STUDY OF FIBROGENIC EFFECT OF VERMICULITE DUST ON RAT LUNG

LIU ZHANYUAN • Fang Yuxiang • Yie Fengting • Xiao Xingyuan
Liaoning Institute of Labour Hygiene, P.R. China

INTRODUCTION

Vermiculite is a water-bearing aluminum silicate with iron and magnesium. Its size expands after it is heated. Expansive vermiculite can be used for heat preservation insulation, sound insulation, fire-proofing, antibiosis, acid-proofing, etc. The reports are few on whether vermiculite dust can cause the fibrose of the lung.[1-3] In order to search into the fibrogenic effect of vermiculite dust, the study of vermiculite dust on animals has been made as follows.

MATERIALS AND METHODS

Dust used for experiment is obtained from vermiculite mine of Qingyuan, and quartz dust used for control is obtained from sandstone mine of Haicheng. The dust was baked and ground into powder in which the dust size of $\lesssim 5$ μm is more than 95%. The content of free silica is 1.96% in the vermiculite dust and 93.8% in the quartz dust.

54 male rats which were of age were divided randomly into three groups. In one of these groups 50 mg of the vermiculite dust was injected intratracheally into each rat and the other two groups were given injection of normal saline or quartz dust in the same way. 1, 3, 6, 9 and 12 months after the injection these rats were killed in batches. The tissue sections of the rats lungs were dyed in HE, foot or VG. The classified criteria of pathology referred to those of experimental silicosis.[4]

RESULTS

Naked Eye Observation

Quartz Group. One month after injecting the dust the lymph nodes of hilus of the lung are the same size as small peas; the surface of the lung is smooth and the quality of the lung is soft. After 12 months the lymph nodes of hilus of the lung are the same size as broad beans, their quality are hard, and the spread, or piecewise spots, were found in the surface of the lung as well as the quality of the spots was hard.

Saline Group. 9 months after the injection, the confined emphysema appeared in some lungs.

Vermiculite Group. One month after injecting the dust the lymph nodes of hilus of the lung are also the same size as small peas and are ochreous; the ochreous spots were seen in the surface of the lung and the lung tissue is soft and sprung. After 9 months the confined emphysema appeared in the lung

Microscopy

Quartz Group. One month after injecting the dust the cell nodes were found in the lymph nodes of hilus of the lung and the lung tissue; after 9 months the cell and fiber nodes appeared; after 12 months the fiber nodes were seen.

Saline Group. The dust response was not shown in the lung throughout the experiment.

Vermiculite Group. One month after injecting the dust, the cell nodes which were of all sizes appeared in the lung tissue. In these nodes there were a lot of the dust particles and epithelium-like cells (23 HE). The proliferation of reticular fiber was found in the nodes and a little collagenous fibers appeared in some nodes (12 VG). Around the nodes there was increased volume widened interval and thickened wall of the alveoli. The proliferation of the epithelium cells was seen in some bronchi and there was a great deal of secretion in their cavities. After 3 months the collagenous fibers were found in the nodes (19 VG) and the confined emphysema appeared around the nodes. After 6(37VG) ~ 12(6HE,VG) months the node-like changes were sti11 seen in the lung. There are a little collagenous fibers, a lot of reticular fibers and spread dust particles in the nodes. The confined emphysema were shown round the nodes. The proliferation of collagenous fiber appeared in the intervals of the alveoli and around various bronchi as well as small blood vessels after 12 months

Biochemical Analyses

The collagen content of the whole lung in each group is shown in Table I and Figure 1.

