Asbestos: current issues related to cancer and to uses in developing countries

Asbesto: seu emprego nos países em desenvolvimento e questões relacionadas ao câncer

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Abstract *Asbestos is one of the main occupational carcinogens recognized and studied in the literature. Its uses have undergone major changes in recent decades, with severe restrictions on commercial amphiboles according to different patterns: in developed countries asbestos is strictly controlled or banned, except in Japan, while in developing countries consumption has leveled off or increased. As an example, Brazil is one the seven world leaders in asbestos production and consumption. Although there is a clear excess of mesotheliomas linked to amphibole exposure, mainly to crocidolite, there is no evidences that chrysotile is harmless to the pleura. Also, the relationship between fibrogenesis and carcinogenesis is not sufficiently understood to defend the concept that there are protective exposure limits to both diseases. "Controlled use" policy may be effective at the occupational level in a select group of companies, representing only a fraction of the exposed population. In developing countries subject to economic pressures, these issues merit proper discussion to avoid unnecessary disease and death.*
Key words *Asbestos; Occupational Exposure; Neoplasms*

Resumo *O asbesto é um dos principais cancerígenos ocupacionais reconhecidos e estudados na literatura científica. A tendência mundial de utilização e consumo sofreu modificações nas últimas décadas, com uma severa restrição ao uso dos anfibólios comerciais e segue padrões distintos: em países desenvolvidos sua utilização é extremamente restrita ou proibida, exceção feita ao Japão, e em uma série de países em desenvolvimento há uma tendência a estabilidade ou aumento na produção e utilização. O Brasil, como exemplo, é um dos sete maiores produtores e consumidores mundiais de asbesto. Embora haja um maior excesso de mesoteliomas relacionados à exposição a anfibólios, notadamente a crocidolita, não há evidências de que a crisotila seja inócua para a pleura. Da mesma forma, as relações entre a fibrogênese e a carcinogênese não são suficientemente claras para afirmar-se que haja limites de exposição que protejam contra ambos efeitos, simultâneamente. A política do "uso controlado" pode ser efetiva, apenas a nível ocupacional, nas grandes empresas, que representam apenas uma fração dos expostos. É necessário que nos países em desenvolvimento, sujeitos a maiores pressões econômicas, estas questões sejam tratadas com seriedade, para evitar-se doenças e mortes desnecessárias.*
Palavras-chave *Asbesto; Exposição Ocupacional; Neoplasias*

Background

Asbestos is a group of silicate fibres with varying contents of magnesiun and iron. They are divided in two groups, the serpentines represented by chrysotile and the amphiboles including crocidolite, amosite (both having industrial applications), tremolite, actinolite and antophyllite (non-commercial fibres). Asbestos uniqueness is reflected in their physical and chemical characteristics which confer a high tensile strenght, thermal stability, chemical resistency to acid or alcali agressions, depending on the fibre type. These properties make them attractive for different industrial applications like asbestos-cement (A/C) products (boards, roof covers, water reservoirs and pipes), friction materials (brake systems, clutch systems) gaskets and textiles.

Asbestos is found in ultramafic rocks (chrysotile and the non-commercial amphiboles), serpentinized limestone rocks derived from the reorganization of ultramafic or silicified dolomitic rocks (chrysotile), and in Precambrian banded ironstones (crocidolite and amosite). Over 95% of the world asbestos mined is chrysotile. Seven countries accounts for most of the production: Russia, Canada, Kazakisthan, China, Brazil, South Africa and Zimbabwe. World production experienced a sharp rise from the end of the Second World War until mid 70s (5 million tons) when started to decline until it leveled in the 90s (3 million tons). Decline in production paralleled the decline in consumption in developed countries, except in Japan. In contrast, asbestos industry grew in developing countries, particularly in South America, Southeast Asia, Middle East and Eastern Europe. Around 85% of the current uses are for asbestos-cement products. Today, most of the developed nations banned or severely restricted asbestos uses, based on technical and/or socio-political criteria.

