

THE EFFECT OF DEUTERIUM DEPLETED WATER ON SOME BLOOD PARAMETERS

EFFECTUL APEI UȘOARE ASUPRA UNOR PARAMETRI SANGVINI

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In the present study, we have observed the effect of deuterium depleted water (DDW) on some blood parameters at rats. We used Wistar rats, whom we administered cadmium chloride in single dose (20 ppm/body weight). Following the intoxication with cadmium chloride, oxidative stress was induced upon the rats, which was reflected also on the blood parameters. We observed, that deuterium depleted water, administrated to rats preventively, as well as after the cadmium chloride intoxication, has an antioxidative effect, helping to restore the white blood cell formula.

Key words: deuterium depleted water, cadmium, white blood cell formula, rats

Introduction

The air we breathe in large cities contains most of the times a very large quantity of cadmium. The existence of cadmium in the atmosphere is due to industrial pollution, pollution caused by vehicles and even cigarette smoke. This is a dangerous pollutant with a potential cancer building factor, [1]. The oxidative stress produced by Cd on the organism was distinguished in many studies [2,3]. Cd produces oxidative stress indirectly by inactivating the thiol compounds (SH), thus inhibiting the antioxidative defence [4,5], modifying the white blood cell formula.

The natural water is a mixture of H₂O and D₂O, the ratio between the hydrogen and deuterium atoms (R=H/D) being approximately 150 ppm (parts per million). The deuterium depleted water is the water where the isotopic ratio R is smaller than 80 ppm. It has been noted, that a decreasing quantity of deuterium in drinking water has favourable effects on the organism, one of these being that it quickens the elimination of cadmium, [6].

The aim of this work was to study the efficiency of deuterium depleted water (DDW – light water) in counteracting the negative effects produced by cadmium on the white blood cell formula at rats.

In this study we used deuterium depleted water, with a deuterium content of 30 ppm as protection against the toxicity of cadmium; we observed the effects of deuterium depleted water given preventively, as well as as treatment for organisms intoxicated with cadmium.

One can consider, that this study observes the qualitative modifications of the white blood cell formula at rats, the cause being the toxicity of cadmium (heavy metal), given as cadmium chloride.

Materials and Methods

The experiment was carried on 48 male rats with a body weight between 250-300 g. The rats were divided into four groups of 12 individuals each. The experiment began after an accommodation period, all the groups being held in physiological conditions for 61 days.

The fodder received was a mixture of cereals (40% corn, 40% wheat, 10% sunflower) – dry food. Half of the groups consumed natural water (tap water with a deuterium content of 150 ppm) ad libitum, while the other half received deuterium depleted water (30 ppm deuterium) instead of natural water.

Group 1 – control group receives dry food and natural water during 61 days.

Group 2 – receives dry food and deuterium depleted water during 61 days.

Group 3 – receives dry food and natural water during 30 days, on day 30 we administrate CdCl_2 (20 ppm/Kg b.w.) in single dose, through gastric intubation, and after, they receive food and natural water for another 30 days.

Group 4 – receives dry food and deuterium depleted water during 30 days, on day 30 we administrate CdCl_2 (20 ppm/Kg b.w.) in single dose through gastric intubation, and after, they receive food and deuterium depleted water for another 30 days.

Blood samples were collected from each group, by cardiac puncture, before the intoxication with cadmium (on the 30th day from the beginning of the experiment), after 24 hours from the intoxication with cadmium chloride and again after another 30 days from the intoxication (at the end of the experiment).

The white blood cell formula was determined using the May-Grunwald Giemsa coloring method (Pappenheim panopticon), [7].

Results and Discussions

In the groups that received natural water, the white blood cell formula was thus modified:

At 24 hours after the intoxication with cadmium (L3 (day 31)) we noticed: an decrease of the eosinophile concentration by 74.36%, an increase of the neutrophile concentration by 48%, a decrease of the monocyte and lymphocyte concentration by 40.6%, and 1.81%, as the control group (L1).

After another 30 days from the administration of the cadmium chloride (L3 (day 61)) we noticed: an increase of the eosinophile concentration, back to the initial

value, and an increase in the monocyte concentration, back to the initial value of the control. The values of the neutrophile and lymphocyte concentrations remained approximately constant throughout the 30 days from the intoxication, but within normal limits, according to the literature, [8].

The groups that received deuterium depleted water, the white blood cell formula was thus modified:

After 30 days of pre-treatment with deuterium depleted water, we noticed an increase in the eosinophile concentration by 76.92%, the neutrophile concentration by 28%, the monocyte concentration by 27 % and a decrease of the lymphocyte concentration by 15%, as the control, these values being still within the normal limits, according to the literature, [8].

24 hours after the intoxication with cadmium (L4 (day 31)) we noticed: a decrease of the eosinophile concentration by 30.43%, as the group L2 (pre-treated with deuterium depleted water), an increase of the neutrophile concentration by 71.12%, as the control , and by 35.23% as the group 2, an increase of the monocyte concentration by 143.56% as the control, a decrease of the lymphocyte concentration by 49.7% as the control. The values of the lymphocyte concentration decrease below normal values 24 hours after the intoxication with cadmium, [8].

