

Environmental Medicine Grand Rounds

Asbestos Toxicity



Learning Objectives

- **What is asbestos?**
- **Most important route of exposure**
- **Populations most heavily exposed**
- **Diseases associated with asbestos exposure**
- **Common findings on medical evaluation**



Learning Objectives (continued)

- **Chest radiograph findings**
- **Pulmonary function test findings**
- **Other tests that can assist with diagnosis**
- **Primary treatment strategies**
- **Instructions for patients**

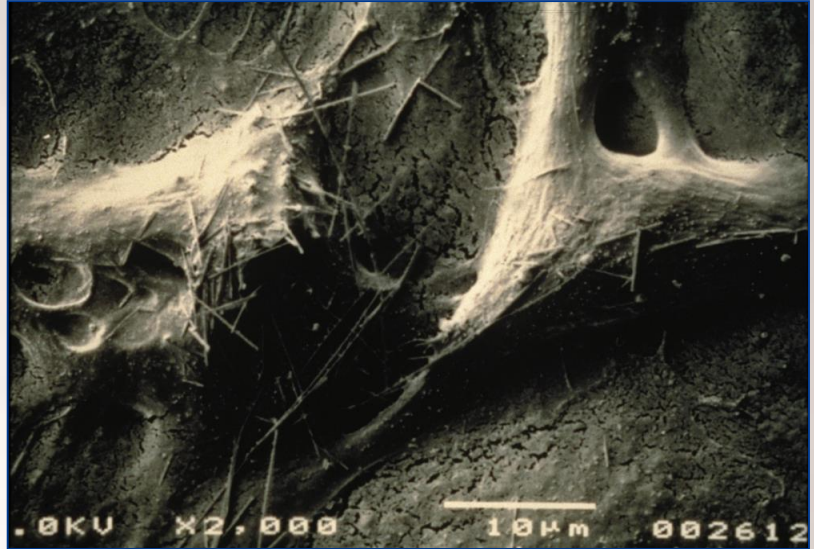


Asbestos: Description

- **Asbestos is a generic term for a group of six mineral silicates**
- **Asbestos fibers are:**
 - Very strong
 - Highly flexible
 - Resistant to breakdown by acid, alkali, water, heat, and flame
 - Non-biodegradable
 - Environmentally persistent



Asbestos: Types



Serpentine (93% of commercial use)	Amphibole (7% of commercial use)
Chrysotile	Actinolite, Amosite, Anthophyllite, Crocidolite, Richterite, Tremolite

Asbestos: Occurrence in the United States

- **Until 1975: Automobile, building construction and shipbuilding industries**
- **Until 1990: Contaminant in vermiculite**



Asbestos: Occurrence in the United States

(continued)

- **Today: Exists in older homes and commercial buildings**
 - problematic when loose, crumbling, or disturbed
- **Today: Still used in brake pads, clutches, roofing material, vinyl tiles, and some cement pipes**
- **Naturally occurring asbestos is found in parts of the U.S. areas in asbestos bearing rocks. It is released:**
 - when disturbed
 - as rocks weather



Populations At Risk

Past Exposures	Current Exposures
<ul style="list-style-type: none">• Mechanics, construction workers, shipyard workers, and military personnel• Secondary exposure in the workplace• Household contacts of workers	<ul style="list-style-type: none">• Construction workers, mechanics (brake pads)• People in homes with friable asbestos materials• People in areas where asbestos-bearing rock is disturbed

For information on where to find certified asbestos removal contractors in your state, contact your local department of health or environment.

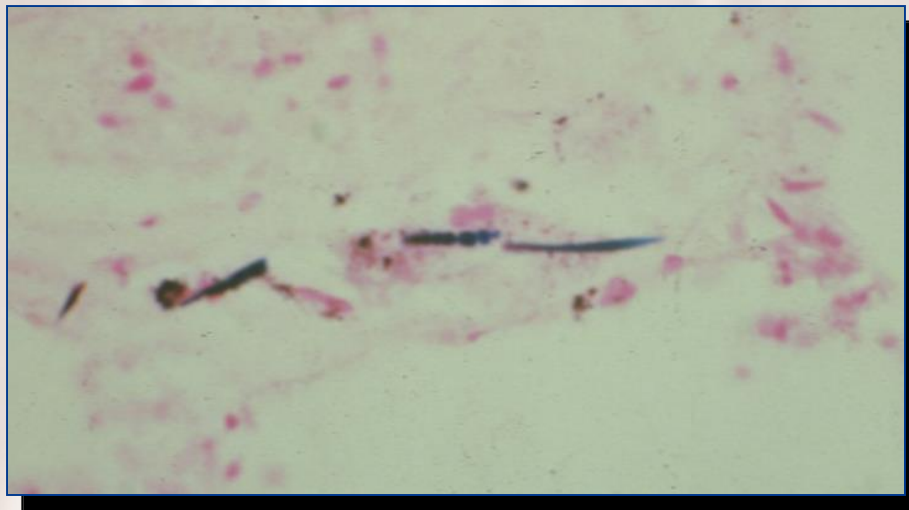


Asbestos Exposure Pathways

- **Most common exposure pathway:**
 - Inhalation of fibers
- **Minor pathways:**
 - Ingestion
 - Dermal contact

