

Research Progress on Exercise Prescription for Chronic Pain

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Abstract: In recent years, exercise prescription has gradually provided a new idea for the treatment of chronic pain, which has been proved to be effective in alleviating pain and preventing recurrence in more and more literatures. This paper attempts to review the mechanism of chronic pain and the application of exercise prescription in patients with chronic pain, with the aim of providing reference for future clinical work.

Keywords: Chronic pain; Exercise prescription; Mechanism of action; Overview.

1. Introduction

At present, about one in five adults worldwide suffers from chronic pain, and the incidence of chronic pain is more than 50 percent among the elderly. [1, 2] Chronic pain not only reduces the quality of life of patients, but also causes a heavy economic burden on families and society. Therefore, as chronic pain is one of the major public health problems in the world, it is very important to find new rehabilitation interventions and explore their mechanisms for the treatment of chronic pain.

In recent years, the application of exercise prescription provides a new means for the treatment of chronic pain. By developing appropriate exercise prescriptions, chronic pain can be alleviated and recurrence prevented. [3, 4] In view of this, this paper will review the pathogenesis of chronic pain and the application of exercise prescription in patients with chronic pain, so as to provide reference for subsequent related studies.

2. Mechanism of Chronic Pain

In theory, chronic pain is defined as pain that persists or recurs for more than three months. Chronic pain is mainly manifested as persistent or intermittent pain in one or more parts of the body, and may be accompanied by sleep disorders and mental disorders. At present, the mechanism of chronic pain is very complicated, and there are still many controversies. In these aspects, a series of topics such as central sensitization, impairment of descending pain inhibition pathways and plasticity changes in damaged brain regions have been recognized by most scholars.

2.1 Central Sensitization

Central sensitization is considered to be the main mechanism of chronic pain. Some researchers have found that many chronic pain patients exhibit central sensitization, such as lower pain thresholds and mechanical pain abnormalities. [7,8] Among these elements, NMDA receptor, which transmits glutamate signal, plays an important role. D-serine released by astrocytes can activate NMDA receptor, which is the basis of LTP formation. LTP is a plastic form of synapses that makes the central nervous system more sensitive to painful stimuli. Sluka et al. found that regular physical activity prevents chronic muscle pain by reducing phosphorylation of the NR1 subunit of the NMDA receptor in the central system.

2.2 Impairment of Descending Pain Inhibition Pathways

Some scholars have found that the impairment of the downward pain inhibition pathway can also cause chronic pain. Conditioned pain regulation is an experimental paradigm that can be used to reflect whether the downward pain inhibition pathway is impaired. In a meta-analysis of 30 studies, Whitehead et al. found a significant reduction in conditioned pain regulation in patients with chronic

pain compared with healthy controls, indicating a reduced downward pain inhibition and thus an increased incidence of chronic pain. Exercise therapy has been shown to activate the endogenous analgesic system in the brain of patients with chronic pain, thereby exerting top-down pain inhibition. [13,14]

2.3 Plasticity Changes in Brain Regions

A number of studies, mainly based on neuroimaging techniques, have found morphological changes in the emotional control system in patients with chronic pain, revealing that persistent pain is closely related to the changes of brain plasticity. Baliki et al. found that gray matter density in bilateral striatum, right NAc, right insula and left sensorimotor (S1/M1) cortex was significantly reduced in patients with subacute back pain through brain imaging. Flodin et al. found that physical exercise can increase the functional connectivity between the insula and other brain regions through fMRI, thereby reducing the incidence of chronic pain.

