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Effects of Chronic Exposure of Lead on Gonadotrophs of Pituitary in Heteropneustes Fossilis

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Abstract—*The apparent impacts of overgrowth of population are many. It has direct impact on natural surroundings, i.e. land, water air and natural resources.*

Lead is found naturally in a variety of minerals. It is most ancient poison known to man. Environmental levels of lead have increased more than 1,000-fold over the past three centuries as a result of human activity. Leafy fresh vegetables grown in lead-containing soils may have lead-containing dust on them. Children can also be exposed when the working parent brings lead dust home from work (on cloths, in hair, or on shoes, etc). Lead absorbed into the body is distributed to three major compartments: blood, soft tissues and bone.Fish readily absorbs dissolved heavy metals in the water and this serves as a reliable indicator of the extent of the pollution by these contaminants.

In this study sublethal concentration of lead acetate i.e. 3.0 mg/litre for six weeks produces alteration in the histology of gonadotrophs in fresh water fish Heteropneustes fossilis.

Keywords*: Chronic exposure, sublethal, lead, Gonadotrophs, Pollution.*

1. INTRODUCTION

Since its independence, India has come a long way having progressed in almost all sectors, but the country's uncontrolled population growth continues to overshadow all its developmental effort. For more food, it is required to generate more agricultural products by either destroying forests to use the land for cultivation or using more chemicals and fertilizers for more production. All developments will be made at the cost of degradation of natural resources besides soil water and air pollution. The major environmental problem, causing serious human suffering and threatening aquatic life, is the contamination of water bodies with the industrial wastes, effluents, solid wastes, particles and other hazardous wastes.

Heavy metals (Cadmium, Lead and Mercury) and their salts constitute a very important group of environmental pollutants since they are potent metabolic inhibitors of both terrestrial and aquatic plants and animals. They exert toxic effects in the organism at tissue, cellular, sub cellular and molecular levels. They may affect the permeability of cell membrane and disturb energy metabolism and also decrease the stability of lysosomal membrane to disrupt cell functions by releasing various hydrolases.

Lead is a slow and cumulative posion and that it does not usually produce striking symptoms that are easily recognized. Being ubiquitous in the environment, lead has been selected for this study. Lead act at a large number of biochemical sites and inhibit a number of enzymes on the other hand, these metals can induce catabolic activity of certain enzymes. It has a long environmental persistence and never loses its toxic potential. Lead compounds are used as a pigments in paints, dyes and ceramic glazes. Drinking water may be appreciably contaminated by the use of lead and polyvinyl chloride (PVC) pipes. Most lead today is "secondary" lead obtained from the lead-acid batteries.

Young children are highly susceptible to the harmful effects of lead. Chisolm 1971 reported 352 adults during 1954 which had childhood lead poisoning. Out of them 165 died due to chronic lead poisoning.

The classical manifestations of lead intoxication are haemotological, as gastrointestinal, neuro-muscular and nervous symptoms. The symptoms of lead poisoning include neurological problem, such as reduced IQ, nausea, abdominal pain, irritability, insomnia, excess lethargy or hyperactivity, seizure, coma and even death. In human lead toxicity often causes the formation of a bluish line along the gums, which is known as the "Burton's line."

2. MATERIALS AND METHOS

Living specimens (approx. 14 to 16 cm in length and approx. wt. 70-80) of fresh water teleost fish, Heteropneustes fossilis were collected from the unpolluted fresh water resources of Hastinapur (U.P.) and were acclimatize to the laboratory condition for 4 to 5 days. Prior to experimentation, fishes were treated in 1% potassium permanganate solution for 15 minutes to disinfect the fishes. Fishes were maintained in laboratory glass aquaria in dechlorinated tap water (pH=7.4, hardness ppm (as $CaCo_3$), alkalinity 87 ppm), fishes were fed twice daily. Water temperature maintained between 18^0C to 24^0C for six weeks .

