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"Impact Of Fluoride Exposure On Cardiac Microanatomy In Albino Rats: An Investigative Study"

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Abstract
The present study was conducted to study the effect of graded doses of Sodium fluoride on the microanatomy of the heart of Albino rats over different periods. Sixty male adult albino rats taken from the animal house of Govt. Medical College Srinagar were divided randomly into four groups of 15 animals each. Animals of the first three groups were given fluorinated water in various concentrations to drink and the fourth group served as the control group getting plain tap water to drink. Animals from each group were sacrificed and examined after 30, 60, and 90 days of therapy and gross and microscopic changes were recorded. It was observed that fluorides induce dose and duration-dependent microscopic changes in cardiac tissue ranging from mild oedema to gross necrosis Fluoride ions have been known to affect the bones and teeth of human beings for a pretty long time now. On the one hand presence of fluoride ions in drinking water is essential for the normal development of the various organ systems of the body, particularly the skeletal system and teeth. However, it is now a well-known fact that the toxic effects of a substance cannot be limited to a particular system only.
Key Words: *Sodium Fluoride, Edema, Necrosis, Fluorosis, Eco toxins*

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I. Introduction

Fluoride ions are one of the most potent eco toxins. These are compounds of the element Fluorine which is found universally throughout nature. Fluorine exists abundantly in living tissue as an ion and is absorbed easily into the enamel of teeth especially in children's growing teeth.

The chief sources of fluorides to human beings in addition to drinking water are vegetables, edible marine oils, animals, drugs and certain other varieties like tea, coffee, tobacco, detergents, cleansing materials, pollen grains etc. Topical fluorides are found in products containing strong concentrations of fluorides to fight tooth decay."

Fluoridated water is believed to protect against dental cavities and root caries. Hence water fluoridation is considered the most efficient and cost-effective dental caries prevention measure available.

Fluorides have also been found to be one of the essential constituents of certain tranquillizers, diuretics, and anticancer drugs". Fluoridated corticosteroids are widely used for various dermatological conditions. Anaesthetics like Fluroxane contain fluorides and are widely used. Fluorides are used or produced in various industries producing fertilizers, insecticides etc. Fluorides have been used for treating diseases like Paget's disease of bone, Osteogenesis imperfecta and

Osteosclerosis. Radioactive Fluoride 18F has been used for bone imaging. Fluorides are absorbed through GIT, Lungs and Skin. About 75-90% of ingested fluoride is absorbed. bed fluoride is distributed to the whole of the body through the bloodstream.

The twentieth century was considered to be the age of industrialization but unfortunately, rapid industrial growth has resulted in a complex range of health problems due to environmental pollution and one of the most important health hazards of environmental pollution is "Fluorosis".

The main clinical signs of Fluorosis are manifest in the skeletal system but there are direct and indirect toxic effects on other systems of the body including the Nervous, Urinary, Respiratory, Reproductive, and Circulatory Systems including the Heart.

II. Aims Of The Study;

Fluoride levels vary in the drinking water throughout the world and fluoridation of drinking water to prevent tooth decay is done in many parts of the world. The present study was therefore aimed at studying dose-related microscopic changes in the heart of animals fed with Sodium Fluoride in drinking water.