After another 30 days of treatment with deuterium depleted water (L4 (day 61)), the values of the eosinophile concentration have increased way past the initial values of the control, by 128.2%, the neutrophile concentration remained approximately constant (from 47.4% to 48.1%), maintaining itself over normal values, the monocyte concentration decreased to the initial value of the group pre-treated with deuterium depleted water (L2), by 29.7% than the control, and the lymphocyte concentration had a slight increase by 8.04%, without reaching the initial value, the normal value according to [8]. The basophile concentration remains constant throughout the experiment.

The average values of the white blood cell components are presented in table 1 and figure 1.

Table 1.

Average values of the white blood cell components in male rats intoxicated with CdCl₂ and treated with deuterium depleted water

	L1 (H ₂ O)	L3(31z) H ₂ O +Cd	L3(61z) H ₂ O+Cd + H ₂ O	L2 DDW	L4(31z) DDW+Cd	L4(61z) DDW+Cd+ DDW
Eosinophiles (%)	1.95	0.5	2	3.45	2.4	4.45
Neutrophiles (%)	27.7	41	41.5	35.05	47.4	48.1
Basophiles (%)	0.25	0	0	0	0	0
Monocyte (%)	5.05	3	5.2	6.45	12.3	6.55
Limfocyte (%)	65	55.4	56	55	37.9	40.95

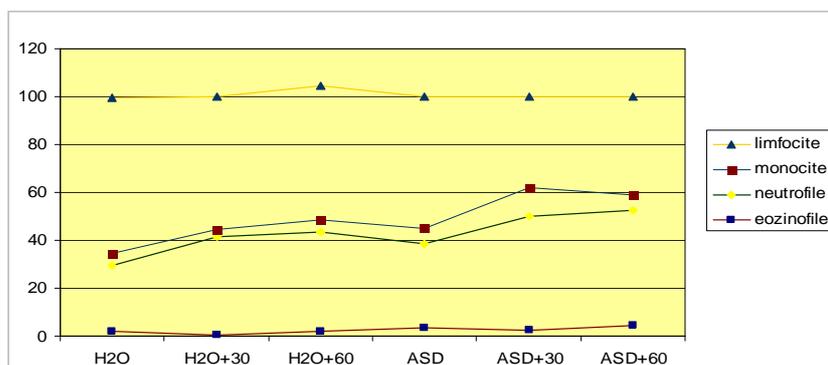


Fig.1. The variation of the average values of the white blood cell components in rats intoxicated with cadmium chloride and treated with DDW

From a medical point of view, the modifications that occurred in the white blood cell formula indicate a white blood cell reaction unrolled in three phases, as in any disease: one neutrophilic battle phase (characterized by an increase of the neutrophile concentration and a drop of the eosinophile concentration after the intoxication with cadmium), a monocyte battle phase (characterized by an increase in the neutrophile concentration and the monocyte concentration) and a curing phase (characterized by an increasing eosinophile concentration and decreasing lymphocyte concentration, implicating the fact, that the disease has a favourable evolution, being in a recovering process).

These phases are very well respected within the groups that received deuterium depleted water, which means, that in there case, the water had a curing role. For the groups that received natural water, the monocyte concentration decreased 24 hours after the intoxication, increasing afterwards, having a reverse variation than when administrating deuterium depleted water. The drop of the lymphocyte concentration is more evident in the groups that were pre-treated with deuterium depleted water.

Stress situations through the vegetative nervous system induce granulocytosis and lymphocytosis in the blood circulation by mobilising the leucocytes and lymphocytes from their storage organs; - stimulating the anterior hypophysis having the result the increase of cortisone production, which determines an increase of the eosinophile concentration, and a decrease of the trombocyte and reticular cell concentrations. Stress situations, as well as intoxications can lead to a redistribution of the blood in the periferic circulation, as well as in other territories, such as: lungs, liver, kidney, digestive tube, mucouse membranes.

By administrating deuterium depleted water, the neutrophile and monocyte concentration increased, which increased the activity of the antioxidant enzymes (there is a strong bond between the function of the fagocitary system, fullfilled by neutrophiles and monocytes, and the antioxidant enzymes) [9,10].

Conclusions

- Administering the cadmium chloride causes large variations (some over 100%) 24 hours after administration, of the white blood cell components in all groups.
- The experiments conducted help support the theory, that light water significantly diminishes the effects of the oxidative stress and has an antioxidative effect by increasing the neutrophil and monocyte concentrations, which determine an increase of the activity of antioxidant enzymes. This is according to the literature, [9,10].
- The return of the white blood cell formula to normal values was strongly and positively influenced by the deuterium depleted water, which could impose deuterium depleted water as treatment in eliminating the effects of intoxication with cadmium.

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