

Prevalence of Pulmonary Tuberculosis in Graphite Miners

by

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SUMMARY A total of 403 workers at a graphite mine was radiologically examined. There was evidence that 10 of them developed pulmonary tuberculosis while working in the mine. The prevalence of sputum positive tuberculosis in graphite miners was found to be higher than in the general population. The probable reasons for this are discussed.

INTRODUCTION

Pulmonary tuberculosis is relatively frequent in workers exposed to silica or a mixed dust containing silica (Marchand, 1972). This increased susceptibility has been shown in relation to silica itself (Hunter, 1962), coal (Rivers, James, Davies & Thompson, 1957) and talc (Siegal, Smith & Greenburg, 1943). Since graphite too contains a proportion of silica which is about 2% in the purest commercial product, one may expect to find an increased frequency of tuberculosis among graphite miners. There are few references in the literature on the association of tuberculosis and exposure to graphite dust. Hirsch, Kaas, Schaefer & Denst (1959) described a case of graphite pneumoconiosis where Battey type of non-tuberculous mycobacteria was isolated. Uragoda (1972a) described 3 cases of pulmonary tuberculosis in graphite miners. Uragoda (1972b) also reported a case of graphite pneumoconiosis which was subsequently complicated by tuberculosis. However, there has been no report on the incidence or prevalence of tuberculosis in graphite miners.

Graphite has been mined in Sri Lanka for decades, some of the largest mines being found here. The total labour force employed in this industry in Sri Lanka in 1969 was 1,391. It would appear that the graphite industry in Sri Lanka is well suited for the study of the effects of graphite dust on the health of the workers.

MATERIALS AND METHODS

A total of 403 workers in the Kolongaha graphite mine (adjacent to the mine previously studied by Ranasinha & Uragoda, 1972) in Dodangaslanda in the North Western Province was examined radiologically on 70 mm film at the Chest Clinic, Kandy. An occupational history was taken at the time. Workers whose chest radiographs showed abnormalities were radiographed again on standard film, and their sputum examined for acid-fast bacilli by direct smear and culture. Workers with a clinical picture suggestive of pulmonary tuberculosis were closely questioned as to any history of previous treatment for tuberculosis.

In patients giving such a history, the previous record was obtained from the chest clinic where the patient had taken treatment. One worker who at the time of the survey was hospitalised for pulmonary tuberculosis was also included in the results.

The survey was carried out in August 1972, but 7 workers who failed to report at the time were subsequently examined in November 1972.

RESULTS

The workers examined consisted of 358 males and 45 females. The latter were all surface workers who were engaged in "curing" or cleaning the mined graphite of granitic impurities. During "curing" lumps of crude graphite are held in the hand and lightly tapped with an iron implement; granite when present gives a metallic sound in contrast to the dull thud heard when the implement hits graphite. This process exposed the workers to graphite dust, but they worked in open, well ventilated sheds. In addition to the females there were 26 male surface workers. The total number of underground miners examined was 332.

17 workers had radiological lesions suggestive of tuberculosis, but in view of the similarity of these lesions to those of graphite pneumoconiosis other evidence in favour of a tuberculous etiology was sought. In 10 (58.8%) of them such evidence of past or present tuberculosis was forthcoming. They comprised 5 cases with active tuberculosis and 5 with inactive lesions. In all of them the condition had developed while working in the mine. In 4 out of the 5 with active disease, the sputum was positive for acid-fast bacilli by either direct smear (3 cases) or culture (1 case) at the time of the present survey. The remaining case had a cavity which underwent reduction in size with anti-tuberculous chemotherapy, thus suggesting the active nature of the lesion. One of the 4 sputum positive cases turned out to be a relapse of tuberculosis which was first treated 5 years earlier. The 5 inactive cases had all taken treatment for tuberculosis prior to this survey. Though, according to the past records, their sputum was never found to be positive throughout their illness, there was hardly any doubt about the diagnosis in view of the considerable improvement seen on serial radiographs while on treatment. Calcification was seen in 4 cases all of whom had received previous treatment for pulmonary tuberculosis.

Salient features in the case records of 10 graphite workers with tuberculosis

Case	Year of diagnosis of tuberculosis	Acid-fast bacilli in sputum	No. of years of service as a graphite miner at the time of diagnosis of tuberculosis
1	1972	+	8
2	1972	+	22
3	1967	+	13
4	1972	+	20
5	1972	—	18
6	1963	—	16
7	1970	—	26
8	1956	—	4
9	1960	—	8
10	1956	—	4

The table summarises the salient points regarding the 10 cases of tuberculosis. Their average period of service as graphite miners when tuberculosis was first diagnosed was 13.9 years.

DISCUSSION

Tuberculosis is a common disease in many countries specially in the tropics. Prevalence of tuberculosis in Sri Lanka in 1970/71 was assessed by a very comprehensive baseline survey carried out throughout the country. 27,500 persons randomly selected by a process of stratified sampling were examined, and 64 cases of pulmonary tuberculosis, bacteriologically positive by direct smear or culture, were detected (National Tuberculosis Survey Team and W.H.O. Regional Tuberculosis Training and Evaluation Team, 1970/71). This gives a prevalence rate of 2.3 sputum positive cases per 1,000 of the general population. On the other hand there were 4 sputum positive cases among the 332 underground miners, giving a rate of 12.0 cases per 1,000, suggesting that the prevalence rate of sputum positive cases of tuberculosis is higher among graphite miners than in the general population in Sri Lanka.

In order to assess the role of silica in the development of tuberculosis a comparison was made of the prevalence of tuberculosis among graphite miners with that of a group of workers who were exposed to a dust that did not contain silica. For this purpose a control group of coir workers who were exposed to the dust of pith of the coconut husk was selected. 779 coir workers were examined radiologically and among them there were 9 cases with evidence of active or inactive tuberculosis, while there were 10 such cases among the 332 graphite miners (Uragoda, in press) This difference was statistically significant ($X^2 = 4.58$, $n = 1$, $P = 0.05$).

All cases of tuberculosis occurred in workers who, at one time or other, had been underground miners. Further, the other cases of pulmonary tuberculosis in graphite workers previously described from Sri Lanka (Uragoda, 1972a, 1972b) were also in underground workers. It is possible that poor ventilation within the mine may have contributed to the spread of infection once introduced by a worker suffering from the disease. Another factor that has to be considered is the relative amount of silica to which the underground and surface workers are exposed. The surface worker is exposed to only the small proportion of silica that is inherently present as an impurity in the graphite. On the other hand the underground miner is exposed in addition to the granite dust that is generated by blasting and breaking of underground rocks that is necessary before the veins of graphite could be reached. Dust suppression methods were not practised at the mine.

Tuberculous infection has been generally incriminated in the pathogenesis of massive fibrosis of coal miners. Since coal and graphite are basically carbon, the possibility of tuberculosis being associated with massive fibrosis in graphite pneumoconiosis deserves

consideration. Gaensler, Cadigan, Sasahara, Fox & MacMahon (1966) ruled out the possibility of such an association in 4 cases of graphite pneumoconiosis they reported. In the present series there were 4 cases where tuberculosis was diagnosed at least 10 years previously. At the time of diagnosis they had worked for varying periods as graphite miners (Table). They did not show any evidence of progressive massive fibrosis in spite of the long history of tuberculous infection and continued exposure to graphite dust. They were treated with anti-tuberculous drugs on diagnosis and the radiological shadows progressively regressed. It would appear from these 4 cases that a treated tuberculous infection in graphite miners is unlikely to lead to massive fibrosis even after many years of subsequent exposure to graphite dust.

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