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INFLUENCE OF CARBON DISULPHIDE ON ENZYMES REGULATING CARBOHYDRATE METABOLISM

B. KARAKAŠEVIĆ, V. DELIĆ, A. GRUJIN,
LJ. GRAOVAC-LEPOSAVIĆ and A. VIDAKOVIĆ
Institute of Occupational and Radiological Health, Belgrade, Yugoslavia

ABSTRACT

Certain effects of CS_2 could be explained by inhibition of some enzymic systems which are involved in the metabolism of carbohydrates.

The activities of lactate dehydrase (LDH), glutamate dehydrase (GLDH), sorbitol dehydrase (SDH) and the level of lactate and pyruvate in blood were determined in a group of 78 exposed workers and 56 subjects removed from the exposure after poisoning.

The results show various changes in the activity of the studied enzymes suggesting a disturbance of carbohydrate metabolism in exposed workers.

The development of vascular and neurotoxic effects in chronic carbon disulphide poisoning is not fully clarified. Savić and Hockwin[4] studied the biochemical changes in the eye of experimental animals exposed to CS_2. They established an inhibition of the following enzymes: aldolase, malate dehydrogenase, glutamate-oxalate transaminase, hexokinase, glycerokinase and pyruvate kinase. On the other hand, vascular changes in overt chronic sulphocarbonism resemble in many aspects diabetic angiopathy.

The aim of this study was to study the activity of some enzymes involved in the metabolism of carbohydrates in workers exposed to CS_2.

SUBJECTS AND METHODS

The investigation was carried out in 134 workers from a viscose factory. They were divided in four groups according to the duration of exposure to carbon disulphide: Group A – 37 workers with exposure up to 5 years, Group B – 16 workers with exposure from 6 to 10 years, Group C – 25 workers with exposure from 11 to 25 years, and Group D – 56 workers once previously poisoned with CS_2 and then transferred to non-exposed jobs ("invalids").

The investigation included the determination of blood pyruvate[1] and lactate concentrations[3], as well as the determination of the enzymes: lactate

dehydrogenase (LDH) by the method of Wroblevski and co-workers[6], sorbite dehydrogenase (SDH) by the method of Gerlach[2] and glutamate dehydrogenase (GLDH) in serum by the method of Schmidt[5].

RESULTS AND DISCUSSION

The concentrations of lactate and pyruvate found in blood and LDH activities are presented in Table 1.

TABLE 1
Pyruvate and lactate concentrations in blood and LDH activities in serum ($\bar{X} \pm$ S.D.).

Group	N	Pyruvate (mg/100 ml)	Lactate (mg/100 ml)	LDH (mU/ml)
A	37	0.4 ± 0.1	8.0 ± 4.8	163.7 ± 39.7
B	16	0.52 ± 0.15	8.3 ± 2.2	179.6 ± 32.7
C	25	0.66 ± 0.24	10.3 ± 2.0	153.9 ± 30.6
D	56	0.42 ± 0.24	9.9 ± 5.0	145.8 ± 66.5

The mean values for pyruvate in all examined groups were within the normal limits. However, analyzing individual results we found increased pyruvate concentrations in 56 per cent of workers in Group C, in 35 per cent of workers from Group A and in 30 per cent of workers from Group D.

The mean lactate concentrations were also within normal limits. There were no significant differences between the observed groups. Analysing the individual results we found a decreased level of lactate in blood in 71 per cent of workers from Group A, in 29 per cent from Group C and in 50 per cent from Group D.

The activity of LDH did not change significantly with increased duration of exposure. However, according to individual values, in 37 per cent of workers with the longest exposure (group C) we found a lowered LDH activity. Among invalids (group D) a decreased LDH activity was evident in 53 per cent of the subjects.

Pyruvate represents an intermediary product in the process of anaerobic glycolysis (Embden – Meyerhoff path), or to be more precise, the final phase of the process. In the conditions of normal oxydation the process continues its pathway over CoA, acetyl CoA into the Krebs cycle. In anaerobic conditions by activation of the enzyme lactate dehydrogenase, the process develops in the sense of the production of lactic acid.

Decreased concentrations of lactate in a high percentage of examined workers as well as decreased activities of the enzyme lactate dehydrogenase, suggest that the glycolytic process from pyruvate does not develop in the direction of lactate production. This is supported by the established increase of pyruvate.

The activities of enzyme sorbitol dehydrogenase and glutamate dehydrogenase are presented in Table 2.

TABLE 2
SDH and GLDH activities in serum ($\bar{X} \pm$ S.D.).

Group	N	SDH (mU/ml)	GLDH (mU/ml)
A	37	0.67 ± 0.70	0.43 ± 0.26
B	16	0.80 ± 0.71	0.61 ± 0.54
C	25	0.20 ± 0.26	0.62 ± 0.54
D	56	0.70 ± 0.90	0.69 ± 0.64

In all examined groups the activity of enzyme SDH was increased. In group C the mean SDH value was normal, but in 33 per cent of individual cases an increase was evident.

The increased SDH activity in the examined workers is a sign that the process has developed in the sense of fructose production, which indirectly means pyruvate production.

The mean activities of the enzyme glutamate dehydrogenase were within normal limits in all examined groups. From the individual values an increase in the activity was evident in relation to the duration of exposure: in invalids the activity was increased in 28 per cent of the subjects, in Group A in 67 per cent, in Group B 63 per cent and in Group C 33 per cent.

The increased GLDH activity in the examined workers suggests that the process of biotransformation of aminoacids in the Krebs cycle has been activated.

CONCLUSION

The pyruvate and lactate concentrations in blood as well as the activities of the enzymes LDH, SDH and GLDH in serum suggest the following effects of carbon disulphide exposure: an increase in pyruvate concentration, a decrease in lactate concentration, a decrease in LDH activity, and an increase in SDH and GLDH activities.

These changes are in agreement with the suggestion that CS_2 influences the glycolytic process of pyruvate and to some extent goes in the direction of lactate production. The transformation of sorbitol to fructose is also activated as well as the biotransformation of amino acids in the Krebs cycle.

The duration of exposure to CS_2 does not seem to play an important role in these disturbances. There are, however, individual variations in the response of observed parameters.

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