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LETTER TO THE EDITOR

Effect of Physical Exercise on Functional Recovery after Injury of Nervous System from the Perspective of Ecological Science

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To explore the effect of physical exercise on the recovery of function after injury of the nervous systemy in Ecological environment, the recovery of hindlimb function of spinal cord injury in rats was taken as an example to explore the effect of exercise training on the mRNA expression of neuroinhibitory factor Nogo-A, receptor (NgR) and Cdh1 in the spinal cord injury of rats. The rat model of T10 spinal cord injury was made by modified Allens strike method. After making the model, the movement function of hindlimbs of rats was observed by BBB scoring method. The relative mRNA content of Nogo-A, NgR and Cdh1 in spinal cord tissues at different time points were measured by Fluorescence quantitative PCR method. The results showed that 4-8 weeks after the surgery, the ranking of BBB scores were: exercise training group (group B) >SCI group (group A) > control group (group C) ($P<0.05$).The peak value of Cdh1 mRNA content in group A and B appeared on the seventh day. The peak value of Cdh1 mRNA content in group D appeared at fifth days, but there was no significant difference between the two groups of E and F ($P>0.05$).The experimental results show that physical exercise training can reduce the mRNA expression of Nogo-A and NgR, promote the mRNA expression of Cdh1 in the injured area of the spinal cord injury rats, and stimulate the recovery of hindlimb function of the rats after spinal cord injury.

I Introduction

Jinchao Gao published "Influence of Physical Exercise on the Mental Improvement of College Students" on Issue: 107, Pages: 2747-2753, Article No: e107305, Year: 2019, in the article, targeted exercises behaviors, individual mood state and connections between the two, it makes analysis, gives three basic hypotheses of researches in the paper, which provides orientations for proceeding with researches. Making empirical analysis of exercises behaviors and mood states differences test analysis in different genders, different grades and different disciplines, on this basis, it explores eight dimensions' mood states differences in sample average value of university students that often take physical exercises and rarely take physical exercises.

The treatment of spinal cord injury has been a major problem perplexing neurobiology and rehabilitation. After spinal cord injury, its functional recovery is very limited. The main reason is that the regeneration of axons in the posterior end of the spinal cord is severely inhibited (Brown 2014).With the in-depth study of spinal cord injury, some factors related to inhibition of axonal regeneration have been found. In 2000, the successful cloning of the gene Nogo was the first major breakthrough in the discovery of the growth inhibitory factor more than ten years. Routine exercise therapy is the main method of rehabilitation for patients with central nervous system injury. The traditional view is that it can play a residual function through improving and compensating mechanism, and improve

movement function (Muramatsu and Yamashita 2014, Hui et al. 2016). In recent years, clinical studies at home and abroad have confirmed that weight loss support plate training (Lambert and Inestrosa 2016), functional electrical stimulation (FES), hindlimb assisting treadmill, robot hindlimb auxiliary training, virtual situation training, compulsory sports training, and so on, have achieved significant results in the functional improvement of the spinal cord injured patients. This has aroused the attention of researchers in the field of rehabilitation medicine in China, and there have been many clinical observations and studies on rehabilitation training to improve the functional improvement of SCI patients (Zhao et al. 2016). The objective data have proved the therapeutic effect of the above technology application (Zainul and Koivisto 2018). Based on the research results of many experts, this paper studied the promotion of physical exercise on the functional recovery after nervous system injury.

II Perspective

Preparation of rat SCI model, Behavioral observation, Rehabilitation training method, Fluorescence quantitative PCR, Statistical analysis.

The 2-ΔΔCt method is used to make relative quantitative statistics on the results of QF2 PCR, and ΔCt=the Ct value of the detected sample- the Ct value of reference gene. ΔΔCt= ΔCt of the positive sample group - ΔCt of the normal sample group ΔCt. The Ct value, also known as the cycle threshold, refers to the number of cycles corresponding to the beginning of the fluorescence signal from the background into the exponential growth stage in the Q-PCR cycle, and GAPDH is as a quantitative internal reference. t-test of independent sample is carried out by pair wise comparison; difference between groups is used for comparison of three samples, $P<0.05$ indicates that the difference is significant.

