Coal Workers Pneumoconiosis – An Old Disease That Is Still Among Us

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University of Cincinnati
Development of Simple CWP

- Anthracosis
- Defense mechanism overwhelmed
- Cellular reaction
- Coal macule formation
Symptoms Simple CWP

- Asymptomatic
- Cough and sputum production
  - Generally secondary

- “The impairment of pulmonary function and mild to moderate pulmonary hypertension may be present in even simple forms or CWP”
  - Yildiz, et al. 2007
Progression to PMF

- Inciting factors
- Over-reaction of immune system
- Fibrosis development
- Disability
- Decreased lung function
- Interstitial necrosis
- Complication
- Early death
- Decreased lung function
- Interstitial necrosis
- Disability
Coal workers’ pneumoconiosis can be categorized into a simple form and a complicated form.

In the simple form, coal macules (nodular aggregations of coal dust and macrophages) contain solid anthracotic pigment without intervening fibrotic tissue.
In progressive massive fibrosis, the complicated form, a fibrotic mass is formed by exuberant fibroblast activity that tends to occur in the upper lobes of the bilateral lungs, showing an “angel’s wing” appearance on plain radiographs.

Classic CT findings in this form include bilateral irregular fibrotic masses with surrounding reticulations and pericicatrical emphysema.
...the chart below lists the five states where miners with PMF last worked in the coal mining industry. The first number is the total number of PMF cases which arose in that state. The second number (in parentheses) is the number of PMF cases involving miners born in 1952 or later. The percentage figure reflects the percentage of PMF cases which involved those younger miners.

<table>
<thead>
<tr>
<th>State</th>
<th>Total Cases</th>
<th>Younger Miners</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Virginia</td>
<td>232</td>
<td>60</td>
<td>25.9%</td>
</tr>
<tr>
<td>Kentucky</td>
<td>178</td>
<td>85</td>
<td>47.8%</td>
</tr>
<tr>
<td>Virginia</td>
<td>107</td>
<td>42</td>
<td>39.3%</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>40</td>
<td>4</td>
<td>10.0%</td>
</tr>
<tr>
<td>Tennessee</td>
<td>17</td>
<td>5</td>
<td>29.4%</td>
</tr>
<tr>
<td>National Total</td>
<td>610</td>
<td>199</td>
<td>32.6%</td>
</tr>
</tbody>
</table>
Progressive massive fibrosis ...

Anthroocotic scars > 2 cm, multiple and containing dense collagen and pigment with the center of the lesions being necrotic

Associated with pulmonary hypertension and cor pulmonale

Disease can progress even if dust exposure ceases

Associated with increased incidence of clinical tuberculosis, chronic bronchitis and emphysema and independent of smoking

In isolation, PMF does not appear to increase the risk of lung cancer
Coal Mine Dust Lung Disease
caused by inhalation of coal mine dust and the body’s reaction to it

- **Fibrotic diseases – damage/destroy lung tissue**
  - Coal workers’ pneumoconiosis “CWP”
  - Silicosis
  - Mixed dust pneumoconiosis
  - Dust-related diffuse fibrosis

- **Airflow diseases – block movement of air**
  - Bronchitis
  - Emphysema
  - Mineral dust small airway disease “COPD”

- **Infectious diseases – dust reduces immunity**
  - Tuberculosis/related (esp. Africa, previously in U.S.)
Forms of Pneumoconiosis

Simple

Complicated:
Progressive Massive Fibrosis
International Labour Office Classification of Radiographs

ILO classification

Profusion of small opacities

Large opacities

Profusion of small opacities:
- 0/-
- 0/0
- 0/1
- 1/0
- 1/1
- 1/2
- 2/1
- 2/2
- 2/3
- 3/2
- 3/3
- 3/+ A B C

Large opacities:
- A
- B
- C
Progressive Massive Fibrosis

Sept. 2007
59 yr old WV miner
Coal Miner Health Surveillance Programs

- CWXSP: Required under Mine Act
  - Code of Federal Regulations 42 CFR Part 37
  - Working miners at underground coal mines
  - Chest radiograph every 5 years: film and now digital (2012)
  - Operators arrange and pay

- Test quality
- Diagnostic accuracy
- Participation

Miner’s risk of disease declined 89% - an excellent public health success

In 10 years US Black Lung rates doubled.
MSHA’s Alleged Support for Its Claim

Percentage of Examined Miners with CWP (category 1/0+) by Tenure in Mining, (1970-2006)

- Presents increasing trend in CWP prevalence since 1995.
- Presents the Data in 5 year periods. MSHA and NIOSH failed to provide detailed annual data.
- 2005-2006 reported as a partial period.
Exposure and Reported Lung Disease Prevalence?

