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The Comparative Research of Kidneys of Rainbow Trout (*Oncorhynchus mykiss,* Walbaum 1792) and Rat (*Rattus norvegicus,* Berkenhout 1769) in Morphometric and Histologic Manner

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Abstract: In this research, the Rainbow Trout (*Oncorhynchus mykiss*, Walbaum 1792) and Wistar Albino Rat (*Rattus norvegicus,* Berkenhout 1769) are chosen vertebrates living in different media. It is seen that fish and rat kidneys differ in morphologic and histologic structures. Fish kidney consists of two different parts as head and body, whereas rat kidney has a more complicated and developed structure. After the examination of the sections taken from the kidney tissues, it is realized that the fish cortex and medulla shows difference with that of mammals in structure. Also, fish do not have a stable nefron system as in mammals and have different nefron structures in terms of structure and function. From the data obtained, it is observed that the fish kidney lacks the Henle part-which is a characteristic of developed vertebrates-it has more concentrated hematophoitic tissues and it has a different nefron structure.

Key words: Rainbow trout, rat, kidney

INTRODUCTION

As valid for all living creatures, the balanced body temperature and extraction of the hazardous metabolism excretes and some pigments of the entire body. The kidney of the vertebrates function on that two important items. It excretes the metabolismic sodium waste from the body and plays important role in osmotic regulation. As a consequence, homeostasis is kept balanced (Bozkirli, 1999). Loss of water occurs by evaporation from the body surface and by excretion from the intestines and kidneys (Hendriks, 1998). While the excess water in the body of a water living body is excreted, it is kept in that of a land living body. In the developed mammals in land bodies, there is a distillation system as in that of water living bodies. But in those, the reverse osmosis mechanism in kidneys is much more developed (Demirsoy, 1993). In our research, a boned fish Rainbow trout (*Oncorhynchus mykiss*) as the water body and Wistar Albino rat (*Rattus norvegicus*) as the land body are chosen. The extraction system in fishes is alike with that of land bodies in general (Balinsky and Fabian, 1981). During the development fishes, one of the kidneys follow the other in two different ways. One of them is pronefrosis-only a characteristic of embrio stage and the other is mezonefrosis which functions for excretion during the whole life (Drummond, 2000). In adult mammals metanefrosis type kidney is seen (Öktay, 1998).

MATERIALS AND METHODS

In this research, two different materials are used. The Rainbow trout (*Oncorhynchus mykiss,* Walbaum, 1792) is taken from the pools of Kadiköy Dicle Fishhouse and the Wistar Albino rats (*Rattus norvecigus*) are taken from the Experimental Medical Research Center of University of Marmara. This study was made in Zoology Laboratory in Biology Department at Marmara University and Histology Laboratory in Histology and Embryology Department at Istanbul University (2001-2002). For the histological research, trouts of 200-400 g and 25-32 cm are used. After anaesthetizing the alive Rainbow trout the dimensions of weight and height are recorded. After that, it is cut carefully without damaging the internal organs through the stomach starting from the anus. By going up vertically from the open stomach part, kidney is reached. However, kidney is cut very sensitively. Then by the help of scissors, the needed parts are taken from the kidneys as 2-3 cm pieces. Before placing the tissues into analyze liquids, it is divided into pieces of suitable largeness. The tissues are fixed for 24 h in two different fixatives of Bouin and 10% Formol (Hofer, 1989). Then, it is taken into tissue persecution for preparing it to cutting and dying. In this research, 250-450 g of mature male and female rats are used. The rats are anaesthetized by ether. Before the existence of Postmorten changes it is cut starting from 1 cm above the anus without damaging the organs

through the stomach. Kidney is taken out as a whole. They are put into analyze liquids (Bouin and 10% Formol) after dividing into pieces. After fixation of tissues persecution is done. As histologic dye, Harris Hematoksilen dye and PAS dying technique is used.

RESULTS AND DISCUSSION

In this research, the morphologic comparison of fish and rat kidney structures are performed histologically and morphologically. As a result:

While the fish kidney takes place in the back part of the stomach gap anatomically, the rat kidney takes place in two sides of the stomach gap, 12th chest and 1st and 2nd vertebrea (Romer and Parsond, 1986). The trout kidney is observed to be a tissue full of blood. The observation of kidney macroscopically is difficult. The front kidney, taking place at the front of the organ, the middle kidney lies through the body (Leitriz and Lewis, 1980). In the structure of rat kidney, little amount of connective tissue blood and lenf vessels, nefrons and collection channels are observed to take place.

In the fish kidney, in the front and middle kidney existance of plenty of hematopoitic tissue is observed. It has been difficult to identify the hematopoitic tissues of fish kidney observed in Bouin liquid and dyed by HE and PAS. These tissues are observed as yellow-brown and dark-brown parts. It is known that the fish kidney is composed of paranchima and subtissue. The observed subtissue, as different than high vertebrates, is hematopoitic tissue.

The wideness of glomerus and Bowman capsule in fish kidney draws attention. The rat kidney has big glomerus compared to that of fish. In rat kidney, big capillar structures consisting glomerus are observed (Meyer *et al*., 1989). In Rainbow trout, glomerus takes place almost filled in the Bowman capsule. In the structure of glomerus, red blood cells, mesenchme cell nucleus and capillar endotel cells are observed. Also, existance of podocites in the viseral epitalum of Bowman capsule is observed.

In the proximal segment of the fish kidney, it is observed that wide lumen. The cells of the part are oval, placed on the basis, intrastructured and apical brush sided (Hoar and Randall, 1969). Also, lumens having the structure of eosinifilic cytoplasm are observed (Takashima and Hibiya, 1993). In the prximally curved tubuls of rat kidney, generally single part cubic epitel is seen. The cytoplasm is seen to have asidofilic structure (Usinger and Storer, 1957). Through the lumen, the existance of microvilluses are seen. The size of the cell structures are determined.

