Absence of Juxtaglomerular Cells in the Kidneys of Chondrichthyes and Cyclostomi*

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In the previous paper¹⁾, we ascertained that the juxtaglomerular cells (JG cells) were present in the teleostean kidney. Renin was detected also in the kidneys of this class²⁾. BOHLE and WALVIG³⁾, CAPRÉOL and SUTHERLAND⁴⁾, and KRISNAMURTHY and BERN⁵⁾ reported the presence of JG cells in teleostean kidney, respectively. On the contrary, renin and JG cells could not be detected in chondrichthyan and cyclostome kidneys⁶⁾. The purpose of this report is to present more of the histological pictures, and to extend the studies into different species. We confirmed the absence of JG cells in chondrichthyan and cyclostome kidneys.

Materials and Methods

The following species were used. Symbols (a-g) after individual species indicate the places where the materials were obtained, as detailed below.

Chondrichthyes: Nekozame, *Heterodontus japonicus* at (b), Oose, *Orectolobus japonicus* at (a,b), Nurse shark, *Ginglymostoma cirratum* at (c), Shumokuzame, *Sphyrna zygaena* at (b), Bonnethead, *Sphyrna tiburo* at (c), Dochizame, *Triakis scyllia* at (b, d), Bull shark, *Carcharhinus leucas* at (c), Blacktip shark, *Carcharhinus limbatus* at (c), Akaei, *Dasyatis akajei* at (b, d), Stingray, *Dasyatis sabina* at (c), and Stingray, *Potamotrygon circularis* at (e).

Cyclostomi: Japanese lamprey, *Entosphenus* (= *Lampetra*) *japonicus* at (f), and Japanese hag-fish, *Paramyxine atami* at (g).

The materials were collected at the following places: (a) the Fisheries Laboratory in Aichi, Faculty of Agriculture, the University of Tokyo, (b) the Shimoda Marine Biological Station, the Tokyo University of Education, (c) the Cape Haze Marine Laboratory, Sarasota, Florida, U.S.A., (d) the Misaki Marine Biological Station, the University of Tokyo, (e) a side channel of the Amazon River, near Leticia, Colombia, (f) Mogami,

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ZENKER-formol or HELLY's fluids were used for fixation of the kidney. The sections were stained with BOWIE's method⁷⁾ which has been used exclusively for staining of JG cells in mammalian kidney.

Results and Discussion

Careful examination was made on the afferent or efferent arterioles in the kidneys of Chondrichthyes. However, the JG cells could not be detected (Figs. 1-4). BOHLE

Figs. 1-4. Photographs showing the absence of JG cells in the kidneys of Chondrichthyes. Fig. 1. *Sphyrna tiburo*, $\times 917$; Fig. 2. *Triakis scyllia*, $\times 697$; Fig. 3. *Dasyatis akajei*, $\times 770$; Fig. 4. *Potamotrygon circularis*, $\times 800$. BOWIE's stain, Af, afferent arteriole; Gl, Glomerulus; Rt, Renal tubule.

and WALVIG³⁾, and CAPRÉOL and SUTHERLAND⁴⁾ also could not find the cells in the kidneys of dogfish, *Acanthias vulgaris*, and barndoor skate, *Raja laevis*, respectively. Furthermore, NISHIMURA *et al.*⁶⁾ could not observe renin activity in the kidneys of 4 species of Chondrichthyes, *Heterodontus japonicus*, *Orectolobus japonicus*, *Triakis scyllia*, and *Dasyatis akajei*. KALEY and his co-workers⁸⁾ and BEAN⁹⁾ also reported the absence of renin activity in the kidneys of Chondrichthyes. Accordingly, the kidney of Chondrichthyes seems to be lacking of JG cells.

In the lamprey the glomeruli were fused into a single large glomus measuring 12 cm in length and 0.33 mm in width, extending through the dorsal side of the kidney. Since the glomeruli were segmentally supplied by the renal arteries, this long corpuscle seemed to consist of many compartments. Several efferent arterioles can be seen to drain off radially from the glomus within one cross section. It was impossible to identify any JG cells in its afferent arterioles.

