

Pneumoconiosis

Coal Workers' Pneumoconiosis (CWP)

- Also called:
 - Coal miner's lung
 - Black lung
 - Black phthisis
 - Miner's phthisis
- Fibrotic diseases of the lungs caused by inhalation of dusts
- CWP: Coal Mine Dust.

A. Simple CWP

B. Severe or complicated form of CWP is:

Progressive Massive Fibrosis (PMF)

Normal



‘Simple’
CWP



‘Complicated’
PMF



Progressive massive fibrosis
Complicated pneumoconiosis₂

Definition Of Coal Worker's Pneumoconiosis:

☐ Coal worker's pneumoconiosis is a lung disease that results from breathing in dust from **coal, graphite, or man-made carbon** over a **long period of time**.

Causes And Risk Factors:

Coal worker's pneumoconiosis occurs in two forms:

1. Simple

2. Complicated

- ✓ The risk of getting coal worker's pneumoconiosis depends on how long you have been around coal dust (duration).
- ✓ Most people with this disease are older than 50.

Pneumoconiosis

Etiology

Etiologic Determinants

1. Size of inhaled particle
0.3 and 0.5 μm reach the alveoli (300-500 nanometer)
2. Chemical nature of the particle (Carbon, nitrous or sulfur)
3. Concentration of the particle (dose)
4. Length of exposure (duration)
5. **The individual's Susceptibility**

CWP: black lung disease

- ✓ caused by long term exposure to coal dust
- ✓ It is common among coal miners and others who work with coal
- ✓ Inhaled coal dust progressively builds up in the lungs and is unable to be removed by the body
- ✓ **CWP** is similar to
 1. Silicosis (silica dust)
 2. long-term effects of tobacco smoking



Coal Workers Pneumoconiosis

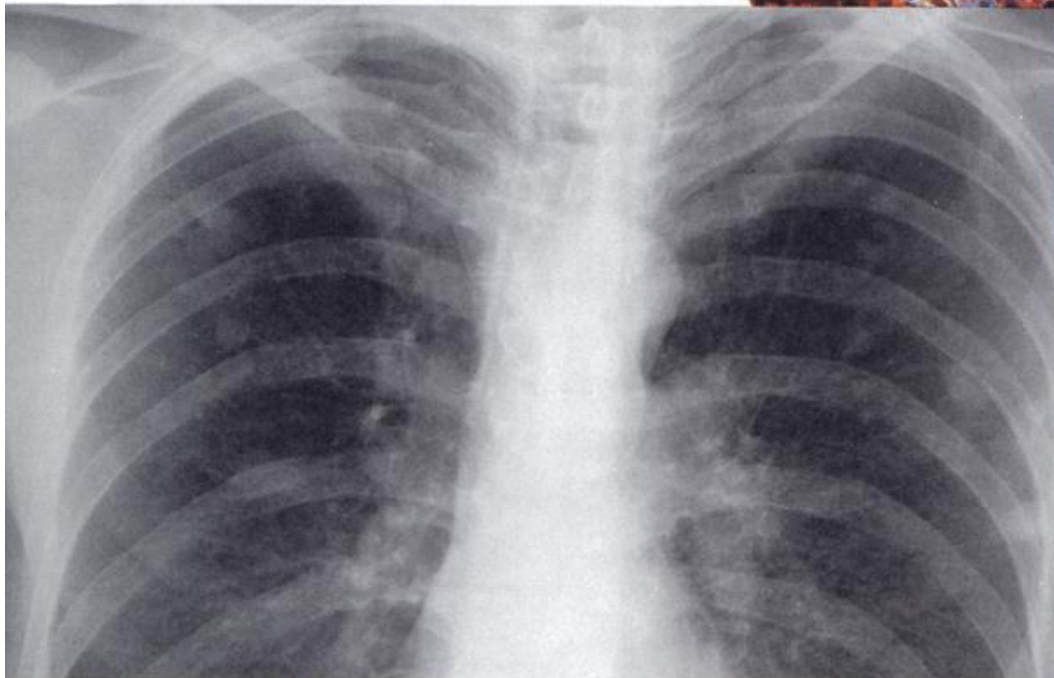
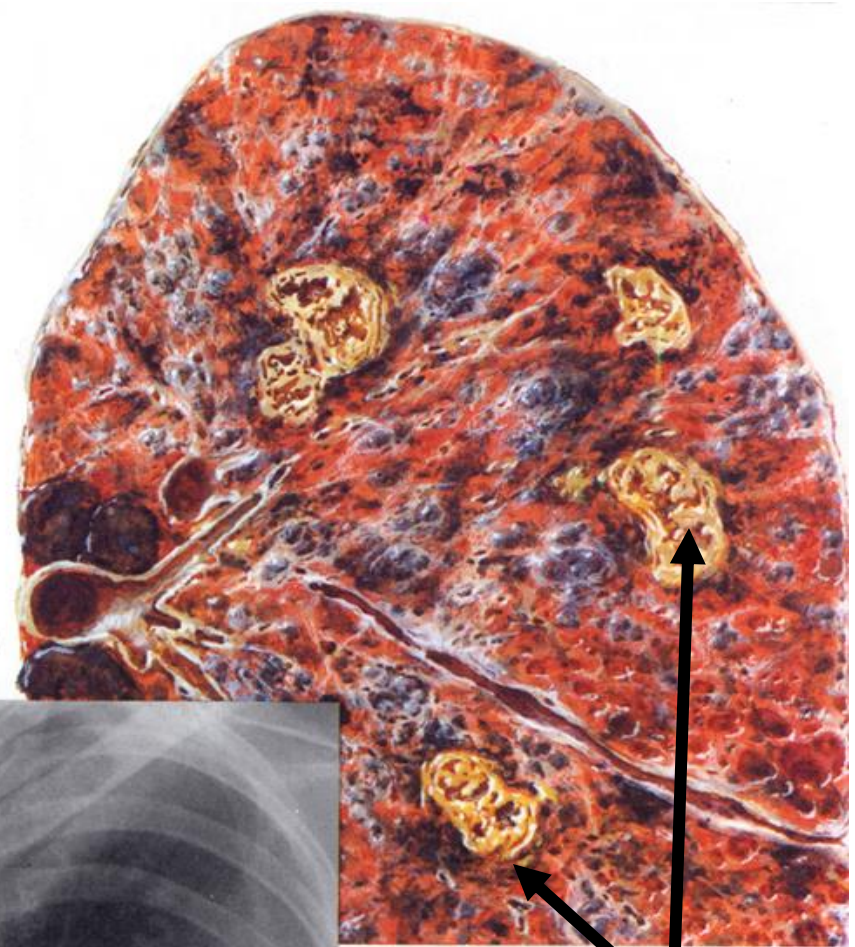
Similar in radiologic appearance to **silicosis**, but considered to be a separate entity.

