Aerobic Exercise Intervenes Cognitive Function Regression and Expression Mechanism of Hippocampal Mitochondrial DNA and Related Proteins in Aged Rats

Yan Song[1], Jiege Jiao[2]

[1] Hainan Medical College, Haiou city, Hainan Province, 571199

[2] Hainan Institute of Science and Technology, College of Health Sciences, Haikou city, Hainan Province, 571126

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Abstract: The hippocampus and its surrounding cortical structure are closely related to human cognition. The aging of the body will cause the functional degeneration of cognitive ability. Physical exercise may affect the cognitive function of the body by acting on the hippocampal nerve tissue. However, at this stage, the purpose of this study was to explore the effects of physical exercise on the neurological function of the elderly population.

1. Introduction

The hippocampus and its surrounding cortical structures are important components of the memory neural pathway and are closely linked to human cognition. It is generally accepted by psychologists and neuroscientists that hippocampus plays an important role in the memory of experienced events (episodic or autobiographical memory), in part because the hippocampus can detect events, locations and related stimuli. Researchers regard the hippocampus as the medial temporal lobe memory system responsible for the general declarative memory. Because the hemisphere contains two hippocampal tissues, the brain can maintain near-normal memory in the event of a damaged hippocampus; however, when the bilateral hippocampus is severely impaired, memory formation can be difficult (forward amnesia), But also affect memory prior to injury (retrograde amnesia) [1]. However, damage to the hippocampus does not suppress all types of memory processes, such as the ability to learn new skills such as playing the piano, unaffected, perhaps because these memories are dominated by other areas of the brain. Related researchers also distinguish "conscious memory" from "familiarity", the former depends on the hippocampus, while the latter is mainly dominated by other parts of the medial temporal cortex.

As the hippocampus is a key part of memory information, the factors leading to hippocampal damage are also closely related to the changes of learning and memory ability. Among the factors related to the pathological changes of the hippocampus, the age factor is the most important and most obvious. The typical symptom is Alzheimer's disease, one of the earliest signs of the disease when the hippocampus is damaged. Studies have shown that normal aging of the body can also lead to some types of memory loss, including episodic memory, working memory, and the like. Given the central role of the hippocampus in memory, there has been a great deal of interest in the study of memory loss due to the deterioration of the hippocampus. MRI findings of some brain tissues showed that the hippocampus of middle-aged and elderly patients had varying degrees of atrophy, and the atrophy of the hippocampus did not achieve satisfactory results in subsequent memory training. Similar reports show that in the memory task, the aging body cannot effectively activate the nerve tissue in the hippocampus, the effect of significant difference with the young body.

2. Effect of Aerobic Exercise on Cognitive Ability in Aged Rats

Aging is often accompanied by a series of functional system degeneration and cognitive decline

is one of the important phenomena. Appropriate exercise can improve the body organs, tissue aging phenomenon. Our study examined the effect of swimming with different loads on working memory errors, reference memory errors and time to complete feeding in aging rats. The results showed that exercise with small load had no significant effect on working memory errors ($P > 0.05$), but significantly reduced the number of reference memory errors ($P < 0.05$) and time to complete feeding ($P < 0.01$) ($P > 0.05$). The rats in high-load exercise significantly increased the number of working memory errors ($P < 0.05$) and reference memory errors ($P < 0.05$) little effect ($P > 0.05$). Eight-arm maze test is an effective way to test the cognitive ability by the nature of rat foraging. There are two kinds of memory in completing this series of behaviors. The first is that working memory belongs to short-term memory type, it is a limited temporary storage of information. The information in working memory is the content of people's own consciousness. Baddeley that working memory can be divided into language working memory and spatial working memory, the two subordinate working memory is also controlled and coordinated by the central executive system, prefrontal cortex involved in working memory process of implementation. This memory is easily erased and replaced at any time. After the hippocampus damage this memory will be difficult. The second is that the reference memory belongs to the long-term memory type, which needs to be achieved after repeated completion of the goal. Reference memory has the characteristics of permanent information storage, generally long-term memory, its main source of information from the working memory to be repeated, but also because of the formation of an impressive [2].

Eight-armed maze data results show that the large load group in the working memory error, the reference memory error of the two indicators relative to the other groups was the worst, the longest completion of the experiment, indicating that the large load group cognitive ability is low, and then infer Heavy load exercise has damaging effect on hippocampal nerve. Small load group of three indicators of outstanding performance, there are fewer errors, and the end of the experiment in the shortest time, indicating that small load group of aged rats learning and memory ability compared to the other groups the most excellent, which draw small exercise can promote the functional improvement of the hippocampus conclusion. There was no difference between the middle load index group and the control group. The data showed that the medium load group had a tendency of large load group, which had a negative impact on the learning and memory ability of the aging rats.

