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Original Article

AN ALARMING HAZARD IN THE COMMUNITY USING ALUMINIUM IN DAY TO DAY LIFE ON THE BASIS OF TOXIC EFFECTS ON THE LIVER OF ABINO RATS BY INGESTION OF ALUMINIUM

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ABSTRACT

Aluminium is widely used in medicines, as food additives, as water purification agent, as in the making of household cookware and storage utensils. Aluminium can get into the human beings via digestive tract or via lungs or through parenteral route. Absorption of aluminium depends upon the chemical forms of aluminium taken up and pH values in GIT. In acidic medium, absorption becomes higher. Aluminium hydroxide and chlorides are absorbed more efficiently than its phosphorus and fluorine compounds. The aluminium content of organs like liver and spleen increased in animals kept on an iron deficient diet[1]. As aluminium is stored mainly in the liver[2], the present work is conducted to study the morphological changes in the liver produced by aluminium chloride (AICI3). 20 inbred adult albino rats weighing 150-200gm each were administered 37.5mg per day of aluminium chloride orally for 21 days with maintenance of 20 similar controls. A small piece of liver tissue was processed for paraffin sections. 7 µ thick sections were stained with hematoxylin and eosin stain and observed under light microscope. The changes were observed at tissue and cellular level along with general architectural derangement, degenerative changes and nuclear variations such as karryorrhexis, pyknosis. These findings are highly suggestive of toxic hepatitis.

Key words: Aluminium, Liver, Hepatocellular degeneration, Nuclear variations, Toxic hepatitis.

INTRODUCTION

Aluminium is among the most plentiful element in the earths crust. Today the annual production of aluminium amounts to about 22,000 metric tones world wide[3]. Most individuals consume 1-10mg aluminium per day from natural sources[4]. According to WHO, provisional tolerable weekly intake of aluminium (PTWI) is 7 mg per kg body weight for adults[5].

The uses of aluminium and its compounds are very extensive. Aluminium metal is an important structural material in the building, canning, automobile, aviation industries, paints, cracking of petroleum as lubricants, tanning agents, in wood preservation and in manufacture of synthetic rubber and papper. Aluminium compounds are widely used in medicines as antacids, vaccines, antidiarrhoeals, phosphate binders and allergen injections[6].

Significant amount of aluminium can get into the human beings through drinking water. In sea water, aluminium can be detected at a concentration of 1 µg per litre while in fresh water the concentration of dissolved aluminium is higher than that[7]. Higher levels of aluminium usually occur in freshwaters and drinking waters treated with aluminium sulphate as a coagulant for clarifying the turbid drinking water since Roman times or even earlier. Acid rains water of Northen European lakes contain higher levels of aluminium [8]. UV rays may liberate the aluminium in waters toxic to aquatic organisms[9].

Inhalation of aluminium oxide containing dust has been produce non nodular type interstitial fibrosis of lung known as SHAVER'S disease[10]. Inhalation of fine particles of aluminium metal dust in factories caused both encephalopathy and pulmonary fibrosis in human beings.

Despite its toxic effects, aluminium remains a metal of choice in the making of various kinds of household cookware and storage utensils[11]. The usage of aluminium in packaging of food stuff is on the increase and is becoming a potential source of contamination. 10-15% production of aluminium compounds are utilized in processing, packaging and preservation of food such as aluminium foils[12]. As the aluminium vessels are the most commonly used cookware in rural and semiurban India, the major contribution of aluminium from Indian foods are through the dietary sources. The average daily aluminium intake of human with food has been found to be 2-10mg. When using aluminium utensils and tableware or taking aluminium containing drugs aluminium intake may reach 40mg[13]. The

aluminium content of pepsi cola in cans may reach 30-40µm. Canned soft drinks fed rats had significant higher liver aluminium concentration than rats given glass bottled soft drinks[14].

Intramuscular administration of aluminium may occur in human beings during vaccination. May et.al;[15] found that the amount of aluminium in different vaccines varies between 34-505µg. Thus an infant administered 0.5ml vaccine intramuscularly takes up approximately 250µg aluminium. A plethora of literature is available regarding the adverse effects of aluminium on liver of albino rats through parenteral route in comparison to oral route.

The aim of this study is to warn the community using aluminium in day to day life on the basis of morphological changes in liver tissue after intragastric exposure of aluminium in albino rats.

MATERIAL AND METHODS

40 inbred adult albino rats weighing 150-200 gm each were randomly divided into 2 groups. Group 1 served as the experimental and Group 2 served as the control. The animals were group housed with ad libitum access to food and water. Group 1 rats received 37.5 mg per day of aluminium chloride in distilled water intragastrically for 21 days. The control group received equal quantity of the vehicle by the same route. The animals were sacrificed within 24 hr. of the last dose. The liver was dissected and processed. Sections 7 µ were cut and stained with haematoxylin and eosin stain.

