Pleural lesions in crocidolite workers from Western Australia

G Hillerdal, A W Musk

Exposure to asbestos can cause benign pleural lesions, the most common of which are parietal plaques. Diffuse fibrotic changes of the pleura can also occur.¹ The clinical significance of plaques is slight. Diffuse pleural thickening, on the other hand, can lead to a considerable decrease in lung function.¹⁻³ The International Labour Office (ILO) system for classification of pneumoconioses does not differentiate large pleural plaques from diffuse pleural thickening.⁴ In populations with a high risk of mesothelioma the occurrence of diffuse thickening relative to plaques is high whereas in populations with low risk of this tumour the opposite is true.^{5,6} It was decided to extend these studies further by investigating patients who had been occupationally exposed to crocidolite (blue asbestos) and had a known high risk of mesothelioma.⁷

Methods

Chest x ray films were reviewed from 174 former workers at the crocidolite mine and mill at Wittenoom, Western Australia who had applied for pneumoconiosis compensation and had been investigated at the Department of Respiratory Medicine, Sir Charles Gairdner Hospital. The films were classified by one of us (GH) according to the ILO system.⁴ Also, pleural changes were classified as either pleural plaques or diffuse thickening.

Pleural plaques were recorded when circumscribed calcified or non-calcified pleural thickening, sharply demarcated against the lung parenchyma, was seen. *Diffuse pleural thickening* was recorded when the thickening was more extensive and poorly demarcated from the lung parenchyma, and also when the costophrenic angle was blunted. Cases with more or less developed fibrous strands or "crow's feet" reaching into the lung parenchyma were seen as variants of diffuse thickening.¹ *Apical lesions* in the form of pleural thickening with or without shrinking of the upper lobe were also recorded.^{1,8}

Results

PLEURAL PLAQUES

Twenty three patients (13.1%) were found to have plaques, and these were calcified in 18 (10.3%).

DIFFUSE PLEURAL THICKENING

Twenty five (14%) of the patients had unilateral blunting of the costophrenic angle, and in 28 (16%) this finding was bilateral. Thus 53 patients (30%) had a blunted costophrenic angle on one or both sides. Of these, 18 patients (10.3%) showed unilateral diffuse pleural thickening and 16 (9.1%) showed bilateral thickening. Crow's feet were visible in 25 (14%) patients (see figure for data on occurrences of pleural plaques and pleural thickening from this study compared with data from Finland and Turkey).

Per cent of patients with pleural plaques, unilateral and bilateral blunted costophrenic angles, and bilateral blunted costophrenic angles in studies of patients from Turkey,⁵ Finland,⁶ and Australia (the present study).

APICAL PLEUROPARENCHYMAL LESIONS

These were seen in 14 patients (8%).

SMALL OPACITIES

Small irregular or rounded opacities ($\geq 1/0$ on the ILO scale) were seen in 92 patients (52.6%), the highest score being 2/2. Changes suggestive of silicosis (small rounded opacities predominantly in the upper lobes) were seen in 10 patients (5.7%).

Department of Lung Medicine, University Hospital, S-751 85 Uppsala, Sweden
G Hillerdal

Department of Respiratory Medicine, Sir Charles Gairdner Hospital, Nedlands, Western Australia
A W Musk

CORRELATIONS

No correlations were found between the occurrence of plaques and blunting of the costophrenic angle ($p = 0.32$), profusion of small opacities ($p = 0.91$), or occurrence of small rounded opacities ($p = 0.051$) or apical thickening ($p = 0.34$). A small correlation was found between plaques and crow's feet ($p = 0.01$). There were highly significant correlations between the occurrence of a blunted costophrenic angle and the presence of crow's feet ($p = 0.0001$), profusion of small opacities ($p = 0.0001$), and apical pleural thickening ($p = 0.0001$) but not with small rounded opacities ($p = 0.49$).

