Степанов Артем Анатольевич
Тюменский государственный университет
Институт биологии
Студент магистратуры
Группа 27Бм177
Stepanov590@mail.ru

СРАВНИТЕЛЬНАЯ ХАРАКТЕРИСТИКА МЕЗОНЕФРОСА РЫБ И ПТИЦ

Stepanov Artyom Anatolyevich
Tyumen State University
Institute of Biology
MSc student of 26Bm177 gr.
Stepanov590@mail.ru

MESONEPHROS COMPARATIVE CHARACTERISTICS IN FISH AND BIRDS

Аннотация. Цель исследования - провести сравнительный морфологический и морфометрический анализ мезонефроса рыбы и птицы. Показано, что на этапах эволюции хордовых – анамний (рыбы) и амниотов (птицы) система мочеобразования характеризуется феноменом параллелизма органогенезов. Выявлено, что структурно-функциональные единицы первичной почки – мезонефроны имеют принципиально идентичное строение у анамний и амниотов и характеризуются детерминированным органотипическим интервалом морфометрических показателей.

Ключевые слова: первичная почка, рыба, птица, морфология, морфометрия.

Abstract. The aim of the study is to conduct a morphological and morphometric analysis of fish and birds mesonephros. It is shown that at the stages of chordates evolution urine formation system of anamniotes (fish) and amniotes (birds) is characterized by the phenomenon of organogenesis name as parallelism. It was

revealed that structural and functional units of primary kidney i.e., mesonephrons have a fundamentally identical structure of anamniotes and amniotes and are characterized by a conditioned organotypical interval of morphometric parameters.

Key words: mesonephros, fish, birds, morphology, morphometry.

Relevance of the topic

The combination of the two most important phenomena, which underlie the evolution of animal world - parallelism and divergence - was presented in the works of I.I. Mechnikov. These conclusions have been redefined by N.G. Chlopin and A.A. Zavarzin. They were formed a fundamental theory on evolution of tissues. Neverthless, domestic publications about the importance of parallelism in the evolution of organogenesis have not been revealed. The problem urine formation is one of the most urgent not only in embryology, but also in ichthyology, comparative physiology and morphology as well.

Materials and methods

For mesonephric study we used 15 fish larvae and 228 chick embyos. Fish material was studied at the stage of atrophy of the yolk sac (36-37 stages according to the classification of Vernier, 1969). The primary kidney of the bird was studied from the stage of 48 hours of incubation in brood chamber to 20 days inclusive.

Morphology of the renal corpuscles, glomeruli, capsular space and tubules of nephrons in the primary kidney of fish (Coregeonus Peled, Gmelin) and birds (Galus Domesticus L.) was studied by light optical microscopy. The materials were stained by H&E and iron hematoxylin. In addition, we used McManus Pas Method.

Results and discussion

Mesonephrons of fish, performing excretory function, simultaneously provide the homeostasis of the body and the excretion of metabolic products. Probably, main feature of fish mesonephros is connection with secondary body cavity through nephrostome, which affects the morphology of mesonephrons.

Fish mesonephron is represented by the renal corpuscle, which includes a capsule of the nephron, arterial glomerulus, urinary space, and tubules. The outer layer

is lined with a single-layered epithelium. Opposite that, the inner layer (podocytes) is part of the renal filter.

We discovered that afferent arterioles (diameter 21.4±3.1 μm), efferent arterioles (13.2±3.0 μm) and capillaries of the arterial glomerulus contain clusters of blood cells and blood plasma.

Mesonephric tubule (cross-sectional area 2476±128 μm2) is lined with a single-layer columnar epithelium (cell height 15.2±0.5 μm, transverse size 8.62±0.41 μm). The number of epithelial cells along the perimeter of the tubule is about 16-17. The epithelium area is about 1837±130 μm2. Epitheliocytes are characterized by a pronounced brush border with a height of ≈ 3 μm.

The formation of birds mesonephros is accompanied by the formation of three generations of mesonephrons, beginning from the cranial and ending with the caudal department of the meso-neural mesoderm. In contrast to fish, mesonephros of birds has much more functions, such as reabsorption, secretion, pinocytosis, and microphagocytosis. This also affects the morphology of mesonephrons.

Mesonephric tubule has a significant gradation of the cross-sectional area in different sections along the length, which can be explained by the unequal functional load.

The results are shown in Tab.1.

Morphometric parameters	Fish, μm2	Birds, μm2
The area of glomeruli	23193 ± 640	5473 ± 320 - 12946 ± 540
The area of glomerular capillaries	21548 ± 590	3292 ± 240 – 5485 ± 428
The area of Bowman's space	2056 ± 270	1638 ± 62 – 4815 ± 260
The area of tubules	2476 ± 128	2500 - 20 000

Table 1. Average morphometric parameters of fish and birds mesonephrons.

We measured that the areas of glomeruli are different: 23 000 μm2 (fish) – 12 000 μm2 (birds). The areas of tubules were also measured: 2500 μm2 (fish) – 2000-20 000 μm2 (birds). The structure of epithelial cells in nephrons structure was directly related to their present function. However, in the areas of tubules and Bowman's space differences were not so pronounced.

Conclusions

1. Reliable differences in size of fish and birds mesonephros glomerulus may indicate process of miniaturization in phylogenesis.

2. Phenomenon of parallelism extends not only to the tissue, but also the organ level of the morphological substrate development and evolution

REFERENCES

1. V.L. Yanin. Mezonefros [monography]. - Ekaterinburg: Ural Branch of the Russian Academy of Sciences, 2000. - 130 p. (in Russian) .

2. L.F. Kalenova. Zakonomernosti funktsionirovaniya immunnoy sistemy v dinamike formirovaniya sistemy «parazitkhozyain» na modeli opistorkhoznoy invazii [Medical science and education of Ural]. – Tyumen: Tyumen State Medical University, 2006. - Pp. 120-128. (in Russian).

3. T.A. Detlaf. Ob"ekty biologii razvitiya [Monography]. – Moscow: Nauka, 1975. - 579 p. (in Russian).

4. E.A. Flerova. Kletochnaya organizatsiya pochek kostistykh ryb (na primere otryadov Cypriniformes i Perciformes) [Monography]. - Yaroslavl: Yaroslavl State Agricultural Academy, 2012. - 140 p. (in Russian).