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EFFECT OF LEAD ACETATE ON THE MICROANATOMY OF CEREBELLUM IN ALBINO RATS

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Abstract: Lead is a common industrial poison that persists in the environment and has many toxic effects on different organs & tissues especially on the central nervous system. This study aimed to investigate the effects of lead administration on cerebellar cortex of adult male albino rats.

Methods: Eleven male albino rats, (150g - 200 g weight) were divided into two groups, 4 in one group (Control Group) and 7 in other (Experimental Group). In the control group rats were normal diet, experimental group of rats were given, in addition to normal diet, 30 mg/ kg of lead acetate dissolved in water orally daily for six months.

Results: By light microscope, in rats treated with lead, the number of Purkinje cells showed a significant decrease in comparison to control group, and appeared shrunken, distorted in shape with irregular nuclei.

Keywords: Lead acetate, cerebellum, albino rats, Purkinji cell

Introduction

Lead acetate [$Pb(CH3COO)_2$], also known as plumbus acetate, sugar of lead, salt of saturnor Goulard's powder, is a white crystalline chemical compound with a slightly sweet taste[1].Like many other lead compounds it is toxic.Lead acetate is soluble in water and glycerine.Lead acetate is used as a reagent to make other lead compounds and as a fixative for some dyes. In low concentrations, it is the principal active ingredient in progressive types of hair dyes[2].It is

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also used as a mordant in textile printing and dyeing and as a drier in paints and varnishes.[3] Lead acetate was historically used as a sweetener[1] and for cosmetics.

Acute lead poisoning usually occurs with high doses of lead acetate. It starts with burning and dryness in the throat, salivation and intense thirst. Vomiting may occur within 24 hours, with a colicky pain and tender abdomen. Constipation is a common feature and urine is scanty. There may be headache, insomnia, paresthesia, depression, convulsions, exhaustion, finally peripheral circulatory collapse and coma leading to death. Lead toxicity is a hazard with the potential of causing health effects which may affect the nervous, hematopoietic, hepatic and renal systems, eliciting various disorders.[2] The mechanism of toxicity common to all toxic metals, including lead, is via oxidative stress leading to production of lipid peroxidation (LPO) secondary to generation of free radicals in the tissues.

Sub-acute poisoning occurs due to repeated small doses of lead acetate. A blue line is seen on the gums, along with gastrointestinal symptoms. Urine is scanty and deep red in colour. During the later stages, nervous symptoms become prominent with numbness, cramps and flaccid paralysis of lower limbs. Death is rare but can occur after convulsions and coma.[4, 5]

Aim of the study

To study the effect of toxic doses of leadacetate on cerebellum of male albino rats

MATERIALS AND METHODS;

The present experimental study was conducted in the Post Graduate Department of Anatomy, Government Medical College Srinagar after obtaining the ethical clearance from the institutions ethical committee. 11 adult albino rats, weighing on an average 150-200 grams, were taken from the Animal House of the college. The animals were divided into two groups after randomization. Eleven albino rats, (150 g to 200 g weight) were divided into two

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groups, four rats in one group (control group) and seven rats in another group (study group). In the control group rats received normal diet and adequate water daily. In the 2nd group (study group) rats were given 30 mg/ kg body weight lead acetate dissolved in water orally daily for six months, as per the following schedule

Group A: (n= 4) of Four rats served as control. They were fed normal diet like gram, vegetables and plain tap water.

Group B: (n=7), Seven rats received normal diet and lead acetate solution 30mg/kg body weight.

These processes of administration of these ingredients were continued for 24 weeks. The animals were sacrificed after anaesthetizing them with chloroform after six, 18 and 24 weeks of the experiment.

Methods: After the animals were sacrificed, the skull was opened and the two cerebellar hemispheres were removed and fixed in 10% formalin. After the fixation, the samples were dehydrated in a graded series of ethanol, and embedded into paraffin. Blocks of samples were, sectioned on a microtome 5-7 µm thick sections and stained with Haematoxylin and Eosin (H&E).

