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Renal architectural alterations in *Channa punctatus* when chronically exposed to mercuric chloride

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ABSTRACT

In the present investigation live specimens of *Channa punctatus* were collected, after acclimatization they were chronically exposed to sublethal concentrations of mercuric chloride for 15 and 30 days. As compared to the control fish, Mercury treated fish kidney showed marked histopathological changes. After 15 days the alterations detected initially were the widening of space between the capsule and the glomerular capillary network. The effect was dose and duration dependents. After 30 days exposure, marked shrinkage of glomerular tuft at all the concentrations were noticed. Further the effect became so severe that visceral epithelium got ruptured, glomerulus got evacuated and necrosis of kidney tubule was seen.

1) INTRODUCTION

Among the natural resources water is the most vital element for all the living organisms as no life exists without water. However, for the last few decades water quality deteriorates because of addition of pollutants from commercial properties, industrial and domestic waste and pollutants of varied origins, where these pollutants are found in their untreated form [1]. As a result of this in India 70% of the avialble water is polluted, out of which 84-92% is polluted by sewage pollution and 8-16% by industrial pollution [2]. Impact on fish scales as indicators of wastewater toxicity from international water channel Tung Dhab drain has been reported [3].

Increase in the concentration of heavy metals (Cd, Cu, Fe, Ni, Mn, Zn, Pb and Hg) has been reported in water of Vasai Creek, Maharastra [4]. Heavy metals salts constitute a serious type of pollution in fresh water and being stable compounds, they are not readily removed by oxidation, precipitation or other processes and affect the activity of recipient organisms [5].

Mercury, one of the heavy metal once released it persists in the environment. It has been extensively used in industries like pesticides, electroplating, medicines and battery manufacturing [6]. Effluents from these sources are ultimately dumped to aquatic ecosystem, where they harm non-target flora and fauna such as fish.

The present study was to study the impact of mercury on the renal architectural alterations in *Channa punctatus* a fresh water fish.

2) MATERIALS AND METHODS

For the present studies live specimens of *Channa punctatus* were collected. They were given bath in 0.1% $KMnO_4$ for 2-3 minutes. The fishes were acclimatized for 7 days under laboratory conditions. Mercury in the form of mercuric chloride was used for present investigations. The salt is selected because of its uses in industries reported toxicity and water solubility.

LC_{50} value for present study was calculated by Probit analysis as suggested by Finney [7]. Based on the Probit analysis technique, 96h LC_{50} value was found to be 1.21 mg/L by graphical interpolation and arithmetic methods. A stock solution of 1 g/L was prepared in normal tap water. From the stock solution measured aliquots of this was added to each experimental tanks so as to bring the mercuric chloride concentrations to required levels i.e. 0.08 mg/L, 0.10 mg/L, 0.25 mg/L, 0.40 mg/L and 0.55 mg/L. The fishes were exposed to these concentrations for 15 days and 30 days.

3) RESULT AND DISCUSSION

According to the classification of the teleostean kidney as given by Ogawa [8], *Channa punctatus* freshwater teleosts, bears type II kidney. It is divided into two portions, an anterior head kidney composed of hematopoetic, lymphoid and endocrine tissue and a posterior trunk kidney composed of numerous nephrons surrounded by interstitial lymphoid tissue.

General Structure of Kidney The basic unit of kidney is a nephron that in C*hanna punctatus* consists of renal corpuscle and renal tubule. Renal corpuscle is having a well-developed vascularized glomerulus with an inconspicuous mesangium

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(Fig. 1 a). The renal tubule consists of initial proximal segment (Proximal I) with prominent brush border, second proximal segment (Proximal II) with numerous mitochondria but less developed brush borded (Fig 1 b); distal segment with relatively clear cells and elongated mitochondria and a collection duct system. Distal tubule and collecting duct both devoid of brush border are much sparsely distributed. The renal corpuscles are generally located in close vicinity to renal tubules and blood vessels in the interstitial tissue.