- **Differences**

1. Less profusion and smaller opacities
2. Peribronchial collections of dust laden macrophages (macules)
3. Less risk of PMF than in silicosis
4. More frequently associated with **Caplan's syndrome** than is silicosis (**Caplan's syndrome** : is a combination of rheumatoid arthritis (RA) and pneumoconiosis that manifests as intrapulmonary nodules, which appear homogenous and well-defined on chest X-ray)
 - Caplan syndrome occurs only in patients with both RA and pneumoconiosis related to mining dust (**coal, asbestos, silica**)

Caplan's Syndrome

- Rheumatoid arthritis
- Pneumoconiosis



**Nodular
pulmonary
lesions**

Types of CWP

✓ Simple CWP

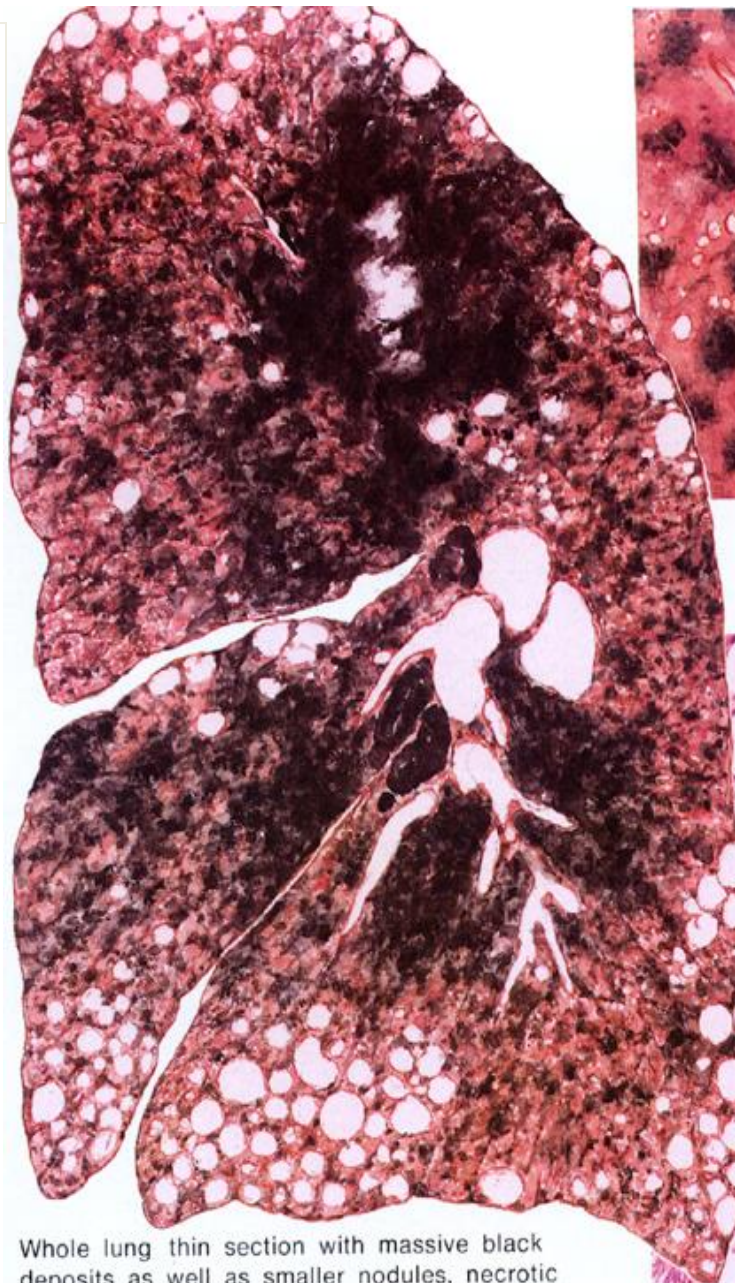
