STUDIES ON PREVENTIVE EFFECT OF ALUMINUM CITRATE ON SILICOSIS

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ABSTRACT

On the basis of experiments, the Al-cit showed its effectiveness in presenting biological effects of silica. A total of 917 cases selected from both engineering corps of railway and coal mines with stage 0 or 0+ by radiographs were studied. All cases were divided into Al-cit group and control group workers with continuing dust exposures. The treatment group workers were injected with Al-cit at a dose of 120 mg Al/person/year and the control group workers received a consolatant or nothing during the time of 1980 to 1985. The radiographic changes were demonstrated that Al-cit showed clear-cut effects in both retardation of the dust-induced fibrosis and reduction of the morbidity of silicosis.

Silicosis is always an occupational disease in many developing countries today. Controlling the concentration of dust in the air at workplaces and keeping it in accordance with MAC were main important measures. But it is not easy to achieve MAC in all workplaces. Particularly for a lot of township industries in China, it will be very difficult. Al-cit showed a good effectiveness in preventing biological effects of silica in our other experimental studies.

This paper compared the efficacy of intramuscularly injected Al-cit group and control group in relieving symptoms, in changes of laboratory examinable indices, and in retarding the progression of established radiological changes.

VOLUNTEERS ACCEPTED AND METHOD

It was decided that all volunteers from both engineering corps of railway and coalmines to be included in the trial must (a) have radiological picture of 0 or 0+ stage according to the Chinese roentgenodiagnostic criteria of pneumoconiosis associated with a history of exposure to silica or coalmine dusts over a period of at least 5 years; (b) show no evidence of cardiovascular disease; (c) be deemed likely to attend regularly for treatment over a number of years and be willing to submit faithfully to all necessary tests of assessment.

All volunteers (1048 male workers) were divided into Al-cit group and control group with continuing dust exposures (Table I showed the dust conditions). The treatment group workers were intramuscularly injected with Al-cit 120 mg Al/person/year and control group workers received Vit B_1 (IM) or nothing during the period of 1980 to 1985.

RESULTS

131 accepted volunteers dropped out in the investigation period. Those dropped out because they changed to other workplaces, retired, did not cooperate or did not receive enough Al-cit, more than 180 mg Al in treatment. At the end of 5 years, 519 group Al-cit and 398 group control persons completed the investigation. The lapses rate, age, years of exposure to dust and distribution of type of job did not show any significance between the two groups (Tables II, III, IV).

All accepted took a radiographic examination once every other year during the period of investigation. The roentgenograms were read and diagnosed by a fixed group of experienced readers according to the Chinese roentgenodiagnostic criteria of pneumoconiosis. Table V shows the progression rate from 0 and 0+ stage group with 1.6%, 10.3% during the period of investigation in the Al-cit group and 12.0%, 26.0% in the control group, i.e., the percentage of retardation of progression of radiograph of silicosis by Al-cit attained 86.6% in 0 stage group and 60.4% 0+ group. Al-cit showed clear-cut effects in both retarding the dust-induced fibrosis and reduction of the morbidity of silicosis. The change in symptoms was assessed by a group of clinical doctors independently, 262 cases in Al-cit group and 180 cases in control group were questioned about their symptoms at intervals during the treatment. Table VI shows the symptoms at incidence of cough, thoradynia, sputum, tympanites in the Al-cit group were decreased more than the control group. 116 cases in the control group received a consolatant vit B_1.

Indices of laboratory examination: such as ceruloplasmine, Lysozyme, Ca++,GPT in serum and blood and urine rule examination, except those of percent of albumin A in Al-cit group showed increased and globalris gamma decreased by electrophasesis examined, did not show any significant changes between both the Al-cit group and control group.

Table I
Condition of Dust in the Air of Workplace

mice or corp	concentration mg/m^3	free SiO_2 %	distribution 5u %
A	7.4(4.7-26.1)	12.3(2.8-37.1)	94.8(91.7-96.6)
B&C			
rock	12.6(4.0- 23.0)	21.1	84.5
semicoal	26.6(18.0- 80.0)	11.6	80.3
fullcoal	89.4(40.0-800.0)	8.9	86.4

Table II
Number of Accepted Volunteers to Drop Out at Different Times of the Investigation

group	started	1982 2 year lapses	invest	1985 5 year lapses	invest	total lapses
Al-cit	588	33	555	36	519	69/588(11.7%)
control	460	28	432	34	398	62/460(13.5%)

Table III
Distribution of Workers' Age and Years of Exposure to Dust

group	n	age(yr)	dust exposure(yr)
Al-cit	519	42.45±0.29	15.46±0.22
control	398	42.80±0.38	15.69±0.33