In the fish kidneys, the distal tubuled cells are more oval and intrastructured. In the tubule lumens, no brush sizes are observed. The lumen structure is observed smaller (Lloyd-Evans, 1994). This segments cells are dyed non-vivid with the HE and PAS dying technique (Tsuneki *et al*., 1984). The reason of that is thought to be the raw particles in the cytoplasm. However, the proximal and distal segments both in the rat and that fish tissues are easily distinguished (Mcewen, 1949). In this research, the fish kidney and rat kidney structures are compared histologically. The fish and mammal kidneys show certain similarity. Although there are many studies searching the rat kidney, the ones comparing it with those of fishes histologically are very rare. Today, rat is widely searced as an experimental issue. The studies on fish kidneys are generally on embriology, biochemistry and pathology. In short,

- Fish kidney and rat kidney have similarities in a limited number. Fish kidneys are hard and long organs morphologically. Yet, rat kidneys are more complex than fish kidneys.
- When rat kidneys and fish kidneys were compared, it was observed that there is a metanephrose kidney structure in rats, but there is a less developed kidney structure in fish, which is mezanephrose.
- It was seen that fish kidneys have a typical bowman capsule with internal glomerulus and have no nephron canal. Yet, a very long nephron canal was seen in rat kidney. The glomerulus and bowman capsule has a smaller morphology. Many nephron structures were observed in rat kidney.
- Since the main function of bony fish's kidneys is procurement of the inner environment which is more stable in comparison to water and salt, these kidneys also have a different nephron structure on the basis of their living conditions. In respect of rainbow trout kidneys, it was seen that they have a mezanephrose nephron of which bowman capsule is big (i.e., the fresh water glomerular nephron). A developed nephron structure was observed in rats.
- When compared to the glomerulus structure of rats, the rainbow trout glomerulus is larger in volume and it has almost filled the bowman capsule.
- It was observed that proximal tubule cells of the rainbow trout have a circular shape, but proximal twisted tubule cells of the rats have a cubic or prismatic shape. In both species, it was seen that the cell apical has a brushy edge and the proximal tubule lumen is large.
- While distal tubule cells of the rainbow trout are oval-shaped, they are cubic-shaped in rats. When the distal tubules were compared to proximal tubule lumens of each species, it was found that the former has a smaller lumen structure than the latter has.

- Any study based on the histological comparison of these two species has not been found.
  The pathological and normal histology of the fish kidney. It was found that there are significant differences between the nephron structures of fresh water fish and sea fish in that study. The size of glomerulus in the rainbow trout used in our study supports this finding.
- A study on the morphological structure of fish kidney was performed by Moeller (1996). Moller's specification about that the kidney structure is dense in regard to hematopoitic tissue supports our study.
- A histological study on rat kidney was made by Moeller (1996). Although this is a pathology-oriented study, it has been a source for us regarding its research method.

Consequently, both differences and similarities of these two types are determined. It is seen that the fish kidney shows primitive structure where mammal kidney is more developed.

REFERENCES

Balinsky, B.I. and B.C. Fabian, 1981. An Introduction to Embriology New York, pp: 476-486.

Bozkirli, I., 1999. Yeni Üroloji Türk Hava Kurumu Basimevi, Ankara,Türkiye, pp: 143-144.

Demirsoy, A., 1993. Yaşamin Temel Kurallari Cilt III-Kisim I Ankara, Türkiye, pp: 308-312.

Drummond, I.A., 2000. The Zebrafish Pronephros: A genetic system for studies of kidney development. Pediatr. Nephrol., 14: 428-435.

Hendriks, J.D., 1998. Urinary System Oregon State University, Corvalis, Oregon, pp: 97-99.

Hoar, W.S. and D.J. Randall, 1969. Fish Physiology. New York, USA., pp: 140-167.

Hofer, R., 1980. Protocol for Fish Histology. Institute of Zoology, UIBK, Austria.

Leitriz, E. and R.C. Lewis, 1980. Trout and Salmon Culture and Development of Trout California, pp: 73-75.

Lloyd-Evans, P., 1994. An ultra-structural and immunocytochemical study on the lymphomyloid tissue in the embryonic kidney of dogfish *Scyliorhinus canicula*. J. Fish Biol., 44: 1061-1068.

Mcewen, R.S., 1949. Vertebrate Embriology. Henry Holt and Company, California, USA, pp: 262-278.

Meyer,V., G. Krefft and K. Lillelund, 1989. Atlas zur Anatomie und Morphologie der Nutzfische Verlag Paul Parey, Hamburg.

Moeller, R.B., 1996. Diseases of Fish Armed Forces. Institute of Pathology, Washington, US.

Öktay, M., 1998. Omurgali Hayvanlarin Karlaştirmali Anatomisi Istanbul Üniv. Fen Fakültesi Matbaasi, Istanbul,Türkiye, pp: 230-250.

Romer, A.S. and T. Parsond, 1986. The Vertebrate Body. New York, pp: 396-417.

Takashima, F. and T. Hibiya, 1993. An Atlas of Fish Histology. Gustav Fischer Verlag, New York, USA, pp: 116-127.

Tsuneki, K., H. Kobayashi and P.K. Pang, 1984. Electron-microscopic study of innervation of smooth muscle cells surrunding collecting tubules of the fish kidney. Cell Tissue Res., 238: 307-312.

Usinger, R.L. and T.I. Storer, 1957. General Zoology. McGraw-Hill Book Company, New York, pp: 498-499.