Biologic Fate

- **Asbestos bodies**
- **Lower airways and alveoli**
- **Pleural or peritoneal spaces or the mesothelium**



Pathogenesis

- **Asbestos fibers induce pathogenic changes via:**
 - Direct interaction with cellular macromolecules
 - Generation of reactive oxygen species (ROS)
 - Other cell-mediated mechanisms
- **These changes can lead to cell injury, fibrosis, and possibly cancer**
- **Asbestos is genotoxic and carcinogenic**

Asbestos-Associated Diseases

- **Respiratory diseases:**
 - Parenchymal asbestosis
 - Asbestos-related pleural abnormalities
 - Lung carcinoma
 - Pleural mesothelioma
- **Nonrespiratory diseases:**
 - Peritoneal mesothelioma
 - Possibly, other extrathoracic cancers
 - Rarely, cor pulmonale or constrictive pericarditis



Parenchymal Asbestosis

- **Diffuse interstitial fibrosis with:**
 - Restrictive pattern of disease on pulmonary function testing (but can see mixed pattern)
 - Impaired gas exchange
 - Progressive exertional dyspnea
- **Radiographic changes: >10 years**
- **Latency period: 20-40 years**

Asbestos-Related Pleural Abnormalities

- **Four types of abnormalities:**
 - Pleural plaques
 - Benign asbestos pleural effusions
 - Diffuse pleural thickening
 - Rounded atelectasis
- **Mostly asymptomatic, though some can cause dyspnea or cough**
- **Latency periods: 10-30 years (shorter latency is for pleural effusion)**



Lung Carcinoma

- **Risk depends on:**
 - Level, frequency, and duration of exposure
 - Time elapsed since exposure
 - Age at time of exposure
 - Smoking history (synergistic)
 - Individual susceptibility factors (under investigation)
- **Latency period: 20-30 years**

Malignant Pleural Mesothelioma

- **Tumor arises from the thin serosal membrane surrounding the lungs**
- **Rapidly invasive**
- **Rare, although incidences are increasing**
- **Long latency period: Usually 30-40 years**



Malignant Peritoneal Mesothelioma

- **“Doughy” feeling on abdominal palpation**
- **Male:female incidence is 1.5:1 (compared to 5:1 with pleural tumor)**
- **Rapidly invasive and rapidly fatal**
- **Often associated with high-dose asbestos exposures**
- **Rare**

Other Extrathoracic Cancers

- **Colon cancer**
- **Possibly cancer of larynx, stomach, kidney, esophagus**
- **Association with asbestos exposure remains controversial**
- **Regular colon cancer screening for people over age 50 years**
- **Screening for other extrathoracic cancers not recommended**



Cardiovascular Conditions

- **Cor pulmonale**
 - Secondary to chronic lung disease
 - Mainly with severe parenchymal asbestosis
- **Constrictive pericarditis**
 - Secondary to asbestos-associated disease
 - Very rare



Risk Factors

- **Nature and extent of exposure:**
 - Concentration of asbestos fibers
 - Duration of exposure
 - Frequency of exposure
- **Cigarette smoking**

Diagnosis

- **Medical evaluation of all patients should include:**
 - **Assessment of clinical presentation**
 - **Exposure history**
 - **Medical history**
 - **Physical examination**
 - **Chest radiograph and pulmonary function tests**
- **Radiologic and laboratory testing can include:**
 - **CT or HRCT**
 - **BAL**
 - **Lung biopsy (rarely needed)**

Clinical Presentation

Disease	Signs and Symptoms
Parenchymal Asbestosis	<ul style="list-style-type: none">• Insidious onset of dyspnea on exertion• Fatigue
Asbestos-Related Pleural Abnormalities	<ul style="list-style-type: none">• Usually: None• Sometimes: Progressive dyspnea and intermittent chest pain (depending on the type of pleural abnormality)
Lung Cancer	<ul style="list-style-type: none">• Usually: None (until later stages)• Sometimes: Fatigue, weight loss, or chest pain
Mesothelioma	<ul style="list-style-type: none">• Usually: None (until later stages)• Sometimes: Dyspnea, chest pain, and fatigue

