Silicosis of the Lung in Saudi Arabia — Role of Traditional Occupations and Environmental Factors

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As pneumoconiosis is usually linked with industrialized societies, we undertook a search for pneumoconiosis in Saudis engaged in traditional occupations. Three cases of advanced silicosis of the lung with progressive massive fibrosis were detected. In two cases, two patients were life-long diggers of wells, and one a grave-digger. The search also detected 13 cases of desert lung (simple silicous pneumoconiosis); 11 of the patients were females engaged in traditional women’s chores like dusting tents. However, two patients were men with no such history, which supports the view that desert lung could be an environmental lung disease; the suspended dust in the periphery of the City of Riyadh, Saudi Arabia averaged 3810 µg/m³. Although desert lung was thought to be free of significant fibrinogenetic activity, we document progressive massive fibrosis in desert lung by CT scanning. Finally, 10 of the 11 women with desert lung had cataract of the eye which lends support to the previously described association between the two conditions. The basis for such an association is discussed.

Occupational silicosis of the lung occurs in three distinct forms. The commonest is chronic silicosis,

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exemplified by miners’ pneumoconiosis, with nodular shadowing on the chest X-ray which progresses to conglomerations of massive fibrosis over many years. Acute silicosis, on the other hand, gives rise to a diffuse ground-glass appearance similar to pulmonary oedema. It occurs in subjects exposed to very high concentration of silica over few weeks to few months and results in rapid death. The third form, termed ‘desert lung’, or simple silicous pneumoconiosis is specific to arid regions where inhalation of sand results in micronodular densities on the chest X-ray in the absence of chest symptoms or progression to fibrosis. To our knowledge, desert lung is the only form of silicosis previously described in Saudis, and its higher prevalence in females was attributed to being
occupied in traditional women’s chores like dusting and herding. A previous report found an association between desert lung and cataract in Saudi females not seen in males. The association was attributed to the use of the ‘tanoor’, a traditional wood-burning oven with an open top. The women who have to lean over the tanoor were thought to be at risk of developing cataract as a result of heat injury to the eye lenses and desert lung resulting from smoke-induced chronic lung disease and diminished ciliary activity.

We undertook this study in order to explore the possibility that other forms of silicosis occur in traditional Saudi occupations, and to find whether we could confirm the presence of an association between desert lung and cataract.

Methods
A retrospective computerized search of discharge data was made at King Khalid University Hospital, Riyadh in order to obtain the files of patients with various forms of silicosis of the lung. The use of computerized hospital discharge data was found by other workers to be useful for occupational disease surveillance. Chronic silicosis was diagnosed if the patient fulfilled four criteria: (1) history of occupational exposure; (2) chest X-ray showing bilateral symmetrical interstitial or nodular infiltrate with or without fibrosis; (3) negative culture of sputum and bronchoalveolar lavage for mycobacteria and fungi; and (4) transbronchial lung biopsy compatible with silicosis (carbon particles surrounded by a cellular infiltrate made of mononuclear cells and macrophages in addition to birefringent particles of silica seen with polarized light).

Desert lung was diagnosed in patients who had bilateral symmetrical micronodular or reticulonodular deposits seen on chest X-ray in the absence of chest symptoms or radiological progression on follow-up. The patients must have lived in the desert for decades but had no occupational exposure to silica, like earth digging or stone cutting.

Results
The computer search detected three cases of chronic silicosis and 13 cases of desert lung. All the patients were Saudis who had never resided abroad.

Chronic silicosis
The first case involved a man of 62 years with bilateral hilar lymphadenopathy and bilateral interstitial infiltrate. He had worked for most of his life as a well-digger. General examination was normal except for two areas of skin hypopigmentation of longitudinal shape (‘coup de sabre’) on the back, proved on histopathology to be morphea (localized scleroderma). Transbronchial biopsy was compatible with silicosis. The second case involved a man of 72 years who had egg-shell calcification of hilar lymph nodes with nodular shadowing of lungs and massive pulmonary fibrosis (Fig. 1). He had worked as a grave-digger for over 30 years. The third case involved a man of 70 years with bilateral nodular infiltrate and massive pulmonary fibrosis most marked in the upper
zones. He worked as a well-digger. He was treated in another hospital for suspected tuberculosis with no improvement of his radiological abnormalities. Transbronchial biopsy was diagnostic of silicosis and cultures were negative for mycobacteria and fungi.

Desert lung
There were 13 patients with desert lung; 11 females and two males. Their ages varied from 45 to 70 years with a mean of 58.7 years. They all had spent most of their life in tents or unpaved mud houses, residing in nomadic aggregates or small desert villages. None were engaged in any earth-digging or stone-cutting. However, all the women were regularly doing household chores like sweeping the floor. Ten of the 11 females had bilateral cataract. All the women with cataract had used the tanour oven regularly for cooking.

Using the ILO International Classification of Radiographs of Pneumoconiosis, the plain X-ray of desert lung cases showed p/p, 2/2 shadows (rounded opacities up to about 1.5 mm in diameter profuse enough partly to obscure the lung markings) in 10 cases and p/s, 2/2 shadows (irregular opacities up to about 1.5 mm in diameter profuse enough partly to obscure the lung markings) in another three cases with predilection for the lower and middle zones in all (Fig. 2). The corresponding CT scan (Fig. 3) showed diffuse interstitial nodules and an area of progressive massive fibrosis (PMF) not seen on plain X-ray.

