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Impact of Home Exercise Training on Patients with Acute Myocardial Infarction

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Abstract. [Purpose] The purpose of this study was to evaluate the impact of home exercise on acute myocardial infarction (AMI) patients undergoing percutaneous coronary intervention (PCI). [Subjects] A total of 46 AMI patients undergoing PCI were randomly divided into an experimental group and a control group. [Methods] The experimental group (n = 22) received education and home exercise training (walking exercise at home five times per week). Diet control and daily life were performed in the control group (n = 24). The lipid profile and high-sensitivity C-reactive protein (hs-CRP) were evaluated at baseline and at 12 weeks follow-up. [Results] From baseline to 12 weeks follow-up, the experimental group had significant improvements in total cholesterol, low-density lipoprotein (LDL), and hs-CRP. The control group showed significant improvements in total cholesterol and LDL, but there were no significant differences between the experimental and control groups. [Conclusion] Our results suggest that home exercise training is advantageous for patients with acute myocardial infarction who have undergone PCI. More clinical applications and studies of home exercise training will be needed in the future.
Key words: Acute myocardial infarction, Home exercise training, Hs-CRP

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INTRODUCTION

The mortality rate from coronary artery disease has decreased recently, but angioplasties and coronary artery bypass graft surgeries (CABG) for diagnosis and treatment are increasing and the incidence of coronary artery disease is still high[1)]. As coronary artery disease has a high incidence of recurrence or death, even after treatment, proper intervention to reduce the onset and recurrence of heart disease will reduce mortality and save costs[2)]. Such interventions in heart disease include diet control, medications, percutaneous coronary intervention (PCI), CABG, and cardiac rehabilitation (CR)[1)]. Presently, the importance of cardiac rehabilitation is being emphasized, and a cardiac rehabilitation program is a critical part of the comprehensive management of patients with coronary artery disease[3)].

In patients with coronary artery disease, low-density and high-density lipoproteins are known to have an impact on atherosclerosis. The reduction of low-density lipoproteins decreases coronary artery disease, whereas an increase in high-density lipoprotein decreases the incidence of atherosclerosis. In particular, C-reactive protein (CRP) has been reported to be associated with an increase in myocardial infarction in both men and women[1)]. For cardiac rehabilitation patients with coronary artery disease, exercise training on a treadmill in a hospital is prescribed for most cases. This training is effective at reducing high-sensitivity CRP (hs-CRP), which is an inflammatory factor used to predict the recurrence of myocardial infarction[4)]. However, a cardiac rehabilitation program is problematic because patients who need cardiac rehabilitation find it difficult to participate in programs in hospitals and many of them drop out[5)]. Therefore, this study investigated the effects of home exercise training on the lipid profile and hs-CRP of patients with acute myocardial infarction who had undergone PCI.

SUBJECTS AND METHODS

The subjects were 46 patients with acute myocardial infarction who had undergone PCI and had been hospitalized in D Medical Center in Daegu, Korea, between January and September 2011. They were randomly assigned to either an experimental group of 22 subjects or a control group of 24 subjects. There were no significant differences between the two groups in sex, age, height, or weight ($p>0.05$); in risk factors, such as smoking, hypertension, diabetes, or hyperlipidemia ($p>0.05$); and in medications, such as angiotensin-converting enzyme inhibitors, calcium channel blockers, statins, or beta-blockers ($p>0.05$). The subjects were selected from among those who were aged between 18 and 80, had been diagnosed with acute myocardial infarction, had undergone PCI, sufficiently understood the intent and content of this study, and voluntarily consented in writing and by word of mouth to participate in this study. Those

Table 1. Comparison of lipid profiles and hs-CRP between the experimental and control groups

Variables	Experimental group (n = 22)		Control group (n = 24)	
	Baseline	After 12 wk	Baseline	After 12 wk
TC	193.91 ± 34.58	148.41 ± 29.00*	189.50 ± 47.28	154.13 ± 38.35*
HDL	38.35 ± 7.21	40.12 ± 5.83	37.72 ± 7.54	39.17 ± 7.76
TG	124.46 ± 64.86	127.95 ± 47.80	118.64 ± 49.20	122.25 ± 35.82
LDL	117.88 ± 29.11	91.97 ± 21.56*	112.45 ± 35.82	94.50 ± 30.30*
Hs-CRP	0.37 ± 0.66	0.08 ± 0.16*	0.31 ± 0.31	0.23 ± 0.65

(unit: mg/dL). *p<0.05, Mean ± SD. HDL: high-density lipoprotein; TG: triglyceride; LDL: low-density lipoprotein; Hs-CRP: high-sensitivity C-reactive protein.

who had chronic stable angina, who were New York Heart Association (NYHA) class III-IV, whose left ventricular ejection fraction was lower than 30%, who had chronic renal failure, or who were unable exercise were excluded.

