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STUDY ON MOTOR NERVE CONDUCTION VELOCITY, PERIPHERAL CIRCULATION AND LIPID METABOLISM IN WORKERS EXPOSED TO CARBON DISULPHIDE

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ABSTRACT

A study of motor nerve conduction velocity, peripheral circulation and lipid metabolism was carried out in 83 workers exposed to increased concentrations of CS_2.

The results were statistically analyzed and evaluated by groups of workers according to the duration of exposure. By their early appearance and frequency the changes in the peripheral nervous system expressed as reduction of motor conduction velocity (MCV) came first. Functional changes in peripheral blood vessels were observed in all groups.

Hypertension and disturbances in lipid metabolism represented important changes in workers with longest exposure. All established disturbances correlated with the duration of exposure.

Due to the improvement of the working conditions in the viscose industry the classical picture of polyneuropathy and vasculopathy has been gradually replaced by subclinical changes of the nervous and vascular systems.

Many authors pointed out that the measurement of maximal motor conduction velocity represented a reliable procedure for detection of early changes[3,5,6,9]. In this Institute the method was applied before but only in a few cases of chronic CS_2 poisoning[1].

Vascular investigations were carried out in viscose workers seven and ten years ago. The obtained results suggested a necessity for further follow-up investigations of the state of blood vessels in increased CS_2 exposure[7,10].

With the aim to reveal such changes we performed a parallel investigation of the peripheral nervous system, peripheral blood vessels, blood pressure and blood lipids in workers exposed to increased CS_2 concentrations.

SUBJECTS AND METHODS

For this investigation we selected 83 workers from the operation of the staple cell production as well as a control group of 32 workers. Some data about workers are shown in Table 1.

TABLE 1
Age and duration of exposure of the subjects.

Group	Number of workers	Age ($\bar{X} \pm$ S.D.)	Duration of exposure ($\bar{X} \pm$ S.D.)
I up to 5 years of exposure	32	25.0 ± 4.0	1.8 ± 1.2
II 6 – 10 years of exposure	26	33.8 ± 4.5	8.5 ± 1.4
III 11 – 18 years of exposure	25	41.2 ± 5.3	14.2 ± 3.8
Control	32	38.2 ± 5.9	

In exposed workers the maximal motor conduction velocities (MCV) were measured on both peroneal and both tibial nerves by means of surface electrodes with one channel "Dissa" electromyograph, according to the routine method of Hodes and co-workers[4]. In the present investigation rheography was used as a suitable method for field research. Peripheral blood vessels in upper and lower extremities were examined by means of a portable Schufried rheograph.

Blood pressure was measured at the same time, and it was also evaluated from the records of the periodical medical investigation during the last two years.

Phospholipids and neutral fats in blood were determined by Boehringer tests.

The same tests were performed in the control subjects, but rheographic investigation was not carried out.

RESULTS

The mean values of MCV with standard deviation for both peroneal and both tibial nerves are presented in Table 2. According to numerous previous measurements performed at the Institute the value of 45 m/sec was established as the lower normal limit for MCV. In the present study the lowest mean MCV values were registered in Group III, especially for the right tibial nerve. There was no significant difference in mean values between Group I or II and control group (except for the left peroneal nerve). A significant difference for all examined nerves existed between Group III and control group ($p < 0.02 - 0.001$) and between Group III and Group I ($p < 0.02 - 0.001$). The MCV of the tibial nerve in Group III was significantly decreased in relation to Group II. In some

TABLE 2
Maximal motor conduction velocity in m/sec ($\bar{X} \pm$ S.D.).

Group	Peroneal nerve		Tibial nerve	
	right	left	right	left
I	47.4 ± 7.3	50.5 ± 6.5	51.6 ± 8.6	49.9 ± 8.4
II	47.6 ± 6.1	45.3 ± 5.6	51.4 ± 8.5	49.1 ± 6.6
III	44.6 ± 5.6*	45.7 ± 6.1***	41.2 ± 10.0***	45.0 ± 7.3**
Control	48.9 ± 7.1	51.0 ± 4.9	50.5 ± 4.1	51.8 ± 9.6

Group III to control group: * $p < 0.02$, ** $p < 0.005$, *** $p < 0.001$

cases we observed a small difference in values obtained on the left and right side. The frequency of cases with reduced MCV in examined groups is presented in Table 3. It is obvious that the frequency of changes increased with the duration of exposure. However the expressed reduction of velocity under 40 m/sec appeared mostly in Group III (36% of subjects). There was a significant difference in the frequency of reduced conduction in all exposed groups in relation to the control group ($p < 0.05 - 0.001$). A marked difference existed also between Group III and Group I ($p < 0.01$). The difference between Groups III and II was at the border of statistical significance.

TABLE 3
Frequency of subjects with decreased MCV.

Group	MCV (m/sec)		
	40–45	<40	Total
I	21.0	9.3	30.3
II	34.6	7.6	42.2
III	32.0	36.0	68.0
Control	9.3	—	9.3

Table 4 shows the results of rheographic examination of arms and legs. Functional changes of peripheral blood vessels were established in all exposed groups. In Group I the functional changes manifested themselves as hypotonia

TABLE 4
Rheographic findings in examined groups.

