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좌심실 보조장치를 삽입한 환자에게 적용된 개별화된 운동 변인의 효과

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The Effect of Individualized Exercise Parameters Applied to Two Patients Recovering from Implanted Left Ventricular Assist Devices in Korea

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Left ventricular assist devices (LVADs) are a treatment option for patients with severe chronic heart failure. These patients are referred to an inpatient cardiac rehabilitation after implantation to improve an aerobic capacity and quality of life (QOL). Several studies have reported that an exercise therapy, which is a component of cardiac rehabilitation, improves exercise capacity and QOL. The LVADs were implanted successfully in a destination therapy in two Korean patients, and these patients were enrolled in the cardiac rehabilitation. After an individualized intervention, they were discharged from improved exercise functional capacity and QOL. This is the first report showing a benefit of the individualized exercise therapy using different parameters after LVADs implantation in Korea.

Keywords: Exercise therapy, Heart failure, Ventricular assist devices

Introduction

The prevalence of heart failure continues to rise, and approximately 5.7 million people are living with heart failure in the United States[1)]. According to a 2013 report of the Ministry of Health and Welfare[2)], mortality due to cardiac diseases of heart failure has increased progressively in Koreans. Several treatments are available for heart failure including medical management, heart transplantation, mechanical circulatory support, and hospice. Left ventricular assist devices (LVADs) are a type of mechanical circulatory support used as a bridge to a cardiac transplantation or destination therapy for patients with congestive heart failure. In addition, when compared with those patients

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with a pulsatile device, an implanted LVAD as a destination therapy shows improved their quality of life (QOL), exercise capacity and significantly improved their survival rates[3]. An exercise therapy is an important factor for improving postoperative outcomes. One study reported that an exercise training was feasible and safe in patients with a LVAD[4]. Moreover, according to Ueno and Tomizawa[5], a structured exercise program was associated with an improved exercise capacity and survival rate in cardiac patients. Therefore, selecting an exercise type by the patient's medical history, previous physical activities, and postoperative complications is a very important factor for improving the exercise capacity and QOL. As I mentioned before, this study will present with two patients who underwent inpatient cardiac rehabilitation after LVAD implantation as the destination therapy. This is the first report of clinical outcomes using individualized exercise parameters for patients with an implanted LVAD in Korea.

Case Report

The first patient was a 75-year-old male who had been diagnosed with systolic heart failure (Table 1). He had undergone aortic valve replacement because of severe aortic regurgitation in 2000. Although the patient was treated with all possible medical treatments included a medication and interventional therapy, his low left ventricular function persisted with severe dyspnea. Therefore, the patient was admitted to our hospital for LVAD implantation, as the first case in Korea and underwent LVAD implantation on August 17, 2012 (Fig. 1A).

The second patient was a 66-year-old male who had been diagnosed with ischemic cardiomyopathy. He had undergone coronary artery bypass graft surgery in 2008 and received percutaneous coronary intervention procedures in both 2007 and 2009. Although he received the intensive medical treatment with the medication and interventional therapy, he suffered from severe dyspnea during his daily living activities. All things considered, the patient was decided on a LVAD implant to improve the severe dyspnea. After conducting his comprehensive evaluation, he was implanted LVAD as the second case in Korea on July 12, 2013 (Fig. 1B).

The exercise intervention was developed and tailored for the

Table 1. Demographic data for patients

Characteristics	Case A	Case B
Sex	Male	Male
Age (yr)	76	66
Height (cm)/weight (kg)	167/50	164/63
Blood pressure (mm Hg)	93/57	76/48
Heart rate (bpm)	99	81
Body mass index (kg/m^2)	21.3	23.1
Diagnosis	Systolic heart failure	Ischemic cardiomyopathy
LVEF (%)	20.0	22.3
NYHA class	II	III
Medication	Spironolactone 25 mg, Furosemide 40 mg, Amiodarone 100 mg, Cilostazole 50 mg, Clonazepam 0.6 mg, Isosorbide mono 20 mg, Warfarin 2 mg, Loperamide oxide, Enoxaparin 60 mg	Furosemide 40 mg, Cefixime 200 mg, Beszyme, Lactulose syrup 15 mL, Cough syrup 20 mL
Echocardiogram	Markedly LV dilation with severe LV systolic dysfunction Moderate TR Mild MR Both atrial enlargement Dilated aortic root (43 mm) & ascending aorta (39 mm)	Ischemic heart disease with severe LV systolic dysfunction Dilated LV Dilated RV with decrease RV dysfunction Mild MR Mild AR Diastolic dysfunction grade 3 with LV filling pressure Both atrial enlargement

