

MORPHOLOGY AND PATHOMORPHOLOGY

EXPERIMENTAL TALCUM PNEUMOCONIOSIS

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Our knowledge of the development of talcum pneumoconiosis is still far from complete. Clinical work indicates that prolonged inhalation of talcum* leads to pulmonary fibrosis [1, 2, 3, 4, 6, 8, 9]. The very few experimental papers describing the results of introduction of talcum into the lungs of animals are inconclusive, inasmuch as the experiments on albino rats and guinea pigs were of short duration [5, 7]. The authors were unable to find any permanent and irreversible changes in the lungs of the experimental animals, and they hence drew the conclusion that talcum can be regarded as an indifferent dust.

Indications that persons who inhale talcum dust over long periods of time can develop fibrosis, and the wide use of talcum in industry led us to undertake the researches described in this paper.

Single 50 mg portions of talcum, containing 1.5% of free silica, and taken from a factory where it was used, were introduced into the trachea of 150-200 g albino rats, and the animals were killed 3-12 months later. The lungs, together with the hilar lymphatic glands, were examined histologically. The sections were stained with hematoxylin-eosin, and picrofuchsin, and were silvered by the Tibor-Papa procedure.

No macroscopic changes were visible on opening the thorax of animals killed 200 days after introduction of talcum. Microscopic examination of the lungs revealed miliary and larger granulomatous nodules made up of lymphoid and histiocytic elements with sporadic giant cells of the type of foreign body giant cells with peripherally located nuclei, containing in their cytoplasm well defined glistening white crystals, some of which had a fibrous appearance (Fig. 1), together with barely visible granules.

In addition, focal thickening of alveolar partitions was observed.

Nodules, characteristic of experimental silicosis of white rats, and which are found after introduction of dust of high silica content, were not seen.

In rats killed 300 days after introduction of talcum the lungs showed patches of atelectasis and emphysema, with barely visible grayish-yellow nodules.

Microscopic examination revealed the presence of submiliary and miliary granulomatous nodules made up of lymphoid and histiocytic elements, together with large numbers of giant cells with peripherally situated nuclei, the cytoplasm of which contained small white transparent and yellowish-brown granules. In addition, many of the granuloma contained large, glistening, completely transparent granules, situated both within and among the giant cells.

The hilar lymph nodes contained numerous submiliary and miliary nodules (Figs. 2 and 3), made up of macrophage elements of the type of rat epithelioid cells, the cytoplasm of which contained very small granules of dust.

* Talcum is a magnesium silicate, $3\text{MgO} \cdot 4\text{SiO}_2 \cdot \text{H}_2\text{O}$.

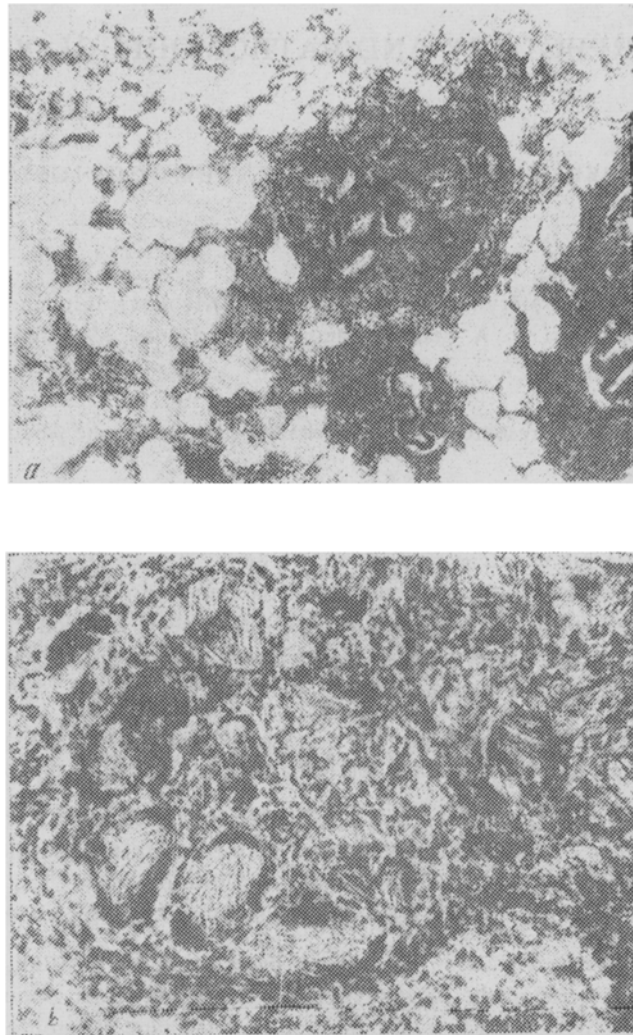


Fig. 1. Rat lung, 200 days after intratracheal introduction of talcum powder. A miliary granulomatous nodule made up of macrophages and lymphoid elements, with numerous giant cells (a — low magnification). Fibrous formations are clearly visible in giant cells (b — high magnification).

