Six Weeks of Swimming Exercise Improve Memory and Brain Derived Neurotrophic Factor in CA1 Hippocampus of Diabetic Rats

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) patients are recognized to have higher prevalence of cognitive impairment. The critical significance of brain-derived neurotrophic factor (BDNF) and irisin in cognition is well established. In animal models, exercise could increase hippocampal BDNF and irisin expression. This study aims to assess the impact of moderate-intensity swimming exercise on BDNF and irisin expression in hippocampal neurons of T2DM rats.

Method: The study involved the random division of twenty-seven male Wistar strain rats into four groups: normal control (NC, n = 6); early-stage T2DM (DM, n = 7); sedentary T2DM rats with six weeks follow-up (DMS, n = 7); and T2DM rats subjected to swimming exercise for six weeks (DME, n = 7). T2DM was induced using injections of streptozotocin with a high-fat diet. Blood glucose levels were measured from tail pricks seven days after induction. Diabetic rats are defined as those with a blood glucose level of more than 250 mg/dl. Hippocampal BDNF and irisin expression was assessed through immunohistochemistry analysis, with the number of CA1 and CA3 neurons in the pyramidal layer expressing BDNF and irisin counted using a light microscope.

Results: The BDNF expression in hippocampal CA1 region in groups DM and DMS were markedly lesser than group NC (p = 0.005 and p = 0.002, respectively). Significantly increased hippocampus BDNF expression was observed in group DME compared to group DMS after six weeks of swimming exercise training (p = 0.040). In the CA3 region, the BDNF expression in groups DM and DMS was substantially lower than that of the NC group (p = 0.035 and p = 0.024, respectively). Meanwhile, although not significant, the DME group had lower BDNF expression than the NC group (p = 0.170). The irisin expression in CA1 and CA3 hippocampus in all groups do not exhibit significant variation. In the Morris water maze test, the escape latency was substantially longer in the DM and DMS groups than in the NC group (p = 0.007 and 0.004, respectively). Likewise, the escape latency of the DM and DMS groups was notably longer compared to the DME group (p = 0.010 dan 0.005, respectively).

Conclusion: Moderate-intensity swimming exercise has the potential to enhance the BDNF expression in CA1 region of hippocampus as well as in memory performance in T2DM rats and slowed the progression of diabetes.

Keywords: BDNF, Hippocampus, Irisin, Swimming exercise, Type 2 diabetes mellitus.

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