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Research Article

The Effect of in-Hospital Physiotherapy on Handgrip and Physical Activity Level after Cardiac Valve Surgery: A Randomized Controlled Trial

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Abstract

Objectives: Patients who undergo cardiac valve surgery undertake routine physiotherapy. Despite its routine use, influences on physical recovery after surgery have not yet been shown. The object of this study was to research whether 5-days physiotherapy could improve the in-hospital physical activity level after cardiac valve surgery.

Design: A single-blind randomized controlled trial.

Setting: Cardiothoracic surgery department at a university hospital.

Participants: Patients undergoing cardiac valve surgery (n = 34) for confirmed cardiac valve disorders were assessed during hospitalization.

Intervention: The intervention group received a daily post-operative physiotherapy intervention, consisting of individualized mobilization, breathing exercises, ambulation and so on. There was no physiotherapy treatment in the control group.

Outcomes: Physical activity was assessed with the grip strength test and time-up and go test.

Results: The treatment group showed significantly more handgrip strength (20.58 kg (7.17) vs. 12.96 kg (4.65)) and less time in the time-up and go test (5.92s (2.91) vs. 6.53s (1.60), comparing to the control group on the fifth day. There was no statistical significance found on the time-up and go tests between the two groups, except for the handgrip strength on the fifth postoperative day.

Conclusions: Patients who received physiotherapy during hospitalization showed increased levels of handgrip strength and physical activity on the fifth day after cardiac surgery compared to the control group. The clinical value of an increased level of physical activity through the physiotherapy intervention following cardiac valve surgery needs a further investigation.

Keywords: Physiotherapy; Physical therapy; Cardiac valve surgery; Randomized controlled trail; Handgrip; Physical activity

Introduction

With increasing prevalence because of an aging population and advances in treatment techniques, heart valve diseases make up nearly one-third of heart diseases. Currently, most heart valve diseases are degenerative in nature, and most previous heart diseases were rheumatic. Heart valve disease is either right-sided (tricuspid and pulmonary valves), left-sided (mitral and aortic valve disease), or a combination of the two. Initially, heart valve disease is usually asymptomatic, but when they exist, symptoms include dyspnea, fatigue, and decreased physical capacity. Symptomatic heart valve disease significantly impacts physical function and quality of life and is also associated with morbidity and mortality [1]. When severe symptoms present, the treatment of choice is valve surgery to repair impaired valves or replacement [2]. Before valve surgery, inactivity as a result of dyspnea and physical inability is common. After surgery, people are often immobilized. As cardiac surgery is an unusual and very stressful life event [3], and quality of life may be influenced [4], some patients can experience mental problems, including depression and anxiety [5]. A Cochrane review [6] indicated that people receiving a coronary artery by-pass graft surgery might benefit from psychological treatments [5]. Little is known about the impacts of psychological interventions in patients postoperation. Cardiovascular diseases rank among the main causes of hospital admission and mortality. Cardiac surgery is distinguished from other kinds of treatment as a result of advances in techniques and materials that have led to safer procedures and lower risks during the perioperative period. In despite of these improvements, complications are still frequent during the postoperative period and are a determinant of functional recovery and length of hospital stay [7]. In one study of 204 patients experiencing cardiac diseases, 58% of them had postoperative complications, mainly in the pulmonary system (31%), cardiac system (15.8%) and neurological system (13.9%) [7]. The most effective contributor to postoperative complications is prolonged bed rest. Postoperative bed rest can contribute to multiple organ system dysfunction. Immobilization impairs oxygen transport ability, increases the risk of deep

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vein thrombosis and even pulmonary thromboembolism, and results in loss of muscle mass and strength. Despite its bad effects, bed rest is prescribed after surgery. For patients experiencing cardiac surgery, mobility limitation has been indicated to reduce cardiac overload [8]. In contrast, recent studies have focused on the significance of early mobilization for improving oxygen transport and functional recovery, lessening postoperative complications and shortening the length of hospitalization [8-11]. Early mobilization after surgery has many benefits, including increasing ventilation, muscle strength and functional ability [9]. A systematic review that analyzed 15 randomized clinical trials about early mobilization in Intensive Care Units (ICUs) found that early mobilization is practicable, safe and has an active effect on functional performance [12]. Another systematic review indicated that breathing exercises alone are insufficient to prevent postoperative complications after cardiac surgery.

Material and Methods

This was a single-blinded, randomly controlled study conducted during 2018 to 2019 in the First Affiliated Hospital, Medical College of Zhejiang University. In the study, 34 patients who were undergoing cardiac valve surgery randomly participated in two groups, except for one patient who refused surgery: an intervention group (n=17) and a control group (n=16). Patients who had a negative history of severe spinal cord injury, stroke or any other diseases that could cause lower extremity impairment were eligible to participate in the study. Exclusion criteria were hemodynamic instability, loss of consciousness, and requiring mechanical ventilation more than 24 hours after the surgery.

