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Microscopic Changes Induced by Cr-VI In Smooth Muscles of Albino Mice

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ABSTRACT

Chromium is believed to be an essential trace element in human nutrition. Evidence suggests that it plays an important role in normal carbohydrate metabolism. It was found that patients receiving long-term total parenteral nutrition (TPN) without chromium developed glucose intolerance, weight loss and peripheral neuropathy Chromium is present in a normal diet at trace (but essential) levels. Occupational exposure is related to the industrial uses of chrome compounds in production and use of steels, pigments, leather tanning and wood preservation solutions, plating chemicals, and cement. Toxicity is predominantly associated with industrial exposures. Hexavalent chromium compounds appear to have greatest toxicity and almost all tissues of body are affected. To evaluate the effects on smooth muscles, present study was carried out. The mice of experimental group (2wks, 4wks, 6wks and 8wks) were injected Potassium dichromate ($K_2Cr_2O_7$) intraperitoneally according to experimental design. The drug caused slight to marked inflammation of smooth muscle fibers and vaculations of nuclei was also observed indicating degenerative changes.

Key Words: Hexavalent Chromium, Smooth muscle, Albino mice.

INTRODUCTION

Chromium is widely distributed on earth's crust. It is found in nature principally as chromate ore. Chromium exists in several valence states, of which the trivalent and hexavalent states are the most common. Most chromium in the food supply is in the trivalent state. Hexavalent chromium compounds are recognized as toxic and are potential carcinogens. Chromium is found in many foods[1], typically in small amounts. Good food sources of chromium include whole grains, cereals, spices (black pepper, thyme), mushrooms and brown sugar, coffee, tea, beer, wine and meat products. Brewer's yeast is also a good source of chromium. Fruits and vegetables are generally poor sources of chromium, as are most refined foods.

Chromium is an essential element required for normal carbohydrate and lipid metabolism. Chromium has been linked to maturity onset diabetes and cardiovascular diseases[2]. Human exposure to these metals occurs principally in occupational settings and environmental contamination [3]. Both acute and chronic toxicity are caused by Hexavalent chromium[4, 5]. Cr (VI) is known to have hepatotoxic, nephrotoxic and teratogenic effects as well[6]. It's also known to have effect on lymphoid tissue. Population exposed to Cr (VI) for longer periods are reported to be at high risk of developing lymphomas[7].

Chromium is used in industries especially in leather tanning in Pakistan. The effluents are in general discharged in adjoining land areas. Study has been conducted on such an area in vicinity of Kasur city, containing pink colored effluent from tanneries[8]. The effects of Cr VI on smooth muscle fibers were analyzed by observing the histological changes induced by this metal in muscularis mucosae of jejunum.

MATERIALS AND METHODS

Forty-eight male albino mice were divided in eight groups. They were kept under constant temperature with 12 hourly light and dark cycle. Animals were acclimatized for one week.

Experimental design

A group of 24 albino mice weighing 20-40gm.were administered 0.6% aqueous solution of $K_2Cr_2O_7$ (20mgCrVI /100ml.) at a dose of 20mg/kg of body weight intraperitoneally on alternate days. Another control group of 24 mice was administered distilled water, i.p. that is on alternate days after every two weeks six mice from each group were sacrificed and jejunum were removed and prepared for histological studies as per routine.

RESULTS

General physical examination

All animals of control and experimental groups were found to be active and healthy at the time of sacrifice. Their feeding behavior was normal & showed no signs of ailment. No gross congenital anomaly in control and experimental animals was observed. However changes in mean weight of animal of experimental groups were observed. In 2 weeks group 13.14% increase in bodyweight and 2.5 % in 4 weeks group was seen. In 6weeks and 8weeks experimentally treated mice significant increase in weight was not appreciated.

Gross appearance of jejunum

Small intestine of control group was pinkish in color whereas that of experimental mice it appeared reddish i.e. in 2 weeks & 4 weeks treated mice where as it was bluish in 6 to 8 weeks treated mice.

Histological changes

Hexavalent chromium when given on alternate days i.p. induced changes in small intestine(jejunum) of treated mice. In 2weeks group smooth muscle fibers did not show any evident change, anyhow patchy areas of inflammation could be seen. Nucleus was ovoid and appeared normal (the respective control showed normal architecture). In 4 weeks treated mice inflammatory cells in surrounding connective tissue could be seen and nuclei appeared larger than normal. At places smooth muscle fibers appeared swollen (Fig. 1). No histological changes were seen in jejunum of respective control animals.

