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Effect of Exercise Intervention on Postoperative Rehabilitation in Stanford Patients with Type B Aortic Coarctation

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Abstract. Aortic dissection is one of the diseases that seriously endanger life and health, and the average age of onset in China is lower than the international average age and shows a trend of rejuvenation. This paper provides an in-depth analysis and discussion of postoperative exercise, influencing factors and improvement measures for patients with aortic coarctation. This paper will focus on specific prescription recommendations for exercise interventions and their effects on improving patients' neurological, circulatory, and emotional well-being. The results of this paper show the need to improve the participation and effectiveness of exercise rehabilitation in Chinese patients with type B aortic coarctation while reducing patient resistance to rehabilitation (location, finances, and fear), and suggest a variety of activity recommendations and a range of activity standards. Based on the patients' own rehabilitation assessment, individualized exercise prescription was developed to achieve the rehabilitation goals of improving cardiopulmonary function, attenuating the influence of negative psychological factors, and reducing the incidence of delirium complications. The effectiveness of this is shown in the improvement of patients' post-operational quality of life and the maximization of their mobility recovery.

Keywords: Type B aortic dissection, Exercise rehabilitation, Secondary defense, Aortic endovascular repair

1. Introduction

Aortic dissection (aortic dissection, AD) refers to a tear in the lining of the aorta to form a false lumen, through which blood enters the media, causing the aortic media to detach. Blood can flow between true and false lumen or form a blood clot, causing blood to not flow properly to vital organs. In the absence of timely treatment, it can cause catastrophic complications like cardiac tamponade, aortic rupture, or organ ischaemia, which is one of the vascular diseases that can seriously endanger life. It usually presents with sudden, severe "tearing" pain in the back, with a mortality rate of more than 50% within 48 hours of onset[1,2]. The Standford type determines the types of aortic dissection, with type A involving the ascending aorta or aortic arch, while type B involves open surgery.TEVAR is the chosen treatment for Stanford Type B Aortic Dissection

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(TBAD) due to the fact that the descending aorta only becomes involved near the rupture spot. The long-term prognosis of patients is significantly improved due to the small surgical trauma and fast postoperative recovery[3]. Foreign countries have an annual incidence rate of 3.5~7.2/10,000, and according to epidemiological surveys, the annual incidence rate in China is 5~10/10,000, and the average age of disease (52) is much lower than the international average (63), showing a younger trend[4].

According to the survey data, the participation rate and completion rate of cardiac rehabilitation patients in China are not ideal. Nearly half of patients in developed countries have completed more than 26 rehabilitation sessions. In contrast, only 18.7% of patients in China have undergone more than 24 cardiac rehabilitations as of 2019. As one of the internationally recognised cardiac rehabilitation methods to enhance patient participation, me-based cardiac rehabilitation (HBCR) forms a rehabilitation system together with hospitals, communities, and families, and forms a long-term rehabilitation system with the family as the main scenario, the patient's body function can be restored to the greatest extent, so that the normal participation in social activities can return to the normal rhythm of life[5]. This article focuses on the risk assessment and exercise recommendations of exercise rehabilitation for patients with type B aortic dissection based on HBCR, and comprehensively expounds on the effects of postoperative exercise training on the nervous system, cardiopulmonary function, and emotional impact of TBAD patients in combination with the current national conditions in China.

2. Stanford B postoperative rehabilitation assessment and exercise recommendations for patients with Aortic Dissection

2.1. Postoperative in-hospital rehabilitation assessment

Patients should undergo a detailed exercise risk assessment and cardiopulmonary exercise test (CPER) in the hospital before home cardiac rehabilitation to develop a highly targeted and personalized exercise rehabilitation plan. Sparky Bartee et al. performed a multifaceted functional assessment to meet the high-intensity exercise requirements of patients with unique exercise needs. Combined with the real action model, the movements are split and the corresponding muscle strength is tested separately. For example, to simulate lifting a suitcase with both hands, a static monitor is used to measure the amount of pressure the patient pulls up and compresses, and blood pressure levels during exercise [6]. In 2024, the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) issued a scientific statement summarizing details of the assessment, interventions, and goals for each core component. From medical history (cardiovascular medical diagnosis and surgery, cardiovascular function, complications, cardiovascular status and other vaccination status) to social history (adherence, affordability, sleep patterns, lifestyle habits, work and personal preferences), the assessment dimensions are broader than those of the current domestic assessment system. In summary, the hospital can evaluate the patient's postoperative vascular function, (such as ventricular function, structural or hemodynamic abnormalities, residual ischaemic burden), potential risk factors (hypertension, hyperlipidemia, hyperglycemia, smoking, family history, obesity), physical examination (focusing on cardiopulmonary endurance and muscular endurance levels), daily living habits and family environment (whether there are stairs, whether family relationships are harmonious, whether there are nearby parks and other social resources), and risk factors can be managed and exercised[7]. The classification of it is low-risk, medium-risk, and high-risk. Low-risk means that exercise is not prohibited and the patient's body does not develop adverse symptoms with

