The Pharma Innovation Journal 2020; 9(4): 04-06

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(4): 04-06

www.thepharmajournal.com
Received: 04-02-2020
Accepted: 06-03-2020

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Gross pathology in female wistar rats due to hexavalent chromium toxicity

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Abstract
An experiment was conducted for a period of four months by obtaining 120 female wistar rats to study the toxico pathological effects of hexavalent chromium. The experimental design consisted of six dietary groups, each group was divided into four replications containing five rats in each. These were fed with control (Group- I), Toxin (Group-II), Vitamin C control (Group –III), *emblica officinalis* control (Group-IV) and ameliorative groups (Groups V and VI). Rats were sacrificed at monthly interval on 30th, 60th, 90th day of experiment and its embryos. Tissue samples of liver, kidney, ovary, uterus, lungs, spleen, heart, fallopian tubes were collected for gross pathological studies. The results indicated a greater damage to internal organs when fed with toxic diets. These adverse effects were moderately ameliorated by Vitamin C and *emblica officinalis*. The group –III and Group – IV results were absolutely normal.

Keywords: Chromium toxicity, gross pathological study, vitamin C, *emblica*, *officinalis*, amelioration

Introduction
Heavy metals are omnipresent in the environment and industrial use has greatly increased their presence in soil, water and air [1]. Chromium has been identified to be one of the toxic metals. Hexavalent chromium (Cr-VI) is used in a wide range of industries. Cr-VI from chromate industries and atmospheric emissions contribute to the chromium contamination in the environment [2]. Cr-VI is a potent toxic agent and it has been considered 1000 times more toxic than trivalent chromium (Cr-III) [3]. Cr-IV is proved to be toxic to livestock, poultry and as well as in human beings. Since the end of the 19th century, its carcinogenic effects were discovered [4]. Cr-VI salts have been recognized as occupational health hazards for more than 160 years [5]. Present investigation was undertaken to study the toxicopathological effect in female wistar rats and its amelioration with Vitamin C (Vit C) and *emblica officinalis* (*E. officinalis*).

Materials and Methods
All rats were handled in accordance with the guidelines of Institutional Animal Ethics Committee (IAEC) (No 1/4/14, date 27.11.2014). The experimental rats were sacrificed at 30th, 60th and 90th day respectively and examined the gross lesions. The dams were sacrificed and the fetuses were collected to record the gross lesions.

Experimental design

Group	No of Rats	Type of treatment / diet
I (Control)	20	Basal diet
II (Toxin control)	20	Basal diet + Potassium dichromate 500 parts per million (ppm) in drinking water orally for 3 months
III (Vit C control)	20	Basal diet + vitamin C @ 100 milligram (mg)/kg body weight (kg.b.wt) orally for 3 months.
IV (*Emblica officinalis* control)	20	*Emblica officinalis* powder given @ 2 % in feed for 3 Months
V (Chromium VI + Vitamin C control)	20	Basal diet + Potassium dichromate 500 ppm in drinking water orally for 3 months + vitamin C @ 100 mg/kg b.wt orally for 3 months.
VI (Chromium VI + *Emblica officinalis*)	20	Basal diet +potassium dichromate 500ppm in drinking water orally for 3 months+ *Emblica officinalis* powder given @ 2% in feed for 3 months.

Results

Gross pathological lesions of internal organs of rats, dams and embryos were studied. Gross lesions are rarely observed in internal organs like kidney, heart, spleen, lung, except few changes in liver, ovary, uterus and fallopian tubes. The toxin group livers showed changes like pale to mild yellowish/fatty discoloration (Fig 1). Similarly, there is a great increase in the size of the ovary, uterus and fallopian tubes was observed in toxin group rats when compared to control group rats. The internal organs of rats and dams including liver of control (I, III, IV), protective (V), and ameliorative (VI) groups were normal.

The toxin group embryos were ill developed and decrease in the size of the foetus (Fig 2), sub dermal haemorrhages were seen when compared to control group (group I) embryos. The improvement is seen in group III (Fig 3), IV, V, VI and control group embryos (Fig 4).

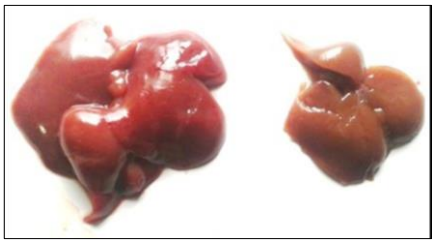

Fig 1: Note the great reduction in the size of the liver with rounded borders, pale yellow discoloration and fatty change in the toxin group (group II) of livers at the end of 60 days when compared to control group liver.

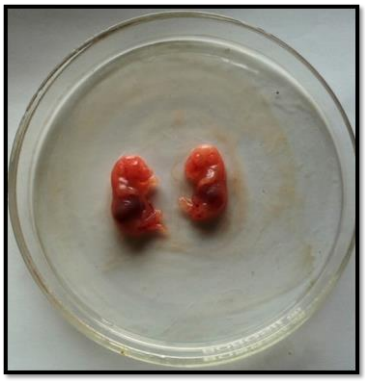

Fig 2: Note the small size of the rat fetuses in the toxin group when compared to control group during the experimental period (30 days).

Fig 3: Note the apparently normal rat fetuses from group III during the experimental period (30 days).

Fig 4: Note the apparently normal rat fetuses from group I (Control group) during the experimental period (30 days).

Discussion

In the present study, upon exposure to hexavalent chromium @ 500 ppm gross lesions are rarely observed in internal organs during experimental period in respective monthly sacrifices of animals except few changes in liver including pale to mild yellowish discoloration and notable increase in size of the uterus, fallopian tubes, ovary were in toxin group. Except in liver no other gross abnormality was detected in internal organs like kidney, heart, spleen, lungs. Embryos of toxin group were ill developed, decrease in the size of the foetus and sub dermal haemorrhages in comparison with control (I, III, IV), protective (V) and ameliorative (VI) groups.

When chromium enters inside the cells first it reduces to its lower oxidation state, during this process reactive oxygen species (ROS) generates and results in oxidative tissue damage[6]. The vitamin C protects these organs from the deleterious effects and also *E. officinalis* improves digestion and cleans the blood, strengthens the heart functional efficiency, invigorate the body as per the ayurvedic system of medicine due to its hepato and cardio protective, restorative function and this agent is also a digestive medicine[7].

From the present study it can be concluded that the toxico-pathological effect of hexavalent chromium can be ameliorated by Vitamin C and *emblica officinalis*.

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