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EFFECT OF LEAD ON STRUCTURAL CHANGES IN LIVER OF WISTAR RATS UNDER THE CONDITIONS OF ACUTE EXPERIMENT

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ABSTRACT — The purpose of this study was to evaluate the structural transformations of Wistar rats liver after oral administration of lead salts. Under the conditions of acute experiment during 5 days the Wistar rats were orally administered the lead acetate solution in the amount of 3 mg/kg. Histological studies were carried out at OSMU upon the completion of the experiment. Effect of toxic doses of lead causes symptoms of both steatosis and hydropic degeneration of the liver. It is assumed that the appearance of hepatic steatosis reflects the reaction of hepatocytes to hemic hypoxia caused by the action of lead, while the signs of hydropic degeneration expressed in varying degrees reflect its direct toxic effect.

KEYWORDS — lead, liver, hepatocytes, hydropic degeneration, hepatic steatosis.

RELEVANCE

In recent decades, heavy metals are increasingly frequently named as the most dangerous environmental pollutants. Their migration and redistribution in the components of ecosystems depend both on the whole complex of natural factors, and the intensity and nature of technogenesis. Lead is not a vital element. It is toxic and belongs to danger class I. Its inorganic compounds interfere with the metabolism and are the enzymes inhibitors (like most of the heavy metals). One of the most insidious consequences of the action of inorganic lead compounds is its ability to accumulate in a number of organs, including the liver, and to be a constant source of poisoning for a long time. The main source from which lead enters the body, is the food, and also the inhaled air plays the important role. Absorption in the gastrointestinal tract is up to a 5–10% in adults, and 50% in children. Thus, there is a need to assess the toxic effect of lead.

The purpose of this study:
to evaluate the structural transformations in the liver of Wistar rats after oral administration of lead salts.

METHODS

20 male Wistar rats aged 4–5 months, weighing 200–220 g were divided into an experimental and control group — 10 rats in each group. The rats were maintained in standard cages under regular daily alternation of light and darkness, temperature 20–22° C and free access to water and food. The studies were carried out in in compliance with the CIOMS-ICLAS International Guiding Principles for Biomedical Research Involving Animals.

Under the conditions of acute experiment during 5 days the Wistar rats were orally administered the lead acetate solution in the amount of 3 mg/kg. Histological studies were carried out at OSMU upon the completion of the experiment. The cut and oriented liver acinuses were fixed in 10% neutral buffered formalin (pH = 7.2–7.4). They were dehydrated and embedded in paraffin according to conventional technique. 4–5 microns thick paraffin sections were stained with hematoxylin and eosin. Ziehl-Neelsen method (detection of fuchsinophile acid resistant intranuclear inclusions) by Lily's formulation (1969) was used to identify lead pellets in a complex with protein deposits in the form of intranuclear inclusions in the cells of renal tubule. Sections were stained with carbol fuchsin (dissolve 25 g of phenol in 50 ml alcohol, then in 5 g of basic fuchsin, fill with distilled water to 500 ml) over a fire until the vapor (4–5 minutes), then the glass was cooled down and colorant drained. Rinsing was performed in running water with differentiation in a 5% solution of sulfuric acid, followed by counterstaining with methylene blue. Pearls reaction was used to identify hemosiderin.

RESULTS

The following data were obtained after the analysis of liver micropreparations of the experimental animals. During an acute experiment in lead poisoning conditions, the signs of hydropic degeneration in the hepatic tissue were observed from the very first day of the experiment. Predominant changes were observed in centrolobular localization hepatocytes, while

proteinosis, recognizable in the light microscope by the irregular cytoplasm (crumpled up paper symptom) was represented unevenly, in the form of peculiar nests. Plethora of central veins and expansion of adjacent sinusoids were observed, and the said changes were already significantly expressed at day 3 or more of the experiment (fig. 1).

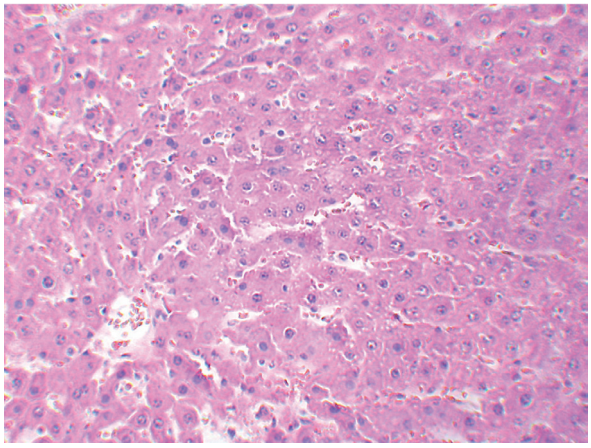

Fig. 1. *Lead poisoning. Dilatation and congestion of central segments of sinusoids. Haematoxylin and eosin staining. ×270*

Signs of proteinosis were characterized by a greater area of distribution covering even the peripheral parts of the acinus. The dystrophy in some hepatocytes of centrolobular localization was expressed up to a balloon type, with the cells with signs of colliquative necrosis (fig. 2).

