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Age-effect on synaptic morphology of male and female Wistar rats: Electron-microscopic and morphometric study

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Aging is a universal phenomenon characterized by the changes in all aspects of cellular machinery and increased risk of developing many diseases. Understanding the consequences of aging on cell function might help to develop new strategies for improving functional abilities in elderly population.

Cognition is especially vulnerable in aging. Various age-related alterations develop in brain regions related with cognition. It is proposed that in females and males cognition is differentially vulnerable to aging. In this electron microscopic and morphometric study, we define how age- and sex related cognitive decline is reflected on synaptic morphology of hippocampus.

The study was performed on adolescent, adult and aged male and female Wistar rats. Transmission electron microscope JEM 1400 was used. On electron micrographs, using Image J software, number and area of presynaptic terminals, number and area of pre- and postsynaptic mitochondria, length of active zone of synapses, total number of synaptic vesicles and number of vesicles in functionally different vesicle pools (readily releasable, recycling and resting pools) were measured. Quantitative analysis was performed using Statistical Computation VassarStats. To reveal the effects of sex and age on abovementioned parameters, two-way ANOVA (sex × age) followed by Tukey's multiple comparisons post hoc test was used.

We show that synaptic morphology is altered with aging and such alterations are sex-dependent. Thus, in aged male rats the decrease of total number of vesicles and number of vesicles in all three pools were revealed. In contrast to this, aged female animals show the decrease of the length of active zone. Because there is a close relationship between vesicles, length of active zone and strength of synapse, such changes may be associated with alterations in the function of hippocampal synapses, hippocampal neuronal health and finally, in cognition.

However, in both, male and female aged rats, significant increase of the area of pre- and postsynaptic mitochondria was shown. Because the intensity and size of mitochondria directly reflect their activity and metabolic state of cell, such changes may indicate compensatory processes that are still operated during aging and hence may be a target for therapeutic intervention at this stage of life.

Thus, some sex-dependent alterations point to the reduction in neurotransmission and synaptic neuroplasticity with aging, while others give the possibility to suggest that in aged brain compensatory mechanisms still operate; one of such mechanisms could be related with synaptic mitochondria.

Biography

I am Nino Lomidze, 36 years old. I have finished Medical School, as a Physician and now working in the University of Georgia as a Head of Study Process and studied PhD in the Ilia State University, on a program Cellular Biology, Neuroscience. Right now, my dissertation is going to end.

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