Kidney in the freshwater fishes functions mainly as an excretory organ. This is accomplished by the filtration at the renal glomerulus and the presence of suitable cellular components that help to conserve filtered ions while dilute urine is excreted. Histopathological examination of fish kidney is an authentic method of determining impacts of contaminants in the aquatic environment [9,10,11] during the present study, response of a teleostean (*Channa punctatus*) kidney to the sublethal concentration of Mercury has been studied.

As compared to the control fish, Mercury treated fish kidney showed marked histopathological changes. The alterations detected initially were the widening of space between the capsule and the glomerular capillary network. The effect was dose and duration dependents. After 15 days exposure, marked shrinkage of glomerular tuft at all the concentrations were noticed (Fig. 2a and 2b; 3a and b 4a).

With increase in exposure period for 30 days more marked shrinkage of glomerular tuft at lower concentration (0.080mg/L Fig. 4b) was noticed. Further the effect became so severe that visceral epithelium also got ruptured and glomerulus got evacuated (5a and b 6a and b) at rest of the concentrations. Mercury also induced necrosis of kidney tubule of the fish (Fig. 7a and b).

Similar observations have been reported earlier also upon exposure to various pollutants: Endosulfan (*Heteropnestus fossilis*- [12]), Cadmium [13] and *Mylio* macrocephalus (Teleostei)- [14], Malathion (*Clarias batrachus* (Linn)- [15] Mercury compound (*Clarias batrachus* (L.)- [16], Elsa (*Channa punctatus*-[17], DDT (Coho salmon – [18], 3, 3, 4 Triaminoazobenzene (*Channa punctatus*- [19], Mercury (*Heteropneustus fossilis*- [20], Mercury, (*Poecilia reticulate*- [13] Lindane (*Colisal fasciatus*- [21], Chlorphyrifos (*Hetropneustus fossilis* – [22], Carbofuran (*Colisa lalia*- [23], Hydrothol-191[24] Malathion (mice- [25]. Kidney tubule necrosis on toxicant exposure has been reported by Srivastava [22,23,24,26,27,28].

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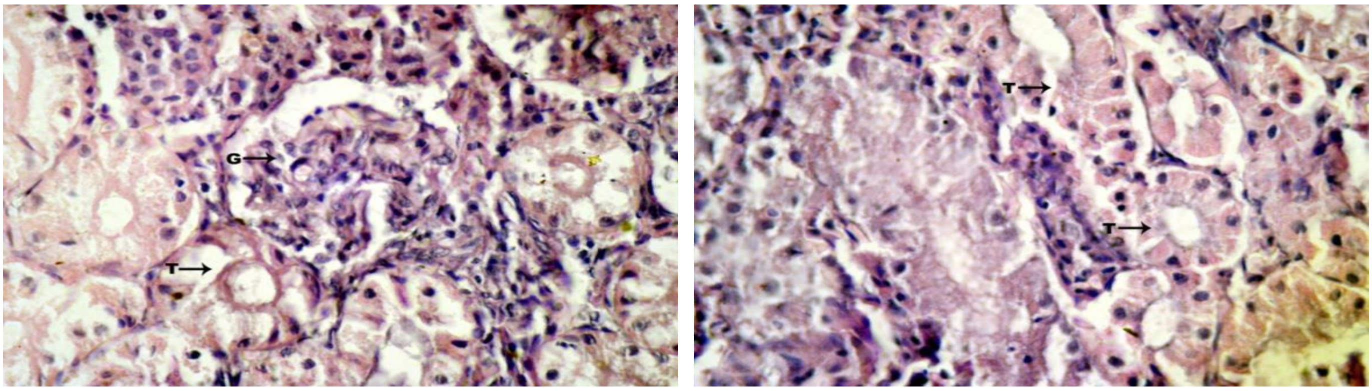
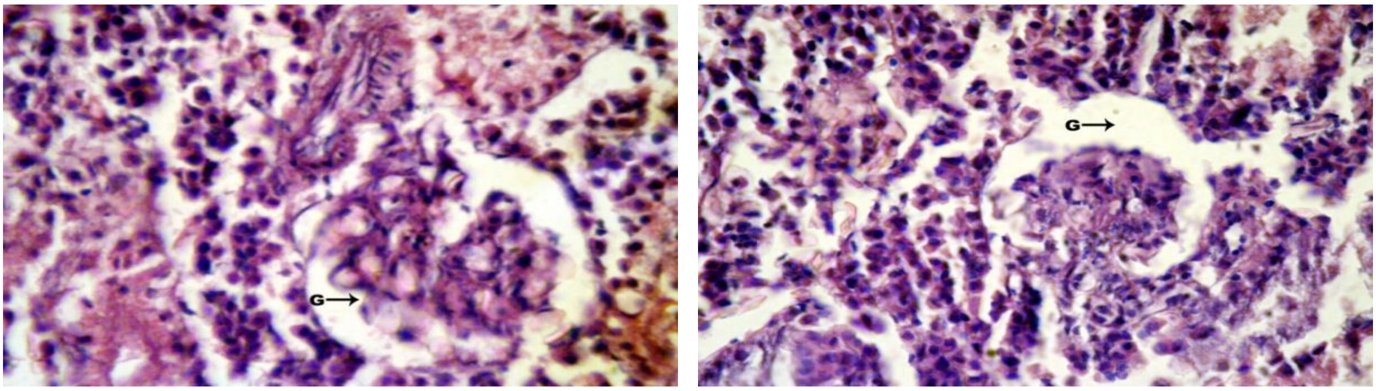