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changes in exercise intensity, is mainly seen in patients suffering from simple hypertension, hyperlipidemia, or metabolic disorders. Medium-risk refers to patients who develop angina during normal exercise and whose coronary artery stenosis improves after surgery. High-risk refers to patients with angina or abnormal heart rate during mild exercise or at rest, left ventricular ejection fraction <40% and multiple cardiovascular obstructions [8]. After about four weeks of in-hospital recovery, it is recommended to go home for self-recovery, coming to the hospital regularly (1-3 months) for a sit-to-stand muscle strength test, and evaluate the patient's muscle strength by recording the time from standing to sitting 5 times in a row. The six-minute walk test (6MWT) tests the patient's cardiopulmonary function and assesses the patient's psychological state, and adjusts the exercise regimen in time through the functional test[9,10].

2.2. Postoperative activity recommendations for TBAD

Sixty-three percent of the cardiovascular experts in the International Aortic Dissection Registry recommend moderate exercise to patients, and most of the recommendations are more general or provide patients with some exercises not to do, but there are no clear recommendations for the intensity of some daily exercises, resulting in 71% of patients still not understanding the safety of exercise. When researchers were asked to define a safe upper limit for haemodynamic response, there was considerable variability in the statements of these physician-researchers, further confirming the ambiguity of current exercise recommendations for AD surgery. Patients with aortic dissection must perform rehabilitation exercises that are appropriate and effective, otherwise they may face issues with insufficient exercise or excessive exercise due to negative emotions such as fear and anxiety after surgery [11,12].

2.2.1. Reduce the number of extractions of heavy objects

According to the 2022 expert consensus on home rehabilitation in China and the research of Chaddha et al., the frequency and time of HBCR exercise are recommended to be > 30 min each time, 3-7 times a week[5]. Simulated daily life of extracting weights using grip strength exercises,when the handle is squeezed with the greatest force, systolic blood pressure increases by 50 mm Hg and diastolic blood pressure increases by 30 mm Hg after one minute, according to the findings. Squeezing the handle at 30% of its maximum force causes systolic blood pressure to increase by about 20 to 30 mmHg and diastolic blood pressure to increase by about 10 to 20 mmHg.Therefore, it can be seen that the squeezing action may cause sudden changes in blood pressure, and patients should minimise the number of times they carry heavy objects and reduce grip strength training after aortic dissection [13].

2.2.2. Moderate aerobic exercise

The level of exercise intensity is used to determine the metabolic amount (MET), and the greater the intensity of the exercise, the greater the MET value. Hypertension is a common symptom in patients with type B aortic dissection who undergo TEVAR. Studies have demonstrated that aerobic exercise has a significant impact on systolic blood pressure and a minimal effect on diastolic blood pressure in patients with signs of high blood pressure. For example, a jump rope activity can have a MET value of 12.0, compared to about 3.0 for a general house cleaning job. When exercising vigorously, the aortic wall can be subjected to greater stress, resulting in an increased risk of complications. Light aerobic activity, i.e., MET values between 3-5 are the most appropriate. Moderate aerobic

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exercises such as mopping the floor, climbing the stairs slowly, cycling, golf, and slow swimming are more suitable for postoperative rehabilitation of patients with aortic dissection[13].

2.2.3. Daily light aerobic exercise

In one clinical study, patients underwent endovascular aortic repair. A routine rehabilitation program was given to the patients in the control group, i.e., passive sit-ups, bedside walking and hall walking, and routine telephone follow-up after discharge. The observation group is based on this plus the treatment method of Baduanjin. Daily 17:00~17:40, 7:00~7:40 regular. The intervention time of the two groups was one month after discharge, and their pain level, ability of daily living (ADL), exercise tolerance (6MWT), and nursing satisfaction were evaluated.The Baduanjin intervention group's pain level was found to be significantly less than that of the conventional control group one month after discharge, and the scores for ADL and 6MWT were higher than those of the control group. As a light aerobic exercise, Baduanjin combines rigid, flexible, aerobic and resistance forms of exercise, and slowly and effectively carries out postoperative rehabilitation for older TBAD patients, during which it is necessary to turn the neck, shoulders, elbows, bend over, climb feet and other actions to relieve physical fatigue and soothe emotions[14].