Discussion

Malignant mesothelioma is caused almost exclusively by asbestos (or, rarely, erionite) and can thus be considered as a "signal tumour" for exposure to this mineral. There is a large difference, however, in the mortality from mesothelioma in various asbestos exposed cohorts. This is not surprising since asbestos is a collective term for several different minerals with varying physical and chemical properties. The risk of mesothelioma is connected to length and diameter of the fibres,⁹ and crocidolite carries the highest risk among the asbestos minerals. Australian crocidolite, formerly mined at Wittenoom, is among the most potent of the crocidolite variants in causing a high incidence of mesothelioma.^{7 10 11}

Benign pleural changes are common in workers exposed to asbestos and much more common than mesothelioma. These lesions are of two types; changes restricted to the parietal pleura (typical pleural plaques) and lesions affecting the visceral as well as the parietal pleura (typically diffuse thickening of the pleura). The simplest of the visceral pleura lesions is blunting of the costodiaphragmatic angle. The ILO system is not useful for discrimination of these types of change; in fact, one of the examples given in the ILO standard collection set to illustrate pleural thickening is probably a pleural plaque.¹¹

This investigation shows that visceral pleural lesions are common among former crocidolite workers in Western Australia who have applied for pneumoconiosis compensation, although, because of the selection of films the study is not representative of the whole population. Benign asbestos pleural effusions in the Wittenoom population are not uncommon, however,¹⁰ and other studies have shown that the occurrence of visceral pleural lesions relative to simple plaques roughly parallels the incidence of malignant mesothelioma.^{5 6} The incidence of blunted angles is not increased in the endemic plaque area

in Finland, where no mesotheliomas have been described so far. On the other hand, the areas with endemic plaques in Turkey have an increased level of the tumour and the Turkish erionite areas even more so.¹³ In both these populations the relative incidence of diffuse thickening affecting the visceral pleura and including the parenchyma is also high. Our preliminary study is consistent with this tendency.

The study also shows that apical lesions in the form of pleural thickening with or without shrinking of the upper lobe are correlated with diffuse pleural thickening and not with silicosis, giving further strength to the idea that this type of lesion is another variant of diffuse thickening of the pleura related to asbestos exposure.¹⁸

Our results are consistent with the suggestion that the occurrence of visceral pleural lesions in a population exposed to asbestos can give information on the relative frequency of malignant mesothelioma. The presence of pleural plaques, on the other hand, does not give information other than that there has been exposure to asbestos.

- 1 Hillerdal G. Asbestos-related pleural disease. *Seminars in Respiratory Medicine* 1987;9:65-74.
- 2 Britton MG. Asbestos pleural disease. *Br J Dis Chest* 1982;76:1-10.
- 3 Miller A, Tierstein AS, Selikoff IJ. Ventilatory failure due to asbestos pleurisy. *Am J Med* 1985;75:911-9.
- 4 International Labour Office. *Guidelines for the use of ILO international classification of radiographs for pneumoconioses*. Geneva: ILO Office, 1980. (Occupational safety and health series No 22.)
- 5 Hillerdal G, Baris YI. Radiological study of pleural changes in relation to mesothelioma in Turkey. *Thorax* 1983;38:443-8.
- 6 Hillerdal G, Zitting A, van Assendelft AHW, Kuusela T. Rarity of mineral fibre pleurisy among persons exposed to Finnish anthophyllite and with low risk of mesothelioma. *Thorax* 1984;39:608-11.
- 7 Armstrong BK, de Klerk NDH, Musk AW, Hobbs MST. Mortality in miners and millers of crocidolite in Western Australia. *Br J Ind Med* 1988;45:5-13.
- 8 Hillerdal G. Asbestos-related pleural fibrosis mainly affecting the upper lung lobes. In *Respiratory Medicine* (in press).
- 9 Stanton MF, Wrench C. Mechanisms of mesothelioma induction with asbestos and fibrous glass. *J Natl Cancer Inst* 1972;48:797-821.
- 10 Cookson WOCM, Glancy JJ, DeKlerk NH, Armstrong BK, Musk AW, Hobbs MST. Benign and malignant pleural effusions in former Wittenoom crocidolite millers and miners. *Aust NZ J Med* 1985;15:731-7.
- 11 Musk AW, Dolin PJ, Armstrong BK, Ford JM, DeKlerk NH, Hobbs MST. The incidence of malignant mesothelioma in Australia, 1947-80. *Med J Aust* 1989;150:242-6.
- 12 McLoud TC, Woods BO, Carrington CB, Epler GR, Gaensler EA. Diffuse pleural thickening in an asbestos-exposed population: prevalence and causes. *American Journal of Radiology* 1985;144:9-18.
- 13 Baris YI, Artvinli M, Sahin AA. Environmental mesothelioma in Turkey. *Ann NY Acad Sci* 1979;330:423-32.

Accepted 12 February 1990