In the hag-fish large, oval renal corpuscles (averaging 0.62 mm in diameter) arranged segmentally on the medial side of an archinephric duct. Each BOWMAN's capsule was connected to the archinephric duct by a short neck segment having flattened epithelium. The glomeruli were supplied by the branches from the segmental arteries. No JG cells were demonstrable on the afferent arterioles in the kidney.

SUTHERLAND¹⁰⁾, and CAPRÉOL and SUTHERLAND⁴⁾ were unable to find JG cells in either the larval or adult lamprey, nor did they find them in the hag-fish. NISHIMURA *et al.*⁶⁾

Fig. 5. Photograph showing the absence of JG cells in the kidney of *Entosphenus* (= *Lampetra*) *japonicus*, $\times 170$. BOWIE's stain, Af, Afferent arteriole; Gl, Glomerulus; Rt, Renal tubule; Ef or $\longrightarrow$, Efferent arteriole.

could not observe renin activity in their kidneys.

On the other hand, the JG cells are present in the kidneys of teleostean kidneys; BOHLE and WALVIG³⁾ reported the presence of JG cells in the kidneys of 16 species of teleosts. CAPRÉOL and SUTHERLAND⁴⁾ also found the JG cells in the kidneys of 19 species of teleosts. We also detected them in the kidneys of 34 species of teleosts¹⁾. Recently, KRISHNAMURTHY and BERN⁵⁾ ascertained also the presence of JG cells in 20 species of teleosts. Furthermore, SOKABE and his co-workers^{2,11,12)} confirmed the presence of renin in teleostean kidneys.

Thus, remarkable differences were observed between Osteichthyes and more primitive forms, Chondrichthyes and Cyclostomi. This may be related to the different osmoregulatory mechanisms involved in these classes of fishes¹³⁾.

Summary

Histological examination was made to identify JG cells on the kidneys of eleven species of Chondrichthyes and two species of Cyclostomi. However, the JG cells could not be detected in them.

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References

- 1) M. OGURI and H. SOKABE: This Bull., **34**, 882-888 (1968).
- 2) S. MIZOGAMI, M. OGURI, H. SOKABE and H. NISHIMURA: *Am. J. Physiol.*, **215**, 991-994 (1968).
- 3) A. BOHLE and F. WALVIG: *Klin. Wochenschr.*, **42**, 415-421 (1964).
- 4) S. V. CAPRÉOL and L. E. SUTHERLAND: *Can. J. Zool.*, **46**, 249-256 (1968).
- 5) V. G. KRISHNAMURTHY and H. A. BERN: *Gen. Comp. Endocrinol.*, **13**, 313-335 (1969).
- 6) H. NISHIMURA, M. OGURI, M. OGAWA, H. SOKABE and M. IMAI: *Am. J. Physiol.*, **218**, 911-915 (1970).
- 7) D. J. BOWIE: *Anat. Rec.*, **64**, 356-367 (1936).
- 8) G. KALEY, G. A. ROBISON and B. LUBBEN: *Biol. Bull.*, **125**, 381 (1963).
- 9) J. W. BEAN: *Am. J. Physiol.*, **136**, 731-742 (1942).
- 10) L. E. SUTHERLAND: Doctoral thesis (1966), cited in CAPRÉOL and SUTHERLAND (1968).
- 11) H. SOKABE, S. MIZOGAMI, T. MURASE and F. SAKAI: *Nature*, **212**, 952-953 (1966).
- 12) H. SOKABE, S. MIZOGAMI, and S. SATO: *Jap. J. Pharmacol.*, **18**, 332-343 (1968).
- 13) H. SOKABE, M. OGAWA, M. OGURI and H. NISHIMURA: *Texas Rep. Biol. Med.*, **27**, 867-885 (1969).