A Nephroblastoma in a Fire-bellied Newt, Cynops pyrrhogaster1

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SUMMARY

A large intraabdominal tumor, consisting of renal blastomatous cells, early defective stages of glomerules, and undifferentiated tubular structures is described in a fully grown female fire-bellied newt (Cynops pyrrhogaster). Questions of nomenclature of renal embryonal tumors in lower vertebrates are briefly discussed. The tumor is designated a nephroblastoma.

INTRODUCTION

Nephroblastomas seem to be very rare in animals with mesonephritic kidneys (fishes and amphibia), although immense numbers of many species are kept as pets and in laboratories. A single case was recorded in the steelhead trout (5).

The steelhead trout (Salmo gairdneri, Rich.) is the same species as the rainbow trout, differing only in that it spends part of its life in the sea and returns to fresh water to spawn.

Twelve nephroblastomas were discovered among 100 rainbow trout during experiments on the hepatocarcinogenic properties of N-nitrosodimethylamine (1).

Still another nephroblastoma in a rainbow trout was identified by the late C. E. Dunbar, who contributed sections of his specimen (RTLA Accession No. 217) to the Registry of Tumors in Lower Animals of the Smithsonian Institution.

More recently, a nephroblastoma in a marine fish, the striped bass (Roccus saxatilis), was discovered and submitted to the above Registry by Dr. C. F. Helmboldt (RTLA Accession No. 292). Information regarding the latter 2 specimens was kindly provided by Dr. John C. Harshbarger, Director of the Smithsonian Registry (4).

In Anurae (Amphibia) of which the South African claw-footed toad Xenopus laevis is especially widely used in laboratories, only one case of this tumor has been recorded in a fully grown female (3). In the second order of the amphibia, the urodeles, to which the salamanders belong, no nephroblastomas have been described.

MATERIALS AND METHODS

The case to be presented is that of a mature female specimen of the fire-bellied newt (Cynops pyrrhogaster). According to the owner, this animal was imported from China via Hongkong, and it appeared to be in good condition at the time of purchase, 6 weeks prior to presentation. During the preceding few weeks, the animal had lost appetite, and became very thin and sluggish in its movements; recently, it had developed a posterior paralysis. Upon inspection, the newt appeared emaciated; the movements of the hind legs were hampered by a large swelling within the abdomen, which dorsally distended the left flank. A firm mass with an irregular surface giving the impression of multiloculated, pea-sized cysts was palpable; it appeared to be adherent to the abdominal wall. A few drops of a watery fluid were obtained on aspiration. In view of the poor condition of the animal, the rapid development of the disease, and the extent of the swelling, the prognosis was very unfavorable; the newt was therefore sacrificed by decapitation.

Macroscopy

At postmortem examination, a large intraabdominal mass, occupying about one-fifth of the body cavity, was present to the left of the spinal column and firmly fused to the abdominal wall. The free surface, covered by the peritoneum, was slightly irregular, presenting low elevations (Fig. 1).

Incision of the tumor exposed several small cavities filled with clear, amber-colored, watery fluid. No abnormalities were observed in other organs.

Histology

Histopathological examination was performed on tissues fixed in neutralized 4% formaldehyde. Paraffin slides were produced in the usual way and stained with hemalum and eosin, the Van Gieson elastic tissue method, and PAS2 technique.

The tumor was composed of both epithelial and connective tissue elements and was surrounded by a capsule of connective tissue. This capsule was ruptured in several places, through which masses of tumor tissue, each provided with its own thin capsule, protruded (Fig. 2).

Epithelial cells made up the bulk of the tumor, but in some regions the stroma predominated (Figs. 2 and 3).

1Formerly known as Triturus pyrrhogaster.

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2The abbreviation used is: PAS, periodic acid-Schiff-hematoxylin stain.
The stroma consisted of fibroblasts and fibrocytes which had produced a loose network of collagen fibers; the intrafibrillar spaces were filled with slightly eosinophilic, PAS-negative edema fluid. Some lymphocytes were scattered in the interstitial tissue.