✓ **Mild** form of the disease known as **Anthracosis**: (Accumulation of carbon in the lungs from inhaled smoke or coal dust): asymptomatic and present mostly in urban settings due to air pollution.

✓ **Sever**: prolonged exposure to large amounts of coal dust can result in more serious forms of the disease: **Complicated CWP** or (PMF).

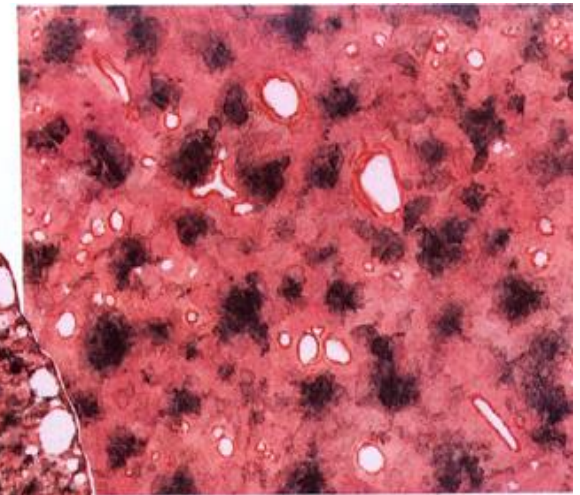
✓ Workers exposed to coal dust develop industrial bronchitis, clinically defined as chronic bronchitis (i.e. productive cough for 3 months per year for at least 2 years) associated with workplace dust exposure.

Coal Workers' Pneumoconiosis

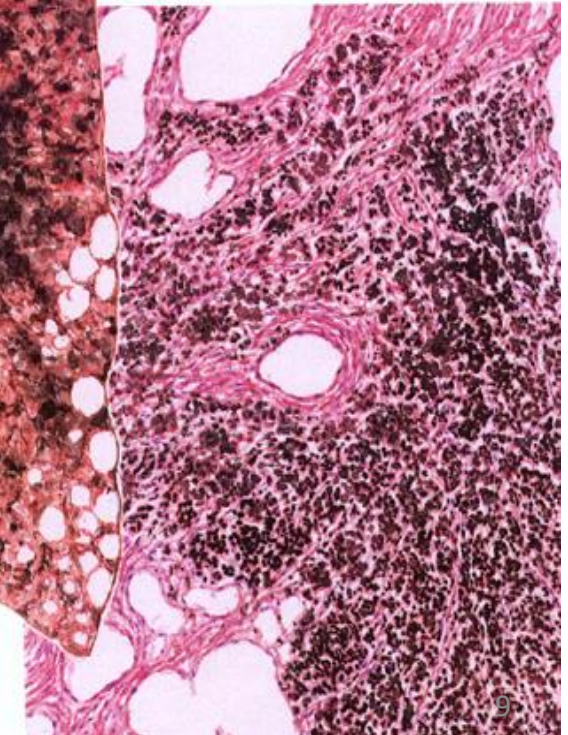
- “Black Lung”
- Asymptomatic Anthracosis
- Simple CWP
- Complicated CWP



