The Role of Exercise Therapy on the Rehabilitation Process of Diabetes and Research Progress

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Abstract: With the increasing number of diabetic patients in China, the impact and role of exercise therapy in the rehabilitation process of diabetes is becoming more and more obvious. Exercise therapy can effectively lower blood glucose and regulate the indicators of diabetes, as well as help improve patients' poor mood and quality of life. This article reviews the effects of different exercises on patients, the mechanisms of action of exercise therapy in the treatment of diabetes, and the considerations of exercise therapy.

Keywords: Exercise Therapy; Diabetes Mellitus; Mechanism; Research Progress

1. Effects of Different Exercises on Diabetic Patients

Diabetes mellitus is a group of metabolic diseases characterized by elevated fasting blood glucose levels due to reduced insulin secretion or weakened pancreatic function. With economic development, urbanization and aging, the incidence of diabetes in China is increasing year by year, and diabetes has become the third most common chronic non-communicable disease, threatening the health of the country [1]. At present, the number of diabetic patients in China is located in the first place in the world, mainly type 2 diabetes [2]. Numerous studies have shown that regular exercise can significantly improve glucose regulation status, control blood glucose, improve glucose and fat metabolism, increase insulin sensitivity, increase cardiorespiratory adaptability, improve exercise compliance and reduce negative emotions in patients with early diabetes [3].

1.1 Effects of High-Intensity Intermittent Exercise on Diabetic Patients

High-intensity interval exercise is a combination of short periods of high-intensity exercise followed by low-intensity intervals (active or complete rest), and multiple cycles of repetitive exercise [4], and for safety reasons, high-intensity interval exercise is commonly used in competitive sports, while continuous moderate-intensity exercise is mostly used for the general population and human diseases. However, the long duration of continuous exercise at moderate intensity, coupled with the tediousness of the process, leads to poor exercise outcomes for patients. With the development of exercise monitoring tools and instruments, high-intensity intermittent exercise has become more acceptable and easier for patients to complete because of its increased safety and the ability to avoid discomfort through intervals, as well as its time-saving feasibility and lack of adverse reactions, thus gradually becoming the focus of research in recent years [5]. It has been shown [6] that high-intensity interval training and continuous moderate intensity exercise can effectively improve blood glucose and lipid levels in patients with type 2 diabetes, but high-intensity interval training is superior to continuous moderate intensity training to improve blood glucose, glycosylated hemoglobin, BMI, self-efficacy, and 2-hour postprandial glucose. Yan Huimin et al [7] showed that high-intensity load duration and number of cycles also had an effect on exercise compliance. Short duration, limited number of cycles, and high motivation to exercise Most of the diabetic patients interviewed reported the least fatigue and the highest exercise compliance for the 2 min/2 min exercise format compared to the 3 min/3 min or 1 min/1 min high-intensity exercise format with intermittent rest periods. Therefore, when developing an exercise program for diabetic patients, exercise compliance can also be improved by adjusting the duration and repetition of high-intensity loads.

1.2 Effects of Aerobic Exercise on Diabetic Patients

Blood glucose metabolism depends on how much glucose is taken up by the cells, and glucose metabolism depends on how much glucose is taken up by the cells, but glucose is not free to enter the cells through the two layers of lipid structures of the cell membrane. Glucose transporter proteins (GLUT) are a family of transmembrane proteins that regulate the influx of extracellular glucose into the cell [8]. Glucose transporter protein-4 (GLUT4) is one of the proteins that facilitate transmembrane transport of glucose in the body, and under normal conditions, insulin binding to the insulin receptor stimulates GLUT4 to transfer from intracellular vesicles to the cell membrane and to function as a transporter of glucose, thereby lowering blood glucose [9]. It was found that skeletal muscle exercise and contraction increased GLUT4 on muscle membranes and T-tubule membranes, while Glut4 knockdown reduced skeletal muscle contraction and glucose uptake in mice [10]. Aerobic exercise in an obese rat model improved stimulation of skeletal muscle insulin glucose transport and better GLUT4 protein expression [11], which then promoted GLUT4 transfer from cell vesicles to cell membranes, improving glucose uptake by skeletal muscle cells and exerting hypoglycemic effects.

1.3 Effects of Resistance Exercise on Diabetic Patients

Resistance exercise improves glucolipid metabolism, increases muscle strength, prevents osteoporosis, and also improves cardiovascular function [12]. Wang, Y.

