Pleural Calcification in Coal Miners

Richard J. O'Brien, M.D.

Introduction

Pleural calcification may be found following hemorrhage into the pleural space and in association with inflammatory conditions that produce pleural effusion and empyema. When it is associated with the above conditions it is usually unilateral and involves the visceral pleura adjacent to the chest wall.[1] For some time it has been known that pleural calcification may also follow exposure to asbestos and to other silicate dusts such as talc and mica.[2] Pleural calcification in the absence of a history of trauma or infection has been thought to be diagnostic of exposure to asbestos.[2 3] Such calcification is often bilateral, involves the parietal pleura, and is found most commonly on the diaphragmatic and mediastinal surfaces.[4]

It has been stated that pleural calcification is rarely present in silicosis,[5] and the finding has never been reported in association with coal workers' pneumoconiosis (CWP). During an epidemiological investigation of CWP currently being conducted by the US Public Health Service, a number of chest films of working coal miners were noted to show the presence of pleural calcification. The following investigation was undertaken firstly, to determine how frequently pleural calcification is found in coal miners, and secondly, to determine if in those subjects with pleural calcification there was any obvious association or explanation.

Material and Methods

The US Public Health Service is currently involved in a long-term study of CWP. The main purposes of the study are: (1) to assess the present-day prevalence of the disease; (2) to ascertain by means of serial radiographs the progression of the disease over five-year periods; and (3) to relate the latter to the dust levels that have prevailed in the mines over the same period. Included in the study are approximately 10,000 miners at 31 mines in ten coal mining states. Postero-anterior and left lateral chest films, simple pulmonary function testing, and an occupational and respiratory questionnaire are taken on each participant. The questionnaire included, in addition to a detailed mining work history, questions about respiratory symptoms, a history of past respiratory disease, and a history of exposure to substances known to produce pulmonary disease.

This report is concerned with the prevalence of pleural calcification in a group of 5,282 miners; 523 of these were anthracite miners, and the remainder were bituminous miners.

Each chest film was interpreted independently by three readers utilizing the UICC/Cincinnati Classification System[6] in which pleural calcification is recorded as to location and extent. The cases of pleural calcification were grouped into definite and suspect. A case was categorized as definite when two readers agreed on the presence of pleural calcification and as suspect when so categorized by at least two readers.

The records of these cases were then analyzed to determine what factors, if any, may have contributed to the pleural calcification.

Results

Twelve cases of pleural calcification were identified, eight categorized as definite and four as suspect.

Two subjects whose history indicated previous chest trauma, gunshot and shrapnel wounds respectively, were eliminated because of the likelihood that these injuries were responsible for the pleural calcification. Both subjects came from the group showing definite calcification.