3. METHODS OF HISTOPATHOLOGY

3.1 Light Microscopic Studies

Pituitary from both the groups were excised, washed in 1% saline solution and fixed in 10% buffered neutral formalin and alcoholic Bouin's fluid for 12hrs. Standard methods of dehydration, clearing and embedding were used. Serial sections of 5-6µm thickness were cut and stained with delafield haematoxylin and alcoholic eosin.

3.2 Electron Microscopic Studies

The ultrastructural studies were carried out in Regional Electron Microscope Facility at All India Institute of Medical Sciences, New Delhi.

For ultrastructural studies, the fishes of control and experimental groups were dissected ventrally and heart was exposed to perfuse intracardially. The perfusion was initiated with normal saline which is followed by 3% gluteraldehyde (GA) solution in 0.1M phosphate buffer for about 10 minutes. Pituitary were removed and placed in GA solution for 2 hr. at room temperature. The tissues were washed in 0.1M phosphate buffer, and placed into buffer over night at 4^0C. Final trimming of the tissues to appropriate size was done in the buffer. The trimmed tissues of about 1 mm. thickness were post fixed in 1% OsO_4.

After this work I took all this work in the All India Medical Sciences, New Delhi, for further processing.

4. OBSERVATION

4..1 Control

The Pituitary of Heteropneustes fossilis is a small and roundish structure, situated on the ventral surface of the diencephalon between the inferior lobes. It mainly composed of four distinct regions namely proximal pars distalis (pars anterior) pars distalis (transitional lobe), pars intermedia (PI) and neurohypophysis or pars nervosa (PN). Gonadotrops (β-cells) are basophil cells found in the pars anterior region but in sexually mature fishes these cells were also present in the rostral pars distalis.

Gonadotrophs are mostly oval and small cells but some cells are slightly elongated having slightly indented nuclei. Variations in the shape and size of the cells take place during the cyclic development of gonads. Two types of gondadotrophs have been observed; some cells are poorly granulated but others are densely granulated.

Ultrastructurally, the most of these cells contain few short and narrow, cisternae of rough endoplasmic reticulum (RER) while some gonadotroph cells have an extensive RER, characterized by wide cisternae, filled with grey material Free ribosomes are present. The mitochondria, with their electron dense matrix, are generally oval to elongate and arranged in small groups. One golgi body per cell. These cells contain many secretory vesicles of variable size (300 to 600 nm).

Homogeneously filled with electron dense material few lysosomes are also observed. Between the gonadotrophs, small nerve fibers can be observed, generally in synaptic contact with these cells.

4.2 Lead Acetate Treatment

Chronic exposure with lead acetate produced severe pathological changes in pituitary. Most of the cells of transitional lobe of pituitary lost their normal architecture and became syncitial mass of cells. Gonadotrophs suffered with degranulation and shrinkage of cytoplasm with pycnotic nulei. Fragmentation of cisternae and degeneration of mitochondrial cristae, and dilation of elements of endoplasmic reticulum.

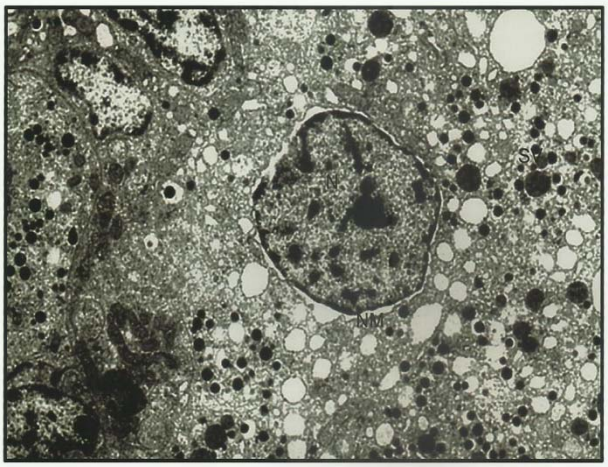

Fig.15. Electron micrograph of a gonadotroph of pituitary of control fish. Note electron dense secretory vesicles of variable diameter and semidense larger vesicles. The nucleus is slightly indented and organelle are normal in structure. X-8300

