Institute of Experimental Morphology and Anthropology

Acta morphologica et anthropologica, 6
Sofia • 2001

Comparative Analysis of the Relative Part of the Light and Dark Epithelial Cells of the Rat Choroid Plexus during Development and Hypokinesia

V. Ormandjieva

Institute of Experimental Morphology and Anthropology, Bulgarian Academy of Sciences, Sofia

In the present study were carried out comparative quantitative investigations of the choroid plexus epithelial cells of the rat during development and hypokinesia. Changes of the relative part of the light and dark epithelial cells were determinated on the semithin sections by light microscope. Relative part of the dark epithelial cells is 25.76% during one month of development, while the relative part of the light epithelial cells is 74.24% during the same month of development. During development the relative part of the dark epithelial cells increases and at the age of 22 months is 66.9%, while the relative part of the light epitelial cells decreases and at the age of 22 months is 33.1%. The percentage of the dark epithelial cells increased during 9 and 12 months of hypokinesia in comparison with control, while the percentage of the light epithelial cells decreased during the same months of hypokinesia. The obtained quantitative data point out that increased relative part of the dark epithelial cells from age one month to 22 months during development and during 9 and 12 months of hypokinesia may be related to the decreased functional activity of the plexus choroideus with the age and may be correlated with the age changes, which begin earlier in the condition of prolonged hypokinesia.

Key words: plexus choroideus, quantitative investigations, light and dark epithelial cells, ontogenesis, hypokinesia

Introduction

The plexus choroideus represents the blood-cerebrospinal fluid (CSF) barrier [1]. The plexus choroideus secretes CSF and actively regulates concentration of molecules in the CSF and makes the blood-cerebrospinal fluid barrier a selective one [2]. Light and dark choroidal epithelial cells were identified by Wislocki and Ladman [3] and they suggested that the difference in cell density reflected different stages in the secretory cycle of the choroidal epithelium. Arginine vasopressin (AVP) decreases CSF formation rate and choroidal blood flow, and AVP also increased by more than twofold the number of dark epithelial cells and possibly dehydrated but otherwise morphologically normal choroid epithelial cells in adult rat choroid plexus [4]. The percentage of dark and light epithelial cells appears constant from 14 days postconception up to 3 months postnatum during development of the mouse choroid plexus [5]. The aim of the present study is to investigate the quantitative changes of the light and dark epithelial cells during development and during prolonged hypokinesia.

Material and Methods

Wistar rats (n=40) aged 1, 1.5, 2, 4, 7, 10, 13 and 22 months and one-month rats (n=20) subjected to 3, 6, 9 and 12 months of hypokinesia in the specially constructed individual cages for physiological immobilization [6] were used in the present study. The animals were anesthetized with sodium pentobarbital (22 mg/kg) and were perfused intracardially with 2.5% glutaraldehyde and 2% paraformaldehyde [7]. The choroid plexus was postfixed in 1% osmium tetraoxide in 0.2M cacodilate buffer, dehydrated through draded ethanol and embedded in Durcupan. Semithin sections were stained with toluidine blue and examined by light microscope CARL ZEISS JENA. For statistical analysis the Student's t-test was applied. Quantitative data are presented by graph in percentage.

Results and Discussion

On the first graph are presented the results of the quantitative investigations of the relative part of the light and dark epithelial cells of the rat choroid plexus during development and after 3, 6, 9 and 12 months of hypokinesia (Fig.1). The relative part of the light epithelial cells is 74.24% of the one month rat, and the relative part of the dark cells is 25.76% during the same period. During development the relative part of the light epithelial cells decreased and at the age of 22 months it is 33.11%, while the relative part of the dark epithelial cells increased and at the age of 22 months it is 66.89%. The relative part of the dark epithelial cells increased statistically significant during 9 months of hypokinesia with 33.9% (p<0.001) in relation to control and with 9.7% (p<0.001) during 12 months of hypokinesia, while the relative part of the light

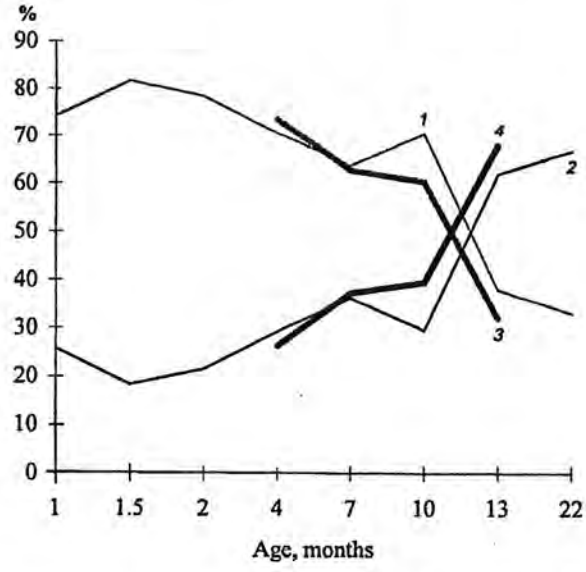

Fig. 1. Relative part of light and dark epithelial cells of the rat choroid plexus during development and hypokinesia
1 — % light epithelial cells; *2* — % dark epithelial cells; *3* — % light epithelial cells during hypokinesia; *4* — % dark epithelial cells during hypokinesia