Results

Microscopic results of Control group: By light microscope: H&E stained sections of cerebellum showed normal histological structure in the form of outer molecular layer (ml) which is mainly formed from fibers with few small stellate cells and basket cells. Middle Purkinje cells in the Purkinje layer (pl) are arranged in one row of large pyriform or flask shape cells, with clear nuclei, prominent nucleoli and cytoplasm. The inner most layer contain the granular cells (gl) which are closely packed rounded small cells. (Figure 1a)

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Experimental group (Lead acetate treated group):

Light microscopic examination of Haematoxylin and Eosin-stained cerebellum sections of group B (Lead acetate) rats did not show any structural changes of the cerebellum at the end of 6th week. (Figure 1b) While sections of group B (experimental group) rats at 12 weeks showed some vacoulations (red arrow) and with pale basophilic cytoplasm (blue arrow) of the white matter of cerebellum. (Figure 1c) At 24 weeks, sections showed more vacoulations of the white matter of cerebellum and disorganisation of cellular layer of cerebellum. Also there were seen hypocellular granular cells and decreased number of Purkenje cells with elongated nuclei and acidophilic cytoplasm at the end of 24th weeks. (Figure1d)

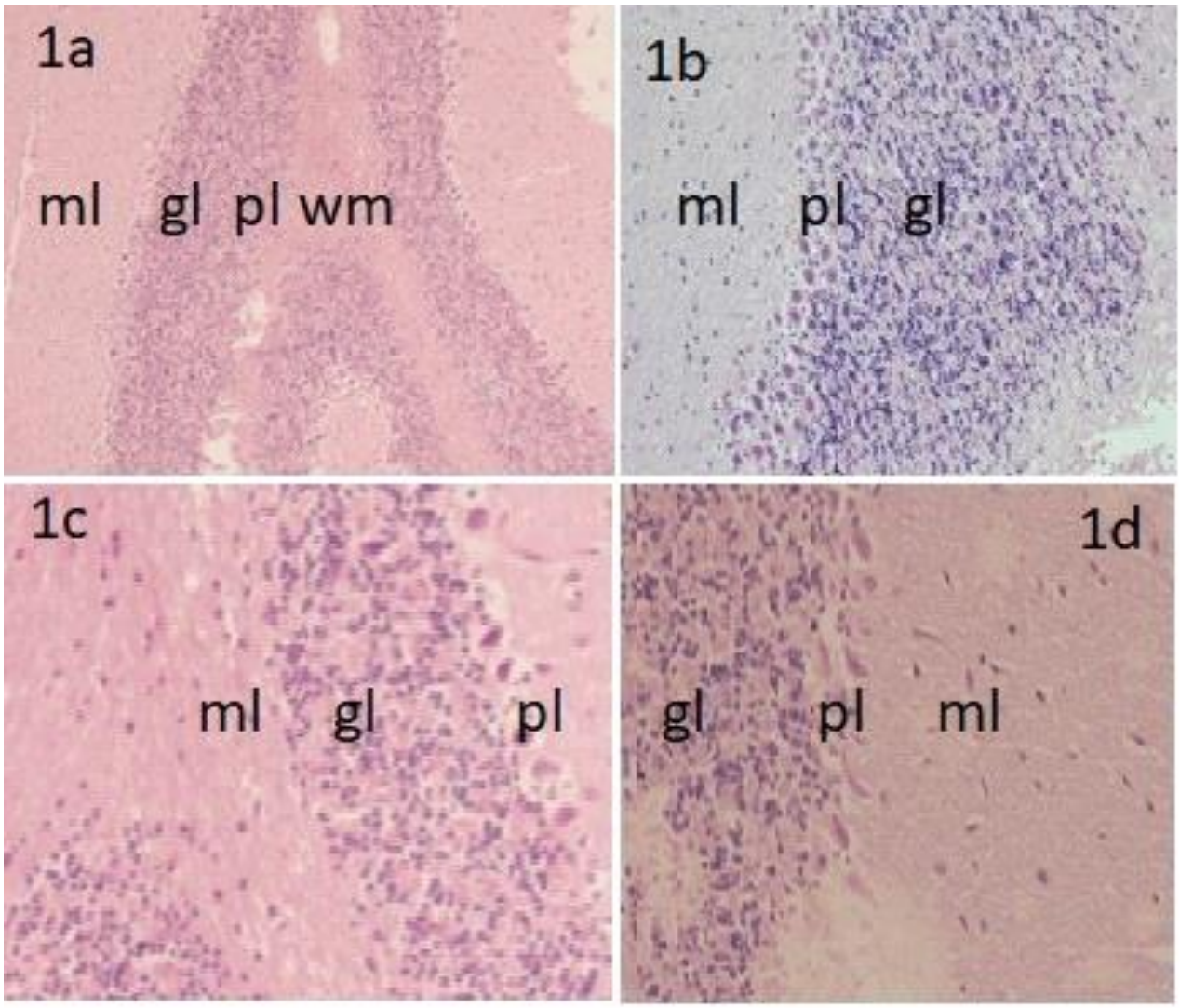

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Figure 1: Microanatomy of cerebellum of Albino rat. 1a- Normal architecture of cerebellum showing division into Granular cell layer, Purkinje cell layer and molecular layer. 1b: structure of cerebellum after six weeks of lead acetate treatment. 1c: structure of cerebellum after 18 weeks of lead acetate treatment. 1d: structure of cerebellum after 24 weeks of lead acetate treatment showing decreased Purkinji cell count with elongated nuclei (H&E Stain; .gl= granular layer, pl= Purkinji layer, gl= granular layer, wm= white mater, ml = molecular layer)

DISCUSSION

Lead toxicity is an important environmental disease and its effects on the human body are devastating. There is almost no function in the human body which is not affected by lead toxicity. Though in countries like US and Canada the use of lead has been controlled up to a certain extent, it is still used vehemently in the developing countries. This is primarily because lead bears unique physical and chemical properties that make it suitable for a large number of applications for which humans have exploited its benefits from historical times and thus it has become a common environmental pollutant. Lead is highly persistent in the environment and because of its continuous use its levels rise in almost every country, posing serious threats. This article reviews the works listed in the literature with recent updates regarding the toxicity of lead. Focus is also on toxic effects of lead on the renal, reproductive and nervous system.