The tumor was well vascularized by thin-walled blood vessels. In the parenchyma four elements could be distinguished.

**Embryonal Renal Blastema.** Ribbons or rosettes of oval or polygonal cells occurred in certain areas and resembled embryonal renal blastema. The cells were provided with a thin rim of cytoplasm around darkly staining, compact nuclei of variable size. The rosettes sometimes showed a small central space, suggesting an early attempt at tubule or glomerule formation.

**Tubules.** Tubules were very variable in appearance. The lumina were always much narrower than those found in the normal kidney (Fig. 4). The epithelial lining showed irregular folds and knobs. Certain tubules were lined by unevenly distributed small, cuboidal, or even flattened cells with scanty cytoplasm and deeply stained nuclei of variable but always small size. Mitotic figures were numerous. A basement membrane failed to develop. Other tubules were formed predominantly of larger cells with more cytoplasm and large polymorphous nuclei. In the latter cells, PAS-positive material could be present along the apical ends, but a continuous brush border was not produced. A basement membrane was present only in those tubules with a regular circular arrangement of larger epithelial cells. Although connections between tubules of the two types were often observed, there was no obvious differentiation into distinct tubular segments (Fig. 5).

**Glomerulus.** Attempts at glomerulus formation were numerous but always defective and abortive. Generally, they did not proceed beyond the stage in which tubular formations were invaginated to a greater or lesser degree by a cellular parenchyma (Fig. 6), occasionally accompanied by connective tissue.

Less often, a core of collagen fibers, lined by epithelial cells with irregular nuclei and nearly devoid of cytoplasm, bulged into the Bowmann's space (Fig. 3). In these proglomeruli, the production of multiple capillaries was never observed. The proglomeruli were connected with tubules (Fig. 3), but the presence of ciliated epithelium was observed only once.

**Pseudocystic Spaces.** Pseudocystic spaces, provided with an endothelial-like lining, were few and haphazardly distributed through the new growth.

**DISCUSSION AND CONCLUSIONS**

The tumor described is a new growth composed of immature renal blastema which mimics or retains the structure of the developing kidney. This is in accordance with the general characterization of a nephroblastoma (7).

Another feature comparable with nephroblastomas in higher vertebrates is the fact that this was a unilateral tumor. For anamniotes (fishes and amphibians), it has been proposed to designate as mesonephromas those tumors comparable to nephroblastomas in amniotes such as reptiles, birds, and mammals (5). However, the assumption that the adult kidney of fishes and amphibians is homologous with the mesonephros of embryonic anamniotes has been disputed (6). The objection is based on the observations that urodèles have structures comparable to ureters and that the anamniote kidney is not solely drained by the archinephric duct.

In addition, the term mesonephroma has been preempted in human pathology, where it designates a rather special group of tumors supposed to originate from mesonephric vestiges.

On the basis of these considerations, the tumor in the fire-bellied newt was termed a nephroblastoma.

Nephroblastomas have been found in a considerable variety of mammals and in birds (7), as well as fishes and amphibians. It would therefore appear to be an excellent tumor for comparative study (2), either in spontaneous cases or as experimentally induced nephroblastomas.

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**REFERENCES**

Fig. 1. Fire-bellied newt (Cynops pyrrhogaster). Survey of the embryonal renal tumor. Positive and negative PAS, X 2.
Fig. 2. Herniation of the tumor capsule and protrusion of tumor tissue. H & E, X 40.
Fig. 3. Two proglomeruli in the tumor. One connected with a tubule; the other presented a vessel in the core of connective tissue. Rosettes of renal blastema-like cells. H & E, X 250.
Fig. 4. Normal kidney of the same animal. H & E, X 100.
Fig. 5. Variability in tubules and the two types of tubular cells in the tumor. H & E, X 250.
Fig. 6. Early attempt of the tumor at glomerulus formation. H & E, X 250.
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