The hindlimb movement function of the sham operation group remained at 21 points before and after the surgery; the injured group recovered most obviously at 2-4 weeks, and reached in the stable state (platform stage) at 4-6 weeks; the recovery amplitude was smaller, and the BBB score was 10.75 + 0.95 at 10 weeks after making the model. The recovery of the exercise group was similar to that of the sham operation group, and there was no significant difference between the 1 to 3 weeks after making the model and the sham operation group ($P>0.05$). There was a significant difference in BBB score at 4 weeks after the making the model ($P<0.05$) compared with the sham group, which lasted until the eighth week after the model building. The scores of the injury group and the movement training group were no difference

The mRNA expression of NgR was analyzed by PCR product, and the mRNA expression of NgR in the control group was low level at all time points. The mRNA expression of NgR in the injured tissue and the exercise training group increased obviously eight days after the model was successful. Among them, the loss group was the highest, and the difference between the three groups was significant ($P<0.05$).After 10 days, the exercise training group had no significant difference compared with the control group ($P>0.05$), and the injured group was significantly higher than the control group at all time points ($P<0.05$), and seen in Table 3.Similar to the mRNA expression of NgR, the mRNA of Nogo-A in the control group was expressed at a low level at all time points, and the mRNA expression of Nogo-A in the injured group and the exercise training group increased obviously eight days after the model success.

After the experiment, the injured area was analyzed, scanned and photographed by the Gel imaging system. The average density and area data of the strip were calculated to analyze the gene expression, as shown in Table 1 and Figure 1. The mean change of Cdh1 mRN content of each time point was shown in Figure 2.

Table 1 Expression of Cdh1 mRNA at different time points in each group ($\overline{x} \pm s$)

Group	3 d	5 d	7 d	14 d	21 d

A group	0.6706±0.0005	0.6670±0.0006	0.7100±0.0008	0.6506±0.0006	0.6296±0.0015
B group	0.6703±0.0010	0.6700±0.0007	0.7139±0.0048	0.6503±0.0009	0.6298±0.0010
C group	0.6702±0.0003	0.4402±0.0008	0.3103±0.0009	0.2103±0.0007	0.1904±0.0100
D group	0.6707±0.0006	0.7600±0.0006[1]	0.8309±0.0024[1]	0.7372±0.0010[1]	0.7272±0.0027[1]
E group	0.9509±0.0004	0.9597±0.0019	0.9595±0.0014	0.9594±0.0015	0.9580±0.0040
F group	0.9509±0.0003	0.9598±0.0031	0.9601±0.0007	0.9601±0.0007	0.9553±0.0051

Note: there was no significant difference (P>0.05) in the mRNA expression of Cdh1 among group A, B, C and D 3 days after surgery, which was comparable. The mRNA content of Cdh1 in group A, B and D at fifth, seventh, 14th and 21th day after surgery was significantly higher than that in group C (P<0.01), the mRNA content of Cdh1 in group D was the highest, and there was no significant difference between group A and group B (P>0.05). There was no significant difference between the group E and group F at each time point (P>0.05).