cells decreased during the same months of hypokinesia. After electron microscopical investigations of the 25, 28 and 31 months mice choroid plexus were observed ultrastructural changes connected with the age which are resulted of decreased functional activity of the choroid plexus epithelial cells during development [8]. The relative part of the dark epithelial cells increased during all the period of development and after the age of 13 months remain higher (61.97%) from the relative part of the light epithelial cells (38.03%), as the same tendency is observed during 9-and 12-month hypokinesia. This tendency concurs with ultrastructural data of decreased functional activity of the choroid plexus with age (Fig.2), and may be correlated with the age changes of the rat choroid plexus epithelial cells more significantly during prolonged hypokinesia [9, 10].

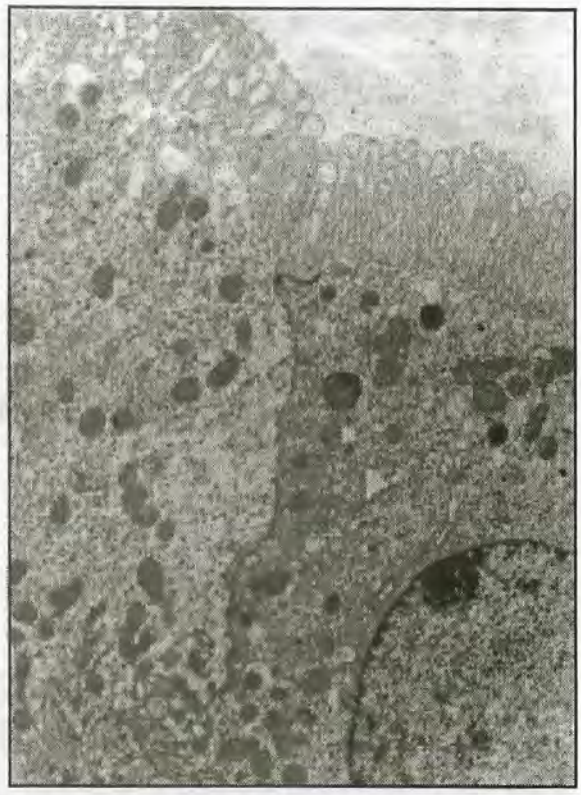

Fig. 2. Light and dark epithellial cells of the rat choroid plexus aged 13 months (× 5000)

References

1. Davis, D., T. A. Milhorat. The blood brain barrier of the rat choroid plexus. — Anat. Rec., **181**, 1975, 779-790.
2. Van Deurs, B. Structural aspects of brain barrier with special reference to the permeability of the cerebral endothelium and choroidal epithelium. — Intern.Rev. Cytol., **65**, 1980, 117-191.
3. Wislocki, G. B., A. J. Ladman. — In: The Cerebrospinal Fluid. The Fine Structure of the Mammalian Choroid Plexus (Eds G.E.W. Wolstenholme, C.M. O'Connor). Boston, Brown, 1958, 55-79.
4. Johanson, C. E., J. E. Preston, A. Chodobski, E. G. Stopa, J. Szmydyngerchodobska, P. N. Mcmillan. AVP V_1 receptor-mediated decrease in Cl^- efflux and increase in dark cell number in choroid plexus epithelium. — Amer. J. Physiol., **45**, 1999, 82-90.
5. Sturrock, R. R. A morphological study of the development of the mouse choroid plexus. — J. Anat., **129**, 1979, 777-793.
6. Черешаров, Л. Клетка за обездвижване на животни. — Изобретателство и рационализаторство, **11**, 1982, 35-36.
7. Karnovsky, M. A. A formaldehyde-glutaraldehyde fixative of high osmolarity for use in electron microscopy. — J. Cell Biol., 27, 1965, 137A.
8. Sturrock, R. R. An ultrastructural study of the choroid plexus of aged mice. — Anat. Anz., **165**, 1988, 379-385.
9. Ormandjieva, V., L. Cheresharov. Ultrastructural and morpholometric investigations of the light and dark epithelial cells of the rat choroid plexus during hypokinesia. — Compt. rend. Acad. bulg. Sci., **47**, 1994, No 9, 109-112.
10. Gitsov, L., V. Bourneva, L. Cheresharov. Ultrastructure of plexus chorioideus of rats subjected to prolonged immobilization. — Structure and Functions of the brain, **9**, 1985, 12-17.