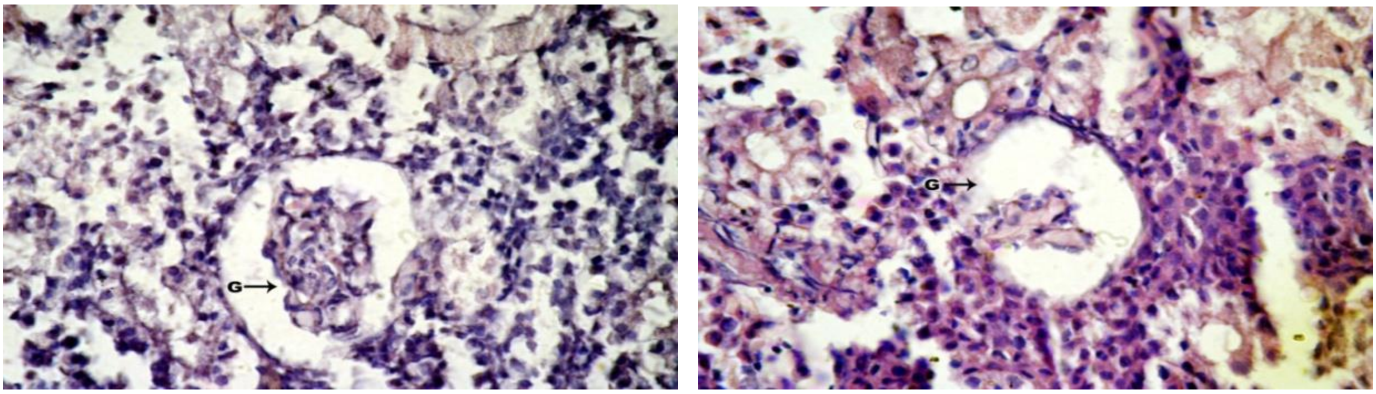
(a) **(b)**

Fig. 1: Photomicrographs of fish kidney (control), showing (a) glomerulus with parietal and visceral epithelium and (b) kidney tubules. G (Glomerulus)



(a) (b)

Fig. 2: Photomicrographs of fish kidney (Mercury treated) showing shrunken glomerulus (a- 0.080 mg/L and b 0.10 mg/L, 15days) G (Glomerulus)



(a) **(b)**

Fig. 3: Photomicrographs of fish kidney (Mercury treated) showing shrunken glomerulus (a-0.25 mg/L and b-0.40mg/L 15 days) G (Glomerulus)

