cm.**
- The nodules typically **appear rapidly**, often in **only a few weeks**.
- **Nodules may grow, remain unchanged in** size,
- **resolve,** or **disappear** and **then reappear.**

They **can cavitate**

Cont. …Caplan's syndrome

- They **can cavitate**, calcify, or **develop air-fluid levels**

❖ **Caplan syndrome** occurs **only in patients with both RA and pneumoconiosis related to mining dust (coal, asbestos, silica).**

❖ **. There is probably also a genetic predisposition**, and

❖ smoking is thought to be an aggravating factor

Comparative features of different types

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Features	Silicosis	Asbestosis	Anthracosis
1. Agent/ dust	•Silica free or silicon dioxid or silicic acid •Particles are 0.5 - 3 µ are most dangerous.	•Asbestos fibres 1. Serpentine or chrysolite (safer) 2. Amphibole i. Crocidolite (blue) ii. Amosite (brown, safer) iii. Anthrophylite (white) • 20-500µ in length and 0.5-50 µ in diameter	• Coal dust

Comparative features of different types

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Features	Silicosis	Asbestosis	Anthracosis
Occupational exposure	Mining, pottery, ceramic, sand blasting, metal grinding, building & construction work, rock mining, iron & steel industry.	Manufacturers of Asbestos cement, fire proof textiles, roof tiling, brake lining & gaskets.	Coal miners, coal processors & coal handlers and those manufacturing carbon electrodes.
Incubation period	6 months to 6 years		12 years

Comparative features of different types

Features	Silicosis	Asbestosis	Anthracosis
Pathogenesis	Fibrosis is initiated by silicic acid leading to nodular fibrosis, emphysema, and right heart failure. Pulmonary tuberculosis may intervene in 50% of cases. Fibrosis is nodular and in upper part of lung.	Asbestos fibers initiate fibrosis of pulmonary tissue, emphysema and its associated complications. **Fibrosis** is due to mechanical irritation, it is peri-bronchial, diffuse and basal in location	•Coal dust initiates diffuse and massiv fibrosis a. Simple pneumoconiosi with ventilator impairment. b. Progressive massive fibrosi leading to emphysema an right heart failu
Clinico-Pathologic features	Irritant cough, dyspnea on exertion & pain in chest. Dense nodular fibrosis 3-4 mm nodules. X-ray shows **"snow-storm"** appearence	**Dyspnea out of proportion**, clubbing, cyanosis, cardiac distress. Sputum shows "asbestos bodies". X-ray shows **ground glass** appearance.	•From little ventilatory impairment to sev respiratory disabil leading to pre-mat death.

Control of pneumoconiosis

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- Rigorous dust control measures
  - Substitution, enclosure, isolation, hydroblasting, good house keeping, personal protective measures
  - Regular physical examination of workers.
- Periodic examination of workers, biological monitoring (X-ray & Lung function)
- Personal protection
  - Masks, respirators with mechanical filters
- Regulated exposure
- Health education

THANK YOU ALL

GOOD LUCK

Chemical hazards

Occupational exposure to Toxic Metals

"heavy metals"

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