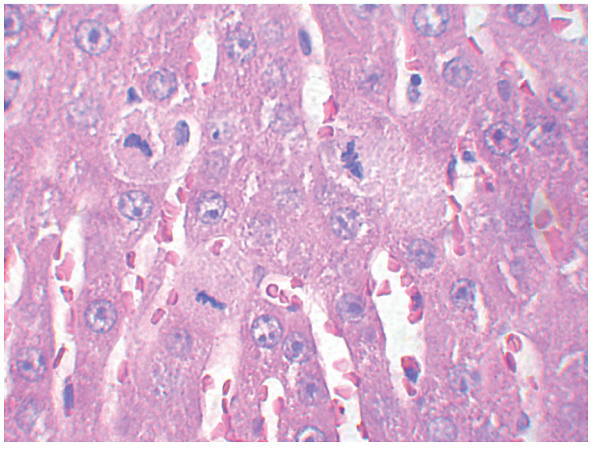

Fig. 2. *Acute lead poisoning. Dilatation and congestion of sinusoids. Coagulative necrosis of hepatocytes, mitoses. Haematoxylin and eosin staining. ×900*

The lumen of the sinusoids and perisinusoidal space was marked with the appearance of hepatic macrophages — Kupffer cells as a rule arranged in groups up to 5–8 cells (fig. 3).

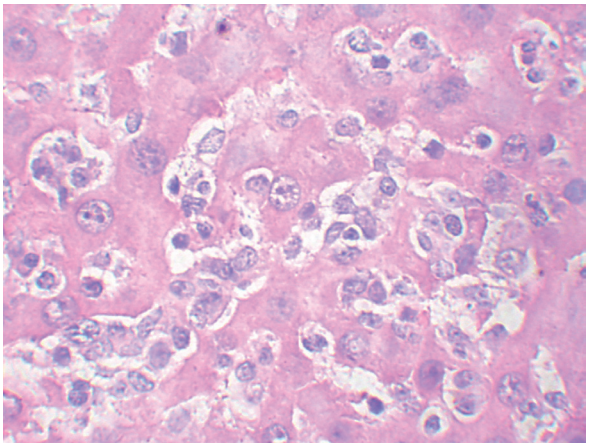

Fig. 3. *Hepatic tissue amid acute experiment of lead poisoning. Clustering of Kupffer cells in congested dilated sinusoids, regenerative transformation of hepatocytes. Haematoxylin and eosin staining. ×900*

By the end of the experiment the majority of the formulations had the signs of not only proteinosis, but also steatosis with small-drop character and represented diffusely in liver acinus (fig. 4).

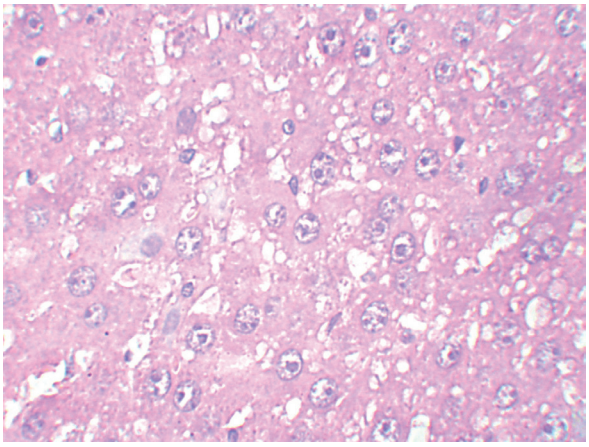

Fig.4. *Lead poisoning. Disseminated small-droplet fatty degeneration of hepatocytes. Coagulative necrosis of certain cells. Haematoxylin and eosin staining. ×900*

Hepatocytes with regenerative changes, hyperchronia of cores with increased size, appearance of binuclear hepatocytes were also observed, mitosis was rarely observed.

CONCLUSION

The effect of toxic doses of lead results in symptoms of both hepatic steatosis and hydropic degeneration of the liver. It is assumed that the appearance of steatosis reflects the reaction of hepatocytes to hemic hypoxia caused by the action of lead, while the signs of hydropic degeneration is expressed in varying degrees reflect its direct toxic effect.

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