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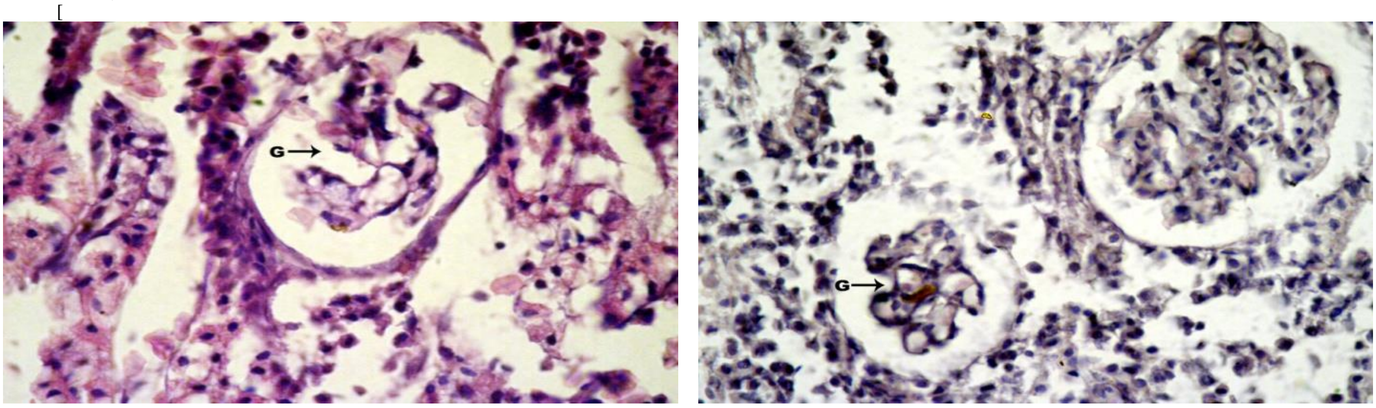
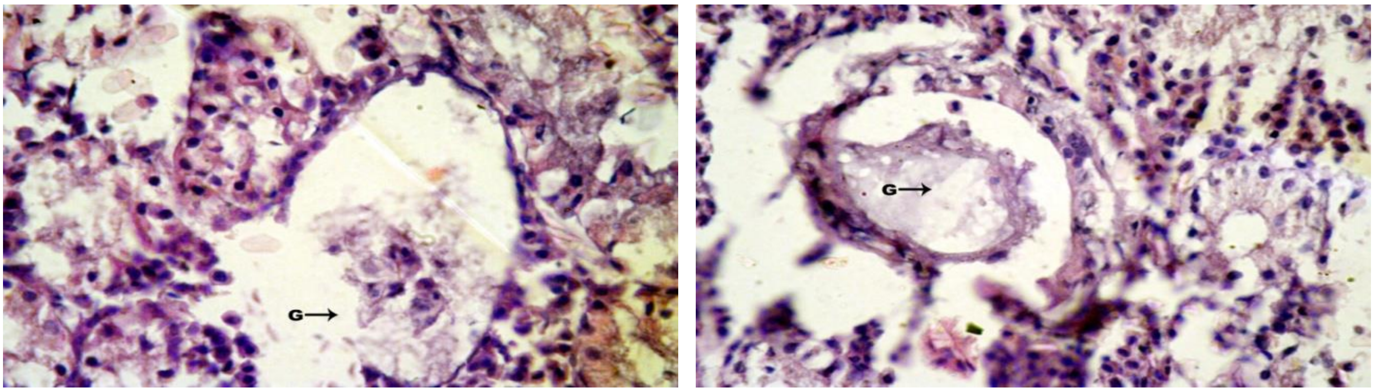


