Letters to the Editors

ACTIVATION OF ACID PHOSPHATASE ACTIVITY IN MACROPHAGE BY QUARTZ PARTICLES

Recent studies ^{1,2)} on the pathogenesis of silicosis have suggested the destruction of macrophages by quartz particles as first step of fibrogenesis. Rapid metabolic disturbances of macrophages after the addition of quartz particles have been demonstrated by the decrease of TTC reducing capacities ^{2,3)}, adenine nucleotide content ⁴⁾ and amino acid incorporation into macrophage protein. ^{5,6)} During the studies on lysosome of macrophages, we recently found the rapid change of acid phosphatase activity in macrophages. Macrophages used in this experiment were collected from rats' intraperitoneal cavity after injection of sterile Tyrode's solution containing 0.001% glycogen. Two kinds of quartz particles were used. The ground quartz samples were obtained by the mechanical grinding in agate mortar, and particles had the sizes of 0.5 to 2 μ and below 0.5 μ . Alkali treated quartz particles were prepared by treating this ground quartz particles with alkali solution to dissolve away the modified layer. This quartz samples were of course alkali-free by repeating washing and had the same sizes as ground quartz samples. Acid phosphatase activity was measured by both the method of King & Armstrong ⁷⁾ and modified method of Bessey-Lowry-Brock. ⁸⁾

Quartz particles were added to 5 million macrophages in Tyrode's solution of 0.5 ml and mixed well. Immediately after mixing, the mixed solution was centrifuged and the supernatant was decanted. The acid phosphatase activity of the cells in the precipitate was determined after adding substrate-buffer mixture and incubating for 20 minutes. The change of acid phosphatase activity by quartz particles was shown in Fig. 1. Acid phosphatase activity increased with the doses of alkali treated quartz, but did not with the ground quartz. The acid phosphatase activity of macrophages with ground quartz particles was the same as that of control. Activation of acid phosphatase by alkali treated quartz was more remarkable by particles of smaller size than that of larger size. This acid phosphatase activation seemed to occur very early after the addition of quartz. To confirm this point, quartz dusts and substrate were added to the cells suspended in buffer solution of pH 4.9 and the activities were determined. Activation was already observed at 3 minutes after the addition of quartz. (Fig. 2). From this, it was very difficult to assume that the activation of acid phosphatase activity occurred after the phagocytosis of quartz particles by macrophages. The activation is due to the surface character

ACID PHOSPHATASE ACTIVATION BY QUARTZ

Fig. 1. Relationship between acid phosphatase activity and dust doses.

Fig. 2. The effect of quartz particles on the acid phosphatase activities in macrophage suspended in citrate buffer of pH 4.9.

of quartz particles, because the ground quartz has no effect. Furthermore, the addition of microcline, cyanite, diaspide toumaline, and actinolite to macrophages did not activated the acid phosphatase activities but cristbalite activated remarkably.

The activation of acid phosphatase activity in macrophages by quartz particles was prevented by the addition of polyvinylpyridine-N-oxide. It is very interesting that preventive effect was seen when polyvinylpyridine-N-oxide was added not only before or immediately after the addition of quartz particles to macrophages but also till 30 minutes after the addition of dust. From this phenomenon we assumed that the preventive action of polyvinylpyridine-N-oxide was not due to the coating of dust surface but to its effect on biological

K. KOSHI AND H. SAKABE

processes of the cells.

The increase of acid phosphatase activity by quartz particles was not changed by the addition of p-fluorophenyl alanine and the increased acid phosphatase activity did not exceed the total acid phosphatase activity of the cells. From these results it was assumed that the increased activity was not the results of activated synthesis of acid phosphatase. This fact may suggest the activation of lysosomal enzymes. But, remarkable activation of beta-glucuronidase and cathepsin in macrophages was not found by the addition of quartz particles. These problems will be discussed later.

In writing this paper, we read the paper of Harington⁹⁾ reporting the activation of acid phosphatase activity observed histochemically after phagocytosis of quartz particles by macrophages.

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