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Recent international medical research on asbestos concerning the use of chrysotile

Хризотилдың қолдануына қатысты асбест туралы ең жаңа халықаралық медициналық зерттеулер

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Мақалада ең жаңа медициналық зерттеулердің нәтижелеріне шолу жасалған. Бұл зерттеулерді 1998–2009 жылдар аралығында әр түрлі мемлекеттердің ғалымдары өткізген, мысалы, Австрия, Ұлыбритания, Греция, Израиль, Литва, Польша, Украина, ЮАР және тағы басқалары. Автордың ойынша, ең жаңа медициналық ғылыми мәлімет және практикалық тәжірибе нәтижесінде, өндірісте қауіпсіздік ережелерді сақтау айтулы кәсіптік асбесттен болған ауруларды азайтуға кепіл бола алады.

В статье сделан обзор результатов новейших международных медицинских исследований, касающихся возможности безопасного использования в контролируемых условиях хризотил-асбеста, его биологической активности в сравнении с амфиболами. Исследования проведены в 1998–2009 гг. учеными разных стран: Австрии, Великобритании, Греции, Израиля, Литвы, Польши, Украины, ЮАР и др. Новейшие медицинские научные данные и практический опыт, по мнению автора, подтверждают, что соблюдение правил безопасности на производстве гарантирует минимизацию случаев профессиональных асбестообусловленных заболеваний.

Asbestos is a common name of six natural fibrous minerals used in industrial products. There are two groups of these minerals: serpentine (chrysotile) and amphibole (crocidolite, amosite, anthophyllite, tremolite, and actinolite).

Particularly in the past decade the issue of health effects of these groups of minerals has become the topic of numerous discussions when it became the focus of numerous very different interests: medical, environmental, commercial, political, etc. Further in this article the question will be only about chrysotile since the use of amphiboles is banned by ILO Convention No.162 on Safety in the Use of Asbestos [1].

Continuing discussions in the world scientific society are mainly related to the question whether the levels of exposure to chrysotile corresponding to the current normatives, at the modern level of equipment and technology in the production of chrysotile and chrysotile-containing materials and products, in the availability of known methods applied for prevention, can cause an increased risk of cancer diseases?

The answers to these questions concern not only the future of chrysotile workers but also of billions of people in the world in need of affordable shelter and pure drinking water. (Chrysotile is one of the components used for the production of slate, the most popular and affordable roofing material for the general population, and the most hygienic, according to the WHO, and cheap chrysotile cement pipes).

To answer these questions, in the second part of the 20th century a lot of studies of health effects of asbestos were conducted. Yet, the majority of researchers did not differentiate the risks of its different types. Only in the past decade many scientists have recognized the necessity to differentiate risks of exposure to chrysotile and amphiboles and to assess the true hazard of the use of pure chrysotile under controlled conditions.

Below are given the conclusions of scientists based on results of recent epidemiologic studies of health effects of pure chrysotile published during 1998–2011.

First of all, the study **«Occupational exposure to asbestos and man-made vitreous fibers and risk of lung cancer: a multicenter case-control study in Europe»** conducted in 1998–2002 under the guidance of the International Agency for Research on Cancer [2].

Seventeen scientists from leading institutes of 11 countries including the U.K., Hungary, Israel, New Zealand, Poland, Russia, Romania, Slovakia, France, the Czech Republic, and Sweden took part in it.

Both occupational and socio-demographic information about 2,205 incident male lung cancer cases and 2,305 controls was collected in the study. The study subjects included residents of the U.K. and of 16 towns of six countries of Central and Eastern Europe.

Based on the study results the researchers concluded that:

- no increased risk of lung cancer related to chrysotile was found in the countries of Central and Eastern Europe. (Notes from the author: the countries of Central and Eastern Europe mostly used chrysotile from the USSR and very small amounts of amphiboles; spraying of asbestos was not applied.);
- an increased risk of lung cancer was registered among the Englishmen exposed to amphiboles.

A number of studies was conducted by scientists at asbestos cement plants in Poland and Lithuania used pure chrysotile asbestos.

The study **«Mortality of workers at two asbestos-cement plants in Poland»** was published in the International Journal of Occupational Medicine and Environmental Health in 2000 [3]. The plants using pure chrysotile only were the study object. The scientists concluded that no increased risk of lung cancer was found in the cohort of workers.

The study **«Cancer mortality and morbidity among Lithuanian asbestos-cement producing workers»** was published in the Scandinavian Journal of Work, Environment & Health in 2004 [4]. The main conclusion drawn by the researchers was that no increased risk of lung cancer was found when studying disease incidence rates at two Lithuanian asbestos-cement plants using pure chrysotile.

