Occupational lung diseases
an overview

22:07:2013
IIT-MUMBAI
• 52/M
• Non-smoker
• Worked in a bakery for > 30 years
• C/O
• Productive cough and exertional breathlessness since 2 years
• Treated with AKT on multiple occasions due to Xray changes with no relief
• No h/o HT/DM/IHD
Radiology: PMF
NEEDLE SHAPED (SILICA) BIREFRINGENT CRYSTALS IN SAMOSA PATTI
(Polarising microscopy)

DEPT. OF PATHOLOGY, K.E.M. HOSPITAL
ILO 2010 RESPIRATORY DISORDERS

- Occupational diseases by target organ systems
  - 2.1. Respiratory diseases
    - 2.1.1. Pneumoconioses caused by fibrogenic mineral dust (silicosis, anthraco-silicosis, asbestosis)
    - 2.1.2. Silicotuberculosis
    - 2.1.3. Pneumoconioses caused by non-fibrogenic mineral dust
    - 2.1.4. Siderosis
    - 2.1.5. Bronchopulmonary diseases caused by hard-metal dust
    - 2.1.6. Bronchopulmonary diseases caused by dust of cotton (byssinosis), flax, hemp, sisal or sugar cane (bagassosis)
    - 2.1.7. Asthma caused by recognized sensitizing agents or irritants inherent to the work process
    - 2.1.8. Extrinsic allergic alveolitis caused by the inhalation of organic dusts or microbial contaminated aerosols, arising from work activities
    - 2.1.9. Chronic obstructive pulmonary diseases caused by inhalation of coal dust, dust from stone quarries, wood dust, dust from cereals and agricultural work, dust in animal stables, dust from textiles, and paper dust, arising from work activities
    - 2.1.10. Diseases of the lung caused by aluminium
    - 2.1.11. Upper airways disorders caused by recognized sensitizing agents or irritants inherent to the work process
    - 2.1.12. Other respiratory diseases not mentioned in the preceding items where a direct link is established scientifically, or determined by methods appropriate to national conditions and practice, between the exposure to risk factors arising from work activities and the disease(s) contracted by the worker
    - 2.1.10. Diseases of the lung caused by aluminium
    - 2.1.11. Upper airways disorders caused by recognized sensitizing agents or irritants inherent to the work process
    - 2.1.12. Other respiratory diseases not mentioned in the preceding items where a direct link is established scientifically, or determined by methods appropriate to national conditions and practice, between the exposure to risk factors arising from work activities and the disease(s) contracted by the worker
National Institute of Occupational Safety & Health (NIOSH)

- priority list of 10 leading work-related illnesses and injuries.
- Three criteria were used to develop the list:
  - a) the frequency of occurrence of the illness or injury,
  - b) its severity in individual cases, and
  - c) its potential for prevention.
- Occupational lung disease is first on the list
Review Article
Occupational Health Research in India
Habibullah N SAIYED* and Rajnarayan R TIWARI

Table 1. Employment (in millions) in different economic sectors of activities in urban and rural areas

<table>
<thead>
<tr>
<th></th>
<th>Total Persons</th>
<th>Total workers</th>
<th>Agriculture</th>
<th>Household</th>
<th>Cultivators</th>
<th>Labourers</th>
<th>Industry</th>
<th>Other Workers*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>275</td>
<td>86</td>
<td>57</td>
<td>8</td>
<td>123</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>127</td>
<td>41</td>
<td>50</td>
<td>8</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>199</td>
<td>84</td>
<td>55</td>
<td>6</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>111</td>
<td>41</td>
<td>48</td>
<td>6</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>403</td>
<td>128</td>
<td>107</td>
<td>16</td>
<td>151</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*: Other workers = Mining and Quarrying, Manufacturing, Processing, Servicing and Repairs, Construction, Trade and Commerce.
Table 2. Prevalence of some of the occupational lung diseases studies carried by National Institute of Occupational Health