Intervention

The intervention group received a daily post-operative physiotherapy intervention, including individually adapted mobilization and ambulation (the patients were instructed to gradually increase in activity until ambulation was achieved with a walking aid or not, according to their needs) and breathing exercises (three sets of 5 deep breaths, performed every waking hour) with instructions on coughing techniques. In the intervention group, all patients received about the same intensity of exercise during the first two days following surgery (20–30 minutes per session), and then beginning from the third day, the intervention was individualized according to the patients' status. The physiotherapy treatment, performing by physical therapists, was available from Monday to Friday. The control group did not receive any physiotherapy intervention or specific treatment during the in-hospital stay. During this process, if the patient's respiratory rate and heart rate increased more than 20% from baseline, the intervention was discontinued.

Outcomes

The outcomes were level of physical activity preoperation and 4th day after surgery. Baseline measurements of grip strength and time-up and go test were taken on the admission day. The measurements were repeated on the fourth day after operation for patients who were still in the hospital and able to take the tests. All these measurements were performed by a physical therapist that was blinded to the group distribution.

Physical activity

It is simple and inexpensive to measure the strength of grip muscles. Low grip strength is considered as a strong indicator of unfavorable outcomes such as longer hospitalization, greater functional limitations, lower health-related quality of life and death [13,14]. Accurate measurement of grip strength requires using a handheld dynamometer under well-defined test situations, for which expositive data was taken from appropriate reference populations [15]. Strength of handgrip is moderately correlated with strength in other body parts; therefore, it is considered as a reliable alternative for more complicated measurements of extremity strength. Due to its ease of use, grip strength is recommended for routine use, especially in some communities and clinical settings [13,14,16-18]. To obtain an optimal result, patients were required to grip the apparatus and then squeeze it three times in as best as possible, with at least 2-min breaks between attempts. In the study, patients' mean and peak measurements were recorded in kilograms. The patients were required to use their dominant hand. It is impossible to test the handgrip strength it the hand is disabled (e.g., with stroke or advanced arthritis); in such cases, lower limb strength can be measured using isometric torque methods [19].

Physical performance

Physical performance has been considered as an objective measurement for total body function, which is associated with locomotion. It is a polydimensional abstraction that includes functions of the musculoskeletal system and also the nervous system, involving balance [20-26]. Physical performance can be assessed by gait speed, the timed-up and go test (TUG), and other measurements. Certain other measures may not be able to be used when a patient's performance is impaired by dementia, balance impairment or gait disorders. To assess physical performance, the TUG was used in this study. The test was performed on a 3-m walkway. The patients were recommended to rise from sitting from a standard armchair, walk 3 meters, turn, walk back to the chair, and sit down. They were suggested to walk as quickly as they could. The use of a walking aid, if needed, was noted. The output parameter was noted in seconds.

Statistical methods

For patients' characteristics, continuous data are summarized as the means ± standard deviations (SDs), and categorical data are presented as numbers and percentages. Two-way analysis of variance with repeated measures was used to determine the significance of differences in proportions between two groups, and the F test was also used to show the differences between two means. For all analyses, a P-value <0.05 was considered statistically significant. Values are shown as the means ± SDs unless otherwise indicated.

Results

During the period from 2018 to 2019, a total of 34 patients at our institution were included in this study. One patient from the control group was excluded due to refusing surgery. Ultimately, the study group consisted of 33 patients (treatment group n = 17, and control group n = 16) (Figure 1). The mean ages in the intervention and control groups were 59 (11.4) and 60 (14.4) years. Seven patients (41%) in the intervention group and 7 patients (43%) in the control group were men. There was no statistically significant difference in the demographic characteristics between these two groups (P>0.05). These data are presented in Table 1. At baseline, there were no major differences between the groups regarding age, gender, body mass index, handgrip strength, or physical function (time-up and go test) in the randomization process yielded (Table 1). All these data were acquired before the patients received the physiotherapy. For patients available for the follow-up test on the fifth postoperative day (treatment group n = 17, control group n = 16), there were significant differences between the groups in handgrip strength and physical performance (time-up and go) (Table 2). There were some improvements in hand-

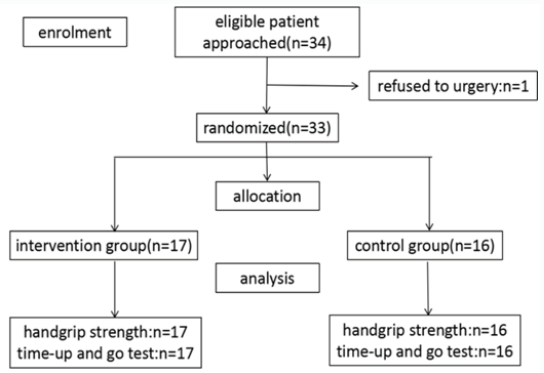

Figure 1: Study flow chart of the patients in this study.

grip strength (from 17.79 to 20.58) and physical performance (from 6.12 to 5.92) in the treatment group, while handgrip strength (from 17.72 to 12.96) and muscle performance (from 6.16 to 6.53) were markedly decreased in the control group. Among these data, only the data for handgrip strength between the two groups on day five after surgery were statistically significant.

