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Short Communication

Histological Alterations in *Cyprinus carpio* Kidney Due to Sublethal Concentrations of Chromium Hexavalent

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ABSTRACT

The objective of the present study was to identify the degree and damage to the histological architecture of *Cyprinus carpio* kidneys exposed to various sublethal concentrations of hexavalent chromium [Cr (VI)]. For this investigation 168 *C. carpio* breeders (W=500±9.5 g; L= 25.60±2.6 cm) were divided at random in to control (n=24) and experimental (n=144) @ 8 breeders/tank (8.84 m^3). Control were kept in normal water, while experimental were monthly exposed to various sublethal (25, 50, 75, 100, 125 & 150 mg/L) Cr (VI) concentrations separately in triplicate for six months. Actual chromium in water was measured on atomic absorption on monthly basis. Exposed kidneys had necrosed and disintegrated hematopoietic tissues with pycnotic nuclei on all the Cr (VI) concentrations; whereas degenerated glomerulus was noted only in the kidneys at 125 and 150 mg/L and atrophy of renal tubules with reduced lumen at 100, 125 and 150 mg/L. Kidneys had normal histological structure in control. Actual chromium concentration varied from 36 to 118 µg/mL in tanks exposed to Cr (VI) from 25 to 150 mg/L. Present results showed that Cr (VI) is highly teratogenic metal and its deteriorating affects increase with the increase in its concentration. © 2011 Friends Science Publishers

Key Words: *Cyprinus carpio*; Glumerulus; Necrosis; Hematopoietic tissues

INTRODUCTION

Indiscriminate introduction of hexavalent chromium [Cr (VI)] from various industries into the aquatic ecosystem has a major threat for the survival and growth of fish (WHO, 2000). Prolonged exposure of sub lethal and least lethal Cr (VI) concentrations exceeded the maximum safe limit for metal accumulation in tissues (Nikkiman *et al.,* 1998). Accumulation of Cr (VI) in the tissues of organisms resulted in chronic illness and caused potential damage to the living organisms (Atli *et al*., 2006). Cr (VI) induced necrosis in tubular epithelium, pycnotic nuclei in the hematopoietic tissue, narrowing of the tubular lumen and expansion of spaces inside the Bowman's capsule (Ahmad *et al.,* 2006; Velmurugan *et al*., 2007; Ashish & Banalata, 2008; Pedro & Alicia, 2008; Lushchak *et al*., 2008; Mishra & Mohanty, 2009; Sannadurgappa & Aladakatti, 2010). Histopathological investigations have been proved to be a sensitive tool to detect any change at organism and tissue levels that's why present study was designed to check the effect of static renewal exposure of Cr (VI) concentrations on *C. carpio* kidneys. This will confirm the level of deterioration by Cr (VI) at organ and tissue level on different sublethal concentrations.

MATERIALS AND METHODS

In this investigation 168 *Cyprinus carpio* breeders (W=500±9.5 g; L= 25.60±2.6 cm) were maintained in cemented tanks (8.84 m^3) of Fisheries Research and Training Institute, Lahore @ 8 breeders/tank. They were divided in to control (n=24) and experimental (n=144). Control were kept in normal water, while experimental were exposed to 25, 50, 75, 100, 125 and 150 mg/L Cr (VI) concentrations separately in triplicate for each concentration for six months on monthly basis. Calculated amount of potassium chromate was refreshed every month for each concentration. Actual chromium in water was measured on monthly basis through atomic absorption. Breeders were provided with feed (30% protein & 8% carbohydrate rich) @ 7% of wet body weight per day spread over two feedings each day (Jhingran, 1995). Aeration was provided with automatic compressor. The water was removed on every alternate day to siphon off the extra food. After six months five pairs were sacrificed on random basis from control as well as experimental (from each concentration). Tissue samples of kidney were collected with sharp razor blade for histological evaluation. Tissues were preserved in Bouin's for 6-24 h, washed with water and ethanol and then processed routinely in to hours, sectioned at 3 µm

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and stained with hematoxylin and eosin (Dacie & Lewis, 1991).