Most often authors of anti-asbestos publications indicate a close relationship between asbestos (without differentiation on types) and mesothelioma (a rare form of cancer) as proved by the predictions for Europe published in 1999 over the next 35 years [5].

A large epidemiologic study **«Three decades of pleural cancer and mesothelioma registration in Austria where asbestos cement was invented»** was carried out in 2003 [6]. The priority of the invention of asbestos cement in 1901 and the onset of its production belongs to this country.

The scientists analyzed pleural cancer incidence and mortality rates for the previous 30 years (1970–2001) in Austria and concluded that:

- predictions were based on data from the U.K. and six other countries that widely used amphibole asbestos. Besides, some dubious methods of overdiagnosis were applied in calculations;
- in Austria there were no reasons to expect a significant increase in the number of mesothelioma cases in the future since the use of asbestos there had been always controlled better than in the countries where the predictions were made;
- a smaller increase in the mesothelioma rate was determined by different types of asbestos used;
- the predictions were far-fetched, and their extrapolation to other countries was erroneous.

The study **«South African experience with asbestos-related environmental mesothelioma. Is asbestos fiber type important?»** was published in 2007 by U.S. scientists [7].

The researchers analyzed four studies covering the period of 1976–1992. It should be noted that South Africa was the world largest producer of amphibole asbestos (280 thousand tons of crocidolite and amosite per year) and its main exporter to Western Europe and the USA. At the same time, about 100 thousand tons of chrysotile asbestos were mined there annually.

The researchers concluded that:

- the relationship between amphiboles and mesothelioma was obvious;
- no chrysotile-induced cases of mesothelioma were found.

The study «*Mortality from occupational exposure to relatively pure chrysotile: a 39-year study*» was published in 2008 by Greek scientists [8].

Having analyzed the data for almost 40 years the authors found that:

- no mesothelioma cases were registered;
- the general mortality rate of the workers was much lower than that of the general population in Greece;
- the occupational exposure to a relatively pure chrysotile within permissible levels was not related to a significant increase in lung cancer or mesothelioma rates.

«*Complex clinical hygienic and epidemiologic studies of labor conditions and health of workers of ten asbestos-cement Ukrainian plants*» were conducted in 2006–2008 by the Research Institute of Occupational Medicine of the Ukrainian Academy of Medical Sciences headed by Academician Yu.I.Kundiyeu [9]. This work is of particular interest since only chrysotile asbestos from Russia and Kazakhstan has been always used in the Ukraine.

Epidemiologic studies helped establish the rates and risks of cancer among workers (30660 person-years) of asbestos-cement industries in 1996–2005. The results were as follows:

- the annual cancer incidence rate was 88.1 per 100,000 workers (RR = 0.26), i.e. 3.8 times lower than the rate for the general population;
- compared to the regional levels, the relative risk in the industries studied ranged 0.06 to 0.67.

Of great importance are the studies of *the biological persistence* of fibers conducted by scientists from Switzerland, Germany, and the USA in 1999–2006 [10]. They made unique laboratory experiments on animals showing that inhaled chrysotile fibers are quickly cleared from lungs whereas amphibole fibers resistant to the acidic lung medium are retained in them for the period of one year and over. Those studies have become an important basis for the kinetic and pathological substantiation of differences between chrysotile and amphibole fibers. The scientists established that the toxicology of chrysotile that is easily disintegrated in lungs into many small particles was comparable to that of non-fibrous minerals, whereas the toxicology of amphiboles is the response to their fibrous insoluble structure.

The authors established that the clearance half-time of asbestos fibers longer than 20 μm was: tremolite — ∞ ; crocidolite — 536 days; amosite — 418 days; chrysotile — 0.3–11 days.

For comparison the researchers reported data on the clearance half-time of mineral fibers > 20 μm that are used as chrysotile substitutes and claimed to be safe by their manufacturers: ceramic fibers — 55 days; fiberglass — 6–79 days; rockwool — 5–67 days; para-aramid fibers — 45 days; cellulose fibers — 1046 days.

In this regard it should be noted that the Directive of the European Commission on Man-Made Mineral Fibers (1997) states that if long fibers are easily dissolved or broken apart and cleared from lungs they have no carcinogenic effect. Among all mineral fibers the solubility of **chrysotile** is the best.

Naturally, the scientists wondered why animal studies of pure chrysotile usually showed a high cancer incidence rate. The answer was provided by toxicology studies: the long-term inhalation exposure of animals to chrysotile was, as a rule, very high compared to that under modern labor conditions. In this connection their relevance to human exposures is extremely low.