3. Exercise Prescription

Exercise prescription refers to that rehabilitation physicians prescribe exercise types, exercise intensity, exercise time and exercise frequency and put forward matters for attention in exercise for the exercisers or patients based on medical examination data, including exercise tests and physical tests, according to their health, physical strength and cardiovascular function. [17,18]

3.1 Exercise Types

The types of exercise prescribed generally include aerobic exercise, strength exercise, stretching exercise and traditional medical physical exercise methods, including Tai Chi, Wuqinxi and Baduanjin. These are the most widely used aerobic and strength exercises for patients with chronic pain. [19, 20] Psycharakis et al. compared the strength training on land and on water power training influence on patients with chronic low back pain pain frequency, found that patients with chronic low back pain of mild to moderate strength training on the water by the buoyancy of water reduce joint load, thus reducing the frequency of pain is to force sex more than twice as many people in the land. Studies have shown that VAS scores of patients with chronic low back pain significantly decreased after suspension exercise combined with ball pad or rocker or suspension exercise alone compared with before training, and there was no difference between groups. Scholars believe that different combinations of suspension exercise can synergistically improve balance ability, flexibility and spinal muscle strength to relieve pain. Richards et al. found that both aerobic training and resistance training could relieve the pain of female fibromyalgia patients by enhancing the adaptability and resilience of trauma muscles, and 8 weeks of aerobic exercise was superior to moderate intensity resistance training in improving the pain of female fibromyalgia patients.

3.2 Exercise Intensity

Exercise intensity can be determined according to the percentage of maximal oxygen uptake, metabolic equivalent, heart rate, conscious fatigue degree, etc., which is an important part of scientific, targeted and safe exercise prescription. [22, 23] At present, the absolute value (VO_2) or relative value (% VO_{2max}) of oxygen consumption is most commonly used. [24, 25] Naugle et al. conducted a meta-analysis to investigate the relationship between aerobic exercise and analgesia in adults with chronic pain at different intensities and for different periods of time. It was found that high-intensity aerobic exercise, i.e., 75% of maximal oxygen uptake and a relatively long duration (more than 10 minutes), had the greatest analgesic effect. When aerobic exercise reached 50% of maximum oxygen consumption for 30 minutes, the analgesic effect was small, which however was still at the moderate level. Ten minutes of high-intensity aerobic exercise, on the other hand, produced little pain relief. Bardal et al. found that endurance exercise at moderate intensity (75% of maximum heart rate) reduced neck and shoulder pain in women with fibromyalgia.

3.3 Time and Frequency of Exercise

The frequency of exercise is determined by the intensity and duration of each exercise. In recent years, many researchers have explored the optimal intensity and duration of exercise for chronic pain relief. In a meta-analysis of 75 studies, Polaski et al. found that the duration of exercise intervention was positively correlated with neck analgesia, with patients with chronic neck pain receiving no more than 120 minutes of aerobic exercise per week lasting no more than 15 weeks for optimal analgesia. Studies have shown that compared with college students who exercise for less than 30 minutes a week, female college students who exercise for more than 1 hour a week reduce their chronic pain by about 20%, indicating that the duration of exercise is negatively correlated with the incidence of pain. Andersen et al. divided patients with chronic neck and shoulder pain into 1 hour strength training group, 20 minutes strength training group three times a week and 7 minutes strength training group nine times a week. Results showed a significant reduction in neck and shoulder pain in the three training groups compared with the control group, with no difference between groups, suggesting the importance of regular training.

At present, the exercise prescription has been improved from a single physical exercise method to a variety of exercise methods combined with chronic pain intervention, and a number of studies found that exercise with 50-75% of the maximum oxygen consumption can often achieve better analgesic effect.

4. Summary and Outlook

Although significant progress has been made in the study of chronic pain in recent years, the specific mechanism of chronic pain is still controversial. Research on the mechanism of cell signals, receptors and pathways involved in chronic pain in the spinal cord may become a hotspot in the future. With the continuous development of rehabilitation, exercise prescription has been widely used in the treatment of chronic pain. A number of studies have proved that exercise training can reduce the disability rate of patients with chronic pain. This therapy also plays an important role in reducing complications and improving the quality of life of patients. However, it is found that the compliance of patients is low. Therefore, further research should focus on how to effectively decide the amount of exercise and how to select the appropriate exercise pattern for different types of chronic pain.

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