Patient History

Exposure History	Medical History
<ul style="list-style-type: none">• Work history• Source, intensity, duration, and frequency of exposure• Time elapsed since first exposure• Workplace dust measurements or description of exposure scenario• Use of personal protective equipment• Paraoccupational exposures• Sources of environmental exposure	<ul style="list-style-type: none">• History of smoking• History of other conditions

Link to Taking an Exposure History CSEM and other publications in this series:

<http://www.atsdr.cdc.gov/HEC/CSEM/csem.html>



Physical Examination

- **Focus on lungs, heart, digits, and extremities**
- **Pulmonary auscultation to detect bibasilar inspiratory rales (not always present)**
- **Observation of other signs, such as clubbing of the fingers and cyanosis**

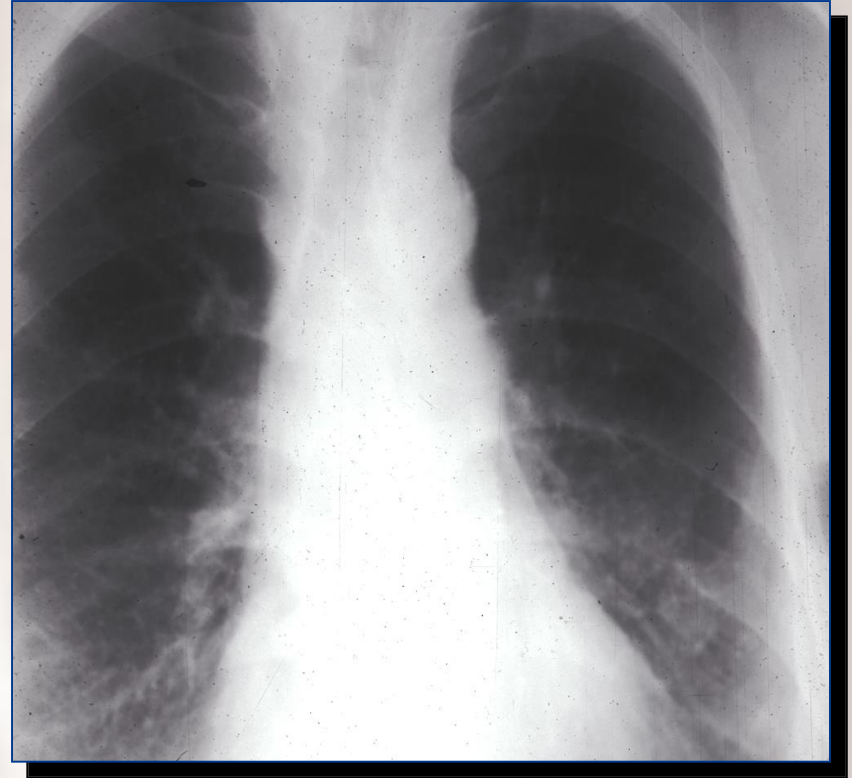


Pulmonary Function Tests

Disease	Pulmonary Function Test Findings
Parenchymal Asbestosis	<ul style="list-style-type: none">• Reduction in FVC; normal FEV1/FVC Ratio• Reduction in FEF (25%-75%)• Restrictive pattern with decreased DLCO• Or, mixed obstructive/restrictive pattern (reduced FEV1/FVC associated with reduced FVC)
Asbestos-Related Pleural Abnormalities	<ul style="list-style-type: none">• Often normal• Reduced FVC can be associated with diffuse pleural thickening

Chest Radiograph Findings: Parenchymal Asbestosis

- **Small, irregular oval opacities**
- **Interstitial fibrosis**
- **“Shaggy heart sign”**



List of certified B Readers: <http://www.cdc.gov/niosh/pamphlet.html>

Chest Radiograph Findings: Asbestos-Related Pleural Abnormalities

- **Pleural plaques**
 - Areas of pleural thickening
 - Sometimes with calcification
- **Pleural effusions**
- **Diffuse pleural thickening**
 - Lobulated prominence of pleura adjacent to thoracic margin (over $\frac{1}{4}$ of chest wall)
 - Interlobar tissue thickening
- **Rounded atelectasis**
 - Rounded pleural mass
 - Bands of lung tissue radiating outwards