OBSERVATIONS

Microscopically, the prominent finding was fatty changes. Affected areas showed large blood filled spaces which replaced the normal liver parenchyma and the hemorrhagic blood was seen into the central vein and the neighboring sinusoids, which had become dilated. The liver hepatocytic plates appeared disheveled (Fig 1). The hepatocytes varied greatly in size. In most areas they appeared hypertrophied with increased cytoplasmic basophillia and a large euchromatic nucleus having a prominent nucleolus (Fig 2). There were foci of hepatocellular degeneration. Degenerating hepatocytes appeared shrunken with dark and highly eosinophillic cytoplasm and a pyknotic nucleus, surrounded with a clear halo (Fig2).

DISCUSSION

Ebina et al.[16]reported that even a low dose of aluminium is toxic to parenchymal cells of liver, kidney and brain when given as chelated form with Nitrilotriacetic acid (NTA). It showed extensive midzonal coagulation, hepatocytic necrosis, inflammatory cells infiltration, degenerating hepatocytes. Ellis et al.[17]injected aluminium chloride intraperitoneally to rats, and noticed osteomalacia in bones. There are a relatively small number of data related to aluminium toxicity on the liver functionally and morphology. According to Galle et al.[18], aluminium does not produce toxic effects in the liver because it is eliminated from hapatocytes into the bile together with lysosomes. On the other hand, Abubakar et al.[19], ascertained that aluminium in hepatocytes, even in small quantities is associated with an increase in reactive oxygen species and peroxidation. According to Somova et al.[20] liver showed high affinity for aluminium when injected intravenously. Galle and Guidicelli[21] have been reported ultra structural localization of aluminium in hepatocytes. Constant finding in our experimental study is fatty changes. This can be explained on the basis that aluminium propagates the reaction between cytochrome C and succinyl dehydrogenase[22] Since cytochrome C is important enzyme in respiration at cellular level, interference in metabolic pathways involving this enzyme may leads to biochemical and histological changes. Berlyne et al.[23] in an experimental study found that oxygen consumption in liver cells decreased by 25% in aluminium treated rats leads to hypoxia, which in turn leads to necrosis and fatty changes.

In the present study, aluminium was seen to cause an increase in diameter of the hepatocytes associated with large euchromatic nucleus and a cytoplasmic basophillia, indicative of an increase in cellular activity.

CONCLUSION

This study reveals that even oral administration of aluminium results in the disheveled pattern of the hepatocytes, increased cellular metabolism, inflammatory cells infiltration, nuclear variations such as pyknosis, karryorrhexis. These findings are conclusive of toxic hepatitis and point to the need of creating awareness among population of the hazards associated with the extensive use of aluminium. It would be prudent to conduct further research in this area given its wide usage and subsequent public health implications.

Figure 1:

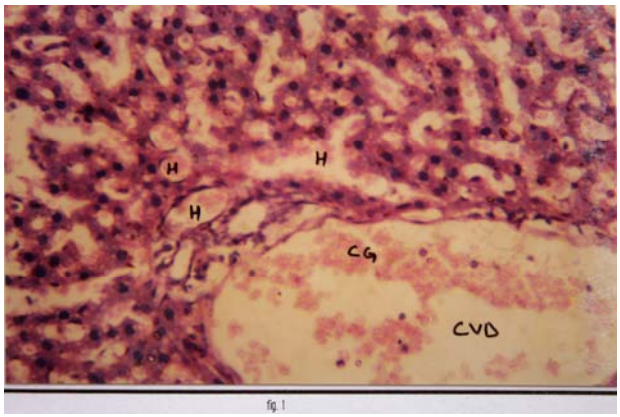
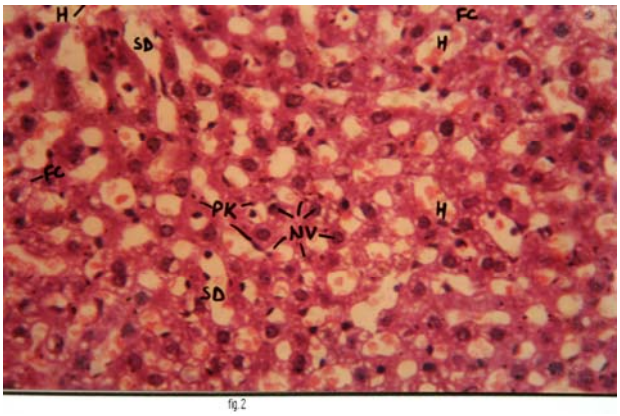


Figure 2:



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