<table>
<thead>
<tr>
<th>Industry</th>
<th>Morbidity</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slate Pencil</td>
<td>Silicosis</td>
<td>54.5</td>
</tr>
<tr>
<td>Agate Polishing</td>
<td>„</td>
<td>38</td>
</tr>
<tr>
<td>Stone Quarries</td>
<td>„</td>
<td>21</td>
</tr>
<tr>
<td>Potteries</td>
<td>„</td>
<td>15.2</td>
</tr>
<tr>
<td>Stone Crushing</td>
<td>„</td>
<td>12</td>
</tr>
<tr>
<td>Coal Mines10 (Underground)</td>
<td>Coal workers’ pneumoconiosis</td>
<td>2.84</td>
</tr>
<tr>
<td>Other respiratory morbidities</td>
<td>45.4</td>
<td></td>
</tr>
<tr>
<td>Coal Mines10 (Open Cast)</td>
<td>Coal workers’ pneumoconiosis</td>
<td>2.1</td>
</tr>
<tr>
<td>Other respiratory morbidities</td>
<td>42.2</td>
<td></td>
</tr>
<tr>
<td>Asbestos mine &amp; mill11</td>
<td>Asbestosis</td>
<td>11</td>
</tr>
<tr>
<td>Asbestos Textile workers12</td>
<td>„</td>
<td>9</td>
</tr>
<tr>
<td>Asbestos cement13</td>
<td>„</td>
<td>3–5</td>
</tr>
<tr>
<td>Textile Mills (Blow Room)14</td>
<td>Byssinosis</td>
<td>30</td>
</tr>
<tr>
<td>Textile Mills (Card Room)14</td>
<td>„</td>
<td>38</td>
</tr>
<tr>
<td>Jute Mills15, 16</td>
<td>Byssinosis and other chronic</td>
<td>48.8</td>
</tr>
<tr>
<td>obstructive lung diseases</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Occupation related

Incidence of Silicosis in Flour mill workers

30.4% flour mill workers had Silicosis
Incidence of silicosis in flourmill workers

Amita Athavale, Aparna Iyer, Debasish Sahoo, Kapil Salgia, Abhijit Raut, and Neeti Kanodra

Department of Chest Medicine and E.P.R.C, Seth G.S. Medical College and K.E.M. Hospital, Parel, Mumbai, India

1Department of Radiology, Seth G.S. Medical College and K.E.M. Hospital, Parel, Mumbai, India

2ICMR Student Research Fellow, Seth G.S. Medical College and K.E.M. Hospital, Parel, Mumbai, India

Abstract

Background:
Silicosis is an ancient occupational illness reported in silica mill workers, agate stone workers, slate pen workers and mining industry. However its association in flour mill workers has not been established.
BRONCHOSCOPY: BAL, TBLB
• Diagnostic modalities available for studying health effects of air pollution.
• **Occupational respiratory diseases**
  - Dust
    - Silica dust
    - Asbestos dust
    - Coal dust
  - Toxic Gases
    - SO2
    - NOx
  - Biologic reaction
  - Inflammatory reaction
- **Neoplastic**
  - Asbestos,
  - nickel,
  - iron
- **Chronic Obstructive Pulmonary Disease**
  - Synergism with tobacco
- **Allergic reaction**
  - **occupational ASTHMA**
  - Organic
  - “dusts”
  - Cotton
  - Wood dusts
  - Flour
  - Particulate matter within the range of 1-5 μm-s penetrate deepest into the lung!
ASTHMA AT WORK PLACE
Equipment Used

PULMONARY FUNCTION TESTING LAB
Chest Medicine & EPRC
Occupation related
Traffic police survey

PFT in traffic police in Smokers

PFT in traffic police in non-smokers
34 yrs GARDENER, WATERED PLANTS WITH TREATED WASTEWATER
THERAPEUTIC BAL UNDER GA
Dust-induced interstitial lung disease in the tropics
Jindal, Surinder K. MD; Aggarwal, Ashutosh N. MD; Gupta, Dheeraj MD

Abstract

Inhalation of dusts is an important cause of interstitial lung disease in the tropical countries such as India. While dusts of organic origin, such as the cotton dust causing byssinosis, generally cause bronchial or bronchiolar involvement and hypersensitivity pneumonitis, inorganic metallic dusts cause progressive pulmonary fibrosis. Silicosis, coal workers' pneumoconiosis, and asbestosis are the three most commonly recognized forms of pneumoconiotic pulmonary fibrosis. Pulmonary tuberculosis is an important complication seen in up to 50% of patients of silicosis in some reports from India. The presentation is generally chronic, although acute and accelerated forms of silicosis are known when the exposures are heavy. Breathlessness, dry cough, and general constitutional symptoms are commonly seen. Patients with silicotuberculosis or other forms of infection may also have significant expectoration, hemoptysis, fever, and rapid progression. Respiratory failure and chronic cor pulmonale occur in the later stages. The diagnosis is easily established if the occupational history is available. Dense nodular opacities on chest roentgenograms, which may be large in patients with massive pulmonary fibrosis, are characteristic. Emphysematous changes generally appear in advanced stages or in patients who smoke. Bronchoalveolar lavage and/or lung biopsy may occasionally be required to establish or exclude other causes of interstitial lung disease. Treatment is largely palliative, although a variety of drugs including corticosteroids and procedures such as whole lung lavage have been tried. None of these methods has yet been found successful in the treatment. Preventive safety steps, including removal of the patient from the site of exposure, are the only effective strategies to control disease progression.
ORGANIC DUST
Risk of tuberculosis infection and disease associated with work in health care settings


Authors: Menzies, D.; Joshi, R.; Pai, M.