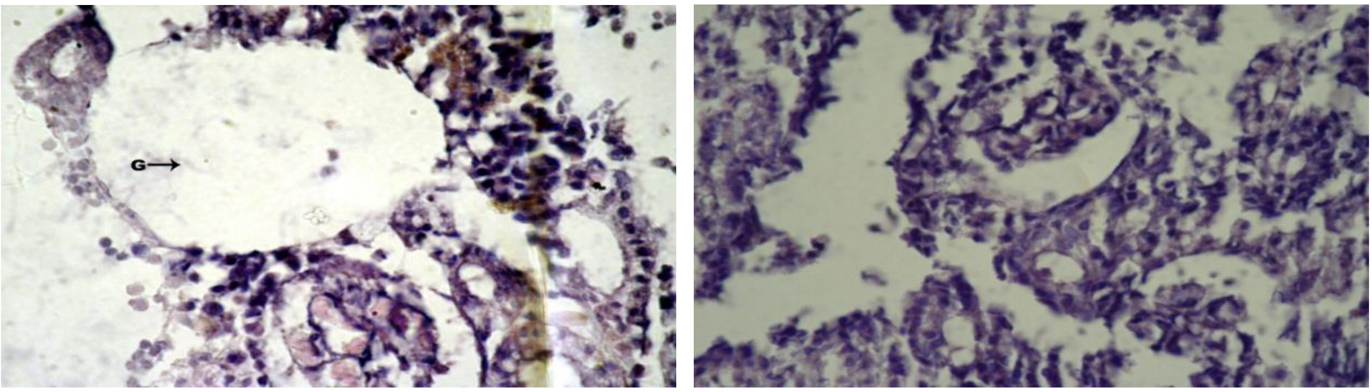
(a) **(b)**

Fig. 4: Photomicrographs of fish kidney (Mercury treated) showing shrunken glomerulus (a-0.55mg/L, 15 days and b-0.080 mg/L, 30days) G (Glomerulus)



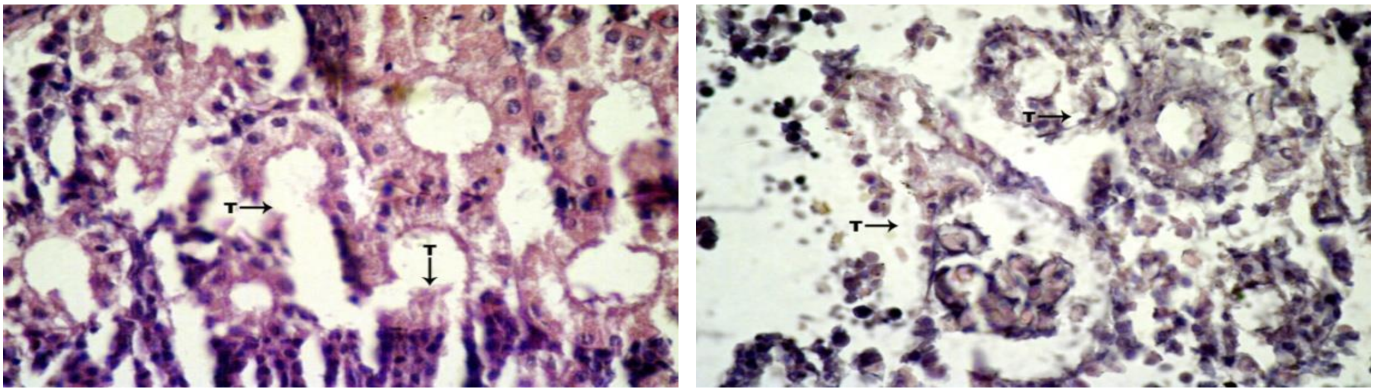
(a) (b)

Fig. 5: Photomicrographs of fish kidney (Mercury treated) showing evacuated glomerulus (a-0.10 mg/L and b-0.25 mg/L, 30 days) G (Glomerulus)



(a) (b)

Fig. 6: Photomicrographs of fish kidney (Mercury treated) showing evacuated glomerulus (a-0.40 mg/L and b-0.55 mg/L, 30 days) G (Glomerulus)



(a) (b)

Fig. 7: Photomicrographs of fish kidney (Mercury treated) showing damaged tubules (a-0.40 mg/L and b-0.50mg/L, 30 days) T (Tubule)