Qun [13] measured and recorded fasting, 2-hour postprandial glucose, glycosylated hemoglobin, lipids and other related indexes in subjects after 3 months of intervention treatment, and found that although the effects of resistance exercise and aerobic exercise on body mass index and low-density lipoprotein were not significant, they had a lowering effect on fasting and glycosylated hemoglobin in the IGR population. Resistance exercise had a significant effect on reducing blood glucose at 2 hours after meal.

2. Pathways of Action of Exercise Therapy for Diabetes

2.1 Mechanism of Action

The body gets its glucose mainly from food, and the liver's glucose isomerization. the role of production and breakdown of liver glycogen and muscle glycogen. the body needs a lot of energy during exercise, when glucose in the blood is consumed in large amounts, and liver glycogen and myoglycogen are broken down for energy, when the glucose consumed is 20 times more than usual [14], and after exercise, the large amount of energy consumed comes from glycogen present in the muscles and liver, and to replenish the body's capacity, to replenish the body's capacity, glucose in the blood is converted into energy-storing glycogen, making the blood glucose concentration decreases. the hypoglycemic effect of exercise is not replaced by insulin [15]. the regulatory effect of exercise on blood glucose is cumulative and insulin dosing can be effectively reduced by exercise [16].

2.2 Psychological Effects

High blood glucose is the main characteristic of diabetic patients, and patients need to take medication for life in order to maintain normal blood glucose levels; therefore, patients can develop negative emotions, such as anxiety and depression, and can also cause certain mental disorders, which can lead to reduced adherence to treatment and affect the therapeutic effect [17-18]. Moreover, due to the 4 characteristics of long duration of diabetes, more complications, poor glycemic control, and higher costs, patients are often prone to negative emotions such as distress, anxiety, and depression, which also bring a heavy burden to the caregiver's family. It directly affects the quality of life of patients. During exercise, patients forget their problems for a short time and feel relaxed and joyful afterwards, an effect that cannot be replaced by medication.

3. Exercise Therapy Considerations For Diabetes

3.1 Timing of Exercise

Consider whether to give the patient insulin and oral hypoglycemic agents. Exercise during maximal insulin activity is not recommended because of the possibility of hypoglycemia. In addition, exercising before bedtime is not recommended because of the risk of delayed hypoglycemic response after exercise. However, if nighttime exercise is required, it is important

to increase carbohydrate intake to reduce the risk of nocturnal hypoglycemia. If possible, regular exercise at the same time each day can help reduce possible hypoglycemic events.

3.2 Applicability to Different Types of Diabetes Mellitus

Since patients with type 1 diabetes are unable to control their blood glucose levels, either hyperglycemia or suffering from ketosis is an issue to be aware of. Symptoms associated with hyperglycemia include polyuria, malaise, weakness, increased thirst, and acetone respiration [19]. Patients with hyperglycemia who feel comfortable and have negative urinary ketones and blood ketone bodies may exercise, but should avoid strenuous physical exertion [20, 21].

3.3 Monitoring Methods

If it is difficult to monitor blood pressure and heart rate during exercise, subjective sensory assessment of fatigue can be used to monitor exercise intensity. Avoid injecting insulin into the exercising limb. Injecting abdominal insulin reduces the risk of hypoglycemia due to physical exertion.

4. Outlook

Diabetes mellitus is a common disease of the clinical endocrine system with no curative approach and requires lifelong treatment [22]. the main treatment is long-term insulin and other medication control, but it is also related to patients' own lifestyle, exercise habits and other factors. Therefore, non-pharmacological means are key in those who need long-term medication and insulin injections to control blood glucose. Studies have shown that aerobic exercise therapy is used in clinical practice [23]. Through long-term aerobic and resistance exercise, it can achieve the purpose of lowering blood glucose and lipid levels [24], reducing body fat content [25], improving vascular endothelial function [26], and reducing insulin resistance, oxidative stress and inflammation. However, the development of body-medicine integration in China started late and did not form a perfect system. For different diabetic patients to develop personalized exercise prescriptions, the intensity, frequency, and duration of exercise developed for different factors such as disease, physical fitness, age, and gender are also different. There are no clear studies to show which exercise modality can improve the effect of regulating blood glucose levels for different types of diabetes. Different combinations of exercises, sequences, and exercise sequences have different effects on regulating blood glucose levels and improving insulin. How to ensure the maximum effect of exercise and ensure the safety of patients during exercise therapy needs to be further explored, and there is a long way ahead.

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