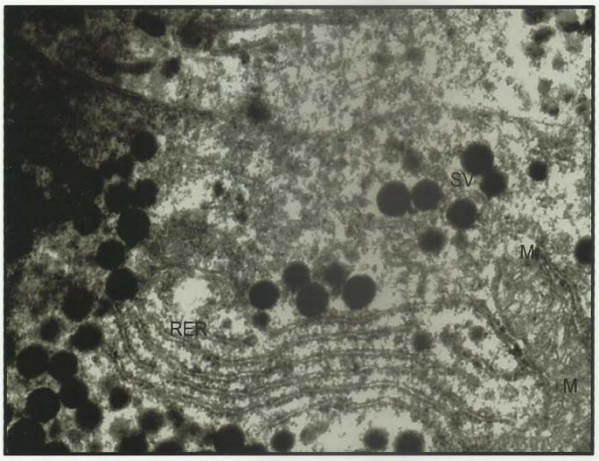

Fig.16. Magnified view of the above showing well developed rough endoplasmic reticulum, elongated mitochondria and electron dense secretory vesicles. X-21000

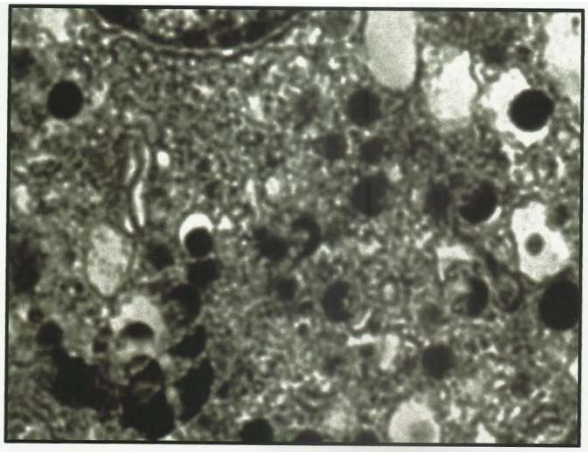

Fig.17. Reduction in the number and fusion of secretory granules, fragmentation of elements of endoplasmic reticulum are visible in gonadotrophs of fish treated with 3mg/l of lead acetate for six weeks. X-17400

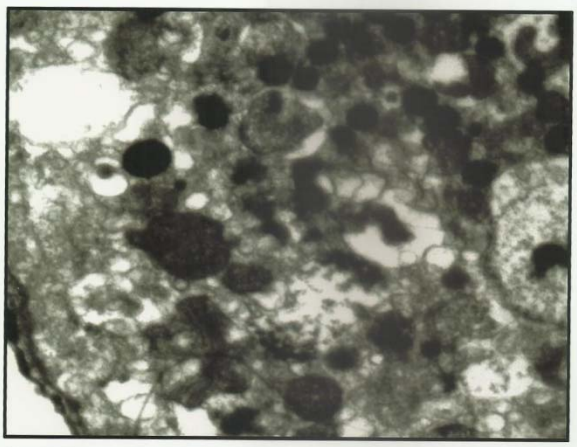

Fig.18. Enlarged view of the above showing degenerative changes in mitochondria, fragmentation of elements of RER and degranulation/degeneration of secretory vesicles. X-18600

5. DISCUSSION

Contamination of water through anthropogenic practices is the primary cause of lead poisoning in fish (Sorensen, 1991)

Toxic stress resulted due to exposure to a number of xenobiotics has become a common phenomenon; stressors disturb an animal's homesostasis which in turn can elicit compensatory of adaptive responses. In this study, the histological changes in the gonadotrophs of pituitary have been studied in fishes exposed to lead for sublethal concentration for six weeks.

Gonadotrophs directly affect the reproductive potential of fishes. Most of the gonadotrophs were reduced in size and cytoplasm was highly degranulated with pycnotic nuclei, Gopinath et al. (1987) reported vacuolation of pituitary cells in the cynomologus monkey due to lead and cadmium intoxication. Histological alterations in gonadotrophs, observed in this study, suggests that chronic exposure to lead acetate adversely affects the secretory functions of gonadotrophs that resulted into to inhibition of GTH secretion.

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