3. Hippocampus VEGF, VGEI Protein Test Results

Immunohistochemistry was used to detect the expression of VEGF protein in hippocampus of rats in each group. The results are shown in Table 7 and Figure 5. The positive rates of VEGF protein expression in the control group, small load group, medium load group, and high load group were 0.07 ± 0.02,0.15 ± 0.02,0.09 ± 0.03,0.03 ± 0.01, respectively. The positive expression of VEGI protein in hippocampus of rats in each group The positive rates of group, small load group, middle load group and large load group were 0.09 ± 0.02,0.03 ± 0.01,0.09 ± 0.03,0.16 ± 0.04 respectively. We compared the statistic differences of exercise group and control group with different load. The results are shown in Figure 7. Compared with control group, the expression of VEGF protein increased significantly in small load group ($P < 0.001$) ($P < 0.001$). Compared with the control group, the expression of VEGI protein in the low-load group had a significant decrease ($P < 0.001$), but the difference was not statistically significant There was no significant difference in the medium load group ($P > 0.05$), and there was a significant increase in the large load group ($P < 0.01$).

4. The Effect of Hippocampus VEGF and VEGI

Hippocampal nerve tissue is an important part of memory neural pathways, and its function is closely related to human cognition. Some factors regulate the molecular expression in the hippocampus, which in turn affects the body's cognitive function. Our study showed that, compared with the quiet control group, the expression of VEGF was up-regulated in the hippocampus and the expression of VEGI was down-regulated in the light exercise group, while the expression in the heavy exercise group showed the opposite trend. As a kind of pro-angiogenic growth factor, VEGF

can promote the division of vascular endothelial cells and has a strong pro-angiogenic effect. It reported that VEGF plays an important regulatory role in the central nervous system. In vivo transfection of VEGF-associated plasmids into the suckling mice resulted in an upregulation of the expression of the VEGF-related plasmids [3]. It was found that high expression of VEGF promoted neural stem cell proliferation and differentiation. Another in vivo study also confirmed that VEGF helps to increase neuronal activity in the cortex and substantia nigra and promote neuronal extension. A number of in vitro experiments on neurons affected by VEGF have also shown similar trends and reports indicate that VEGF protects the growth activity of cells in serum-free or hypoxic conditions. Gu etal. Cultured dorsal root ganglia in vitro and found that high expression of VEGF can increase neuronal activity and promote axonal growth. Zhang and other studies have shown that VEGF can promote the proliferation of oligodendrocyte precursors cultured in vitro, and further that this mechanism may be related to Notch signaling pathway related protein upregulation. Notch signaling pathway is a widespread pathway with a variety of cells that can participate in the regulation of cell proliferation, apoptosis, differentiation and many other biological behaviors. Similar studies have also shown that the notch signaling pathway plays an important role in the proliferation and differentiation of neural stem cells derived from VEGF. Jiao Yan and other prepared animal models of cerebral ischemia in rats and found that the proliferation of NG2 cells in ischemic rats increased activity and the expression of VEGF was positively correlated, suggesting that cerebral ischemia may be by up-regulating the expression of VEGF induced NG2 Cell proliferation. Our results show that exercise with different loads can affect the expression of VEGF in the hippocampus of aged rats. The expression of VEGF is up-regulated in the light exercise group, suggesting that this effect may be the effect of light exercise on cognition in aging rats one of the mechanisms.

VEGI (vascular endothelial growth inhibitor) is a vascular endothelial cell growth inhibitor. At the end of the last century, Tan et al. Obtained a new member of the tumor necrosis factor family by human umbilical vein endothelial cell cDNA library and named TNF-like ligand 1 (TL1). The researchers found that TL1 is very different from other members of the tumor necrosis factor family. It is specifically expressed in vascular endothelial cells. Its main function is to inhibit the growth of vascular endothelial cells. Therefore, it is named as vascular endothelial cell growth inhibitor (VEGI). At present, the research on VEGI is more inclined to its value in anti-tumor application. The main manifestation is that VEGI can inhibit the proliferation of vascular endothelial cells and inhibit the migration of vascular endothelial cells, therefore, it has a good research value in anti-tumor application. At present, there are few researches on VEGI in the central nervous system. Our experimental results show that exercise with different loads can affect the expression of VEGI in the hippocampal nervous tissues of aging rats, and this effect is opposite to the change of VEGF expression. As an angiogenesis inhibitor, the biological function of VEGI is antagonistic to VEGF. Both of them work together to maintain the normal angiogenic activity of the body. The imbalance of VEGF expression is not conducive to the angiogenesis of tissues and thus to the normal organism of tissues and organs learn function [4].

5. Conclusions

In this paper, experiments show that different exercise loads have different effects on cognitive ability and hippocampal neurons in aged rats. It is generally believed that exercise can promote the proliferation of hippocampal neurons in rats. In this paper, aging rats were studied and the results show that different exercise load on the hippocampal neurons showed two distinct directions [5]. Compared with the control group, the expression of VEGF in hippocampus tissue of low-load exercise group was up-regulated and the expression of VEGI was down-regulated, which corresponded to the improvement of cognitive ability. However, the high-load exercise reduced the VEGF expression in hippocampus and upregulated VEGI Proliferation of hippocampal neurons in aging rats shows a declining trend with cognitive ability. Moderate-load exercise had little effect on the behavior and hippocampal VEGF and VEGI expression in aged rats, but tended to be at high load.

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