Whole lung thin section with massive black deposits as well as smaller nodules, necrotic areas, and emphysematous changes



Slightly magnified detail of lung showing indurated coal nodules



Symptoms:

Cough

Shortness of breath

Treatment:

There is no specific treatment for this disorder.

You should avoid further exposure to the dust.

Expectations (prognosis):

The outcome for the simple form is usually good. It rarely causes disability or death.

The complicated form may cause shortness of breath that gets progressively worse.

Complications:

1. Chronic bronchitis
2. Chronic obstructive pulmonary disease (COPD)
3. Cor pulmonale (failure of the right side of the heart)
4. Respiratory failure

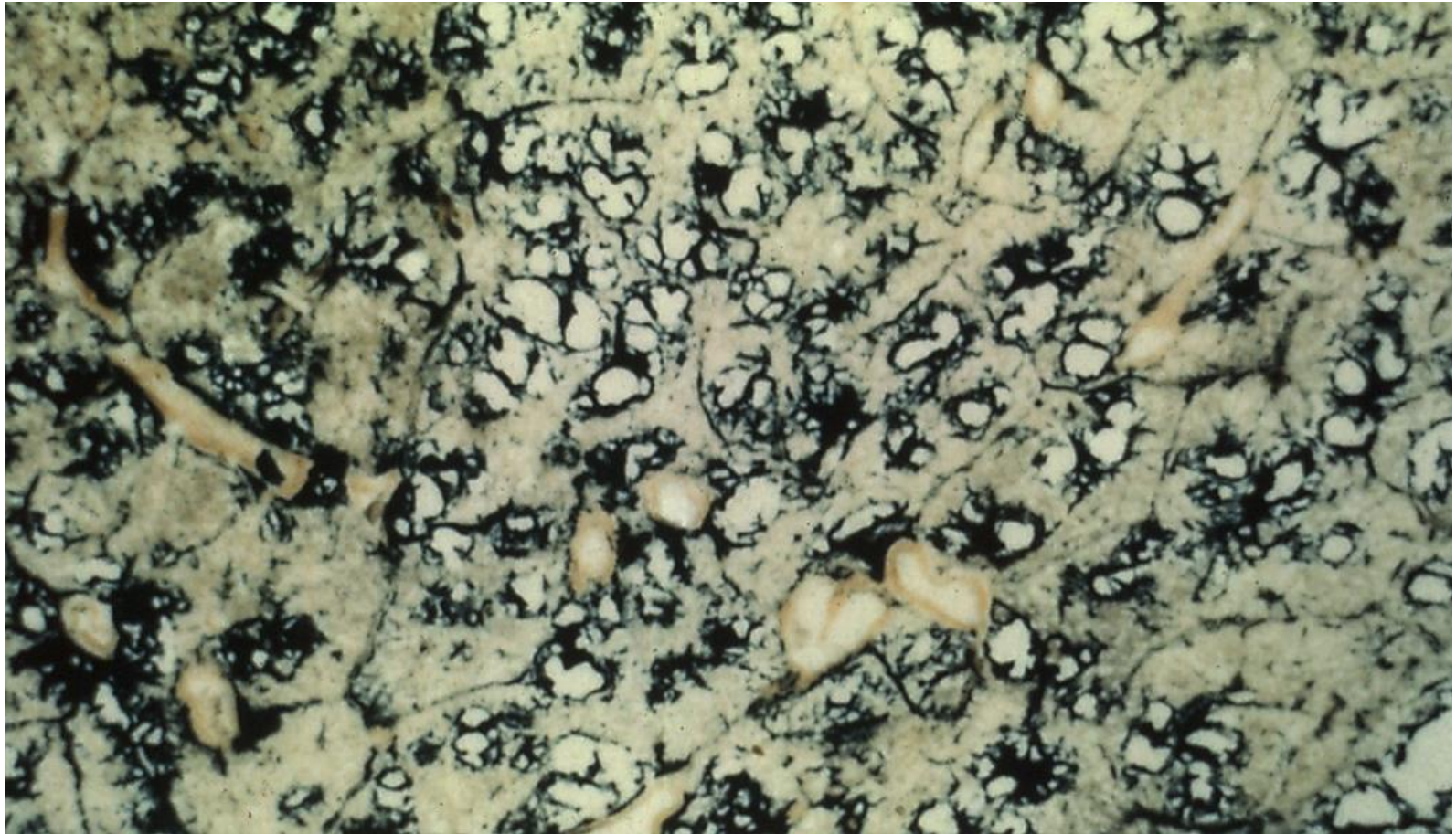
Prevention:

