

Morphologic Changes in Vascular Dementia

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Abstract

Morphologic changes in cortex and white matter of the cerebral frontal lobes in vascular dementia were studied. The signs of leukoariosis in white matter were revealed. Obvious signs of neurodegeneration expressed in loss of neurons, which is considered to be the attribute of aging process and may be one of significant etiologic factors of vascular dementia, had not been identified.

Keywords: vascular dementia, neurodegeneration, loss of neurons, leukoareosis, aging

1. Introduction

Dementia pathogenesis, in particular vascular dementia pathogenesis, is considered to be complex (Cumming TB et al., 2013, Emelin, 2014). The leukoariosis of cerebral white matter, caused by small cerebral vessels lesion and blood flow changes due to instable blood pressure, can play a significant role in vascular dementia origin. Some authors present the connection between hypertension and leukoariosis. Except morphological changes in brain vessels, the systemic processes of neurodegeneration in vascular dementia pathogenesis are

considered to be of some importance (Tullberg M et al., 2004; Damulin et al., 2014,). Neuronal loss in various brain structures as age-dependent process is obvious (Kolomiytsev, 2012). However, vascular dementia morphological changes seem to be studied insufficiently especially concerning the question about degree of expression of neurodegenerative changes.

2. Study Design

The main aim of the research was to reveal morphologic changes in cerebral white matter, degenerative and atrophic changes of the cerebral cortex which may be the leading elements in vascular dementia pathogenesis and brain aging.

3. Materials and Methods

The study was conducted on autopsy material of various age groups. In each case cerebral tissue fragments of cerebral front lobe of right and left hemispheres were studied. Tissue fragments were fixed in 10% formaldehyde and underwent standard histological processing. Cross-sections were prepared and stained by means of standard histological and histochemical methods. In each case 10 serial cross-sections were prepared (5 cross-sections of right and left hemisphere cerebral tissue, 10 micrometers thick). The calculation of number of neurons per field of vision (420x) of optic microscope was undertaken with mean number identification. The neurons were counted in the cortical substance according to the projection of pyramidal cells layer, the internal granular layer, and ganglion cells layer. In each case the total number of neurons was counted and the average values were calculated. All observations were distributed according to age groups. In addition, a morphological study of sections of white matter in the subcortical zones of the frontal lobes was carried out. In all cases the degree of atherosclerosis expression in cerebral vessels was studied.

4. Results and discussion

30 autopsies were studied from subjects demonstrating cardiovascular and cerebrovascular pathology varying in age from 34 to 91 years. There were studied 12 autopsies of male (40%) and 18 autopsies of female (60%). Vascular dementia was obvious from the anamnesis data in 10 cases. The following results were obtained.

1. The number of neurons in the right and left cerebral hemispheres differs insignificantly, fluctuations of this value have no statistical significance.

2. There are signs of reducing the number of neurons in the cerebral cortex frontal lobes with increasing the age. The number of neurons percentage decrease within the age groups of 71-80, 81-90 and 91-100 years comparing with the groups of 31-40 and 41-50 years made up 13.78%, but this decrease in each case was not obvious. At the obtained data statistical processing, the value of the Student's criterion was equal to 1.77, that confirms these changes are not statisti-

cally significant. The data do not coincide with the generally accepted data concerning the processes of atrophy of the cerebral cortex in old age.

3. When studying changes in white matter of the frontal lobes in all 10 cases of vascular dementia, there were found loss of axons, focal gliosis, focal expansion of perivascular spaces, which can be estimated as a histological picture of leukoaraiosis.

4. The signs of marked atherosclerosis of cerebral vessels with a total area of lesion up to 50% were found that is probably the reason of cognitive declines.

Statistics.

For statistical processing of the results we calculated Student criterion ($P < 0,01$) and Pearson criterion X^2 which reflected the significance of distinction of parameters of the group. At the obtained data statistical processing, the value of the Student's criterion was equal to 1.77, that confirms these changes are not to be statistically significant. The data also do not coincide with the common literary data concerning the processes of atrophy of the cerebral cortex in old age.

The calculation of X-square criterion with Yates's correction when studying white matter morphology was as follows: the value was 16,20 that was much more than the minimum of 5.00 value for the given study. This corresponds to the significance level of $p < 0.01$ and confirms the statistical significance of the results.

Conclusions. Morphological changes in cerebral white matter due to atherosclerotic lesions of vessels are the leading elements in vascular dementia pathogenesis; degenerative and atrophic changes of the cerebral cortex are less expressed and are not obvious for vascular dementia.

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Competing interests. The authors declare no conflicts of interest.

Ethics approval. RostGMU Bio-Ethical Committee.

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