SALT MANAGEMENT IN FUNDULUS HETEROCLITUS KIDNEYS: A HISTOLOGIC STUDY

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Typical mammalian kidney function is met in the Teleost fish by both kidneys (pronephrons, mesonephrons) and the gills. In a fresh water environment the kidney has the role of conservation of electrolytes and maintenance of osmolarity. This is complemented by the activity of the gills in NaCl extraction and maintenance of the acid-base balance. In a salt environment, the fish has the need for the secretion of electrolytes in order to maintain osmolar balance. This ordinarily occurs at the level of the gills through the medium of the chloride cells (Zadunaisky, J., Fish Physiol., Vol. 10B, pp129, 1984).

Nevertheless, chloride cells have been identified in the kidneys of the fresh water catfish, Parasilus asotus (Komuro,T.,et al, Cell Tiss. Res. 160,263-271,1975). Similarly, renal chloride cells were found in the lower tubules of the rainbow trout Salmo gairdneri (Tsuneki, K., et al, Cell Tiss. Res., 160:263-271, 1975). They specifically stated that such cells were not found in the killifish, Fundulus heteroclitus.

In these experiments it was our intention to study the kidney of the killifish in 2x sea water in comparison with fresh water.

Fundulus heteroclitus caught in local estuaries were acclimated to fresh water and 2x sea water and used after four weeks of exposure. Two groups of ten fish each were used for these experiments. After four weeks of exposure, individual fish were pithed and dissected. The kidneys in Fundulus heteroclitus are paired. One kidney was removed and placed in 10% buffered formalin. The second kidney was removed and placed in 3% gluteraldehyde in phosphate buffer, pH 7.4.

Formalin fixed tissue was mounted in paraffin, cut and stained with hematoxylin and eosin. Glutaraldehyde fixed tissue was embedded in LX112 epoxy resin and prepared for light and electron microscopy. The blocks were cut with a Reichert microtome. Specimens for light microscopy were cut at 0.5 micron and stained with Toluidine blue.

Sections of fresh water kidney revealed no pathologic alterations. A photograph of a fish kidney from a fish exposed to a 2x sea water environment (Figure 1) reveals vacuolization and lysis of individual cells in tubules from the lower nephron and the collecting tubules. It is our interpretation that these findings are consistent with toxic damage. This could be due to increasing hypertonicity in the extracellular fluid or effects of individual divalent ions.

Mitochondria-rich cells are seen in the lower nephron of fresh water fish. Whether these cells meet the criteria for chloride cells must wait for electron microscopy. Confirmed identification of renal chloride cells in the fresh water catfish and the rainbow trout in addition to the findings noted in our previous paper, reinforce the concept that renal oncocytomas, which are mitochondria-rich cells, may be chloride cell atavars (Murray, M., et al. Bull. MDIBL, 31:7-9, 1992).

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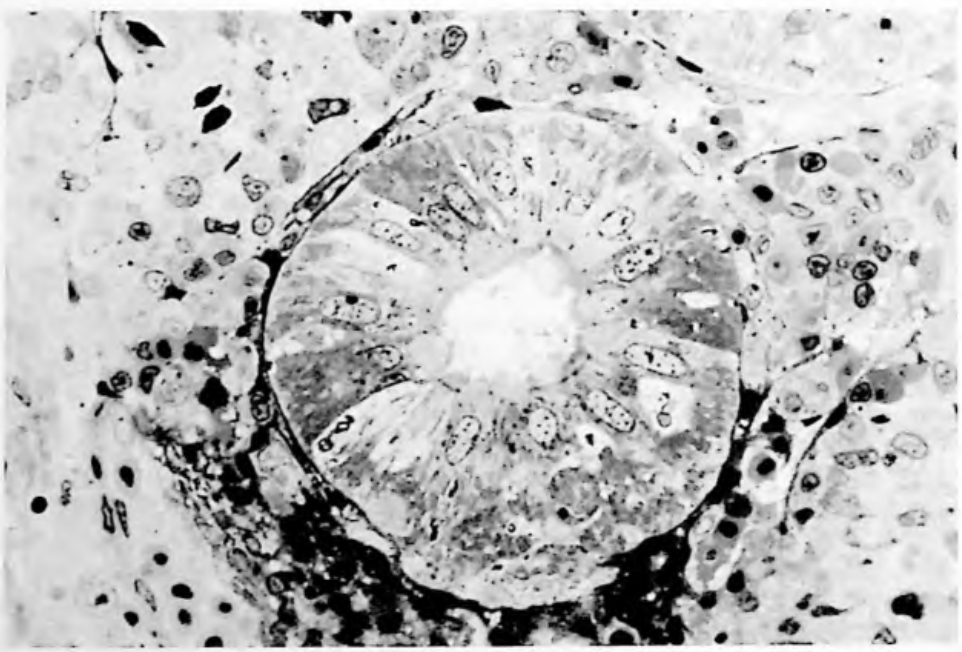

Fig.1. Cross section of tubule from the lower nephron amid hematopoietic tissue. Varying degrees of lysis and protein precipitation are noted in the kidney acclimated to 2x sea water. 630x.