Wear a protective mask when working around coal, graphite, or man-made carbon.

Companies should enforce the maximum permitted dust levels: **(respirable coal 'mine dust = 2 mg/m³)**

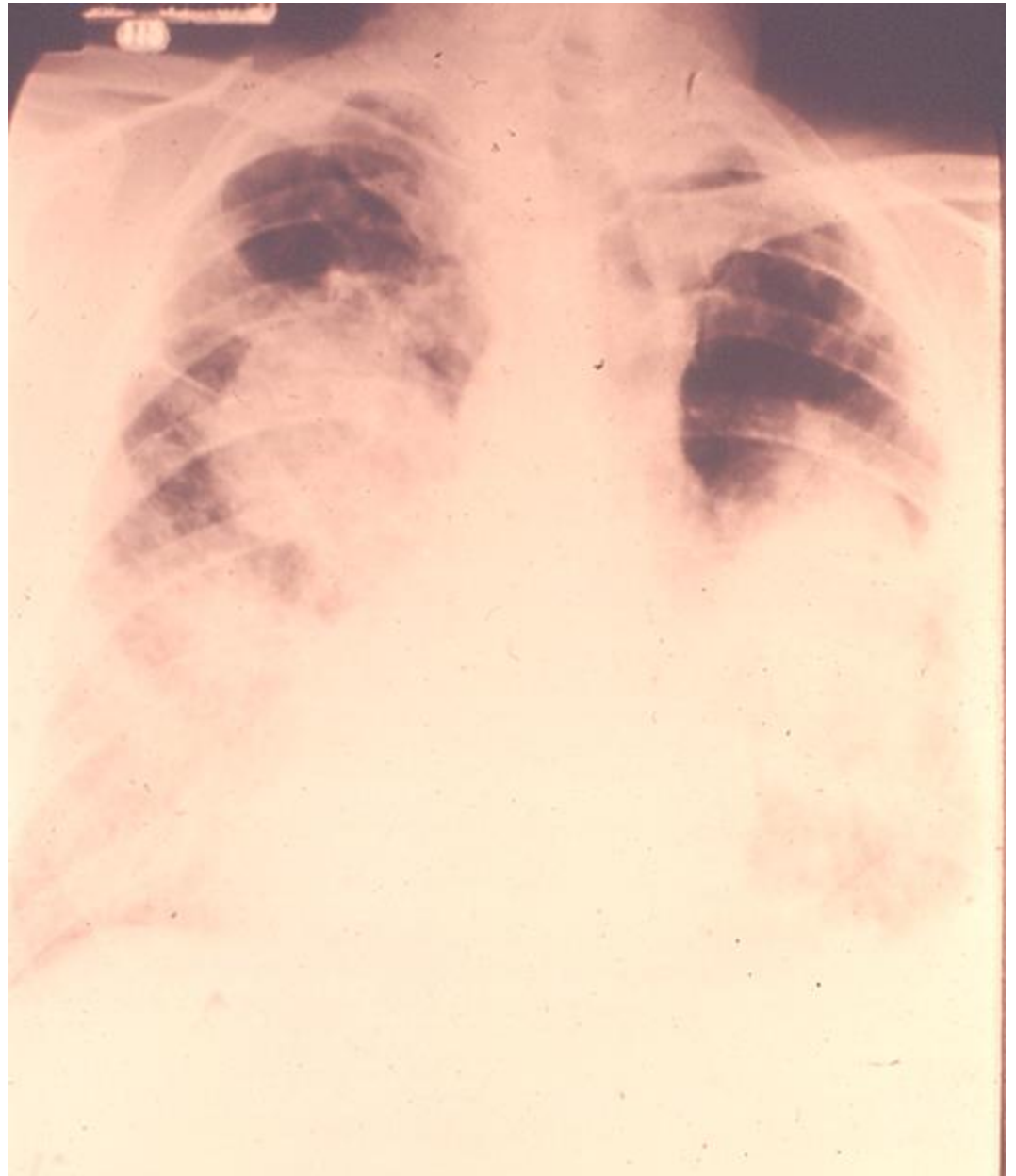
Pathogenesis

- ✓ Coal dust is not as fibrogenic as is silica dust.
- ✓ Coal dust that enters the lungs can neither be destroyed nor removed by the body.
- ✓ The particles are engulfed by resident alveolar or interstitial macrophages and remain in the lungs.
- ✓ Coal dust provides a sufficient stimulus for the macrophage to release various products, **including enzymes, cytokines, oxygen radicals, and fibroblast growth factors**, which are important in the **inflammation and fibrosis** of CWP.
- ✓ Aggregations of carbon-laden macrophages can be visualized under a microscope as granular, black areas.
- ✓ These aggregations can cause inflammation and fibrosis, as well as the formation of nodular lesions within the lungs.
- ✓ The centers of dense lesions may become **necrotic** due to ischemia, leading to large cavities within the lung.



Coal lining alveolar spaces and along lymphatic

Progressive Massive Fibrosis (PMF)



Progressive Massive Fibrosis (PMF)

chronic pleurisy

Dense fibrotic tissue with massive amounts of dust

Simple CWP

Coal Workers' Pneumoconiosis: Clinical

CWP

- coal macules, not fibrogenic
- benign
- incidence of tuberculosis (TB) increased
- Upper lung zones (mostly)

PMF

- Pulmonary hypertension
- Cor pulmonale

Disease Prevention