Group	Arms				Legs			
	hypertonia		hypotonia		hypertonia		hypotonia	
	N	%	N	%	N	%	N	%
I N = 32	–	–	7	21.8	–	–	3	9.3
II N = 26	8	30.7	1	3.8	3	11.5	4	15.4
III N = 25	11	44.0	2	8.0	5	20.0	3	12.0

more in arms than in legs. Not one case of hypertonia was observed. On the other hand, in Groups II and III the hypertonia in arms was more pronounced than hypotonia. The greatest percentage of cases with hypertonia in arms was recorded in Group III. Only in sporadic cases did we observe a decrease in elasticity of blood vessels or organic changes.

Table 5 shows the mean values of blood pressure and the percentage of cases with hypertension. The mean value of the systolic as well as diastolic pressure increased with the duration of exposure, but also with increase of age. Statistical evaluation did not show any significant difference among the exposed groups in relation to the control group. The cases with hypertension were most frequent in Group III in relation to the other exposed group and the control group. However, the difference in the percentage was not at the level of statistical significance because of the relatively small number of cases.

TABLE 5
Percentage of subjects with hypertension.

Group	Hypertension %	Blood pressure in mm Hg ($\bar{X} \pm$ S.D.)	
		Systolic	Diastolic
I	6.2	121.4 ± 8.3	80.0 ± 7.2
II	23.0	131.5 ± 13.9	86.1 ± 10.1
III	40.0	139.2 ± 15.7	90.2 ± 12.1
Control	17.9	133.7 ± 16.9	86.6 ± 10.5

Table 6 shows the mean values of phospholipids and neutral fats in blood. The highest values of phospholipids and neutral fats were found in Group III.

TABLE 6
Phospholipids and neutral fats in blood (mg/100 ml).

Group	Phospholipids ($\bar{X} \pm$ S.D.)	Neutral fats ($\bar{X} \pm$ S.D.)
I	208.1 ± 39.9	136.4 ± 96.0
II	241.6 ± 49.5	162.8 ± 59.8
III	270.8 ± 62.9	196.4 ± 82.9
Control	254.0 ± 56.0	137.3 ± 56.8

DISCUSSION

The changes of the peripheral nervous system expressed as reduced MCV values were usually the first to be found in exposed subjects. Among all the impairments they were by far the most frequent (47%). This phenomenon appeared in some workers after a short exposure of only two years. In these cases the decrease of the conduction velocity was moderate and mostly evident in both nerves. In spite of the fact that these changes appeared after a short exposure it seems that their further development was relatively slow. With the duration of exposure up to approximately ten years the number of changes increased but the obtained values were still moderate. Only in workers exposed for more than 11 and 15 years a pronounced decrease of MCV appeared in about one third of cases. In this phase the clinical symptoms of polyneuropathy became evident. In the beginning of investigation MCV was also determined on the nerves of upper extremities (ulnar, radial and median). We did not find any case with decreased MCV values. This fact suggests that CS_2 affects predominantly the lower extremities. Our observations are in accordance with the results obtained by other authors[6,11]. It is interesting to note that the authors from Finland obtained similar results in workers exposed to lower CS_2 concentrations.

A lack of the control group made the interpretation of rheographic results more difficult, but some facts are worthwhile mentioning. This time, as before, the rheographic investigation did not reveal organic changes of peripheral blood vessels even in workers with exposure of more than 15 years[7,10]. The findings suggest that CS_2 does not produce organic changes on the peripheral vessels, or they are so moderate that they can not be revealed by this method. Functional changes of peripheral blood vessels were found in 35% of examined workers.

These changes were more frequent in the upper extremities than in the lower ones, and in this respect they are different from the changes of the peripheral nerves. In workers with a short exposure the changes were manifested exclusively by hypotonia. On the other hand in longer exposure hypertonia was dominant, and its frequency increased with the duration of exposure.

It is difficult to evaluate the role of CS_2 in the development of functional changes. We suppose that the toxic action of CS_2 involved in the tonus regulation of blood vessels could disturb the tonus. It is more certain that CS_2 shows a selective action on the cerebral blood circulation. The rheoencephalographic investigation recently performed in a group of workers aged up to 50 years, once poisoned with CS_2, revealed in about 70% of examined persons abnormalities, most probably of the atherosclerotic type. These results are in accordance with the findings of other authors[2,8]. Hypertension was found in 22.2 per cent of all examined workers. It was especially pronounced in the group with the longest exposure where every second worker had hypertension. However, even in this group hypertension was moderate and mostly diastolic pressure was increased (95–110 mm Hg). We also compared the frequency of hypertension in workers from staple cell production with the hypertension in workers from the viscose yarn production. The duration of exposure and age were identical for both groups. The difference of 20% to 40% suggests an important role of CS_2 in the development of hypertension.

The lipid changes came second in the frequency of obtained results. The increase of lipids appeared before hypertension which is of interest especially for the group of workers with the longest exposure. We compared the obtained data to find out correlation among them. We compared functional changes of blood vessels with hypertension, lipid values with hypertension, phospholipids with changes in the peripheral nerve system.

CONCLUSION

Measurement of MCV revealed a considerable number of changes even in workers with a short duration of exposure. It is suggested that the method be used as a routine investigation in control of the health of workers exposed to CS_2. Rheographic investigation did not reveal changes in peripheral blood vessels, even in workers with the longest duration of exposure.

Hypertension and disturbances in the metabolism of lipids were found in workers after ten years of exposure. All established changes showed a correlation with the duration of exposure so that the most pronounced clinical symptoms belonged to the workers with the longest exposure. This fact has to be considered when a decision about maximal permissible years of work in places with CS_2 hazards is to be made.

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