Some animals killed on the 300th day of the experiment had submiliary and miliary nodules in their lungs, composed mostly of lymphoid cells, with some macrophages, but not containing giant cells.

Numerous lymphoid and macrophage elements were infiltrated around the small vessels. The lungs displayed focal emphysema and slight hyperplasia of the peribronchial follicles. However, fairly numerous submiliary and miliary nodules of the above-described type, made up of epithelioid type cells, were found in the hilar lymph nodes.

We could not find any nodules typical of experimental silicosis in animals killed 300 days after introduction of talcum.

The experiments show that, in the majority of animals killed a long time after a single intratracheal introduction of talcum, submiliary and miliary granulomatous nodules develop, made up of lymphoid cells, macrophages, and giant cells, which are of the nature of foreign body giant cells, and which contain phagocytized dust crystals in their cytoplasm.



Fig. 2. Hilar lymphatic node of a rat 300 days after intra-tracheal introduction of talcum powder. Numerous miliary and submiliary nodules made up of small reticuloendothelial elements. Low magnification.

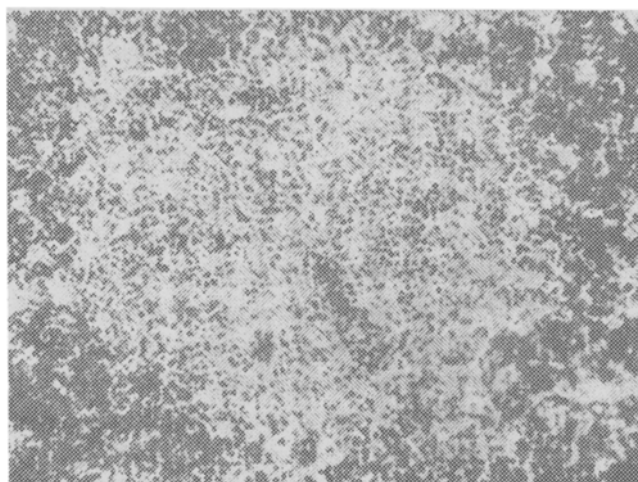


Fig. 3. From the same slide as Fig. 2. A miliary nodule in a lymphatic node. High magnification.

This process of formation of granulomatous nodules in the lungs is a reaction of the lung tissue to introduced dust, and it differs from the experimentally provoked process of silicotic nodule formation in the same animals when dust with a high silica content is inhaled, and that it is associated with the presence of large numbers of giant cells.

At the same time, many animals showed moderate thickening of the alveolar partitions and development of fibrous tissue around the bronchi, i.e., signs of mild, mostly focal, sclerosis.

Submiliary and miliary nodules made up of epithelioid macrophage cells, with very fine dust inclusions in their cytoplasm, are found in the hilar lymph nodes. These dust particles must have been transported from the lungs to the regional lymph nodes, where they were deposited in cells of the reticulo-endothelial system, with consequent proliferation of the cells, giving rise in some cases to nodules.

These experiments show that the introduction of talcum powder into the lungs of albino rats causes formation of granulomatous nodules, the process of formation of which differs from that found in the same animals after introduction of dust of high free silica content.

The response of lung tissue to introduction of talcum more closely resembles a foreign body reaction, with development of granulomatous nodules, with more numerous foreign body giant cells than result from introduction of free silica, which exerts a much stronger chemical action.

In addition, interstitial sclerosis of a mild degree is observed, mostly of focal distribution, whereas when dust of high free silica content is administered marked sclerosis of lung tissue is found.

Our experimental studies provide confirmation of clinical observations of development of mild nodular and interstitial sclerotic processes in the lungs of persons who inhale talcum dust over a long time.

LITERATURE CITED

- [1] Bardin, N. S., Proceedings of Scientific Meetings of San.-Hyg. Institutes and Depts. of Hygiene of Institutes of the RSFSR, 10-14 June 1952, pp. 73-74.
- [2] Shatalov, N. N. Hygiene and Sanitation, 1954, No. 2, pp. 29-30.
- [3] Biasi, W., Arch. path. Anat. u. Physiol., 1951, Bd. 319, S. 505-525.
- [4] Dreessen, W. C. and Dalla Valle J. M., Publ. Health Reports, 1935, v. L. N. 50, 131-143.
- [5] Fossel, M., Frankfurt Ztschr. f. Path., 1935, Bd. 49, S. 90-95.
- [6] McLaughlin, A. J., Rogers, E., and Dunham, K. C., Brit. J. Indust. Med., 1949, v. VI, pp. 184-194.
- [7] Policard, A., Arch. d. maladies profess., 1940, v. II, pp. 530-539.
- [8] Porro, F. W., Patton, J. R. and Hobbs, A. A., Am. J. Roentgenol., 1942, V. XLVII, pp. 507-524.
- [9] Siegal, W., Smith, A. R. and Greenburg, L., Am. J. Roentgenol., 1943, v. XLIX, pp. 11-29.