Toxicological studies of fibers *in vitro* are often very useful to establish possible mechanisms of pathogenesis; yet, their results are very difficult to interpret as they do not account for differences in solubility of different fibers. High doses of fibers are used in the experiments to get the positive result but it is very difficult to extrapolate it to low exposures that occur *in vivo*.

To prove that the authors conducted an experimental study on laboratory animals with different exposures to chrysotile and obtained the following results:

- no fibrosis was observed following the 90-day exposure to chrysotile fibers > 20 μm at the average concentration of 76 f/cm³ and 92 post-exposure days;
- a slight fibrosis was observed following the exposure at 207 f/cm³, L > 20 μm .

The researchers came to the following conclusions: a long-term exposure to sufficiently high concentrations of chrysotile-containing or any other mineral dust has a potential to induce a professional disease including cancer. If the exposure levels are low, human lungs can cope with inhaled short fibers and particles well.

«Quantification of the pathological response and fate in the lung and pleura of chrysotile in combination with fine particles compared to amosite-asbestos following short-term inhalation exposure» is a continuation of the above study [11].

The authors describe the results of this work in the Abstract:

«The marked difference in biopersistence and pathological response between chrysotile and amphibole asbestos has been well documented. This study is unique in that it has examined a commercial chrysotile product that was used as a joint compound. The pathological response was quantified in the lung and translocation of fibers to and pathological response in the pleural cavity determined. This paper presents the final results from the study. Rats were exposed by inhalation 6 h/day for 5 days to a well-defined fiber aerosol. Subgroups were examined through 1 year. The translocation to and pathological response in the pleura was examined by scanning electron microscopy and confocal microscopy (CM) using noninvasive methods. The number and size of fibers was quantified using transmission electron microscopy and CM. This is the first study to use such techniques to characterize fiber translocation to and the response of the pleural cavity. Amosite fibers were found to remain partly or fully imbedded in the interstitial space through 1 year and quickly produced granulomas (0 days) and interstitial fibrosis (28 days). Amosite fibers were observed penetrating the visceral pleural wall and were found on the parietal pleura within 7 days postexposure with a concomitant inflammatory response seen by 14 days. Pleural fibrin deposition, fibrosis, and adhesions were observed, similar to that reported in humans in response to amphibole asbestos. No cellular or inflammatory response was observed in the lung or the pleural cavity in response to the chrysotile and sanded particles (CSP) exposure. These results provide confirmation of the important differences between CSP and amphibole asbestos».

On the basis of the aforesaid the conclusions can be drawn that the results of the studies conducted by scientists from Russia, the Ukraine, Austria, the United Kingdom, Lithuania, Poland, Germany, the USA, and other countries show their practical identity that the risk of developing a professional disease is negligible by using pure chrysotile under control. At the same time the studies show a high risk of negative consequences of using amphiboles.

But different anti-asbestos organizations still create an atmosphere of fear and even psychosis around the use of chrysotile. For this purpose they carry out powerful PR-actions by using mass media, at numerous international seminars and conferences in different countries. Unfortunately, without delving into essence of arguments of one of the parties that is substantiating the possibility of a safe use of the mineral by scientific studies (in 60 countries of the world chrysotile has been used for over 100 years) some officials from international organizations have agreed with the arguments of initiators of the anti-asbestos campaign, the goal of which is to ban the use of all types of asbestos including chrysotile on an international scale.

On the basis of the results of the above recent scientific studies there are no doubts that the anti-asbestos campaign is mostly based on unreliable, flawed in essence and often false predictions of the future epidemics of asbestos-related diseases, for example, in 1980 and then in 2000. Now predictions relate to 2020–2050.

Unfortunately, predictions are taken by the public very seriously, and the anti-asbestos campaign distracts attention from real factors having a negative impact on the health.

Today, when over 30 years have passed after the first predictions, we can state that they have nothing to do with reality. The predictions are nonexistent, nobody can even remember them, but the produced asbestos scare is still there in people holding no information about scientific evidence.

Many of the above studies were conducted by scientists from the countries that had already banned asbestos. So the question is how justified the bans are? The answer is practically unequivocal: in all these countries political decisions to ban asbestos were first made and only after that people began to try to find out medical grounds for it. The asbestos scare intensively forced by certain circles is frequently perceived by some politicians without any analysis of its negative influence on the national economy, on the solution of social problems of the society.

It is no wonder that in October 2007 the American Council on Science and Health in its position paper «Asbestos exposure: how risky is it?» [12] stated: «The challenge today is whether regulatory agencies will utilize current scientific knowledge even though it will necessitate a paradigm shift in long-held views on asbestos exposure and its implications for human health».

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