Exposure occurs through various ways like inhalation, ingestion or skin contact. Direct contact of lead or lead based compounds through the mouth, nose, and eyes and through cracks of the skin may also increase lead levels. In adults, about 35–40% of inhaled lead dust is deposited in the lungs and about 95% goes into the bloodstream (Merill et al., 2007).[6] On ingestion of inorganic lead almost 15% is absorbed, however this value is higher in children,

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pregnant women and people with deficiencies of calcium, A certain amount of the lead which is generally bound in tissues like bones, teeth, hair or nails is considered to be nontoxic because of its unavailability to other tissues. The rate of absorption of lead in bones and teeth is high amounting to almost 94% in adults, while in children this rate is 70%, which allows the soft tissues to absorb more lead and thus to cause serious health consequences (Barbosa Jr et al., 2005)[7]. The half-life of lead in such tissues results in its induction into the blood stream long after the initial exposure (Patrick, 2006). Lead is also speculated to alter the permeability of blood vessels and collagen synthesis (Needlemann, 2004)[8]. Damaged activity of cells of the immune system, such as polymorphonuclear leukocytes, results in decreasing immune activity (Kosnett, 2006)[9]. One of the main reasons for lead poisoning causing anaemia is that lead interferes with the activity of an essential enzyme called delta-aminolevulinic acid dehydratase, or ALAD, which is important in the biosynthesis of heme, the cofactor found in haemoglobin (Patrick et al., 2006)[10]. Heme precursors, such as aminolevulinic acid, have been found to build up due to their interference with lead, which may be directly or indirectly harmful to neurons (Fujita et al., 2002).[11]

Histological section of the cerebellum of the rats showed mild changes in the 6th and 12th week of the leadacetate administration. With time at 24th week of the study the significant histological changes were observed in the form of shrinkage of the Purkinje cells with pyknotic nuclei. In addition of the above findings increased cytoplasmic acidophilia was also seen. Similar findings were also reported by Siddhu P et al., (2004)[12] the result of their study showed that after administering 50mg/kg body weight of leadacetate to rats for 8 weeks resulted in appearance of large spaces in between purkinje cell layer. Similar findings were also reported by Saleh S and Meligy F (2018).[13] Their study also revealed that the sections stained by H & E showed the shrinkage of the Purkinje cells with increased acidophlia. Similar findings were reported by Zulfikar N et al. (2015).[14]

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CONCLUSION

The present study proved that Lead acetate causes cytotoxic microscopic changes in the cerebellum of albino rats. The cerebellum showed shrinkage of Purkinje cells with pyknotic nuclei, increased cytoplasmic acidophilia and granular cell layer appeared to be hypocellular**.** Thus, it is suggested that in spite of lead being useful in various day to day activities, its harmful effects cannot be overlooked and people working in such areas should be cautions of adverse effects of lead.

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