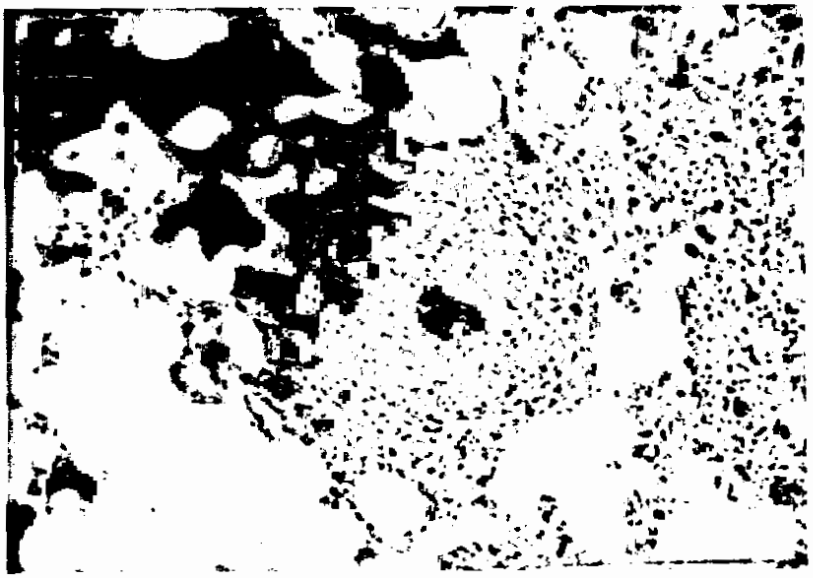
DISCUSSION

The fibrogenic effect of various silicate dust on the lung is quite complex, and it is a wide field in the study of pneumoconiosis etiology. In the group of vermiculite dust of this experiment one month after injecting the dust, the thinner fibers which were dyed in red were found in the cell modes; after 3 months little recognizable fibers of collagen were seen in the nodes and the intervals of the alveoli which were dyed in VG. These changes are rare in other silicate dusts. After 6 ~ 12 months the collagen fibers were still shown but they differ from the typical silicosis-like changes in amount and distributive scope of the nidus and component change in the node. The results of pathologic observation is in agreement with the result of collagen content of

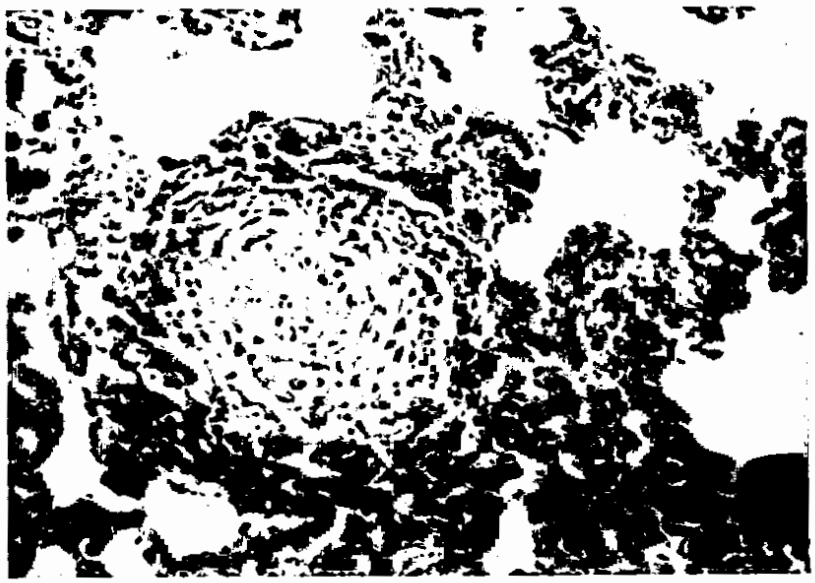
Table I

Collagen Content of Whole Lung in Each Group (mg/whole lung)