III. Material And Methods;

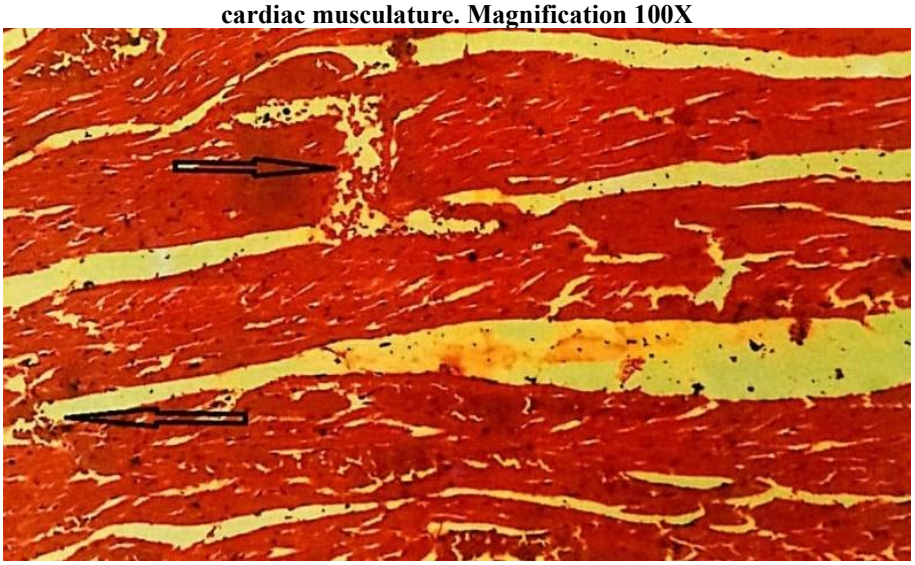
A total of 60 male adult albino rats were randomly selected and divided into four groups of 15 animals each. Group A: The animals of this group were given drinking water with a 10-ppm concentration of fluoride besides a standard diet. Group B: The animals of this group were given drinking water with a 500-ppm concentration of fluorides besides the standard diet. Group C: The animals of this group were given drinking water with a 1000 ppm concentration of fluoride besides a standard diet. Group D: The animals of this group were given plain tap water to drink besides a standard diet. This served as the control group. Fluorinated water was prepared by dissolving sodium fluoride in tap water. The addition of one mg of sodium fluoride to one litre of water makes a concentration of one part per million (ppm). The animals were observed daily for changes in appearance and body weight. Animals of different groups were studied after 30, 60, and 90 days of therapy when 15 animals from each of the four groups were sacrificed and examined. At the time of each examination, the animals were weighed and anaesthetized by chloroform. A midline incision was given and the heart was dissected out and put on a dish containing chloroform. Macroscopic changes if any were observed and compared with the control group. The heart was subjected to processing in an automatic tissue processor, sections 0.5 to 0.7 micrometres thick were cut with a rotatory microtome, stained with Haematoxylin & Eosin stain and observed under a compound light microscope.

Observations;

On gross examination, the hearts of both the control and experimental animal groups were normal in appearance. However, in the animals of groups B and C after 60 and 90 days of therapy, the colour of the heart was slightly lighter and discolouration patches were visible.

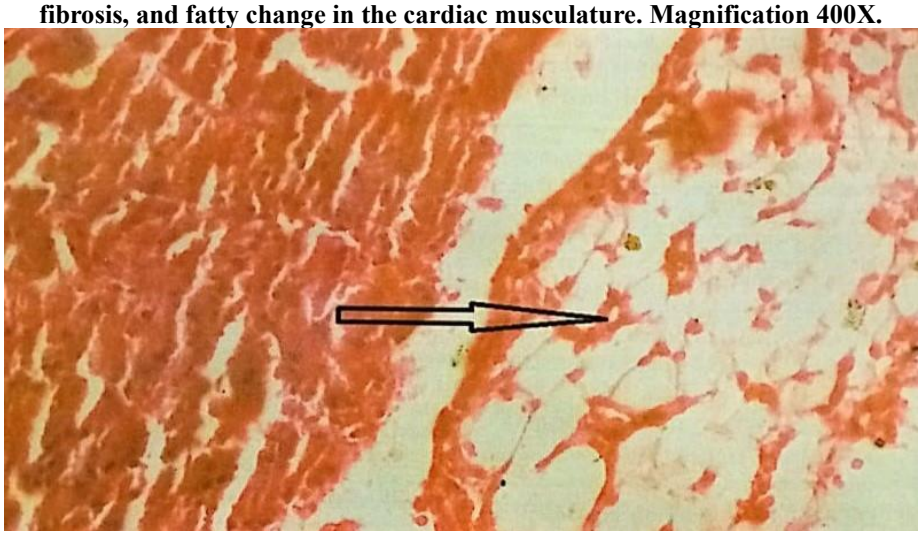
Microscopic changes: The heart of group A showed minimal microscopic changes after 30 days of treatment. The cellular architecture of the heart of this group was maintained even after 60 and 90 days of therapy but mild oedema and occasional haemorrhages were seen. The heart of group B after 30 days of treatment showed oedema, and frequent haemorrhages However after 60 and 90 days of therapy occasional necrosis was also seen. The animals in group C were the worst affected. After 30 days of treatment, the heart of this group showed oedema, frequent haemorrhages and occasional necrosis (Fig No.1).