Source: The International Journal of Tuberculosis and Lung Disease, Volume 11, Number 6, June 2007, pp. 593-605(13)
<table>
<thead>
<tr>
<th>Major Disease Category</th>
<th>Representative Causative Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper respiratory tract irritation</td>
<td>Irritant gases, solvents</td>
</tr>
<tr>
<td>Airway disorders</td>
<td>Diisocyanates, anhydrides, wood dusts</td>
</tr>
<tr>
<td>Occupational asthma</td>
<td>Animal-derived allergens, latex</td>
</tr>
<tr>
<td>Sensitization</td>
<td>Irritant gases</td>
</tr>
<tr>
<td>Low molecular weight</td>
<td>Cotton dust</td>
</tr>
<tr>
<td>High molecular weight</td>
<td>Grain</td>
</tr>
<tr>
<td>Irritant-induced, RADS</td>
<td>Mineral dusts, coal</td>
</tr>
<tr>
<td>Byssinosis</td>
<td></td>
</tr>
<tr>
<td>Grain dust effects</td>
<td></td>
</tr>
<tr>
<td>Chronic bronchitis / COPD</td>
<td></td>
</tr>
<tr>
<td>Acute inhalation injury</td>
<td>Irritant gases, metals</td>
</tr>
<tr>
<td>Toxic pneumonitis</td>
<td>Metal oxides: zinc, copper</td>
</tr>
<tr>
<td>Metal fume fever</td>
<td>Plastics</td>
</tr>
<tr>
<td>Polymer fume fever</td>
<td>Combustion products</td>
</tr>
<tr>
<td>Smoke inhalation</td>
<td>Bacteria, fungi, animal proteins</td>
</tr>
<tr>
<td>Hypersensitivity pneumonitis</td>
<td>Tuberculosis, viruses, bacteria</td>
</tr>
<tr>
<td>Infectious disorders</td>
<td>Asbestos, silica, coal, beryllium, cobalt</td>
</tr>
<tr>
<td>Pneumoconioses</td>
<td></td>
</tr>
<tr>
<td>Malignancies</td>
<td>Wood dust</td>
</tr>
<tr>
<td>Sinonasal cancer</td>
<td>Asbestos, radon</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>Asbestos</td>
</tr>
<tr>
<td>Mesothelioma</td>
<td></td>
</tr>
</tbody>
</table>

Note: RADS = reactive airway dysfunction syndrome; COPD = chronic obstructive pulmonary disease.
The etiology of many lung diseases may be multifactorial and occupational factors may interact with other factors.

The dose of exposure is an important determinant of the proportion of people affected or the severity of disease.

Individual differences in susceptibility to exposures do exist.

The effects of a given occupational or environmental lung exposure occur after the exposure with a predictable latency interval.
Pathogenesis

The effects of an inhaled agent depend on many factors:

- its physical and chemical properties
- the susceptibility of the exposed person
- the site of deposition within the bronchial tree
ASBESTOS

HEAVY EXPOSURE TO ASBESTOS

MESOTHELIOMA DUE TO ASBESTOS EXPOSURE
Asbestos vs Silica
Physical properties

- physical state (solid particulates, mist, vapor and gases)
- solubility
- size, shape and density
- concentration
- penetrability
- radioactivity
- **Chemical properties**
  - alkalinity and acidity
  - fibrogenicity
  - antigenicity

- **Susceptibility of exposed person**
  - Integrity of local defense mechanisms
  - Immunological status (atopy, HLA type)
  - Airway geometry
Site of deposition

When airborne particles come in contact with the wall of the conducting airway or a respiratory unit they do not become airborne again.