Primary disease prevention

- **Dust control**
- Alternatives
- Ventilation
- Respirators

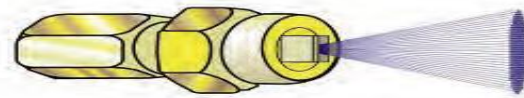
Secondary disease prevention

- Early detection of disease and reduction/elimination of further exposure may slow down or prevent severe disease development, However, those with simple pneumoconiosis are at greatly increased risk of severe disease, regardless of future dust exposure
- Secondary prevention reduces the likelihood of future severe disease but does not prevent its development
- Only adequate **dust control** prevents disease

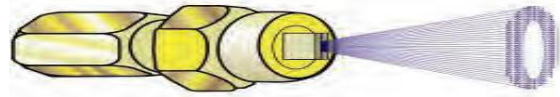
Spray Type



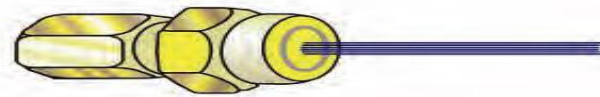
Full Cone



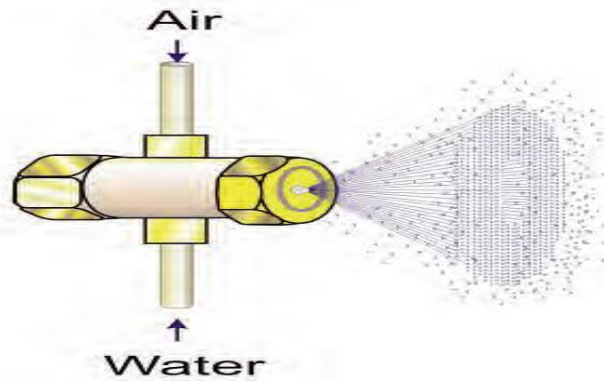
Flat Spray



Hollow Cone



Solid Stream



Atomizing Spray

Spray types used for dust control in mining.

A recent death with severe CWP



Died age 66
27 years as a coal miner
17 years underground

Clinical Data Obtained at the Patient's Bedside

- Increased respiratory rate
- Increased heart rate, cardiac output, blood pressure
- Cyanosis
- Digital clubbing
- Peripheral edema and venous distention
 - Distended neck veins
 - Pitting edema
 - Enlarged and tender liver
- Cough and sputum production

Take Home Message

- Black Lung is entirely preventable using dust control
- No other prevention method (respirators, x-rays) can guarantee such success
- It behooves every employer and employee to minimize dust production
- Especial care is needed when rock is being cut