In 6 weeks & 8weeks treated mice marked histological changes were seen. There was infiltration of macrophages & diffuse lymphocytic infiltration. In the last group (8 weeks) interstitial hemorrhages were seen & nuclei showed vaculations (Fig. 2). Jejunum of control mice showed normal architecture. (Fig.3)

DISCUSSION

Chromium is an essential trace element having multiple valancies Cr III is required for normal metabolism but its hexavalent form is used in industry and its indiscriminate use has caused serious health concerns. In cities like Kasur and Sheikhupura where this heavy metal is being used in leather tanning industries, fetuses have been born with congenital malformations, and people drinking this water are suffering from several gastrointestinal problems. Previous studies have revealed that chromium picolinate modulates rat vascular smooth muscle cell intracellular calcium metabolism. Studies regarding microscopic changes induced by Cr Vl in smooth muscle cells have not been reported much. So keeping in mind present research was carried out to assess the effects of Cr Vl on smooth muscle cells of small intestine (jejunum) of albino mice, as this metal was absorbed from peritoneal cavity and affecting the smooth muscles of gut. The microscopic changes observed in sections of small intestine showed infiltration of macrophages & also diffuse infiltration of lymphocytes. This inflammatory response was not so marked in 2 & 4 weeks treated mice where as in 6 & 8 weeks treated mice, interstitial hemorrhages were seen and muscles showed vacuolations.

Cr Vl was assessed as a toxic agent affecting smooth muscles when given intraperitoneally.Any significant increase in weight of mice was not observed except in 6 weeks treated mice. Studies conducted by Hajo & Satoni (1991), did observe a marked decrease in weight which may be due to the

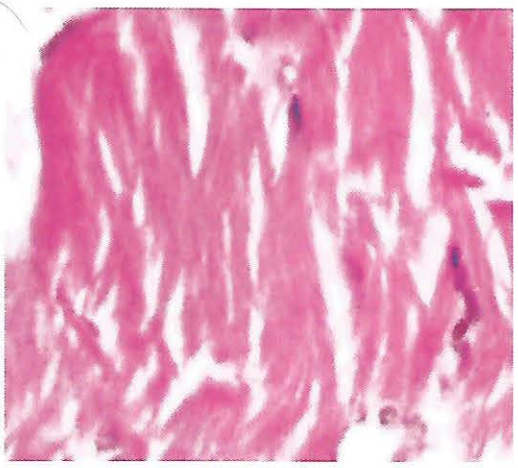

Fig. 1. Swollen smooth muscle fibers appear normal with patchy areas of inflammation.

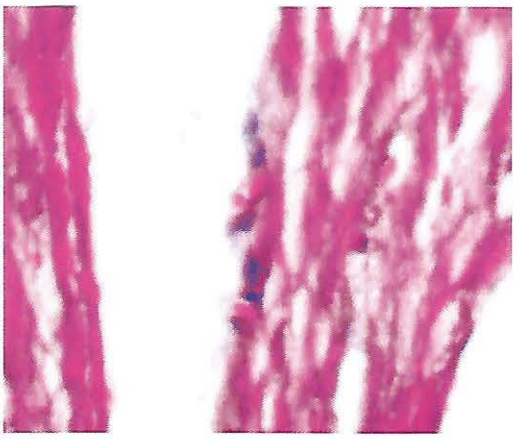

Fig. 2. Smooth muscle fibers appear swollen, inflammatory cells also visible.

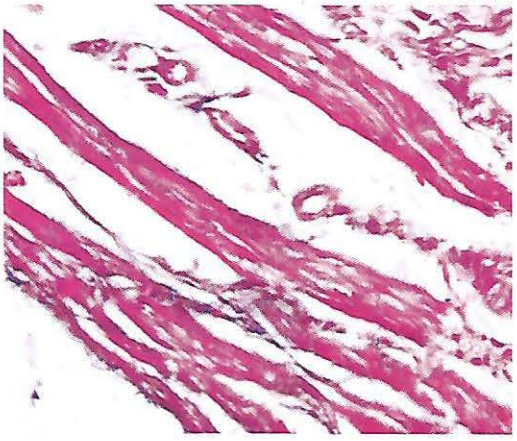

Fig. 3. Macrophages with diffuse lymphocytic infiltration, Nuclei showing vacuolations.

fact that they gave single dose of Cr Vl intraperitoneally. viz, 0.6 mmol/kg of body weight, the mice must have reacted acutely to this dose.

CONCLUSION

The microscopic findings show us the time dependency effect of Cr Vl on smooth muscles of mice. It's prolonged use cause adverse effects indicating that smooth muscle cells present else where in the body can be effected. This can be avoided if Cr Vl is not thrown away unprocessed by the industries using it. So guidelines can be formulated for the industrial use of this metal which can help mankind to live in a non-polluted environment.

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