At a health level, exercise is important for every individual. The above exercises can be used for cardiac rehabilitation at home, which resolves the issues of patients regarding distance, cost and resistance to the hospital, and facilitates efficient postoperative rehabilitation. Medium-and low-risk patients should return to the hospital regularly for physical skills assessment and exercise prescription adjustment after three months of home exercise training. High-risk patients should go to the hospital for re-examination in time after one month of home exercise rehabilitation, and adjust the exercise plan according to the recovery situation.

3. Effect of exercise intervention on patients with TBAD

3.1. Nervous system

Despite endovascular aortic repair has greatly improved the survival rate of patients, there are still some postoperative complications, such as endoleakage, delirium, stroke, etc. Delirium is an acute brain dysfunction disorder. It is usually manifested as inattention, disordered level of consciousness, and altered mental status, and the complication rate is as high as 21~50% in 24~72 hours after surgery. Movement at the supramolecular level has been demonstrated in neurobiological studies to stimulate angiogenesis and synaptogenesis;Molecular growth factors, such as brain-derived neurotrophic factors, undergo changes during movement at the molecular level, which are crucial for neuroplasticity and neuroprotection. Delirium was found to be a motor disease in Gual et al.'s study. Hyperactivity, oligoactivity, mixed, and non-motor delirium can be classified according to the classification of movement disorders. The higher the degree of disability, the higher the risk of hypoactive delirium. However, at present, it can only be concluded that physical training intervention can contribute to the development of delirium complications, but it cannot be proved that it is the only factor affecting the incidence of the disease, and other drug factors cannot be ruled out, and further research is needed[15,16].

3.2. Cardiopulmonary function

In one study, cardiopulmonary rehabilitation exercise was found the effectiveness of improving the cardiopulmonary function of patients with acute myocardial infarction after percutaneous coronary

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intervention has been demonstrated. A controlled experiment was used, the control group was treated with conventional nursing methods, and the observation group was based on routine nursing and cardiac rehabilitation exercise intervention, and effective functional training was carried out with the help of quadriceps training chairs. According to the results of the patient's postoperative in-hospital rehabilitation assessment, a targeted cardiopulmonary rehabilitation exercise plan can be formulated, and the patient can be guided to carry out an exercise in an orderly manner. In the process, the relevant precautions during the monitoring of dietary conditions and medication are emphasized. The results showed that cardiac rehabilitation exercise was beneficial to the recovery of cardiopulmonary function, effectively improved cardiac diastolic function, improved patients' exercise tolerance, and prevented adverse events such as cardiac complications[17].

3.3. Emotional impact

Postoperative anxiety and depression in TBAD patients is much higher than the normal level, which is 3.5 times that of normal people. This psychological problem affects the daily life of the patient to a certain extent. The study found that patients who participated in physical exercise three times a week, each time for 30 minutes, and reached the highest heart rate of 60%~80% during exercise, had significantly lower depression scores than those who exercised once a week. The results showed that exercise frequency was simply associated with depression treatment. If the amount of exercise is prescribed, it is quantified to find that the degree of depression is different in patients with different levels of exercise[18].

4. Conclusion

This article expounds on the concept of home-based cardiac rehabilitation based on exercise training. While reducing the resistance to rehabilitation (place, economy, fear psychology) of patients, exercise rehabilitation has been found to be more effective and effective for patients with type B aortic dissection In China, and a variety of activity suggestions and activity standard ranges were proposed. According to the patient's own rehabilitation assessment, the goal of rehabilitation is to improve cardiopulmonary function through the development of personalized exercise prescriptions, weakening the influence of negative psychological factors, and reducing the complication rate of delirium. Effectively improve the quality of life for patients after surgery and restore their mobility to the greatest extent. However, this study still has certain limitations, and compared with the Western rehabilitation system, China's home-based cardiopulmonary rehabilitation system is not perfect. At present, the number of domestic literature that can be referred to is small, and the physical differences of patients in different countries are not taken into account, which has certain limitations. In addition, this study lacks depth and breadth in the exploration of home-based cardiopulmonary rehabilitation, does not follow up the patient's rehabilitation status for a long time and proposes an adjustment plan, and lacks possible risks and countermeasures in the process of building a home-based rehabilitation system.

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