Peculiarities of Vascular Plexus Structure in Amphibian Brain

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Structural peculiarities of the epithelium and connective tissue stroma of vascular plexuses in amphibian brain are examined. Quantitative and qualitative characteristics of the pool of cell regulators of regional hemodynamics during normothermy and deep winter torpidity are determined.

Key Words: *amphibia; cerebral vascular plexuses; structure; cell regulators of regional hemodynamics*

Cerebral vascular plexuses (CVP) are important structural components of the blood-brain barrier providing optimal function of the brain. There is evidence [1, 2,4,7] that CVP produce the cerebrospinal fluid, which explains actuality of its study.

CVP are present in all ventricles of amphibian brain [6-8]. There is evidence on participation of choroid epithelium in the production of cerebrospinal fluid [9,10]. However, morphology of the structural elements of CVP is not comprehensively known. In particular, there are no data on their connective tissue component.

Our aim was to study morphological organization of amphibian CVP during active life and hibernation.

MATERIALS AND METHODS

Experiments were performed on 60 edible *Rana esculenta* and brown *Rana temporaria* frogs (males predominantly). The specimens for light microscopy were embedded in paraffin and stained with toluidine blue, alcian blue, and safranin in combination with resorcin and impregnated as described elsewhere [3]. Enterochromaffin cells were revealed as described previously [6]. Morphometric data were analyzed statistically.

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RESULTS

Amphibian CVP have clear structural organization. Phylogenetically, amphibia are the first animals with separated lateral cerebral ventricles.

Anatomical structure of CVP is similar in edible and brown frogs. Duplicature of alternated ependyma forms villi (Fig. 1) consisting of connective tissue stroma with vessels of the microcirculatory bed (MB) covered by simple epithelium exposed to the ventricle lumen. It should be noted that CVP of the lateral and IV ventricles have more arborized villi than CVP in the III ventricle. In addition, the populations of cell regulators of regional hemodynamics are different in these ventricles. As MB plays an important functional role in CVP, this feature seems to be important. Among these regulators, enterochromaffin cells and melanocytes are most abundant, although tissue basophil cells can also be found.

Morphometric analysis of CVP in all ventricles showed that CVP epithelium in the lateral ventricles of summer edible frogs is almost 1.5-fold higher ($p<0.05$) than in winter frogs, while the volume of epitheliocyte nuclei in summer edible frogs only 1.2-fold surpasses that in winter frogs. In summer edible frogs the connective tissue layer in CVP of the lateral ventricles is also 1.4-fold thicker than in winter frog, while in brown frog this index is season-independent ($p>0.05$). In winter edible frogs the mean MB vessel

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diameter almost 2 times surpasses that in summer frogs. Evidently, in winter frogs this part of MB serves as a blood depot.

In winter, the thickness of the epithelium in the III ventricle in edible and brown frogs is respectively 1.5-fold and 1.47-fold lower than in summer frogs. In addition, in winter frogs the diameter of epithelial cell nuclei in the III ventricle is 1.3-fold smaller. At the same time, in winter edible frogs the connective tissue layer in CVP is 2.5 times thicker than in summer frogs.

In winter edible frogs the thickness of the epithelium and the diameter of epithelial cell nuclei in the IV ventricle are 1.8- and 1.1-fold smaller than the corresponding values in summer frogs. The thickness of connective tissue layer does not significantly vary (4.80± 0.46 μ in summer and 4.60±0.94 μ in winter frog). Diameter of vessels in MB of the IV ventricle also does not significantly differ in winter edible frogs in comparison with that of summer frogs, while in winter brown frogs this index is 1.33-fold greater than in summer frogs.

In brown frogs epithelium thickness in the lateral ventricles slightly decreases in winter, while the mean diameter of epithelial cell nuclei and the thickness of the connective tissue layer virtually do not vary. By contrast, the mean MB vessel diameter in winter frogs increases 1.23-fold.