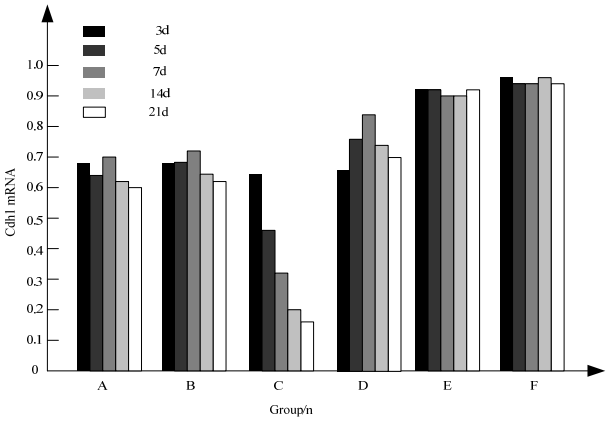

Fig. 1 Cdh1 mRNA at different time points in each group

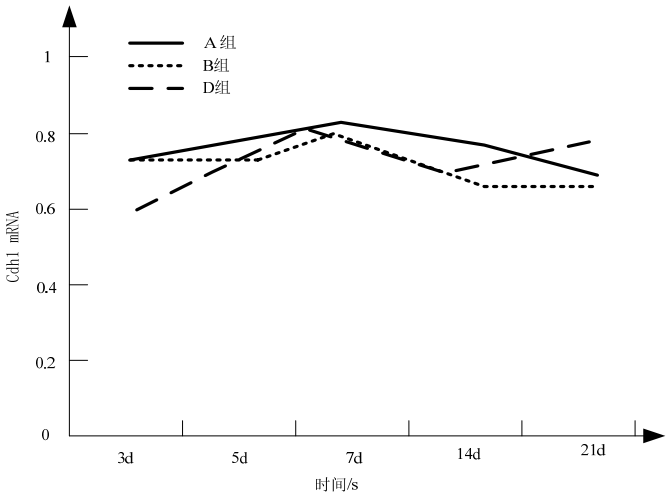

Fig. 2 Cdh1 mRNA mean change of time points in each group

III Personal View

In this paper, a small amount of mRNA expression of Nogo-A and NgR in the spinal cord tissue of the sham operation group was found. The physiological significance of the nerve fiber growth inhibitory protein expressed in the normal tissue was to limit the growth of central nerve fibers, so as to prevent the later growth of the fiber bundle branch into the intact fiber bundle. However, in the pathological conditions of adult central nervous system, these inhibitory factors have become an important factor to prevent axonal regeneration. This experiment found that after spinal cord injury, the mRNA expression of Nogo-A and NgR increased in the injury group and the exercise training group, and the expression level gradually decreased in the two groups over time. The mRNA expression of Nogo-A in the injury group was the highest after eight days, and then decreased gradually. The difference of the 3 time points was significant. The expression of the exercise training group in eighth day after spinal cord injury was at a lower level, and no significant decrease was found at tenth day, indicating that the exercise function training should be carried out as early as possible after the spinal cord injury, and the mRNA expression of Nogo-A should be reduced to the low-level. On the fourteenth day, there was no difference in the expression of the injury group and the exercise training group, but both of them were higher than that of the sham operation group. The exercise function training could improve the decrease of the mRNA expression of Nogo-A in the SCI rats, which reduced it to a lower level in a shorter time, which was significant to the nerve business. Our preliminary study also showed that early rehabilitation played an important role in functional recovery of patients with spinal cord injury.

The test results showed that the weight loss walking training could obviously promote the mRNA expression of Cdh1 in the injury area, which could help to inhibit the apoptosis of neuron cells, promote the differentiation of nerve cells, regulate the growth of axon, and benefit the recovery of limb function after spinal cord injury. At the same time, we found that the expression of rats in each group showed a certain time correlation: the expression of three treatment groups of A, B and D reached the peak at 7 days after injury, and could maintain a period of time, while group C reached the peak at 3 days after the injury and then fell quickly. We also found that in the fifth, fourteenth and twenty-first days, the hindlimb function score of group B rats was higher than that of the group A, and there was a significant difference in the two groups ($P<0.05$), but there was no significant difference in the mRNA expression of Cdh1 at these time points ($P>0.05$).The statistical difference between the BBB score of hind limb function and the mRNA expression of Cdh1 in rats was different. The reason is related to the difference in substrate required for weight loss walking training during the onset of Cdh1 mRNA, that is, although the therapy could promote the mRNA expression of Cdh1, the path of action was different. The above results indicate that the weight loss walking training can promote the expression of local tissue after spinal cord injury and the recovery of movement function of the hindlimb, and further confirm the correlation between sports and the repair of spinal cord injury. The correct walking mode can be established as early as possible to promote the function of limb surviving with neural feedback regulation mechanism and compensatory mechanism, so as to promote the recovery of walking ability. Acupuncture treatment can stimulate the operation of meridian-Qi in the injured area, dredge Qi and blood, regulate Yin and Yang, and make the Qi and blood flow againof damaged governor meridian, and then cultivate the muscles that are weakened and wasted. Weight loss walking training combined with acupuncture treatment to promote the mRNA expression of Cdh1 is one of the important ways to play a therapeutic role (Bayrak et al. 2018).

IV Conclusion

In summary, exercise training can effectively reduce the mRNA expression of Nogo-A and NgR after spinal cord

injury, and promote the recovery of hind limb movement function in rats with spinal cord injury. While promoting functional recovery, it will also be accompanied by the effects of axonal plasticity and endogenous neural stem cell differentiation. Weight loss walking training can improve the movement function of rats with spinal cord injury. The effect of weight loss walking training and other treatment methods on the mRNA expression of Cdh1 in the spinal cord injury rats was significant, and the improvement of the movement function of rats with spinal cord injury was more prominent.

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