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Epidemiology of mesothelioma—a South African perspective

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1. History

During the 1950s, a medical practitioner responsible for the tuberculosis service in the district around the city of Kimberley in the Northern Cape Province of South Africa, noted that there was a group of patients with pleural effusions that were non-responsive to the new anti-tuberculosis drugs becoming available. He further noted that all of these patients came from the west, where the Asbestos Mountains contained many bodies of workable crocidolite ore and that many of his patients, but not all, had worked in such mines. This practitioner, Dr. C.A. Sleggs linked up with a thoracic surgeon and a pathologist who assisted him in establishing that this growing series of cases was due to the usually rare pleural tumor, mesothelioma. These physicians were able to assemble a series of 33 cases of this hitherto rare tumor in only 4 years. Following publication of their 1960 paper [1] it was recognised that mesothelioma was caused by asbestos exposure. Mesotheliomas, previously termed endothelioma, had been recognized as a rare disease, probably occurring with an annual incidence of 1–2 per million population since the late 19th century. There has been a prodigious increase in mesothelioma in the latter half of the twentieth century.

There was a deliberate attempt by asbestos companies to obfuscate the relationship between mesothelioma and exposure to asbestos, both in the workplace and in the general environment close to where asbestos was processed. Castleman has investigated and documented the history of asbestos company research from the 1930s concerning adverse health effects of asbestos. There are a number of clear instances of suppression of important findings and deliberate fraud [2]. There were a number of instances of reputable scientists' findings being questioned, their opinion on asbestos being portrayed as personal aberrations or deliberately ignored [3].

2. Asbestos

Asbestos is a heterogeneous group of minerals belonging to the group termed fibrous silicates. They fall into two main groups, the serpentine group, principally chrysotile (white asbestos) and

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the amphibole group, to which crocodilite (blue asbestos) and amosite (brown asbestos) belong. Asbestiform minerals have different chemical and physical properties. Serpentine asbestos fibers are longer, more flexible and often curly. These properties suit this fiber to textile applications. Serpentine asbestos is more soluble and clears faster from the lung than amphibole asbestos. Amphibole fibers are shorter, stiff and straight, making them better suited to asbestos cement and fire resistant applications. Only 9% of the crocodilite lung burden is cleared every year, with a half-life of about 7 years [4].

South Africa and Australia are the only countries that have commercially mined amphibole asbestos. South Africa was the major world exporter of these minerals when the global market in these minerals started to collapse in the mid 1980s.

3. Etiology

3.1. Asbestos and mesothelioma

The three major commercial asbestos fibers vary in their power to induce this cancer. Crocodilite is approximately ten times worse than amosite, which in turn is 10 times worse than chrysotile [5].

Exposure–response relationships for asbestos and mesothelioma have been well investigated. Following asbestos exposure the incidence of mesothelioma increases with time, to the third or fourth power. Incidence is related to intensity of exposure and the mesotheliomagenic property of the asbestos involved [6]. The lower end of this exposure response relationship is hardest to document and study. From case histories, it is clear that apparently very low dose crocodilite exposure or high dose exposure of short duration can cause mesothelioma [7].

4. Exposures to asbestos

4.1. Occupational exposures

The majority of cases of mesothelioma arise in people who have been directly exposed to asbestos as a part of their job. This may occur from mining or in secondary industry where it has been widely used as it is an insulator for heat and sound and for its good tensile strength. Examples of the latter include those in the shipping, locomotive and construction industries [8].

Casual use of asbestos as well as, transporting raw asbestos fiber in unlined hesian or jute bags, rather than impermeable material, led to many bystander or casual occupational exposures to asbestos around the world. These included mainly transport workers, in railways and shipping.

Finally, it is not just the workers who may be exposed to asbestos fiber, but also their family members. Among the unsafe practices that contributed to this was allowing workers to take their work clothes home for laundering. This exposed wives and other family members to sufficient asbestos fiber to cause mesothelioma.

4.2. Environmental exposures

Cases of mesothelioma occurring among people resident but not employed in the asbestos mines and mills in the area were part of the original 1960 report [1] of the first wave of the mesothelioma epidemic in South Africa. Since that time it has been repeatedly documented that people resident close to mines, mills or factories processing asbestos have an increased risk of this cancer. Such occurrences have been described in relation to the large asbestos cement factory at Casale Monferrato in North West Italy and in relation to dwelling in the vicinity of an anthophyllite mine in Finland [9,10].

5. Incidence of mesothelioma

Worldwide the occurrence of mesothelioma parallels the exploitation and use of amphibole asbestos, with a lag phase of 20–40 years [11]. Highest rates of mesothelioma are in those countries that have mined amphibole asbestos (principally South Africa and Western Australia) and in those countries that made extensive use of amphibole asbestos, particularly in the shipbuilding and construction industries. Mortality rates from the WHO mortality database for 1993 show that in most Western European countries mesothelioma mortality rates (death per million population, all ages) for males are in the region of 10–50 per million, whereas in females they are 5–10 per million population, all ages (WHO, 1993).

The sex related differences are accounted for mainly by exposure differences. Occupations, such as shipbuilding, construction and insulation were predominantly the preserve of males during the 1960s and 1970s when asbestos use was at its peak. Incidence increases with age from the fifth decade onwards, peaking after age 70.

Worldwide, the mesothelioma epidemic can be understood as occurring in three waves that principally parallel the exploitation and use of amphibole

asbestos. The first wave of the epidemic occurred amongst the miners and millers, principally in South Africa and Western Australia where amphibole asbestos was mined. It further included transport workers (e.g. stevedores) and the earliest industrial uses of asbestos in lagging. The second wave paralleled the increasingly diverse use of amphibole asbestos, principally in Western Europe and Japan, but also in many other countries following the Second World War. South African crocodilite and amosite exports peaked in the late 1970s and declined progressively thereafter, finally ceasing in the mid 1990s [12]. In the epidemiology of mesothelioma, the third wave refers to possible exposures to residual amphibole asbestos or in its removal from the urban and industrial environment. Asbestos has been extensively used in buildings and factories as an insulator. It was very widely used on boilers and steam pipes. Asbestos cement was a widely used construction material. The removal of such asbestos, if not done with great care, may result in sufficient exposure to cause mesothelioma.

6. Conclusion

There has been a concerted focus in South Africa by the legislature on asbestos related matters. The last functioning asbestos mine in South Africa (Msauli) has been closed down. A settlement by Cape Asbestos PLC was reached in favour of South Africans suffering from asbestos related diseases, in a court case in London. Hopefully future prospects in mesothelioma prevention and treatment will offer hope to those who are still at risk.

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