Discussion

Chronic silicosis
Silicosis is the name given to the fibrotic disease of the lung caused by inhalation of dust containing crystalline silicon dioxide (silica). Silica is the most abundant mineral in the earth's crust which accounts for the wide prevalence of silicosis. The principal occupational sources are: mining, quarrying, tunnelling, stone-cutting or polishing, abrasive blasting, foundry work and glass and pottery manufacturing. As large scale industrialization started less than two decades ago in Saudi Arabia and the workers employed are nearly totally expatriates, one must be tempted to believe that heavy fibrosis resulting from silicosis would not exist in elderly Saudis previously engaged in traditional occupations. Digging wells in the central area of Saudi Arabia was performed by specialized workers called locally 'heem' beaters who used a dry technique without the aid of mechanical air ventilation. The heem is an iron bar with a sharp edge used for digging earth and which is so heavy that it needs up to four workers to operate. The local saying 'died of beating the heem' refers to the widespread knowledge that earth-digging was linked to premature death. The occupation was also locally linked with severe dyspnoea, cyanosis and haemoptysis. The latter symptom possibly reflects the increased incidence of tuberculosis in silicosis of the lung. The clinical and radiological features displayed by our three patients with occupational silicosis are not different from those described in Western literature, namely upper lobe predilection, bilateral hilar lymphadenopathy, slow but relentless progression of the symptoms even after cessation of exposure to dust, and increased incidence of localized scleroderma of the skin (morphoea).

Patient 3 who had fibrotic changes in the upper lobes was started empirically, in another hospital, on a three-drug prolonged antituberculous chemotherapy regimen with no response. The case highlights the importance of considering alternative diagnosis to tuberculosis in cases with upper lobe fibrosis, even in a community like Saudi Arabia where tuberculosis is common. The occupational history, symmetrical nature of upper lobe fibrosis and the presence of generalized nodular lesions in four lobes should be useful clues to diagnosing silicosis. The other pitfall, once silicosis has been diagnosed, is to overlook the fact that the incidence of active tuberculosis (caused by M. tuberculosis or atypical mycobacterial) is greatly increased in silicotic lung. Although bronchoscopic transbronchial biopsy carries an increased risk of pneumothorax in silicosis, in view of the presence of emphysema and a lung biopsy is not routinely indicated for the diagnosis of silicosis; transbronchial biopsy is nevertheless useful in Mantoux-positive cases to search for mycobacteria. If repeated cultures for mycobacteria are negative, and the chest X-ray remains stable, then chemoprophylaxis with isoniazid for 1 year should be given to all Mantoux-positive cases.

Desert lung
Desert lung (simple siliceous pneumoconiosis) has already been documented in Saudi Arabia where lung biopsy demonstrated silica granules by
polarized light. The first report was made by Policard & Collect in 1952 from the African Sahara desert, followed by similar cases described from the Lybian Desert and Negev Desert. The high predilection for females seen in our cases was a feature in previous studies and attributed to the occupational risk of traditional women's chores like dusting and preparation of sheep wool for weaving, particularly as they are performed in the confined space of tents and in a squatting position. The fact that all the women in our series were engaged in these activities in poorly ventilated or unpaved houses or tents, supports that occupational aetiology of desert lung. However, two of our cases were males who had no such occupational exposure, which suggests that at least in some regions with high dust fall, desert lung could also result from environmental exposure to sand.

The yearly average of suspended dust (respirable fraction) was found in 1982 to be 3810 μg/m³ in the periphery of the City of Riyadh, 1180 in residential areas, and 667 in a tree-lined park. These figures are over 10 times higher than those recorded in European cities (personal communication with Dr N. Al-Odat, formerly Professor of Environmental Studies, College of Science, King Saud University). This supports the presence of an environmental role and could explain why males, with no occupational exposure, develop desert lung.

The radiological features in our series are similar to previous studies in showing predilection for lower and middle zones of the chest X-ray, and the predominance of micronodular over reticulonodular pattern. However, we could not detect any Kerley B lines as previously reported. The CT scan in one of our cases showed additional information not detected by plain X-ray. First, it located the nodules of fibrous thickening predominantly in the interlobular septa which explains the predominance of micronodular and reticulonodular patterns seen on plain X-ray. Second, it showed early conglomerates of progressive massive fibrosis (PMF) that are not seen on plain films even retrospectively. This, to our knowledge, is the first documentation of PMF in desert lung which was thought to be free of fibrogenic activity although one patient in Hawass's series had a 'diffuse opacity reminiscent of progressive massive fibrosis' on plain X-ray. The fact that PMF was not documented in studies done in other desert regions might reflect the fact that CT scanning was not used in those studies or that higher rates of dust fall in Saudi Arabia resulted in higher propensity for fibrosis. The finding confirms the superior sensitivity of CT scan over plain radiology in detecting conglomerates of massive fibrosis in silicotic lungs.

The strong association between cataract and desert lung in women supports a similar report in 1987 by Hawass based on a survey at another hospital in Riyadh, Saudi Arabia. The nature of the association is hard to ascertain but Hawass attributed it to the use of the tanoor, a traditional oven for baking bread. The tanoor has an opening at the top and women have to lean over to look inside during baking. This subjects them to both infrared injury to the eye lenses as well as smoke resulting in chronic lung disease and diminished ciliary clearance of dust particles which renders them more susceptible to develop desert lung. The presence of cataract in 10 of 11 (90%) of the women with desert lung in our series lends support to the association. However, large epidemiological studies are needed before the association can be statistically confirmed.

In conclusion, we document the presence of chronic silicosis in non-industrialized communities in Saudi Arabia. We also document by CT scanning, for the first time, the presence of progressive massive fibrosis in desert lung. Finally, our findings lend support to the presence of an association between desert lung and cataract.

References