Occupational and environmental exposure to asbestos are associated with fibrotic reactions in the lungs and pleura, an excess of lung cancer and pleural and peritoneal mesotheliomas. Causal relations with laryngeal cancer, cancer of the digestive and urinary tract are still a matter of debate. Although it is not the main cause of occupational respiratory diseases in many of the developing countries, taking Brazil as a good example, data on asbestos related diseases is quikly rising. Recent Brazilian federal laws and regulations permitted the continuation of mining, transformation and utilization of chrysotile. Use of amphiboles is not permitted.

As there still remain questions related to the effects of chrysotile in humans, these developments point for an urgent need to openly discuss related issues of the subject.

The question of chrysotile exposure and mesothelioma

In humans all forms of asbestos are causally related to parenchimal and pleural fibrosis, bronchogenic carcinoma and mesotheliomas. Clinical effects show an industry-specific variation, with strong associations with fibre type and fibre size distribution, among others. This is particularly the case for mesothelioma. From epidemiology there is no dispute that amphiboles carry a higher risk in humans, but there is no evidence that chrysotile is harmless to the pleura. Recent reanalysis of historical cohorts do not support the belief that chrysotile carries a lower risk than amosite in producing mesotheliomas. In experimental animals, inhalation and pleural injections studies showed that all types of asbestos cause mesotheliomas.

Fibre analysis in mesothelioma cases (as in other asbestos-related diseases) are done in lung tissue. Methods for fibre identification and counting in pleural tissue are the same as in lung tissue, but quantitative analysis has not been standardized until now. Short chrysotile fibres in the parietal pleura have been described in varying cases of asbestos-related diseases with no systematic association with lung fibre content. They represent the main fiber type encountered in pleural tissue. Therefore, it is biologically plausible that pleural fibres play an important role in pleural carcinogenesis.

The question of rapid chrysotile clearence is also challenging. Electrostatic bonds between fibrils are removed by the leaching of Mg ions, splitting the fiber longitudinally in smaller fibrils that could be more easily fragmented and removed from tissue. At the same time thinner fibrils can remain undetected by electron microscopy and play a role in fibrogenesis and carcinoma induction.

Persistence of fibres in lung tissue is accepted as necessary for carcinoma induction, but, in vitro essays with mesothelial cells of experimental animals incubated with chrysotile, show early and persistent chromossomal changes. To what extent prolonged persistence is necessary after induction to maintain the noxious stimuli is still a matter of debate. Lung fibre content studies are performed at the time of overt disease, or at necropsy, years after the exposure took place, because of long latency periods. Results may not reflect the fibres linked to the cascade of events that took place years before. In rat experiments, exposure to chrysotile or amphibole fibres show similar fibrogenic responses, despite lower pulmonary accumulation of chrysotile at necropsy.

It is estimated that 65-70% of the mesothelioma cases are explained by the presence of long, thin and durable amphiboles fibres in the periphery of the lungs. For decades, chrysotile has accounted for 95% of the world asbestos production and consume. Human lungs, which are the best possible samplers, always show the presence of amphiboles even when the exposure is considered to be amphibole-free. Contamination of chrysotile deposits with tremolite is almost universal. The high proportional tremolite content of humans exposed mainly to chrysotile is considered as the main explanatory variable linked to mesothelioma occurrence, by some researchers. Others, think that tremolite content may reflect past chrysotile exposure, without being necessarily implicated with the tumour.

In summary, chrysotile has largely been the main fibre type mined and consumed. The rapid clearence of chrysotile fibres from the lungs does not convincingly justify a "small risk" of mesothelioma. The role of short pleural chrysotile fibers in pleural tissue has not been routinely addressed in scientific studies. Contamination of chrysotile by amphiboles is almost always found and largely unavoidable. Short duration experimental studies show that all asbestos fibres are potent carcinogens. To our understanding chrysotile exposure is still a problem that is far from settled.