LVEF: left ventricular ejection fraction, NYHA: New York Heart Association, LV: left ventricle, TR: tricuspid regurgitation, MR: mitral regurgitation, RV: right ventricle, AR: aortic regurgitation.

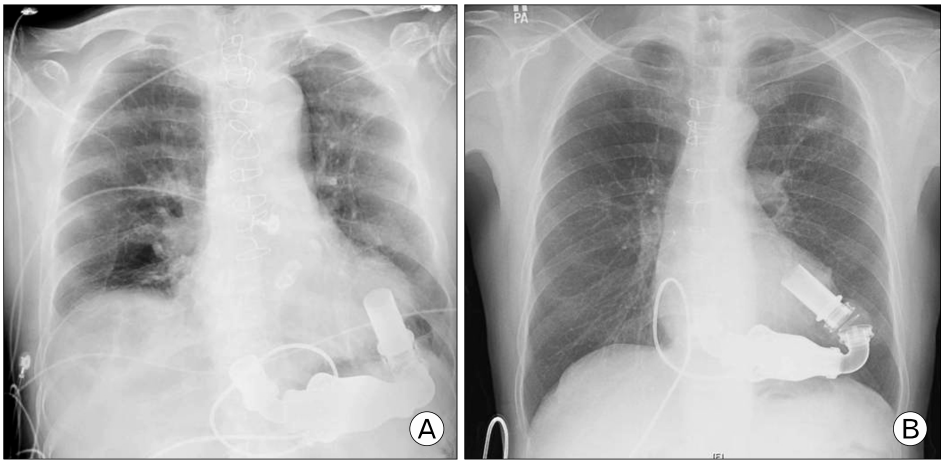

Fig. 1. Chest X-ray view after implantation. The successful implantation of the continuous flow left ventricular assist device (HeartMate II) was showed in the figure. First case (A), second case (B).

Table 2. Clinical exercise data for exercise intervention

Variable	Case A	Case B
Initial time of rehabilitation	POD 3	POD 3
Transferred to the ward	POD 10	POD 10
Exercise frequency	5/wk	5/wk
Exercise intensity	Target HR+30 bpm: 109 bpm RPE: 11–14 is more suitable or modified Borg scale (3–5)	Target HR+30 bpm: 118 bpm RPE: 11–14
Exercise time (min/day)	30–60	30–60
ICU walking	POD 5	POD 5
Corridor walking	POD 10	POD 10
Step up and down	POD 27	POD 18
Stationary bike	POD 19 (level 0–1)	POD 19 (level 0–1)
Treadmill	POD 90 (speed 2.7 km/hr, grade 2)	POD 26 (speed 4.0 km/hr, grade 2)
Postoperative complication	Aspiration pneumonia, delayed wound healing, NSVT	Post OP bleeding tendency → massive transfusion, hematoma or effusion, LVAD site hematoma (+)
LOS in the ICU (day)	10	10
LOS in the ward (day)	126	29

POD: postoperative day, HR: heart rate, RPE: rating of perceived exertion, ICU: intensive care unit, NSVT: non sustain ventricular tachycardia, OP: operation, LVAD: left ventricular assist device, LOS: length of stay.

