Feasibility of a screening program for lung cancer in 1119 former asbestos workers

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Early Lung Cancer Action Project
[Hensche 1999]

<table>
<thead>
<tr>
<th></th>
<th>Rx+</th>
<th>Rx -</th>
<th>Total</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT+</td>
<td>33</td>
<td>200</td>
<td>233</td>
<td>27</td>
</tr>
<tr>
<td>CT-</td>
<td>35</td>
<td>732</td>
<td>767</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
<td>932</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure A: Conventional CT scan
Figure B: Spiral CT scan
Factors that effect the level of airborne asbestos:

- the nature of the asbestos materials
- how the work is performed
- the availability of controls to limit exposure
Criterion for cohort selection

Workers at high risk of exposure to asbestos engaged in:
  - railway stock fabrication and repair
  - manufacture of cement/asbestos products
  - shipyards
  - insulators
Identification of cohorts

The relevant companies were identified through the application forms completed by their workers according to an Italian low (decree no. 257/92) providing benefits for workers formerly exposed to asbestos.
Subjects

- 5379 Initial number
  - 4367 Matched
    - 2000 Invited
      - 1165 Examined
        - 1119 Included in the analysis
      - 881 Not examined
    - 2367 Not invited
  - 1012 Not matched
- 2000 Invited
  - 1165 Examined
    - 1119 Included in the analysis
  - 881 Not examined
- 1012 Not matched
## Diagnostic workup of screen-detected NCN

<table>
<thead>
<tr>
<th>Characteristics of NCN (number &lt; 6)</th>
<th>CT follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Shape</td>
</tr>
<tr>
<td>&lt; 1 cm</td>
<td>Regular</td>
</tr>
<tr>
<td>&lt; 1 cm</td>
<td>Irregular</td>
</tr>
<tr>
<td>&gt; 1 cm</td>
<td>-</td>
</tr>
</tbody>
</table>
Cost analysis

The screening program was subdivided in 3 processes

- Study design
  - Training of Interviewers (fixed cost)

- Preparation of list
  - Development of software (fixed cost)

- Carrying out the screening (variable cost)
25 biopsies and 5 lung cancer cases

25 biopsies:
• 13 of lung
• 9 of pleura
• 3 of both

Out of 16 lung biopsies:
• 5 lung cancers (4 primary and 1 secondary)

1 additional lung cancer diagnosed by cytology
Screening outcomes

<table>
<thead>
<tr>
<th>Screening</th>
<th>Cases</th>
<th>Non cases</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>5</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>-</td>
<td>0</td>
<td>1103</td>
<td>1103</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>1114</td>
<td>1119</td>
</tr>
</tbody>
</table>

Sensitivity = \( \frac{5}{5} = 100\% \)
Specificity = \( \frac{1103}{1114} = 99\% \)
Positive predictive value = \( \frac{5}{16} = 31\% \)
Lung cancer incidence rates

<table>
<thead>
<tr>
<th>Rates $\times 10^5$</th>
<th>Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>149</td>
<td>1119 screened workers</td>
</tr>
<tr>
<td>154</td>
<td>4367 workers in the original cohort</td>
</tr>
<tr>
<td>149</td>
<td>Veneto, males, aged 55-59 years</td>
</tr>
</tbody>
</table>
## Characteristics of cases

<table>
<thead>
<tr>
<th>Cases</th>
<th>Age, Smoking</th>
<th>Cumulative asbestos exposure (f/ml×years)</th>
<th>TSFE, TSLE (years)</th>
<th>Asbestosis Pleural plaques</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>61, ExS</td>
<td>13.6</td>
<td>18, 15</td>
<td>A₀, P₀</td>
</tr>
<tr>
<td>2</td>
<td>65, ExS</td>
<td>182</td>
<td>50, 17</td>
<td>A₁, P₀</td>
</tr>
<tr>
<td>3</td>
<td>63, ExS</td>
<td>108</td>
<td>25, 11</td>
<td>A₁, P₀</td>
</tr>
<tr>
<td>4</td>
<td>56, CS</td>
<td>4.0</td>
<td>25, 13</td>
<td>A₀, P₀</td>
</tr>
<tr>
<td>5</td>
<td>52, CS</td>
<td>35.0</td>
<td>36, 17</td>
<td>A₀, P₁</td>
</tr>
</tbody>
</table>
## Characteristics of cases

<table>
<thead>
<tr>
<th>Cases</th>
<th>First CT: date and Ø of NCN</th>
<th>Last CT: date and Ø of NCN</th>
<th>Histology</th>
<th>TNM classification and Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>May 2002 Ø &lt; 1 cm</td>
<td>Feb 2005: Ø &gt; 1 cm</td>
<td>AC</td>
<td>T2/N1/M0 Stage IIB</td>
</tr>
<tr>
<td>2</td>
<td>Jun 2002 Ø &gt; 2 cm</td>
<td></td>
<td>NSCC</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sep 2002 Ø &lt; 1 cm</td>
<td>May 2003 Ø =1.5 cm</td>
<td>AC, SC</td>
<td>T1/N2/M0 Stage IIIA</td>
</tr>
<tr>
<td>4</td>
<td>Oct 2001 Ø = 1 cm</td>
<td>Apr 2002: Ø = 1 cm</td>
<td>AC</td>
<td>T1/N2/M0 Stage IIIA</td>
</tr>
<tr>
<td>5</td>
<td>Dec 2001 Ø &lt; 1 cm</td>
<td>Nov 2004: Ø &gt; 1 cm</td>
<td>SC</td>
<td>T1/N0/M0 Stage IA</td>
</tr>
</tbody>
</table>
Costs

Overall cost 1,224,811 euro

- Study design
  - Training of Interviewers (1,276 euro)
- Preparation of list
  - Development of software (42,225 euro)
- Carrying out the screening (1,181,310 euro)

Cost for screen-detected lung cancer case = 244,962 euro
Radiation dose

Overall radiation dose
\( \sim 1,100 \text{ mSv} \)

- \( 1119 \times (0.5 \text{ mSv}) \)
- \( 338 \times (0.5 \text{ mSv}) \)
- \( 40 \times (10 \text{ mSv}) \)

Radiation dose for screen-detected lung cancer case \( \sim 220 \text{ mSv} \)
Conclusions

Screening with low-dose CT for early diagnosis of lung cancer in former asbestos workers was unsatisfactory because of:

• low adherence
• low yield of cases detected
• high cost and radiation dose delivered to healthy subjects

As no advantage concerning prevention could be achieved in the target group, the screening program was discontinued

Our findings do not support testing for early lung cancer detection in asymptomatic individuals previously exposed to asbestos