Relationship between fibrosis and cancer

Increasing grades of asbestosis are associated with higher risks of bronchogenic carcinoma. The problem remains in asbestos exposed workers without asbestosis. Most of the publications that addressed the subject used conventional x-rays as the image tool for assessing fibrosis. Methods for detecting asbestosis have evolved in the last years, with the use of high resolution computed tomography scans, which is considered to be superior to conventional x-rays in the early diagnosis of the disease. These developments certainly will lower the oftenly quoted figures of 20% of cases missed by conventional image techniques, and will allow more confidence in attribution of cases to asbestos exposure. Lung fibre burden in the range of asbestosis cases, coupled with a proper latency time since first exposure, even in the absence of asbestosis, is also considered by some researchers as sufficient evidence for attribution of lung cancer to asbestos.

There is no proof that fibrogenesis and carcinogenesis join a common path. They may well be different processes that can interact in the lung environment. Up to now, it cannot be stated that asbestosis is a pre-requisite for the development of an asbestos related cancer. We certainly need more data to help understanding the question.

Asbestos and developing countries

Since the seventies, due to the increasing scientific evidence of cancer risk, strong restrictions to asbestos have been adopted in developed nations, ranging for lower exposure limits, amphiboles ban, restriction of asbestos containing products and total ban. Some of the restrictions have been based in scientific facts, others in socio-political willness.

In developing countries the scene is different. Taking Brazil as an example, production and consumption rose during the eighties, peaked and stabilized in the nineties. At present, a mean of 1,300g/year of chrysotile is consumed per capita. Strategies for utilization and marketing of asbestos and its products vary: "light, durable and cheap" for A/C products, "resistant and with good safety performance" for friction materials and gaskets. All of the above qualities are true, but there are also doubtful strategies as "it's a well known fibre, why change to others that one does not know the effects?", "chrysotile is far less harmful than amphiboles" or "present low exposure levels are safe".

Risk assessment and control of occupational settings by industry and government are very poor in Brazil. In addition, workers are not sufficiently aware of their work environment and their rights. In practice, it makes very little difference to have low permited fibre levels, good and modern labour laws when one does not have means and support to enforce them. The question of asbestos use, as other carcinogens, should be discussed on real grounds. The concept of controlled use of asbestos may well be applied in developed countries but, feasibility in developing countries is restricted to a few industries, not as a rule.

Published reports of asbestos-related diseases in Brazil are limited to one radiological survey of asbestos-cement workers from medium-size plants in the eighties, case reports of asbestosis, case reports of asbestos-related bronchogenic carcinomas (3 cases) and case reports of asbestos-related mesotheliomas (3 cases). Not much epidemiological information is available from other developing countries. The small number of publications reflect the lack of awareness of asbestos-related diseases from health professionals and also, the timing course of events in countries with more recent industrialization. Given to this peculiar situation it does not take much effort to conclude that in the next century these diseases will be largely restricted to developing countries.

Present global economy brought further problems to workers and unions by changing the focus of the discussion for preservation of job posts. Developing countries in their struggle for attracting investments and business are more prone to close their eyes for risky and unsuitable technologies. In Brazil, unions and union-related agencies have played an important role in contributing to the knowledge of the risks of exposure to different agents, and to the worker's rights, but it is clear that their strenght is fading.

Technology for replacement of asbestos for other fibres and/or other products are available for most of the uses. In developing countries liabilities for causing preventable occupational diseases are still irrelevant, society is not properly informed and prepared to discuss issues related to asbestos use and, governments are sensitive to industry interests. It seems that the continuation of asbestos use will be managed only by economic interests, no matter the advances in scientific and socio-political discussions. Even so, it is our duty to try to contribute to proper solutions in a reasonable time, to avoid unnecessary diseases and deaths.