In comparison with summer frogs, the thickness of CVP epithelium and the diameter of nuclei in the III ventricle of winter frogs decrease 1.7- and 1.07-fold, respectively, while the thickness of the connective tissue layer increases 1.55-fold. In winter, the mean MB vessel diameter in CVP of III ventricle decreases 1.45-fold.

In brown frogs, the thickness of the epithelium and nuclear diameter of epithelial cell nuclei in the IV ventricle in winter decrease 1.43- and 1.2-fold, respectively. However, the thickness of the connective tissue layer does not vary.

The population of cell regulators of local hemodynamics consists of enterochromaffin cells, melanocytes, and tissue basophils. Enterochromaffin cells are presented in all ventricles in summer and winter brown and edible frogs. In winter edible frogs the content of these cells in lateral ventricles 1.5-fold surpassed that in summer frogs. In winter, the number of enterochromaffin cells of the lateral, III, and IV ventricles of brown frogs increases 1.3-1.5-fold.

Melanocytes were observed in CVP of the lateral and IV ventricles of brown and edible frogs. The number of these cells in the lateral and IV ventricles of winter frogs higher 1.25- and 1.6-fold, respectively, compared to summer edible frogs. In winter, the number of enterochromaffin cells in CVP of the lateral and IV ventricles of brown frogs increases 1.2- and 1.75-fold, respectively.

Thus, all cerebral ventricles in frogs contain CVP formed by epithelium, stroma, and vessels. In winter, stroma of all ventricles in edible and brown frogs contains predominantly melanocytes and enterochromaffin cells, which provide regulation of local hemodynamics. Tissue basophil cells are observed irregularly

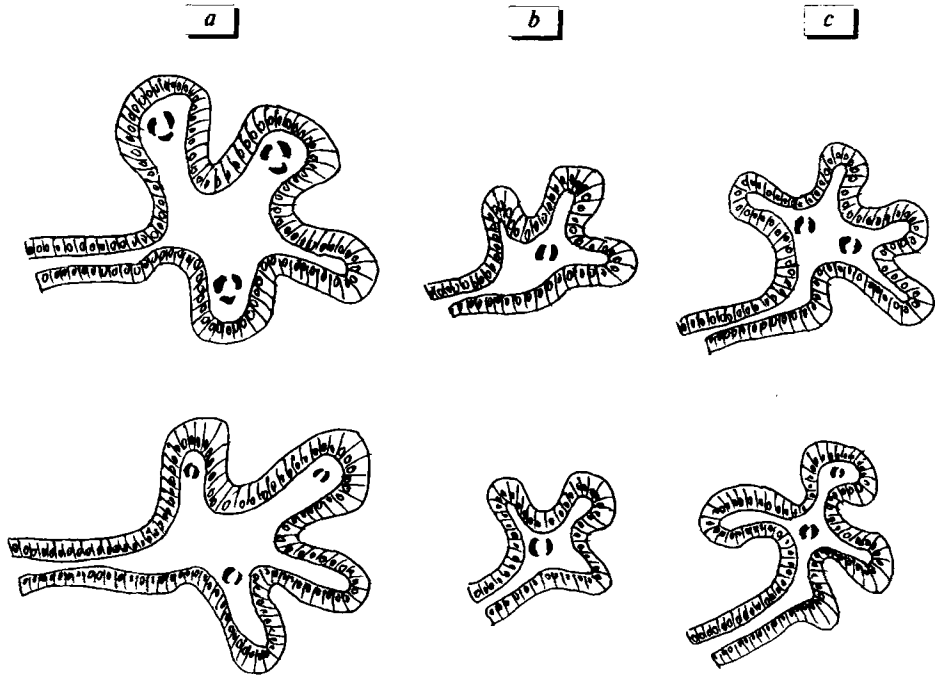

Fig. 1. Structure of cerebral plexuses in edible (at the top) and brown (at the bottom) frogs in the lateral (*a*), III (*b*), and IV (*c*) ventricles.

and only during normothermy. The examined CVP are similar by anatomical structure and differ in biometric parameters and cell regulators of local hemodynamics.

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