Govern the lung response substantially

Mechanisms of dust deposition:

- Sedimentation
- Inertial impaction
- Diffusion
- Interception
- Electrostatic precipitation
<table>
<thead>
<tr>
<th>Size of particle</th>
<th>mechanism of deposition</th>
<th>site of deposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large particles (6 – 25 um)</td>
<td>Sedimentation and inertial impaction</td>
<td>Nose, trachea and conducting airways</td>
</tr>
<tr>
<td>Smaller particles (0.5 – 6um)</td>
<td>diffusion</td>
<td>gas exchanging portions of lungs</td>
</tr>
<tr>
<td>Particles of &lt; 1 um</td>
<td>diffusion</td>
<td>most of them exhaled out, &lt;10% of them deposited in alveoli</td>
</tr>
</tbody>
</table>
Diagnostic criteria

- The clinical presentation and workup are consistent with the diagnosis.

- A causal relationship between the exposure and the diagnosed condition has been previously established or strongly suggested in the medical, epidemiologic or toxicologic literature.

- There is sufficient exposure to cause the disease.
The details of the particular case, such as the temporal relationship between exposure and disease, are consistent with known information about the exposure-disease association.

There is no other, more likely diagnosis.
Determination of casual relationship

Three main types of information can be used to establish a casual relationship between an exposure and a respiratory condition:

- Case series or reports
- Epidemiologic studies
- Toxicologic studies
Impairment Assessment guidelines used for calculating pulmonary disability of affected workers.

<table>
<thead>
<tr>
<th>Class</th>
<th>Upto 25% Impairment</th>
<th>Class II 26% - 50%</th>
<th>Class III 51% - 75%</th>
<th>Class IV 76% - 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnoea</td>
<td>When it occurs, is consistent with the circumstances of activity</td>
<td>Does not occur at rest and seldom occurs during the performance of the usual activities of daily living. The patient can keep pace with persons of same age and body built on the level without breathlessness but not on hills or stairs</td>
<td>Does not occur at rest but does occur during the usual activities of daily living. However, the patient can walk a mile at his own pace without dyspnoea although he cannot keep pace on the level with others of the same age and body build</td>
<td>Occurs during such activities as climbing one flight of stairs or walking 100 yards on the level, on less exertion, or even at rest</td>
</tr>
<tr>
<td>FEV(_1)</td>
<td>&gt; 80% of predicted</td>
<td>60 - 79% of predicted</td>
<td>51 - 59% of predicted</td>
<td>&lt; 50% of predicted</td>
</tr>
<tr>
<td>(\text{AND} \quad \text{OR})</td>
<td>(\text{AND} \quad \text{OR})</td>
<td>(\text{AND} \quad \text{OR})</td>
<td>(\text{AND} \quad \text{OR})</td>
<td></td>
</tr>
<tr>
<td>FVC</td>
<td>&gt; 80% of predicted</td>
<td>60 - 79% of predicted</td>
<td>51 - 59% of predicted</td>
<td>&lt; 50% of predicted</td>
</tr>
<tr>
<td>(\text{AND} \quad \text{OR})</td>
<td>(\text{AND} \quad \text{OR})</td>
<td>(\text{AND} \quad \text{OR})</td>
<td>(\text{AND} \quad \text{OR})</td>
<td></td>
</tr>
<tr>
<td>((\text{FEV}_1/\text{FVC}) \times 100)</td>
<td>&gt; 75% of predicted</td>
<td>60 - 74% of predicted</td>
<td>41 - 59% of predicted</td>
<td>&lt; 40% of predicted</td>
</tr>
</tbody>
</table>

Recommended by OHSC, Mumbai.
Notifiable diseases


Silicosis
Asbestosis
Coal miner’s pneumoconiosis
Byssinosis
Berylliosis
Various radiation induced diseases
Occupational cancers
Chrome ulcerations and sequelae
Carbon monoxide poisoning
Isocyanates poisoning
The Factories Act, 1948

- **The First Schedule** – List of industries involving hazardous processes

- **The Second Schedule** – Permissible levels of certain chemical substances in work environment

- **The third schedule** – List of notifiable diseases
Add years to life......
Life to years

- Prevention – central to the practice of occupational and environmental medicine.

- Two main strategies:
  Primary prevention – removal or modification of hazardous risk or exposure before disease has occurred.
  Secondary prevention – early detection and prompt treatment of adverse effects of the exposure.
PNEUMOCONIOSIS

PREVENTABLE?
Prevention is the key

Pre employment health check

Health education

Periodic health check

Ensuring use of protective gear

Early diagnosis & treatment
PROTECTIVE GEAR : FIT TEST
Educate to Ensure

CULTURAL

SOCIAL

ECONOMICAL