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Asbestos and mesothelioma in South Africa

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Summary Asbestos has been used by man since 4000 before the Christian era (BCE) in many different parts of the world and for a wide range of functions. Blue asbestos (crocidolite) was first discovered in South Africa in 1805 and within a few years was being mined there extensively. Mining reached its peak in 1977 with >380,000 tons being exported and 20,000 miners employed in the industry. South Africa also has large deposits of white asbestos (chrysotile) and brown asbestos (amosite) both of which have been mined extensively. At the turn of the 20th century, it was noted that those working with asbestos suffered lung disease and in 1960, the link between asbestosis and mesothelioma was established in the Kimberley area of South Africa. Further studies in the 1970s and 1980s showed an alarming incidence of mesothelioma based on pathology reports. The majority of the reported mesothelioma cases result from exposure to asbestos in its many uses in secondary industry although incidence of the condition among miners is also significant. A high proportion of mesothelioma in patients in South Africa is attributed to environmental origin with a high incidence of women and children affected.

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1. History

Asbestos is a remarkable material and has been used by humans for many years.

4000 before the Christian era (BCE)	Asbestos was used for wicks in lamps and candles. "Asbestos" means inextinguishable or unquenchable.
2000–3000 BCE	Embalmed bodies of Egyptian pharaohs were wrapped in asbestos clothes to offset the ravages of time.

2500 BCE	Used in Finland to strengthen clay pots.
800–900 AD	Anecdotal evidence of Charlemagne's table cloth made from woven asbestos.
1000	Mediterranean people used chrysotile from Cyprus and tremolite from upper Italy for the fabrication of cremation cloths, mats and wicks for temple lamps.
1300–1400	Marco Polo visited an asbestos mine in China in the latter half of the 13th century. He concluded that asbestos was a stone and lay to rest the myth that asbestos was the hair of a woolly lizard.

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Early 1700s	Asbestos papers and boards were made in Italy.
1724	Benjamin Franklin brought a purse made of asbestos to England. The purse is now in the Natural History Museum.
1828	United States (US) patent issued for asbestos insulating material used in steam engines.
1853	Asbestos helmet and jackets worn by Parisian Fire Brigade.
1866	Moulded lagging material made from water glass and asbestos.
1896	First asbestos brake linings were made by Ferodo Ltd., in England.
1900	High pressure asbestos gaskets made by Klinger in Austria.
1913	First asbestos pipes developed in Italy.
1919	Standard corrugated sheet introduced in Australia by Hardies.
1939–1945	Wartime use included fireproof suits and parachute flares.
1945–1975	Post-war construction projects relied heavily on the use of asbestos, reaching an all-time high in 1973.
1939	In the film 'The Wizard of Oz', the Wicked Witch of the West appeared on a broom made of asbestos.
1990s	The solid fuel boosters of the space shuttle are insulated with asbestos, one of the few remaining current uses.

However, at the turn of the 20th century, it was noted that those working with asbestos suffered lung disease. In 1897, a Viennese physician wrote that emaciation and pulmonary problems left no doubt that asbestos dust inhalation was the cause. In 1898 in England, inspectors of factories wrote regarding the asbestos manufacturing processes "... and because of ascertained cases of injury to bronchial tubes and lungs medically attributed to the suffering of the employees". In 1931, asbestos industry regulations were passed in the UK to address concerns that asbestos exposure, particularly among textile factory workers led to lung damage.

The link between asbestos and mesothelioma was established in the Kimberley area in South Africa. In 1956, Wagner performed a necropsy on a black male shower attendant at a gold mine. He was surprised to find tumour filling the right chest with collapsed lung in the centre. Tuberculosis had been endemic in the area but anti-tuberculous treatment, which was introduced in 1952, had a dramatic effect, except for cases from west of

Kimberley. In 1956, Sleggs, Chief Medical Officer of Kimberley Tuberculosis Hospital, collected together the radiographs of 14 patients. These were biopsied and this showed mesothelioma. Most cases lived in the vicinity of an asbestos mine and some had lived there for only a short period. A long latent period of up to 44 years between exposure and mesothelioma was noted. Wagner reported the link between asbestos and mesothelioma [1].

2. South African mining

Blue asbestos (crocidolite) was first discovered in South Africa in 1805. It was originally named "Woolstone". All commercial asbestos fibres were mined in South Africa. Mining reached its peak in 1977 with the export of >380,000 tons and 20,000 miners were employed in the asbestos mining industry.

3. Major types of asbestos

3.1. Crocidolite

The name was coined in 1831 by Hausman, a German geologist, from the Greek "Krokis" meaning woolly and "lithos" meaning rock. It is also known as blue asbestos. South African mining of crocidolite began in the mid 1800s. Initially, the mining took place with many small digging operations—"outcrop mining". The mining and milling are highly labour intensive, with the fibre cobbled from the rock by hand-held hammers, sieved by hand, sorted by a combination of manual and mechanised methods and transported in sacks. Crocidolite is less heat resistant than some other forms of asbestos but very acid resistant as well as very elastic. It is used mainly as a reinforcing agent for binding with cement, rubber and plastics, friction materials (brake linings), packing and jointing products.