Table 1: Patient characteristics on preparation.

	Treatment group (n=17)	Control group (n=16)	P value
Age (years)	58.94±11.38	60.19±14.39	0.78
Sex, Male (%)	7 (41.18%)	7 (43.75%)	0.58
Height (m)	1.61±0.05	1.62±0.06	0.81
Weight (kg)	58.86±12.35	60.91±9.36	0.6
BMI (kg/m2)	22.62±4.02	23.27±2.70	0.59

Data were present as mean ± SD or number (n) of patients. BMI = body mass index. HSG = and strength. TUG = time up and go. The P-value refers to the difference between the groups.

Discussion

The main finding from this study was that patients who took physiotherapy during the first postoperative days had better physical strength and performance during their hospitalization than patients not receiving physical therapy. Overall, patients in the treatment group achieved significantly more strength and performance than the patients in the control group. Postoperative early mobilization is associated with multiple benefits, including improved pulmonary function, muscle strength and functional performance. A systematic review of early mobilization in Intensive Care Units (ICUs) studied 15 randomized clinical trials and discovered that early mobilization is practicable, safe and has an active effect on the functional capacity of patients who are critically ill [27]. The strength of handgrip muscles was significantly higher in the experimental group than in the control group in our study (Table 2). After five days of physiotherapy intervention, the recovery of muscle strength in the intervention group was much quicker than that in the control group. Da Silva TK, et al. [28] showed that Handgrip Strength (HGS) appeared to be related to mechanical ventilation time, Intensive Care Unit (ICU) Length of Stay (LOS) and hospital LOS after surgery in patients undergoing cardiac surgery. Handgrip strength (HGS) has been regard as a useful functional ability test for evaluating muscle strength not only in the general population but also in hospitalized and non-hospitalized persons with illnesses [29,30]. It has also been studied in the clinical environment and as a diagnostic tool for assessing malnutrition, overall nutritional risk and mortality [31]. In our study, the muscle performance measured in the TUG test did improve compared to the control group; however, there was no statistical significance between these two groups. A lack of difference in physical performance between the intervention and control groups was presented previously, supporting our results. Supervised postoperative walking in the ward might have been at too low an intensity to have an effect on functional capacity, as measured with the TUG. However, the four days of treatment might not be enough to show results on the TUG. Studies [7,31] found that exercise training was beneficial in terms of short-term improvements in exercise capacity. They also found exercise-based cardiac rehabilitation might have an impact on adverse events. Patman et al. [33] did not find any difference between the intervention and control groups in any of the outcomes measured. However, many lines of evidence support the effect of early mobilization on the patient's functional performance. More studies are needed to describe in-hospital physical activity after cardiac valve surgery. The patients in our study were at a low level of physical activity; nevertheless, they were considered fit for discharge. This could indicate a need for outpatient physiotherapy. Post-discharge cardiac rehabilitation may potentially increase the patients' exercise capacity [14]. Despite the potential benefits of cardiac rehabilitation [5], referral to such rehabilitation is rare in China. One significant role the physiotherapist can fulfill during the hospitalized phase is to inform patients about the benefits of cardiac rehabilitation and reference it. It is unclear whether it is crucial to be physically dynamic in the early postoperative phase after cardiac valve surgery, but it seems that it would be favorable to get a good start. Our results indicate that physiotherapists can play an important part in helping patients to be physically active early in the postoperative period.

Limitations

First, the sample size in our study was not large enough. Another limitation is the fact that the study was not double-blinded. However, the nature of physiotherapy treatment makes it impossible to conduct a double-blinded study. To minimize the potential bias, the assessments were made by a physiotherapist who was blinded to group allocation. Another limitation is the lack of a long-term follow-up. As physiotherapy is not such acceptable to some people in China, it is hard to carry out a follow-up intervention program after patients are discharged.

Conclusion

Patients who received five days of hospitalized physiotherapy showed improved levels of physical activity after cardiac valve surgery, compared to a control group. However, no significant effects on the time-up and go test were found. The clinical value of increasing physical activity degrees during the early postoperative phase needs to be further evaluated.

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Table 2: Date on pre- and post-operation HSG, TUG.

	Treatment group (n=17)			Control group (n=16)		
	Preoperative	Postoperative	P value	Preoperative	Postoperative	P value
HSG (kg)	17.79±6.39	20.58±7.17	p<0.001	17.72±5.25	17.43±6.73	0.22
TUG (s)	6.12±2.10	6.32±2.73	0.65	6.16±1.55	6.46±1.71	0.02

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