Table. Serum Cu, Zn or Cu/Zn ratio in silicotics ($\mu\text{mol/l}$)

Group	No. of cases	Cu	Zn	Cu/Zn
control	37	22.19 ± 3.90	16.70 ± 4.20	1.323 ± 0.852
stage I	33	$27.31 \pm 0.02^*$	$28.41 \pm 4.28^*$	$0.962 \pm 0.004^*$
stage II	19	$31.83 \pm 0.02^*$	$28.86 \pm 16.52^*$	1.103 ± 0.001
stage III	11	$33.59 \pm 0.02^*$	$24.19 \pm 10.17^*$	1.39 ± 0.002

*Every value in the silicosis group was compared with the corresponding control value and found different with $p < 0.01$.

compensating mechanism. An increase in Zn absorption or a decrease in Zn excretion may contribute to the rise in the Zn level. The increase in Zn may depress Cu absorption and hence lower the Cu level. This would result in the inhibition of Cu enzymes and in the prevention of Cu activated lung fibrosis⁶. If the patient's condition has worsened and the compensating mechanism is destroyed, the Zn level will decline.

References

- 1) Bai Y, Wang JJ, Wei SC, Hao DQ. Changes of trace element copper and zinc in sera of cases with silicosis. *Chinese J Ind Hyg Occup Dis* 1993; 11: 280–280 (in Chinese with English abstract).
- 2) Konishi A, Iguchi H, Ochi J, Kinoshita R, Miura K, Uchino H. Increased lysyl oxidase activity in culture medium of nonparenchymal cells from fibrotic livers. *Gastroenterology* 1985; 89: 709–715.
- 3) Liu BX. Study on trace element in the serum of patient with silicosis, *Chinese J Ind Med* 1989; 2: 16–18 (in Chinese).
- 4) Niculescu T, Dumitru R, Burnea D. Changes of copper, iron, and zinc in the serum of patient with silicosis, silicotuberculosis, and active lung tuberculosis. *Environmental Research* 1981; 25: 260–268.
- 5) Ren ML, Jiang XL. Detection of coalsilicosis by radioimmunoassay used for ceruloplasmin, *Chinese J Ind Hyg Occup Dis* 1993; 11: 146–146 (in Chinese with English abstract).
- 6) Ji Shugo. Study on copper level in the serum of patient with chronic obstructive disease of lung. *Trace Element* 1987; 4: 37–40 (in Chinese).

Short Communication

Serum Concentrations of Copper and Zinc in Patients with Silicosis

Wenlong WANG, Lihui WANG and Yiwen LU

Department of Occupational Disease, Yangpu District Central Hospital, Shanghai 200090, P.R. China

Key words: Silicosis, Trace element, Copper, Zinc, Ceruloplasmin

The primary pathologic changes in silicosis include fibrosis and the proliferation of collagen tissue in the lungs. Bai *et al.*¹⁾ indicated that Cu plays a very important part in the progress of lung fibrosis, and zinc (Zn) takes part in the synthesis of collagen in the progression of lung fibrosis. Koniski *et al.*²⁾ indicated that fibrosis was promoted by Cu and depressed by Zn. Although serum levels of trace elements in silicotic patients have already been investigated in several studies, the relative importance of Cu and Zn in the progression of silicosis has rarely been documented. This paper presents the results of our study on the change in Cu and Zn levels in the sera of silicotics.

Subjects and Methods

Sixty-three in patients diagnosed to have silicosis, with an average age of 65.7, ranging from 56 to 84 years, participated in this study. Among them, 33 were classified as stage I, 19 as stage II and 11 as stage III. They had been engaged in sand preparation, knocking out, fettling and sandblasting in certain foundry operations, in the manufacture of refractory materials for 10 to 34 years with an average of 16.8 working years. Among them 53 were diagnosed as having simple silicosis (84.1%), 8 were complicated with non-tuberculosis respiratory disease and two were complicated with non-active tuberculosis. They were all ex-smokers, having given up smoking several years before. They had good nutritional condition. Thirty-seven healthy persons (control group) were matched with the silicosis group in age and sex.

Fasting blood was obtained from cases and controls. The serum Cu and Zn levels were determined by means of a flameless atomic absorption spectrophotometer (VIEO 22, Instrumentation Laboratory Inc., Lexington Massachusetts, USA). Before atomic absorption analysis the serum samples were diluted about 5 times with a mixture of 1% HNO₃ and 2‰ Triton. Every sample was analyzed in triplicate and the average value was adopted.

The coefficients of variation of Cu and Zn determinations were 3.2% and 5.1%, respectively. The statistical method used was an analysis of variance with multiple comparison.

Results

Serum Cu and Zn levels and Cu/Zn ratios in the silicosis groups are listed in Table. Cu and Zn levels in the silicosis groups were higher than those in the control group ($P < 0.01$). Higher Cu levels in the sera were observed in advanced stages of silicosis such as stages II and III. As summarized in Table, the serum Cu/Zn ratio in stage I silicotic patients was lower than that in the control group ($P < 0.01$), but there were no statistically significant differences in the ratio among stage II, stage III and the control group.

Discussion

The serum Cu level was higher, the Zn level was lower, and the Cu/Zn ratio was higher in Stages I, II and III of the silicosis group than those of the control group reported by Liu³⁾ and Niculescu *et al.*⁴⁾, but the present study indicates that the serum Zn level was higher in all stages of the silicosis group and the Cu/Zn ratio was lower in stage I. The difference between findings in previous studies and the present study could be attributed to our small number of subjects with complicated respiratory tract disease as well as progression of silicosis. In previous studies there were more than fifty percent of cases complicated with respiratory tract diseases and their conditions were more serious^{3, 4)}, but there were a few cases of mild respiratory tract complications in our silicosis group. In our study there were only 2 patients whose condition was complicated by non-active tuberculosis. This paper suggests that the serum Zn level may not decrease but may increase in patients with silicosis. The higher the serum Zn level, the lower the Cu/Zn ratio was in the stage I silicosis group. Whereas in stages II and III silicosis groups, the increase in the serum Zn level was less than that of Cu. In other words, what is relevant is not the decrease in the Zn level but the increase in the Zn level. The mechanism of the increase in serum Cu and Zn levels is still not understood. Ren and Jiang⁵⁾ suggested an increase in ceruloplasmin levels in the silicosis group. Each ceruloplasmin molecule contains eight Cu atoms, and Cu levels were mainly maintained by ceruloplasmin levels. The Cu increase may therefore be explained by an increase in ceruloplasmin levels. We believe that silicosis always accompanies lung fibrosis which increases ceruloplasmin as well as Cu levels. Zn is an activator of a vast variety of enzymes, directly taking part in tissue metabolism and is involved in respiration. Hence, in hypoxemia, due to increased Zn enzyme consumption, the level of Zn would decline. The authors postulate that the human body has a certain

Received Dec 15, 1996; Accepted Feb 9, 1998

Correspondence to: W. Wang, Department of Occupational Disease, Yangpu District Central Hospital, Shanghai 200090, P.R. China