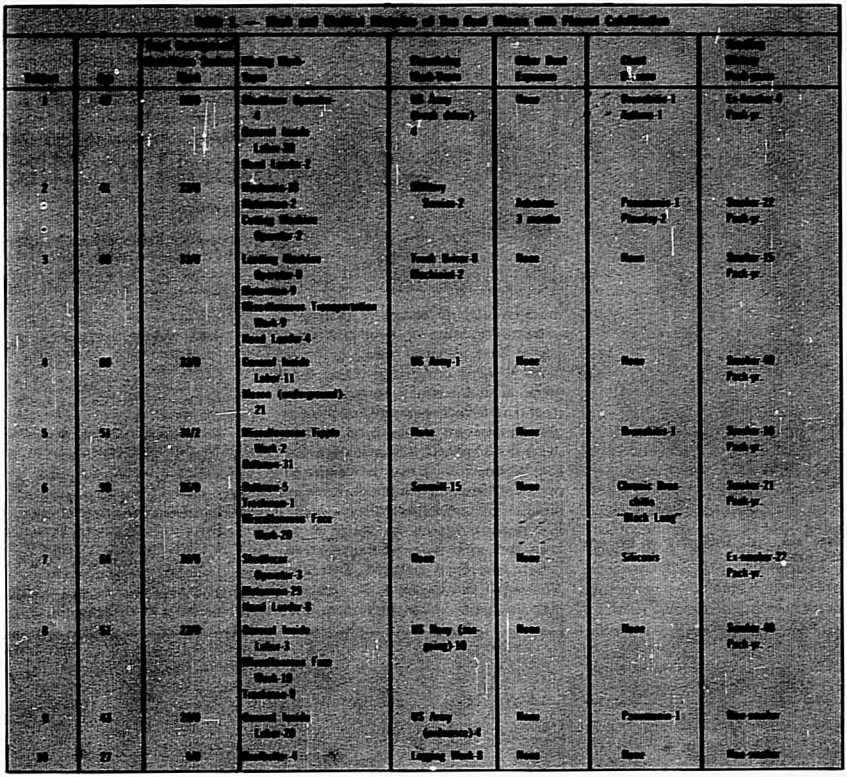
The remaining ten subjects came from nine different mines (Table 1). They were, in general, older (mean age 50.7 years) than the average subject included in the epidemiological survey (mean age 45.7 years). Likewise, they had spent a greater number of years working underground (24.9 years as compared to 19.4 years). The mining jobs of the group with pleural calcification varied widely. Nearly all spent some time at face activities where dust exposure is likely to be highest. No one job was associated with pleural calcification, with the possible exception of general inside labor. However, in this job which involves different types of work in all parts of the mine, it is difficult to trace a definite exposure pattern.

Most subjects spent some time in non-mining occupations, the most common being duty in the US Armed Services. None had worked in a job known to be associated with occupational respiratory disease. With one exception (Table 1, Subject 2), there was no recorded exposure to specific occupational inhalants. This miner did give a history of exposure to asbestos, but only for a three-month period. While there is a known association between asbestos and pleural calcification, it is unlikely that such a short duration of exposure would have produced the pleural calcification in this case.[2]

There was variable response to questions designed to elicit information about other respiratory illnesses. Subject 2 gave a history of chest illness which may have been responsible for the pleural calcification, viz, two episodes of pleurisy. Other diseases recorded were bronchitis (three subjects), pneumonia (two subjects), asthma (one subject), "black lung" (one subject), and silicosis (one subject). When smoking histories were compared there was no significant difference between the group with x-ray evidence of pleural calcification and the entire study group (means of 18.0 and 17.7 pack-years respectively). Radiographic evidence of CWP (Table 2) was present in all but two subjects (6 and 8), a not-too-surprising finding in view of the fact that most of the men had spent a significant part of their work-

From Appalachian Laboratory for Occupational Respiratory Diseases, National Institute for Occupational Safety and Health, Morgantown, WVa.

Reprint requests to Appalachian Laboratory for Occupational Respiratory Diseases, P.O. Box 4292, Morgantown, W.Va 26505.



ing lives underground exposed to coal dust.

The distribution of calcification followed no definite pattern (Table 2). There was unilateral chest wall calcification in one case (Subject 1), bilateral chest wall calcification in one case (Subject 4), and unilateral diaphragmatic calcification in two cases (Subjects 3 and 6). The figures show the calcification of the right diaphragmatic pleura in Subject 6. The diaphragm and pericardium were involved in two cases (Subjects 5 and 10), the chest wall and pericardium in one (Subject 2), and the chest wall and diaphragm in another (Subject 7). Two subjects (8 and 9) had more extensive involvement.

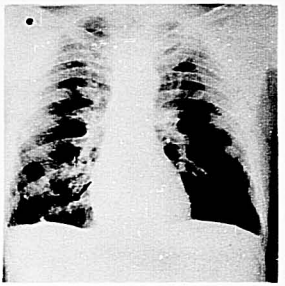
Discussion

It is concluded that pleural calcification may be found in association with CWP, although somewhat infrequently (approximately one case in every 500 working miners). This study has elicited no factors perculiar to the development of pleural calcification other than those known to be associated with CWP, ie, amount and duration of exposure to coal dust. Since the subjects were from nine different mines, an etiologic factor peculiar to only a few mines cannot be implicated. An additional factor in the development of calcification may be the length of time after exposure (ie, a latent period), such as is known to occur with pleural calcification following asbestos exposure.[2] One then might expect to find a greater prevalence of pleural calcification in a group of retired miners with CWP.

