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Dissolution of silicic acid from amosite and quartz dusts under physiological conditions

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RAHMAN, Q., BEG, M. U. and VISWANATHAN, P. N. Dissolution of silicic acid from amosite and quartz dusts under physiological conditions. *Scand. j. work environ. & health* 1 (1975) 117—119. The dissolution of silica from amosite dust in human serum and in Ringer buffer at 37° C was found to be significantly higher than that from quartz. The significance of this finding in relation to their fibrogenic effects has been discussed.

Key words: experimental physiology, silicic acid, amosite, quartz, dust, toxicity.

The fibrogenic response of guinea pig lung to amosite consists mainly of reticulin formation (9). Since asbestosis is considered to be a modified form of silicosis (3), the retarded collagen formation has been attributed to the nonavailability of sufficient silicic acid. The dissolution of silica from amosite was therefore studied by the present authors and compared with that of quartz, which produced pronounced collagen deposition in guinea pig lung (11) in a preliminary report.

MATERIAL AND METHODS

Dusts

The samples of dusts, amosite (fiber size below 30 μ) and quartz (particle size below 5 μ), were prepared according to the procedure described by Zaidi (11).

Dissolution media

The media employed for the dissolution of silicic acid were King's Ringer buffer, pH 7.4 (5) citrated human plasma, and human serum. The buffer solutions were sterilized by autoclaving, while plasma and serum were passed through a bacteriological filter.

Experimental procedure

Fifty milligrams of each of the dry dusts were accurately weighed in 15-ml polyamide centrifuge tubes and autoclaved at 15 lbs of pressure for 15 min. Ten milliliters of the respective media were added to each tube, and the tubes were subsequently stoppered tightly with sterilized polyamide caps and sealed with paraffin wax. A control set of tubes contained only the medium. The tubes were incubated at 37°C under sterile conditions. At zero time and after specified intervals, six tubes from each group were taken out and opened. The dust was removed by centrifugation at 12,000 g for 15 min, and the supernatant was collected and measured. Silica was determined with the use of 1.0-ml aliquots according to the method of King et al. (7).

RESULTS

As the period of incubation advanced, the dissolution of silica increased both from amosite and quartz (fig. 1). The dissolution was significantly greater from amosite

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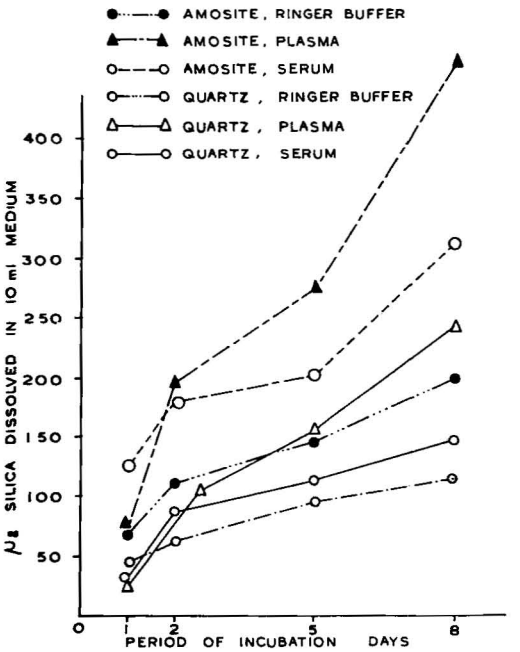

Fig. 1. Dissolution of silica from an 0.5 % suspension of amosite and quartz dust in Ringer buffer, plasma, and serum at 37° C. The arithmetic mean of six estimations is given. The data are expressed as µg silica dissolved in 10 ml.

than from quartz in all cases. Plasma eluted 424 and 243 µg of silica, respectively, from 50 mg of amosite and quartz in 8 days. The corresponding figures for serum were 371 and 233 µg. Since the amosite sample contained only 51 % silica, this amounted to 1.67 % of the available silica. The corresponding figure for quartz was 0.48 % only. Dissolution of silica by Ringer buffer was only 45 to 55 % of the level obtained with plasma or serum. With buffer also the rate of dissolution was significantly higher for amosite than for quartz.

DISCUSSION

Silica dissolution from quartz by ascitic fluid at 37°C was higher than that from asbestos (6), while the reverse was the case with water at 100°C (1). The present results indicate that the dissolution of silica from the amosite sample was faster than that from quartz at 37°C. Morris et al. (8) observed that the elimination rates of amosite and silica from rat lung were similar. Since the dissolution of trace elements from asbestos was similar in human and bovine serum (2), the present data with human serum may be applicable to animal sera also. Thus amosite may be eliminated at a faster rate from guinea pig lung without the accumulation of silicic acid. An accumulation of mucopolyaccharide along with insufficient silicic acid, according to Holt and Went (4), favor reticulin formation rather than collagen deposition. The low fibrogenic effect of chrysotile was attributed to its faster elimination rate (10). Thus the absence of reticulin to collagen transformation in our earlier experiment in guinea pigs may be due to the quick elimination of the dust from the lungs.

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