RESULTS AND DISCUSSION

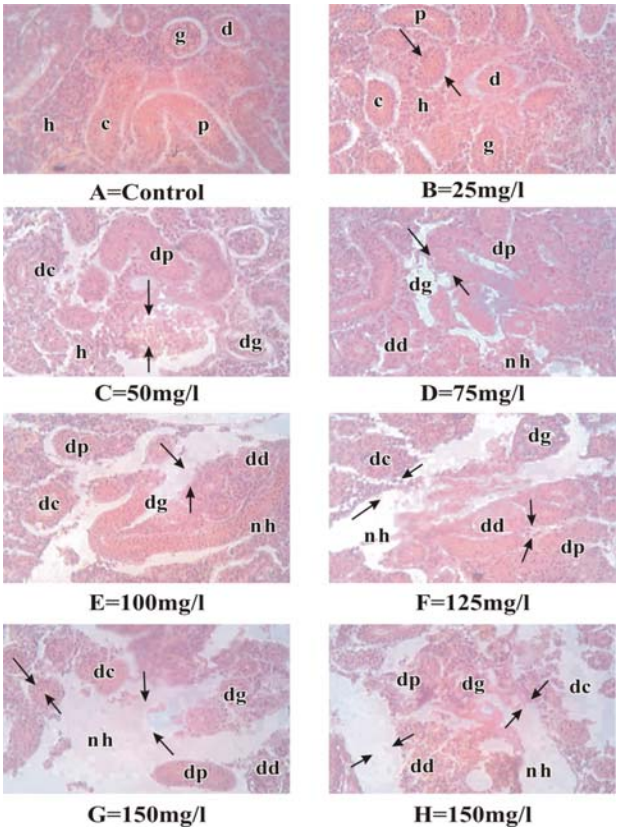
Control (Fig. 1A) had normal structure with numerous nephrons. The renal corpuscle of the nephron consisted of glomerulus and Bowman's capsule. The other regions of the tubule were proximal, collecting and distal tubule. The interstices of the tubules were enriched with hematopoetic tissues, which contained round to polygonal cells possessing hyper chromatic nuclei with red blood corpuscles. Progressive degenerative changes due to Cr (VI) were noticed with the increase in concentration. Slight disintegration of hemetopoietic tissue and degenerated glomerulus was at 25 mg/L (Fig. 1B). Disintegration of Bowman's capsule (arrows) damaged proximal tubular cells and pycnotic nuclei were at 50 mg/L (Fig. 1C). Disintegration of glomerulus, proximal tubule and necrosed hematopoietic tissues with disorganized glomerular tuft, distal tubule and pycnotic nuclei were noted at 75 mg/L (Fig. 1D). Disintegrated proximal, distal and collecting tubule with pycnotic nuclei in proximal tubule and hematopoietic tissue having clump of cells containing hyper chromatic nuclei were noted at 100 mg/L (Fig. 1E). Melanization of glomerular tuft and islands of necrotic hematopoietic tissues (arrows), disintegrated proximal, distal and collecting tubule was observed at 125 mg/L (Fig. 1F). Tubular cells lost their integrity (arrows) along with acute necrosis of hematopoietic tissues at 150 mg/L Cr (VI) concentrations (Fig. G & H). Cr (VI) damaged the kidney of *C. carpio*. In general, the degree of damage was proportionate to the concentration of metal in the medium.

Cr (VI) has been shown to cause shrinkage of glomerular tuft, disintegration and vacuolation with in the glomeruli of fish after exposure to Cr (VI) (Velmurugan *et al*., 2007; Mishra & Mohanty, 2009). Proximal tubules were the first to be affected. This functional disorder in the kidney of fish produced abundant lesion in the proximal tubule (Athikesavan *et al*., 2006). The glomerular lesions were secondary and resulted from tubular dysfunction. The disruption of the renal tubules together with the renal corpuscles was bound to hamper tubular reabsorption and glomerular filtration (Farag *et al*., 2006; Ghedira *et al*., 2010). The kidney of exposed fish had ruptured epithelium including its brush border, degradation of glumeruli, extrusion of cellular material into the tubular lumen and extensive loss of interstitial hematopoietic tissue and severe apoptosis as compared to control. Similar results were observed by Lushchak *et al*. (2008) and Ashish and Banalata (2008).

CONCLUSION

The findings of present investigation demonstrate a direct correlation between Cr (VI) concentrations and histological disorder in tissues of kidney.

Fig. 1: (A-H) Microphotograph showing marked histological alteration in Cyprinus carpio kidney due to Cr (VI) at 25 (B), 50 (C), 75 (D) and 100 (E). 125 (F) and150 (G & H) mg/L respectively while control (A) showed normal tissue architecture. Note: c= collecting tubule, d=distal tubule, dc=disintegrated collecting tubule, dd= disintegrated distal tubule, dg= disintegrated glomerulus, dp= disintegrated proximal tubule, g= glomerulus, h= hematopoietic tissue, nh= necrosed hematopoietic tissue
p= proximal tubule (100 X)



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