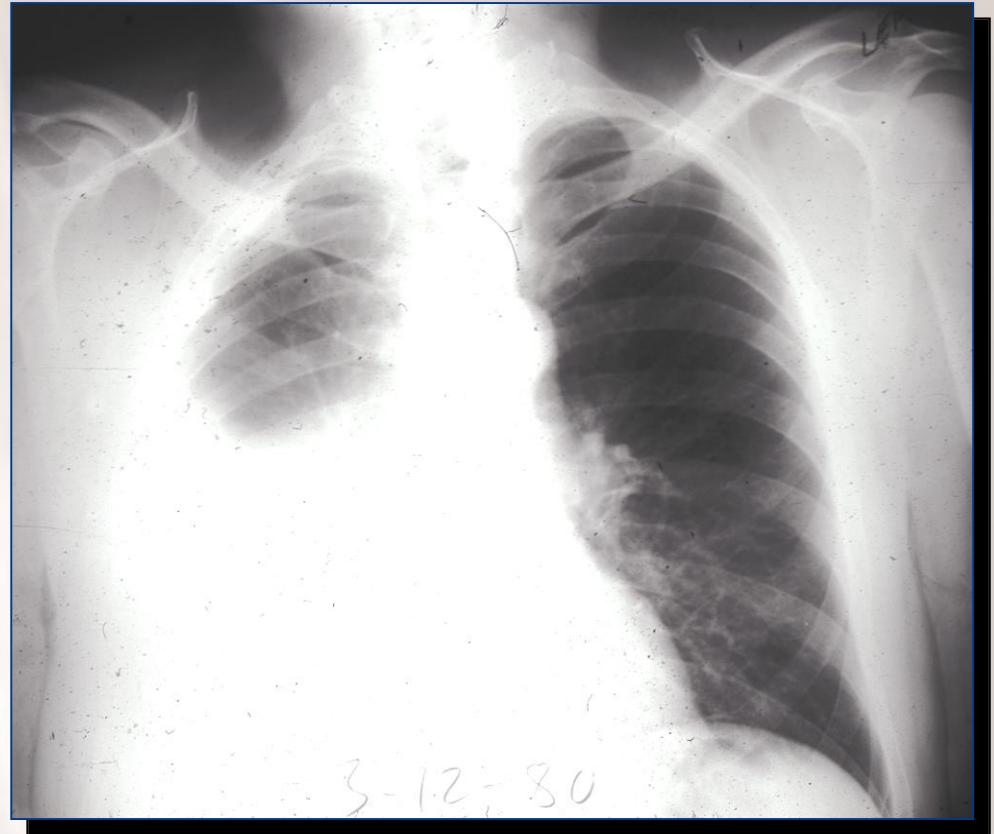


Chest Radiograph Findings: Lung Cancer

- **Same findings as those of other lung cancer etiologies**

Chest Radiograph Findings: Mesothelioma

- **Pleural effusions**
- **Pleural mass**
- **Diffuse pleural thickening**



Other Tests

- **CT and HRCT**
- **BAL and lung biopsy**
- **ABGs and pulse oximetry**
- **Colon cancer screening**

Disease Management

Asbestos-associated Disease	Treatment Strategy
Parenchymal Asbestosis and Asbestos-Related Pleural Abnormalities	<ul style="list-style-type: none">• Stopping additional exposure• Careful monitoring to facilitate early diagnosis• Smoking cessation• Regular influenza and pneumococcal vaccines• Pulmonary rehabilitation as needed• Disability assessment• Aggressive treatment of respiratory infections
Lung Cancer and Mesothelioma	<ul style="list-style-type: none">• Early diagnosis• Surgery• Chemotherapy• Radiation

Communication with the Patient

- **Obtain patient's employer contact information to facilitate occupational exposure prevention (OSHA mandates PPE and medical surveillance)**
- **Counsel patient regarding smoking cessation**
- **Have patient consult you for health changes**
- **Provide and review patient education and instruction sheet with patient**



Summary

- **Asbestos exposures peaked in the United States in 1940-1980, but continue to occur today**
- **Inhalation of asbestos can lead to**
 - **parenchymal asbestosis,**
 - **pleural abnormalities,**
 - **lung carcinoma, and**
 - **mesothelioma**



Summary (continued)

- **Diagnosis involves**
 - **exposure and medical history,**
 - **physical examination,**
 - **chest radiography,**
 - **pulmonary function tests, and**
 - **other tests as needed**



Summary (continued)

- **Management focuses on:**
 - **Preventing further exposures**
 - **Smoking cessation**
 - **Monitoring to aid early detection**
 - **Patient education**



For More Information

- **Contact CDC-INFO**
 - 800-CDC-INFO (800-232-4636)
 - TTY 888-232-6348
 - 24 Hours/Day
 - E-mail: cdcinfo@cdc.gov
- **CDC Emergency Response:**
 - 770-488-7100 - for state and local health department assistance
- **Also refer to *Where can I find more information?* in the Asbestos Toxicity CSEM for a list of Web resources and suggested readings:**
<http://www.atsdr.cdc.gov/HEC/CSEM/asbestos/index.html>