3.2. Chrysotile

Chrysotile is also called white asbestos, although the fibres are pale green. In South Africa, the area near Barberton was mined since the beginning of the 1900s. In 1937, the Msauli mine in South Africa started mining operations in the largest deposit of chrysotile in the world. Chrysotile fibres have less tensile strength and less resistance to corrosion by acid than crocidolite. It is more suitable for spinning and weaving and more heat resistant than other asbestos fibres, so it is used mainly as fire resistant and insulator material.

3.3. Amosite

This is a pale, silvery fibrous mineral. It is also called grey or brown asbestos. Asbestos Mines of South Africa Ltd. (Amosa) first mined it at the turn of the last century. It occurs mainly in the area of Penge and has been mined there for the past 80 years, mainly with small operations and crude technologies, causing extensive environmental pollution and exposing the labour force to high levels of dust. The Penge deposit is the largest in the world, and stretches for 40 km (25 miles).

4. Asbestos and mesothelioma

In 1960, Wagner reported the link between asbestos and mesothelioma as described above. In 1960, Pneumoconiosis Research Unit undertook a survey of every 10th house in areas at risk. They found an alarming incidence of mesothelioma in and out of the industry. In addition, 4.8% of the population outside the industry had asbestos fibres in their sputum. The fibre concentration in the general ambient atmosphere was measured at 0.09 fibres/ml. Webster informed the mining houses. This had the unfortunate result that the funding discontinued, except for the final report, which continued on condition that it would not be published externally. In addition, the report was denigrated.

As a result of the withdrawal of support, studies were only picked up again in the 1970s. The residents of areas which were at risk, such as Prieska, were not informed of the hazards and there was no control of atmospheric pollution.

There have been three overall series reported. Webster reported 232 cases based on pathology reports sent to the National Centre of Occupational Health [2]. Zwi reported on 1347 cases diagnosed between 1976 and 1984 [3]. He actively sought out cases in addition to those reported to a Central Asbestos Tumour Board. Only 59% of their biopsy proven cases were known to the Tumour Board and Zwi also attempted to estimate the true incidence.

The South African National Cancer Registry has reported cases since 1986 and has relied on a passive reporting system based on the forwarding of pathology reports [4]. This would result in an under reporting of proven cases as shown by Zwi.

During Zwi's 9-year study, the age standardised incidence rate (ASIR) in white males rose from 23.6 per million in 1976 to 40.5 million in 1984. The comparable figure from the SANCR is 54 million giving an indication of a steady increase in mesothelioma incidence over the years.

The incidence in South Africa is amongst the highest anywhere. It is six times higher than in England and at least as high as Western Australia. The male:female ratio is 2.5:1. The incidence in blacks is particularly under diagnosed. Zwi speculated that this was due to the reluctance of physicians to undertake invasive procedures for untreatable conditions, the shortened life expectancy in blacks and the migrant labour system whereby blacks would return to rural conditions in South Africa or to other countries where they were not followed up.

Mesothelioma can develop 20 or more years after the first exposure, while the peak incidence is between 35 and 45 years after exposure. The cumulative lifetime risk of developing mesothelioma rises as a constant multiplied by the third or fourth power of years since first exposure.

The peak production of crocidolite in South Africa was in 1977. All those exposed during the 1970s and 1980s will be approaching the peak in their occurrence of malignant mesothelioma. It can be expected that the "epidemic" will continue at least for the lifetime of those large numbers of people exposed to crocidolite in mining and in industry.

5. Mesothelioma and the mining industry

Four case series have been published in South Africa that detail the source of exposure in >500 cases of histologically proven malignant mesothelioma [5-7].

If we remove the unknown and no exposures, mining-related exposures represent 40% of those mesotheliomas for which exposure is known. The majority of them are related to crocidolite exposure, which is considered to be more carcinogenic than the other fibres. The biologically active or inhaleable particles are those with a diameter of less than 3 µm and a length between 5 and 100 µm. Only 20% of all asbestos fibres fall into this category and the most common is crocidolite.

6. Mesothelioma and secondary industry

The majority of the reported mesothelioma cases result from exposure to asbestos in its many and varied uses in secondary industry. Three major occupations at risk stand out:

1. the maintenance of steam locomotive and other railway-related procedures;
2. the asbestos cement industry; and
3. boilermakers and other artisans who use asbestos for insulation applications.

7. Mesothelioma from environmental exposure

A high proportion (26%) of mesothelioma in patients in South Africa is attributed to environmental origin, particularly in the Northern Cape area. Of all environmental cases in South Africa, 93% originate from exposure to crocidolite in that area. An interesting observation is the high incidence of women and children affected (>70% of all reported environmental cases). This is presumably due to asbestos brought home in the hair and clothes of the miners. The closure of the last mine is therefore not the end of the problem. There are 82 asbestos mine dumps in the Northern Cape.

8. Conclusion

The story of mesothelioma within South Africa is dismal indeed. More than 2700 South Africans have died of mesothelioma. Government officials have failed to prevent the disease and protect citizens. Mine owners have focussed excessively on profit. The legal system has offered no means of redress for patients with malignant mesothelioma resulting from environmental exposure. The medical community has had minimal impact on policy and/or practices.

Some recent developments are a little more positive. 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 in favour of South Africans suffering from asbestos-related diseases, was reached in a court case in London. Hopefully, future prospects in malignant mesothelioma prevention and treatment will offer hope to those who are still at risk.

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