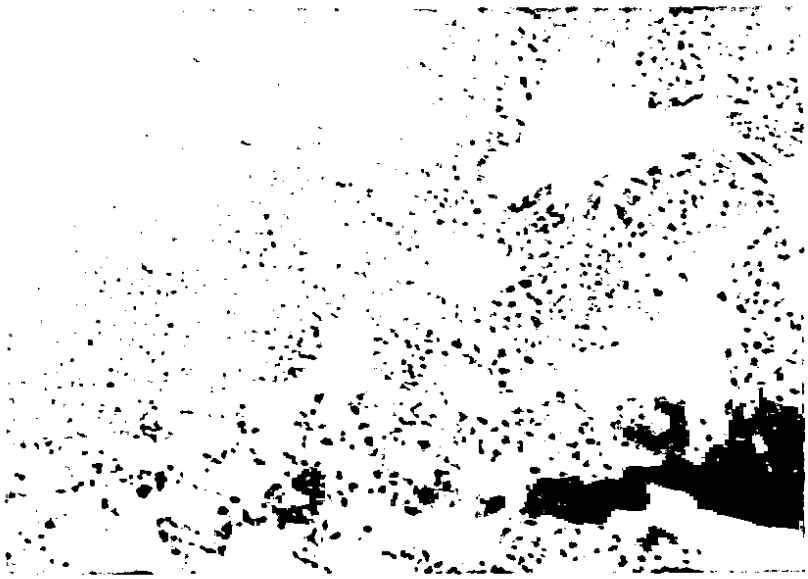
Observation Term (month)	1		3		6		9		12	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Saline Group	2	32.4	2	28.8	2	39.2	2	34.4	2	63.0
Quartz Group	2	35.7	2	38.5	2	75.7	2	116.5	2	259.8
Vermiculite Group	2	44.4	2	55.1	2	94.1	2	88.0	2	106.5



Vermiculite (One month) 23 HE 6.7×10



Vermiculite (Three months) 19 VG 6.7×10



Vermiculate (Nine months) 35 HE 6.7×10

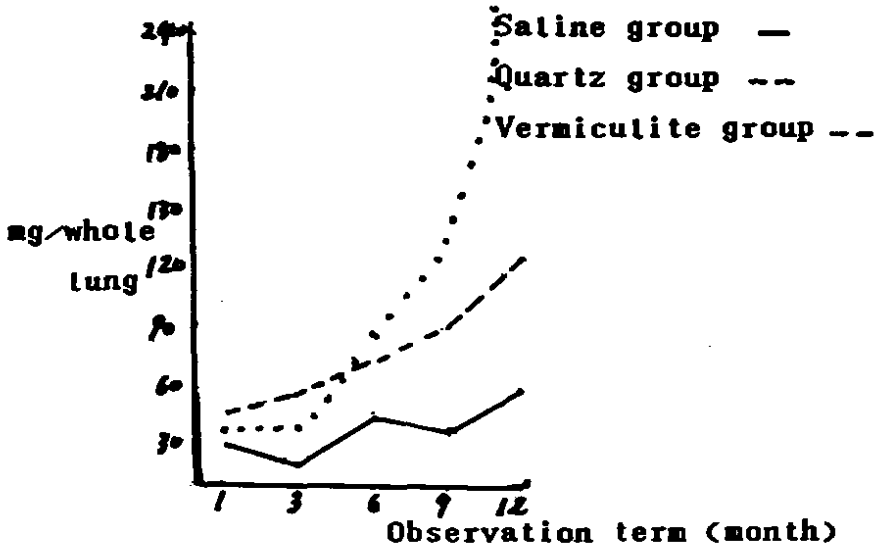


Figure 1. The change of the collagen content of the whole lung in each group.

whole lung. It is indicated that the slight fibrogenic effect on the rat lung is caused by the vermiculite dust.

CONCLUSION

50 mg of the vermiculite dust was injected intratracheally into each rat and after 1 ~ 12 months the pathologic observation and the analysis of collagen content of whole lung were made. The author indicated that the slight fibrogenic effect on the rat lung was caused by the vermiculite dust. The progress of the effect was slower and milder than that of the quartz group and the typical silicosis-like change was not seen.

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