Pneumoconiosis and Lung Cancer

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Introduction — Potential carcinogenicity of crystalline silica

The age-old controversy about the carcinogenicity of silica remains unresolved. In 1987, the International Agency for Research on Cancer (IARC) concluded that silica was a Group 2A carcinogen (probably carcinogenic to humans). It was then classified as an IARC Group 1 carcinogen (carcinogenic to humans) in 1998, and as a human carcinogen by the Japan Society for Occupational Health in 2002. The current classification is based on the following findings: 1) the risk of lung cancer is increased by 1.5 to 8 times among workers exposed to silica in some special occupations such as quarrying and firebrick manufacturing, 2) carcinogenicity cannot be excluded although bias owing to smoking cannot be completely removed, 3) the incidence of lung cancer is partly associated with the duration of exposure although the dose-response relation has not been fully verified, and 4) carcinogenicity has been demonstrated experimentally (although only in rats).

The Japanese Ministry of Health, Labour and Welfare has not recognized lung cancer as an occupational disease in workers exposed to workplace dust because of the lack of sufficient proof of carcinogenicity, as described above, and the low risk of lung cancer (only an increase of 1.2 to 1.5 times). The Ministry regards lung cancer as occupational in workers with Management Class 3 and 4 pneumoconiosis, which is mainly characterized by a Type 2 roentgenographic pattern, because such severe pneumoconiosis can interfere with the diagnosis and treatment of lung cancer.


The study group held meetings in 2001 and 2002, and reached the following conclusions. (1) A meta-analysis of the epidemiological studies conducted outside Japan showed that the risk of lung cancer was slightly increased among workers exposed to silica dust (Table 1). (2) Among exposed workers with no signs of pneumoconiosis, the risk of lung cancer is approximately the same as in the general population (Table 1 and Fig. 1). (3) Among workers exposed to silica dust who show and signs of pneumoconiosis, the risk of lung cancer is high. The risk is particu-
Table 1  Risk Assessment by Meta-analysis

<table>
<thead>
<tr>
<th>Epidemiological study included in the statistical analysis</th>
<th>Weighting by paper evaluation</th>
<th>Fixed effect model*</th>
<th>Random effect model**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation of exposure to silica and lung cancer</td>
<td>−</td>
<td>1.31 (1.24–1.38)</td>
<td>1.34 (1.22–1.47)</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>1.32 (1.24–1.39)</td>
<td>1.34 (1.22–1.47)</td>
</tr>
<tr>
<td>Investigation of lung cancer in workers with pneumoconiosis</td>
<td>−</td>
<td>3.52 (3.30–3.76)</td>
<td>2.89 (2.32–3.60)</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>3.71 (3.45–3.99)</td>
<td>3.14 (2.40–4.10)</td>
</tr>
<tr>
<td>Separate investigations in workers with or without pneumoconiosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With pneumoconiosis</td>
<td></td>
<td>2.13 (1.75–2.59)</td>
<td>2.13 (1.75–2.59)</td>
</tr>
<tr>
<td>Without pneumoconiosis†</td>
<td></td>
<td>0.97 (0.84–1.14)</td>
<td>0.96 (0.81–1.15)</td>
</tr>
<tr>
<td>Investigation in workers with pneumoconiosis by smoking status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-smokers</td>
<td></td>
<td>1.89 (1.37–2.61)</td>
<td>2.31 (1.68–3.19)</td>
</tr>
<tr>
<td>Smokers</td>
<td></td>
<td>4.93 (4.49–5.41)</td>
<td>4.73 (3.71–6.31)</td>
</tr>
</tbody>
</table>

† In groups other than that marked with a dagger (†), the risk was significantly increased.

Fig. 1  Meta-analysis of the studies on lung cancer risk in workers exposed to silica
larly high in the smoking subgroup, but it is also high for non-smokers.

4) The risk of lung cancer is not associated with the severity of pneumoconiosis. The risk for workers with Management Class 2 pneumoconiosis is as high as those with Management Class 3 or 4 disease.

5) In animal experiments, lung cancer developed only in rats, which have lungs that are vulnerable to fibrosis. In humans, the risk of lung cancer is also increased among patients with idiopathic pulmonary fibrosis.

6) Crystalline silica is not mutagenic.

Amendments to the relevant law are being prepared according to the following proposals based on the findings described above.

1) All patients with Management Class 2 and 3 pneumoconiosis should undergo spiral CT and sputum tests once a year.

2) Lung cancer is to be considered as one of the complications of pneumoconiosis, and hence is an occupational disease. Consequently, work-related disability compensation should be available for this condition.

3) Workers with pneumoconiosis of both Management Class 2 and Class 3 should be qualified to receive a Health Management Note, which should be issued when they quit their jobs.

4) The necessity of medical treatment should be stipulated for workers who have lung cancer complicating pneumoconiosis (Article 23 of the Pneumoconiosis Law).

5) Measures to prevent or control exposure to workplace dust should be fully implemented. In addition, the current permissible concentration limit for airborne dust that is specified in order to control exposure should be reduced.

6) All possible action to control tobacco smoking should be carried out.

2. Usefulness of spiral CT

According to an investigation conducted by Cornell University in the United States, spiral CT was superior to conventional radiographic examination for the detection of lung cancer and the detection rate with spiral CT was 4 times higher than with conventional methods. Tumors measuring of 20mm or less in size accounted for 85% and 57% of the lung cancers detected by spiral CT and conventional methods, respectively. The rate of detection of stage IA (or early) tumors by spiral CT and conventional methods was 81% and 57%, respectively.

The results of an investigation conducted in Japan were similar to the above findings obtained in the United States. In addition, spiral CT employs a low radiation dose and thus can reduce exposure to radiation.

It is important that lung cancer in workers with pneumoconiosis has now been officially recognized as an occupational disease, and that screening examinations and preventive measures for pneumoconiosis have been improved.

REFERENCES


2) IARC: Silica, some silicates, coal dust and para-amide fibrils. IARC Monographs 1997; 68: Lyon, France.