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Histological study on the olfactory bulb of adult male albino rat exposed to different concentration of manganese chloride ($MnCl_2$)

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Abstract:-Manganese is named for pyrolusite and other black minerals from the region of Magnesia in Greece, which also gave its name to magnesium and the iron ore magnetite. Manganese (II) ions function as cofactors for a large variety of enzymes with many functions. Manganese enzymes are particularly essential in detoxification of superoxide free radicals in organisms that must deal with elemental oxygen. Manganese is regarded as one of the important elements for both plants and animals but sometimes when taken in heavy amount it becomes toxic in nature. Especially through inhalation, it can cause manganism, a condition in mammals leading to neurological damage that is sometimes irreversible. Manganese (Mn) is one of the trace elements that is required for human metabolisms and activity of several enzymes, but it also could induce toxic effect when it's ingested in high amount.

Keywords: olfactory bulb, histology, male albino rat, manganese chloride

INTRODUCTION

Manganese is a naturally occurring element found in rock, soil, water, and food. In humans and animals, manganese is an essential nutrient that plays a role in bone mineralization, protein and energy metabolism, metabolic regulation, cellular protection from damaging free radical species, and formation of glycosaminoglycans.[1] Manganese acts as both a constituent of metalloenzymes and an enzyme activator. Enzymes that contain manganese include arginase, pyruvate carboxylase, and manganese-superoxide dismutase (MnSOD)[2-4]. Manganese, in its activating capacity, can bind either to a substrate (such as adenosine triphosphate, ATP), or to a protein directly, thereby causing conformational changes.[5] Manganese has been shown to activate numerous enzymes involved with either a catalytic or regulatory function (e.g., transferases, decarboxylases, hydrolases). Although manganese is an essential nutrient, exposure to high levels via inhalation or ingestion may cause some adverse health effects.

Entrance of the manganese into the body usually occurs through the pulmonary route and as the constituents of the Mn enters the brain it remains there for longer period due to it its inability to get rid of it. High level of Mn intake can also lead to irreversible brain disease and the symptoms may be similar to those of Parkinson's disease.

The olfactory bulb is one of the structures located in the limbic region of the brain. It is an oval mass that lies below the anterior end of the olfactory sulcus. The olfactory bulb is supported and protected by the cribriform

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plate of the ethmoid bone, which in mammals separates it from the olfactory epithelium, and which is perforated by olfactory nerve axons. The olfactory bulb consists of a collection of nerve cells that receives impulses from the olfactory nerves of the nasal mucosa and continues as the olfactory tract [15].

MATERIAL AND METHODS

For the study of effect of manganese on the different olfactory organs of albino rat 15 adult male albino rats weighing about 180-200 g each were taken from the local market. All of these mice were kept in ventilated cages maintained on a 12:12-h dark–light cycle and provided with balanced food and water. Each of these mice was divided into 3 groups having 5 mice in each of it.

Group I:-known as control group:- the mice present in this group were fed with 1 ml of sterile saline which was given orally by a gastric tube once daily for 4 weeks.

Group II:-the mice present in this group was given $MnCl_2$ (10 mg/kg body weight) which was dissolved in 1 ml of sterile saline given orally by a gastric tube once daily for 4 weeks.

Group III:-the animals present in this group were simultaneously given $MnCl_2$ at the same doses and duration as given in group II

After completing the division of animals into groups and conduction of the experiment the experimented animals were anesthetized using intraperitoneal injection of sodium pento-barbital. After this through the left of the heart perfusion was done with fixative containing 2.5% glutaraldehyde and 4% paraformaldehyde in 0.1M phosphate buffer at Ph.7.4. The brain was then immediately extracted and the olfactory bulb was dissected for the further study.

For light microscopy the specimens of mice were

- fixed in 10% neutral-buffered formalin,
- dehydrated in ethanol
- cleared, infiltrated and embedded in paraffin wax.
- the sections were then cut in thickness of 5 ìm and finally
- stained with hematoxylin and eosin

For electron microscopy the specimens of mice were

- immersed in 2.5% phosphate buffered glutaraldehyde solution for 2 h at 4°C.
- washed with phosphate
- fixed in 1% osmium tetroxide solution for 1 h.
- specimens were then dehydrated, cleared in acetone and embedded in epoxy resin.

RESULT AND DISCUSSION

When the specimen of mice were observed under light microscope in control the species present in control group showed normal laminae olfactory nerve layer, mitral cell layer, internal plexiform layer and granular cell layer (fig1).when the ultrasections of the olfactory bulb was done it showed normal mital nerve cells with quite elomgated perikaryon with euchromatic nucleus and abundant cytoplasm containing free ribosomes amd mitochondria. In group 2 $MnCl_2$ treated animals the olfactory bulb was found to be abnormally distributed with loss of normal laminar organization. The cytoplasm was darkly stained, shrunken, small and appeared distorted (fig 2). The granule nerve cells were found disorganized and the neuropil showed vascular spaces. The nerve cells showed prominent ultra structural alterations such as accumulation of lysosomal dense bodies.

At last the animals fed with simultaneous $MnCl_2$ mild structural changes were observed in nerve cells.

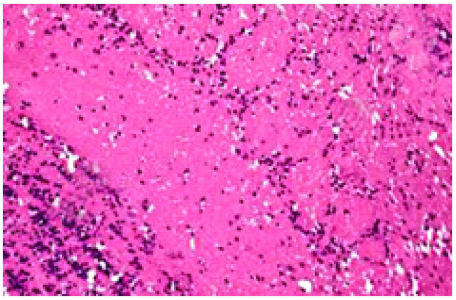

Fig : 1

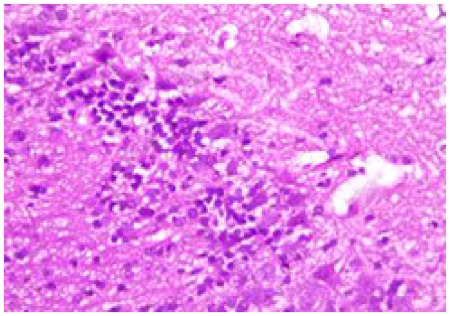

Fig: 2

The present work showed that administration of $MnCl_2$ induced structural changes in the olfactory bulb of adult albino rat in the form of loss of normal laminar organization, distortion of mitral and granule nerve cells, shrinkage of mitral cells with darkly stained cytoplasm and dark pyknotic peripheral nuclei as well as pericellular spaces and vacuolar spaces in the surrounding neuropil.

Several studies have shown that the olfactory bulb is one of the brain regions with the highest Mn concentration.[6-7]

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