- Concentrations of respirable coal mine dust, as measured by MSHA and operators, have steadily declined since 1995.
The First Problem: A “Hot Spot” Focus in 2006

Enhanced Coal Workers’ Health Surveillance Program (ECWHSP)

<table>
<thead>
<tr>
<th>MSHA district</th>
<th>year</th>
<th># of x-rays</th>
<th># of miners employed</th>
<th>disease prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>2008</td>
<td>58</td>
<td>92</td>
<td>10</td>
</tr>
<tr>
<td>D2</td>
<td>2009</td>
<td>687</td>
<td>4150</td>
<td>2</td>
</tr>
<tr>
<td>D3</td>
<td>2008</td>
<td>1055</td>
<td>4122</td>
<td>2</td>
</tr>
<tr>
<td>D4</td>
<td>2007</td>
<td>1077</td>
<td>7072</td>
<td>7</td>
</tr>
<tr>
<td>D5</td>
<td>2006</td>
<td>649</td>
<td>2456</td>
<td>8</td>
</tr>
<tr>
<td>D6</td>
<td>2006</td>
<td>379</td>
<td>3740</td>
<td>11</td>
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<tr>
<td>D7</td>
<td>2006</td>
<td>448</td>
<td>2592</td>
<td>8</td>
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<td>707</td>
<td>1928</td>
<td>1</td>
</tr>
<tr>
<td>D9</td>
<td>2007</td>
<td>898</td>
<td>3833</td>
<td>1</td>
</tr>
<tr>
<td>D10</td>
<td>2009</td>
<td>142</td>
<td>1770</td>
<td>2</td>
</tr>
<tr>
<td>D11</td>
<td>2007</td>
<td>617</td>
<td>2598</td>
<td>2</td>
</tr>
</tbody>
</table>

- Early phases of program targeted Central Appalachian “hot-spot” areas where regional clusters of rapidly progressive cases of disease have been observed.

- District 5 (Southwest VA), District 6 (Eastern KY) and District 7 (Southeast KY) surveyed in 2006.

- 2005-2006 period influenced by ECWHSP focus on Central Appalachian region in 2006 and is not representative of the entire mining industry.
Rapidly progressive coal workers' pneumoconiosis in the United States: geographic clustering and other factors

V C dos S Antao, E L Petsonk, L Z Sokolow, A L Wolfe, G A Pinheiro, J M Hale, M D Attfield

*Results from NIOSH Coal Workers Health Surveillance Program, 1996-2002
Not shown are counties with fewer than 5 miners evaluated
New results confirmed that a problem exists.
NIOSH returned to "Hot Spots" to survey working US miners 2006-07

- 0% of participating miners with Black Lung
- 4.5 - 20.0%
- 22.2 - 40.0%
- 41.7 - 60%
- 61.5 - 80%

* preliminary
**Is silicosis becoming more frequent in coal miners?**

Robert A Cohen

**Pneumoconiosis among underground bituminous coal miners in the United States: is silicosis becoming more frequent?**

A Scott Laney, Edward L Petsonk and Michael D Attfield

*Occup Environ Med* published online September 22, 2009

**Figure 3.** Percentage of r-type opacities by region and decade, 1980–2008.
Coal Workers’ Health Surveillance Program Update 2009-2013

- 2,328 surface coal miners examined 2010-2011 as part of ECWHSP
  - 16 states / 7% of US surface miners
- Pneumoconiosis 1/0+
  - 3.7% Central Appalachia / 1.1% elsewhere
- PMF
  - 1.2% Central Appalachia / 0.1% elsewhere

Mine Safety and Health Research Advisory Committee Presentation - July 24, 2013
FIGURE 1. Prevalences of CWP (A) and abnormal spirometry results (B) by county among 6373 underground coal miners in the Enhanced Coal Workers' Health Surveillance Program, 2005 to 2009, including 77 counties with at least five participating miners. Inset shows counties included in the cluster area.
Conclusions

- US coal miners continues to experience severe and fatal dust disease
- Radiographic surveillance underestimates the burden of lung disease
- Dust controls in US mines are failing to adequately protect employee health
- Actions need to be taken to prevent this problem from continuing to worsen
The world is watching the U.S. mining industry

Basic protections are still lacking

Dana Loomis

A tragic failure to put into practice what we have learned through decades of research.

Two other recent coal-mining tragedies on opposite sides of the world give further evidence of this failure to act. Between 41 and 67 miners died as a result of flood in a Chinese coal mine and an explosion in an American one that occurred just 8 days apart in March and April. The American mine disaster was that country’s worst in 40 years. Methods to prevent mining environments is needed. We welcome research contributions on these problems. Nevertheless, it is clear that many of the hazards of work in developing countries are established ones, and that much could be

Competing interests None.

Provenance and peer review Commissioned; not externally peer reviewed.

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