each patient's condition and exercise capacity after surgery (Table 2). The patients were transferred to the intensive care unit (ICU) after surgery, and the inpatient cardiac rehabilitation was initiated on postoperative day (POD) 3. The first exercise for two patients was a breathing technique including pursed lips and diaphragm breathing to prevent pulmonary complications, followed by a range of motion exercises and ambulation in the ICU. On POD 10, the patients were transferred to the ward and then started immediately exercise walking in a corridor using the walker. A target heart rate (HR) for patient was calculated as the resting HR plus 30 bpm, which was recommended by the American College of Sports Medicine Guidelines for patients undergoing cardiac surgery. The upper limited target HR for first patient was 109 bpm, and 118 bpm was for the second patient. However, the first patient was not able to reach the target HR during an aerobic exercise due to some post-complications, such as severe dyspnea (New York Heart Association III) and traced non-sustain supraventricular tachycardia. Therefore, different exercise parameters (rating of perceived exertion [RPE] using Borg Scales and Modified Borg Scales) were applied to patients for monitoring their exercise intensity during training time. The exercise intensity in second patient was increased progressively with monitoring of the target HR, although RPE was intermittently used due to dyspnea. The patients were able to perform all conducted exercise in the inpatient cardiac rehabilitation.

A 6-min walk test (6-MWT) was conducted to evaluate the functional exercise capacity at pre- and post-rehabilitation; the results of first case were 121 m and 285 m, and the second case were 228 m and 375 m, respectively (Fig. 2). For evaluating QOL, the Minnesota Living with Heart Failure Questionnaire (MLHFQ), included a physical dimension (PD) and an emotional dimension (ED), was administered. The scores of first case decreased post-rehabilitation (PD: 21, ED: 12) relative to those pre-rehabilitation (PD: 34, ED: 23) and the second case was also showed decreased scores on POD 38 (PD: 12, MD: 8) relative to those pre-rehabilitation (PD: 37, MD: 23) (Fig. 3).

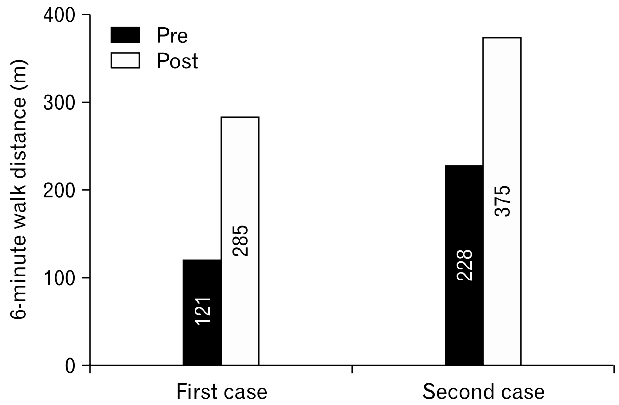

Fig. 2. The 6-minute walk test results for the patients (bar). There was improvement to walk distance in our cases. It means that these patients were improved exercise capacity after the intervention. Pre: pre-rehabilitation, Post: post-rehabilitation.

Discussion

This study showed that an exercise therapy applied different exercise parameters improved patient's exercise capacity and QOL following LVADs implantation surgery. Several studies[4,6,7] have reported that the exercise therapy based on the patient's condition was the safest and improved his or her exercise capacity and QOL. According to this study, the result showed that an individualized exercise intervention using different parameters should be considered when an exercise prescription was conducted for patients with implanted LVADs to supporting more suitable exercise programs.

Guidelines for inpatient cardiac rehabilitation based on a patient's exercise capacity and strength were published by Wells[8] and recommended that the exercise intensity should be considered when planning an exercise program. In this study, because dypnea had a largely effect on the exercise intensity, the parameters of exercise intensities were applied differentially to patients. The modified Borg scale (0–10) and the Borg scale (6–20) were good options to monitor an exercise tolerance in patients with implanted LVADs[6]. After implanted LVADs, shortness of breath in the first patient has been worsened compared with before the surgery. Therefore, the initial exercise for the first patient focused on breathing exercises to improve dyspnea by monitoring using the modified Borg and Borg scales. In contrast, the second patient