Although unlikely, it is possible that despite the lack of a definite history, either chest infection or asbestos exposure would account for some of the cases included in this report. There have been several reports of "endemic" or "non-occupational" asbestosis with pleural calcification occurring in populations living in proximity to an asbestos factory[3] and living near asbestos mines[7] and in agricultural workers where the exposure was presumably from asbestos in the soil.[4] Recent investigators studying the occurrence of pleural calcification in a large rural population concluded that asbestos could not be implicated and that a tuberculous etiology was a likely explanation for the finding.[8]

Summary

Ten subjects with pleural calcification



Above and right. Calcification of the right diaphragmatic pleura.

by x-ray and no history of prolonged asbestos exposure or significant chest illness were identified from a group of 5,282 working coal miners. Other than duration and intensity of exposure to coal dust, factors seemingly important in the development of pleural calcification were not identified. It is concluded that pleural calcification may be associated with CWP in rare cases but the cause of this calcification is uncertain.

The author wishes to thank those physicians who reviewed the x-rays on which this report is based. They are: Wm. Keith C. Morgan, M.D., Director, Appalachian Laboratory for Occupational Respiratory Diseases; George Jacobson, M.D., Professor and Chairman, Department of Radiology, Los Angeles County—University of Southern California Medical Center; and Eugene Pendergrass, Emeritus Professor of Radiology, University of Pennsylvania.

References

1. Kendall B, Caplin M: Pleural calcification. *Brit J Dis Chest* **61**:126-130, 1967.

2. Selikoff IJ: The occurence of pleural calcification among asbestos insulation workers. *Ann NY Acad Sci* **132**:351-367, 1965.

3. Hourihane D O'B, Lessof L, Richardson CP: Hyaline and calcified pleural plaques as an index of exposure to asbestos. *Brit Med J* **1**:1069-1074, 1966.

4. Zolov C, Bourilkov T, Babadjov L: Pleural asbestosis in agricultural workers. *Environ Res* **1**:287-292, 1967.

5. Stephanopaulos C: Pleural calcification following dust exposure. *Acta Tuberc Scand* **42**:228-232, 1962.

6. Bohlig H, et al: UICC/Cincinnati classification of radiographic appearances of pneumoconiosis. *Chest* **58**:57-67, 1970.

7. Kivilnoto R: Pleural calcification as a roentgenologic sign of non-occupational endemic anthophyllite-asbestosis. *Acta Radiol (Stockholm) Suppl* 194, 1960.

8. Rous V, Studeny J: Aetology of pleural plaques. *Thorax* **25**:270-284, 1970.

Table 2. — Roentgenographic Findings in Ten Coal Miners with Pleural Calcification

Subject	Coal Workers' Pneumoconiosis (UICC Classification)*	Pleural Calcification	
1	Category 1 simple pneumoconiosis	Definite	Right wall
2	Category 1 simple pneumoconiosis	Suspect	Left wall and pericardium
3	Category 1 simple pneumoconiosis	Suspect	Left diaphragm
4	Stage A complicated pneumoconiosis on a background of category 2 simple pneumoconiosis	Definite	Right and left walls
5	Category 1 simple pneumoconiosis	Definite	Left diaphragm and pericardium
6	Category 0—no definite evidence of pneumoconiosis	Definite	Right diaphragm
7	Stage A complicated pneumoconiosis on a background of category 1 simple pneumoconiosis	Suspect	Left wall and diaphragm
8	Category 0—no definite evidence of pneumoconiosis	Definite	Right and left walls and left diaphragm
9	NA*	Definite	Right and left walls, pericardium and diaphragm
10	NA*	Suspect	Left diaphragm and pericardium

* Consensus reading not available.