Faculty of Medicine, Ain-Shams University and National Research Centre, Dokki, Cairo (Egypt)

Effect of carbon-disulfide intoxication on the levels of serum copper and ceruloplasmin

A. A. Massoud, M. F. S. El-Hawary, R. Awadallah, and E. A. El-Dessoukey

With 1 table

(Received January 19, 1977)

Carbon disulphide is widely used in many industrial processes as a solvent of fats, sulphur, oils, and most especially, in the xanthathion of cellulose for the preparation of viscose (10, 5). Carbon disulphide in vitro reacts with the amino group of the free amino acids and proteins extracted from the blood plasma or blood corpuscles to form thiocarbamate and thiozolidone (14). Cohen et al. (2) presented the hypothesis that chelation of copper ions by dithiocarbamate and thiozolidone, produced during the biotransformation of carbon disulphide in the body, disturbs cellular metabolism and leads to cell injury.

Copper is an essential component of several critical tissue oxidases as aminolevulinic acid dehydrase, dopamine beta oxidase, and monamine oxidase. The chelate thiocarbamate and thiozolidone make copper less available for essential enzyme function (16). Dopamine beta oxidase inhibitor was possible as it was blocked in vivo by diethdithiocarbamate (17).

Different authors also studied the effect of carbon disulphide on serum ceruloplasmin. Andruszak (1) reported that in men exposed to carbon disulphide the serum ceruloplasmin level was essentially the same as in controls. Serum copper and ceruloplasmin of rats were not affected by inhalation of 3 mg CS₂/1 for 3 weeks, while inhalation of 0.1 mg CS₂/1 for 13 weeks depressed blood serum copper and ceruloplasmin. Inhalation of 0.01–0.05 mg CS₂/1 for 9 weeks increased excretion of copper in faeces (7).

The aim of the presented work is to study the levels of serum copper and ceruloplasmin changes after intramuscular injection of carbon disulphide in rats for different periods. Such changes might be of help in explaining such derangement due to carbon-disulphide intoxication.

Materials and methods

A. Experimental materials

The animals chosen for this work were the albino rats. The rats were maintained on a stock colony diet consisting of bread, milk, and carrots and were allowed to eat at libidum. The material of this study comprised 80 rats of both sexes weighing 150–200 gm, they were kept under observation for about 15 days before the onset of experiments to exclude any intercurrent infection.
Table 1. Levels of serum copper and ceruloplasmin in controls and carbon-disulphide-intoxicated rats.

<table>
<thead>
<tr>
<th>Const.</th>
<th>Control</th>
<th>Carbon-disulphide intoxication</th>
<th>Stopp. inj. for 20 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>10 inj.</td>
<td>20 inj.</td>
</tr>
<tr>
<td>Copper</td>
<td>97.0</td>
<td>112.0</td>
<td>107.0</td>
</tr>
<tr>
<td>S.E. ±</td>
<td>4.60</td>
<td>5.78</td>
<td>7.59</td>
</tr>
<tr>
<td>P</td>
<td>0.05</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Cerulopl.</td>
<td>Mean</td>
<td>437</td>
<td>471</td>
</tr>
<tr>
<td>S.E. ±</td>
<td>15.84</td>
<td>16.76</td>
<td>22.09</td>
</tr>
<tr>
<td>units</td>
<td>0.15</td>
<td>0.15</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The rats were divided into six groups each of ten rats, and were daily intramuscularly injected with 0.05 ml of \( SC_2 \) in 0.02 ml olive kernel oil/rat over a period of 50 days. Every 10 days, one group was killed by decapitation and blood serum was collected for analysis.

Carbon-disulphide injection was stopped 20 days for group VI after the 50 injections of the experiment to test for the extent of regression of the developed biochemical derangements.

Twenty rats of the same weight were included fed on the same diet, injected with 0.2 ml olive kernel oil alone as controls. A number of these control rats were sacrificed on the same day on which the different groups of rats receiving carbon disulphide were decapitated.

B - Methods

1 - Serum copper was determined by atomic absorption spectrophotometer method described by Sinaha and Gabrieli, (13).

2 - The ceruloplasmin oxidase activity was determined by the method of Ravin (11), which is based on the measurement of the rate of oxidation of p-phenylene diamine by ceruloplasmin.

Calculation used in the determination of ceruloplasmin

The conversion factor used by Ravin (11) is not applicable to this work, since the conditions are different. To obtain the whole figures, we adopted the method used by Henry et al., (8) in which the net optical density is multiplied by 1000, and ceruloplasmin expressed in units.

Results and discussion

The results of the present work indicate that in control rats the mean serum copper and ceruloplasmin were found to be 97.0 ± 4.60 \( \mu g/\% \) and 437 ± 15.84 units, respectively.

Intramuscular administration of carbon disulphide for the different period caused a slight increase of serum copper and ceruloplasmin levels occurred on groups I and II. Their values were found to be lower in group III, and the decrease was aggravated by prolongation of intoxication.

The observed drop in serum copper and ceruloplasmin may result if restricted mineral uptake due to decreased food consumption as a sequence of loss of appetite. El-Shobaki et al. (6) observed the loss of appetite of rats under the effect of carbon-disulphide intoxication, while Massoud