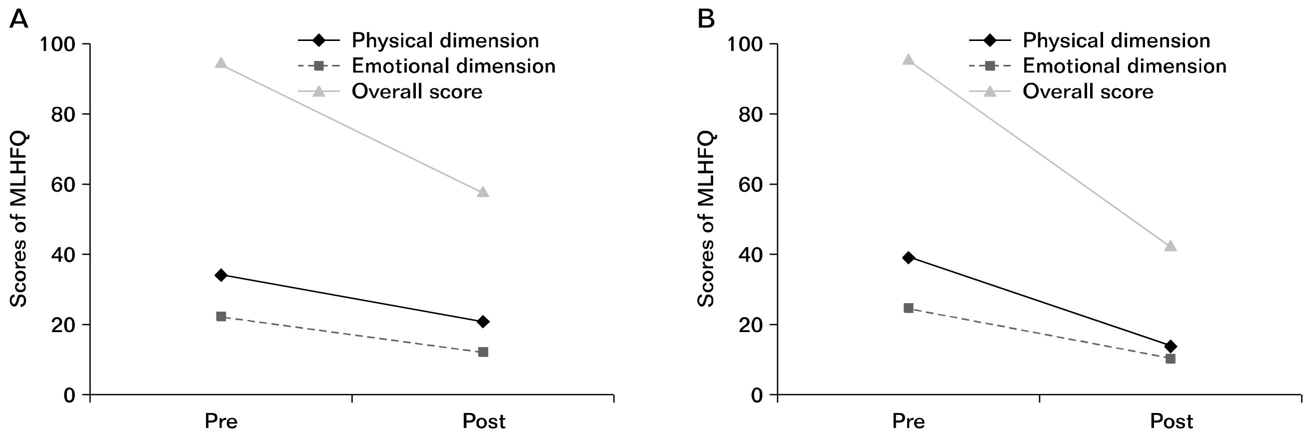

Fig. 3. Minnesota Living with Heart Failure Questionnaire (MLHFQ) score was showed. All scores of post-rehabilitation (Post) were decreased that means quality of life was improved relative to pre-rehabilitation (Pre). First case (A), second case (B).

was able to carry out more intensive exercises due to improved dyspnea after surgery. His exercise program focused on improving his cardiopulmonary capacity through aerobic exercises such as a corridor walking, stationary bike and treadmill activities with his target HR monitoring. Given this aspect, exercise parameters such as target HR, RPE, modified Borg scales must be considered differentially depending on the postoperative patient's condition and complication.

The exercise capacity was usually evaluated after implanting a LVAD to determine the effects of the therapy. The 6-MWT was an inexpensive, relatively quick, safe and well-tolerated method to assess functional exercise capacity and can be used to predict peak oxygen uptake[9]. According to Hayes et al.[4], the 6-minute walking distance improved 52% after exercise training compared with those before rehabilitation. These results obtained with our cases (49%) were similar. Therefore, this study showed that the tailored exercise reduced the LVADs patients exercise intolerances.

Some of these patients developed depression, as they felt tethered to a life-sustaining device and suffer from dyspnea. Also, the depression can be affect to QOL which reflects a person's overall appraisal of their physical and mental states. The MLHFQ was useful as a general survey of the physical and mental states of patients with an implanted LVAD[7]. The MLHFQ of this study increased significantly, but the improvement in score was greater in the second case than in the first case. Kirklin et al.[10] study reported that older age is affected to the postoperative outcome, this study postulated that differences in QOL between this case after implantation may have been affected by these variables.

This study have a limitation. The two patients were only participated in this study because the Korea cases of LVADs implantation are small in number. However, this study showed that an exercise therapy can be safely performed on Korean patients recovering from LVADs implantation. This result will help to provide an effective and safety exercise therapy program to exercise specialist or physiotherapist who are working in Korea.

In conclusion, considering individualized exercise parameters improved patient's exercise capacity and QOL in Korean patients with implanted LVADs. The exercise parameters should be differently applied to patients recovering from implanted LVADs as considering postoperative conditions in severe dyspnea and age. Consideration of these factors in the exercise intervention was a very important aspect to support more optimal patient's exercise intensity and to improve patient's exercise compliance.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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