Medical Aspects of Beryllium Production at the Ulba Metallurgical Plant

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Presented at the AIHCE
May 14, 2003
Processes

Beryllium

Uranium

Machining

Tantalum
Fifty years of beryllium production

- **Establish Production-- 1951-1959**
  - Developed sulfate-ammonium and chloride methods
  - Maximum to 400 TPC

  - Be metal manufacture; Initiated BeO operation
  - Maximum to 5000 TPC

- **Post Reconstruction – 1970 to present**
  - Significant improvements in labor conditions
  - Average air concentrations were 1-3 TPC where 98-150 cases exceeded the TPC
U.S. Definition of CBD

- Two positive peripheral blood Lymphocyte Proliferation Tests (LPT)
- Confirmation positive lung lavage LPT
Lung disease terminology at UMP

- Acute toxic bronchitis
- Acute broncho-bronchiolitis pneumonitis
- Primary chronic toxic bronchitis ?
- Chronic toxic bronchitis (pre-CBD)
  - Due to damaging impacts of acids, fluorides, and soluble be compounds
  - In beryllium hydroxide and crude be production
  - 4:1 toxic chronic bronchitis over granulomatosis
- Granulomatosis, also called berylliosis (CBD)
  - Due to damaging impacts of beryllium oxide
  - 5:1 granulomatosis over toxic chronic bronchitis
Controls

- Operational segregation
- Monitoring (skin, air, water, soils)
- Clothing
- Respiratory protection
- Shower/sauna
- Special free curing and preventing diet
- Medical surveillance
Analysis methods

skin

Air, soil & water
Lepestok Respirators
200 allowable concentration units
Static inner cloth
Reported coefficient of breakthrough 0.1-0.4%¹

Environmental sampling results

- Perimeter sampling
- Data from Jan. to Aug. 2002
  - 3600 samples
  - Average ranged from 0.003 to 0.007 µg/m³
  - Maximum 0.7 µg/m³
Workplace monitoring

- Filters analyzed by LANL, area?
  - Unloading beryllium carbonate – 1.1 – 3.3 µg/m³; under 3 hours sampling time

- Filters analyzed by UMP, 8-hr TWA, personal?
  - Workers dismantling BeF₂ furnace – 17-122 µg/m³
  - Truck Drivers of BeO shipment – 1.3-6 µg/m³
# Disease number by type and form

<table>
<thead>
<tr>
<th>Disease</th>
<th>Acute</th>
<th>Chronic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>252</td>
<td>478</td>
<td>730</td>
</tr>
<tr>
<td>Dermatitis</td>
<td>602</td>
<td>43</td>
<td>645</td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>432</td>
<td>23</td>
<td>455</td>
</tr>
<tr>
<td>Totals</td>
<td>1286</td>
<td>544</td>
<td>1830</td>
</tr>
</tbody>
</table>
### Disease prevalence by occupation

<table>
<thead>
<tr>
<th>Occupation</th>
<th>% of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators</td>
<td>48.6</td>
</tr>
<tr>
<td>Repairman</td>
<td>13.6</td>
</tr>
<tr>
<td>Engineering personnel</td>
<td>11.6</td>
</tr>
<tr>
<td>Other personnel (workers, electricians, turners, laboratory assistants, cleaners, etc.)</td>
<td>26.2</td>
</tr>
</tbody>
</table>

Total Cases - 1830
## CBD prevalence by duration

<table>
<thead>
<tr>
<th>Duration of Exposure</th>
<th>% of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 years</td>
<td>15.2</td>
</tr>
<tr>
<td>6-10 years</td>
<td>19.0</td>
</tr>
<tr>
<td>11-15 years</td>
<td>24.2</td>
</tr>
<tr>
<td>16 years or more</td>
<td>41.6</td>
</tr>
</tbody>
</table>
Granulomatosis lung disease (CBD)

- Average duration from diagnosis to death is 8 years; for some it is 1-3 years
- Average age of death is around 55
- Average age of patients is 44
- Females have 3 years less life expectancy than males
- Two types of progressive diseases
  - Slow
  - Quick
<table>
<thead>
<tr>
<th>Cause of death</th>
<th>% of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary cardiac insufficiency</td>
<td>49.6</td>
</tr>
<tr>
<td>Malignant tumor</td>
<td>17.2</td>
</tr>
<tr>
<td>Cardiac ischemia</td>
<td>13.0</td>
</tr>
<tr>
<td>Poisonings (suicide), trauma</td>
<td>8.0</td>
</tr>
<tr>
<td>Acute failure of cerebral circulation</td>
<td>3.8</td>
</tr>
<tr>
<td>Cirrhosis of liver</td>
<td>1.7</td>
</tr>
<tr>
<td>Other</td>
<td>6.7</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

120 cases from complications          Total of 238 deaths
## More statistics

<table>
<thead>
<tr>
<th>Year started work</th>
<th>% of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-1960</td>
<td>40.5</td>
</tr>
<tr>
<td>1960-1970</td>
<td>38.5</td>
</tr>
<tr>
<td>1970-1980</td>
<td>17.2</td>
</tr>
<tr>
<td>1980-1990</td>
<td>2.8</td>
</tr>
<tr>
<td>1990 to present</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Noteworthy variables of location

- Nuclear firing ground in Semipalatinsk
- Zinc-lead plant nearby
- Power plant nearby uses black coal
- 176 industrial enterprises in city
- 60 chemical agents and compounds emitted into environment from industrial enterprises
- Past 30 years beryllium emissions have decreased by approximately 50 times
Treatment options

- **Complexation**
  - Shown to be insufficient

- **Corticosteroidal hormones and immunomodulators**
  - Slows progression of disease but has complications (hormone dependence, steroid diabetes, blood disease, etc.)
Conclusions from UMP

- Disease incidence is in direct relation to technology level of production and degree of personal protection.
- Risk of CBD increases with number of years worked and age of workers.
- Acute forms can be completely eliminated by adherence to requirements.
- Chronic forms at this time are inevitable.
- Medical efforts should be directed for CBD to improve diagnostics, prophylaxis, and treatment.
Questions?