Table IV
Distribution of Type of Job Between the Two Groups

group		type of job				total
		driller	trans-porter	many sided worker	others	
Alcit	n	235	100	155	26	519
	%	45.3	19.8	29.9	5.0	100.0
control	n	171	104	99	24	398
	%	43.0	26.1	24.9	6.0	100.0

Table V
The Radiographic Changes with Al-cit to Prevent Silicosis

	group	total	after treatment		progression rate %	P
			no prog	prog		
0 before treatment	Al-cit	306	301	5	1.6	0.01
	control	225	198	27	12.6	
0+	Al-cit	213	191	22	10.3	0.01
	control	173	128	45	26.0	

progression: 0 into 0+ or I; 0+ into I or II

DISCUSSION

Since the 1930s, a lot of experimental studies and clinical investigations have been reported in literature, which suggest that the therapeutic inhalation of metallic aluminium dust is beneficial to silicosis. But from the mid 1940s to the early 1950s, there is the important additional feature that inhaled aluminium dust may itself be capable of causing diffuse interstitial fibrosis. Over ten years ago, the efficacy of aluminium chlorohydroxyalltoate inhalations in reducing fibrosis of rats which suffered quartz dust was reported by Policard (1966) and Bouffant (1967, 1977). Unfortunately, we have not found the practical report about it. As we know insoluble aluminium (as metallic Al) dust inhalation might be retained and demonstrated to cause fibrosis in lung. According to the experimental study, Al-cit intramuscularly injected on rats which suffered silica dust, the Al contents in lungs increased more than that in livers and kidneys (Table VII). It may be very useful to prevent silicosis with Al-cit, but intramuscular injection is not an ideal method to give the medicine for every recipient. So to find a more ideal method would be necessary to study in the future.

The results of this study showed that retarding progression rate of radiographic of silicosis by Al-cit attained 86.6% in 0 group and 60.4% in 0+ group for the investigation period of 5 years. The retarding rate of both treated groups showed

Table VI
Symptom Level of Al-cit Group and Control Group

variable	Al-cit group (n 262)		Control group (n 180)	
	1980	1985	1980	1985
cough (%)	20.2	6.9	13.9	11.2
thoracodynia(%)	21.8	10.8	13.3	11.2
sputum	18.9	5.0	13.9	10.0
tympanites	11.8	7.6	10.6	17.8
electrophasesis				
albumin(%)	68.7	70.1		
globulins(%)	15.6	15.1		

Table VII
Al Content in Lung, Liver, and Kidney of Rats Compared Between Injected and Not Injected Al-cit

organ	normal		suffered quartz dust	
	control	injected Al-cit	control	injected Al-cit
lung				
ug/g	10.36±0.71	12.40±0.31	5.29±0.38	17.13±1.12
ug/total	23.01±1.72	28.73±1.12	37.05±2.68	98.41±6.76
liver				
ug/g	5.50±0.40	21.0±0.96	4.77±0.40	5.08±0.22
ug/total	83.78±5.60	326.59±4.96	59.23±5.76	66.10±3.50
kidney				
ug/g	7.82±0.38	32.60±1.35	4.88±0.25	6.83±0.55
ug/g total	79.70±1.13	85.70±5.30	11.37±1.20	16.64±1.32

a significance in comparison with each control group.

In this investigation we did not notice any toxicity or side effects from the use of Al-cit.

How to prevent or retard the fibrogenesis of inhalated silicon dust is an important problem. On the basis of our result, the Al-cit complex may be a practical method to cope with it.

SUMMARY

A controlled trial of Al-cit intramuscular injections in the prevention of ERC and coalmine workers silicosis with continuing dust exposures was conducted over 5 years. Retarding progression rate of radiographic by Al-cit attained 86.6% in 0 group and 60.4% in 0+ group. Al-cit does not show any toxicity and side effects from this study condition. This investigation shows that the Al-cit may be a practical method to prevent the fibrogenesis of silicon dust in body.

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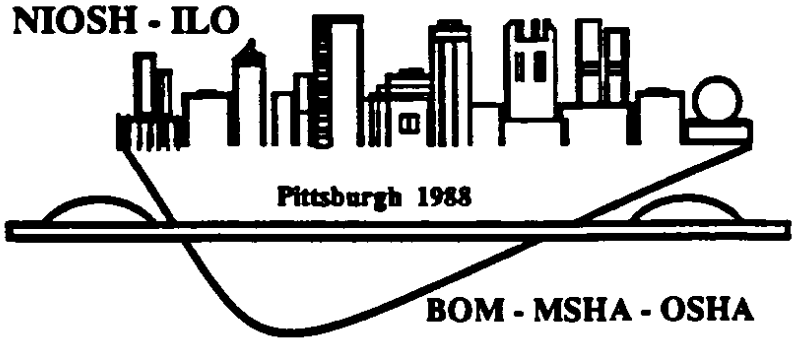

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