Fig No. 1. Microphotograph of the heart of group C after 60 days of treatment showing diffuse necrosis of cardiac musculature. Magnification 100X



After 60 days of therapy, the heart of this group showed distortion of the cardiac musculature with frequent haemorrhages and necrosis. The heart of the animals of this group after 90 days of treatment was the worst affected and hardly any normal cardiac musculature was visible. The histological architecture of the cardiac muscle was distorted and frequent areas of haemorrhages in necrotic were found. Fibrosis was also seen in some cases (Fig No.2).

Fig No.2. Microphotograph of the heart of group C after 90 days of treatment showing diffuse necrosis, fibrosis, and fatty change in the cardiac musculature. Magnification 400X.



IV. Discussion;

The present study was aimed at evaluating the effects of varying strengths of Sodium Fluoride on the hearts of Albino Rats. A notable reduction in the body weight of experimental animals was seen after Fluoride administration which was more obvious in the animals of the higher dose group. Fluoride toxicity causes metabolic and structural changes which in turn cause wasting of muscle mass and loss of body weight. With low concentrations of fluorides, the histological architecture of cardiac muscle was maintained but there were occasional haemorrhages and oedema of the cardiac muscle cells. With increased concentration and duration of exposure to fluorides frequent haemorrhages, oedema of muscle fibres, distortion of cell outline, small areas of cardiac cell necrosis and haemorrhages, diffuse areas of cardiac muscle necrosis and finally fibrosis were observed. Taylor et al (1961) and Simon et al (1968)" have also reported weight loss in the animals fed on fluorides. Weight loss in fluorotic humans was reported by Short et al (1937)" and Siddiqui (1955)". Roholm (1937)" observed calcification of aorta in patients suffering from Fluorosis. Lidbeck et al (1943) observed that there was dilatation of the right chamber of the heart in fluorotic individuals. Okushi (1954) in a study on ECG and X-ray of people in an area where the fluoride level in drinking water was found to be 6-13 ppm revealed severe damage to the cardiac muscle. Teka Mori (1955)" reported damage to the cardiac muscle in human patients having mottled enamel as a result of Fluorosis. JD Ebert (1959) observed that Sodium Fluoride almost completely blocked the embryonic regions destined to form muscle primarily affecting cardiac muscle. Call et al (1965) after an autopsy study of bodies and histological examination of various tissues reported that the fluoride content of the aorta was higher and it was associated with calcification. Abukurrah et al (1972)' observed that Sodium Fluoride in large doses was extremely toxic resulting in severe symptoms and death due to severe hypokalaemia and cardiac arrest. Johnson et al (1974) reported a striking increase in the death rate due to heart disease among the population of Antigua (Wisconsin) after the fluoridation of water. Rusch G Metal (1999) in a study reported an increase in the incidence of myocarditis in all animals exposed to 5000 ppm and the majority of animals exposed to 10000 ppm of fluoride concentration. Previous workers who have studied the effects of fluorides on the heart have mostly focused on the physiological effects and have observed functional derangements of the heart after prolonged periods of exposure.

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