Medications for usual treatment and a cardiac rehabilitation program were provided to the experimental group. The cardiac rehabilitation program consisted of educational rehabilitation and home exercise training. For educational rehabilitation, the researcher of this study personally educated the subjects on the preformance of exercise training including the risk factors of heart disease, dietary treatment, and self heart rate measurement. For the home exercise training, the subjects performed a walking exercise five times per week for 12 weeks after leaving the hospital. The total duration of one session of exercise was 50 min. For warm-up and cool-down, flexibility exercises were performed for 10 min, which consisted of stretching the upper and lower limbs and the trunk. The walking exercise, which was the main portion of the exercise, was performed on flat ground for 30 min. Because of their health conditions, subjects were advised to avoid exercising in the morning and evening, and to perform the exercise before and after lunch. They were also advised to immediately stop exercising if they experienced pain in their heart, or if it became difficult for them to walk. Furthermore, the researcher called the subjects once a week to provide consultation on the improvement of risk factors and set the step-by-step intensity of the exercise.

The exercise intensity was increased step by step from 40% to 80% after calculating the heart rate reserve (HRR), based on the maximum heart rate and resting heart rate, which had been measured in a gradual symptom-limited exercise stress test. The target heart rate was determined by Karvonen's formula: Target Heart Rate = (Max Heart Rate − Resting Heart Rate) × %Intensity + Resting Heart Rate. The exercise intensity was set to 40% for weeks 2–4, 50% for weeks 5–6, 60% for weeks 7–8, 70% for weeks 9–10, and 80% for weeks 11–12. The heart rates were self-measured. The control group was educated on daily life at home in addition to medication and dietary treatment, the usual treatment, and they did not participate in the cardiac rehabilitation program. Both the experimental and control groups performed the gradual symptom-limited exercise stress test on discharge and 12 weeks after discharge from hospital. The gradual symptom-limited exercise stress test was conducted using the modified Bruce protocol on a treadmill (Marquette, GE, USA). Subjects' heart rate, blood pressure, and metabolic equivalent of the tasks were measured at 2 min intervals using a 12-channel real-time electrocardiogram tester and an automatic blood pressure measuring instrument (ambulatory blood pressure, GE, USA). Blood samples were taken from both groups after a minimum 10-hour empty stomach before discharge from hospital and 12 weeks after discharge from hospital, and the total cholesterol, high-density lipoproteins, neutral fats, low-density lipoproteins, and hs-CRP were measured.

The experimental results were statistically analyzed using SPSS 12.0 KO (SPSS, Chicago, IL, USA). After the general characteristics of the subjects were determined, the paired t-test was used to compare the changes in the lipid profile and hs-CRP between pre- and post-intervention within each group. The significance of the difference between the two groups was investigated with the independent t-test. The statistical significance level, α, was chosen as 0.05.

RESULTS

The experimental group showed a significant decrease in total cholesterol and low-density lipoproteins from the baseline ($p<0.05$), and hs-CRP also significantly decreased from 0.37 ± 0.66 mg/L before cardiac rehabilitation to 0.08 ± 0.16 mg/L after 12 weeks of cardiac rehabilitation ($p<0.05$). The control group showed a significant decrease in total cholesterol and low-density lipoproteins from the baseline ($p<0.05$) (Table 1). However, there were no significant differences between the groups in any of the measured items.

DISCUSSION

Coronary sclerosis can cause angina pectoris and myocardial infarction. In particular, low-density lipoprotein and neutral proteins are known to be risk factors of myocardial infarction[6]. In this study, total cholesterol and low-density lipoprotein significantly decreased in both the experimental and control groups, and there was no difference in lipid profiles between the two groups after 12 weeks of cardiac rehabilitation. A study of cardiac rehabilitation patients with acute myocardial infarction found no particular changes after 6 weeks, but after 6 and 12 months, the lipid profile, e.g., total cholesterol and low-density lipoproteins, showed significant improvements[7]. Most studies that have

reported a significant improvement in the lipid profile have combined cardiac rehabilitation with administration of a lipid-lowering agent. It has recently been reported that the lipid profile can be improved through improvement of dietary habits[1]. In a cardiac rehabilitation study lasting 12 weeks of acute myocardial infarction patients who had not taken a lipid-lowering agent, Lavie et al.[8] found no significant changes in total cholesterol, low-density lipoproteins or neutral proteins. However, another study that combined exercise training with statins for patients with acute myocardial infarction found decreases in on total cholesterol and low-density lipoproteins, although the decrease were not statistically significant[9, 10]. In our study, statin was prescribed to 48%–54% of the subjects, and total cholesterol and low-density lipoprotein significantly decreased in both groups, but showed no significant difference between the two groups. These results suggest that in the short term, the administration of a lipid-lowering agent is more important than the improvement of dietary habits in cardiac rehabilitation. hs-CRP is a known inflammatory factor which is associated with cardiac death, peripheral vascular disease, stroke, and myocardial infarction in healthy people with no past history of cardiovascular diseases, or acute recurrence and death of patients with coronary artery disease[11], and hs-CRP can be reduced through regular exercise[12]. In this study, hs-CRP significantly decreased in the experimental group, but it did not significantly change in the control group. However, there was no significant difference in hs-CRP between the two groups.

A study of exercise training for patients with coronary artery disease found a significant decrease in hs-CRP[4]. In a study combining exercise training and statin for patients with acute myocardial infarction, Kim et al.[9] found a significant decrease in hs-CRP, but they found no significant differences between exercise training and drug therapy. These findings are similar to the findings of our present study: the experimental group, which combined home exercise training and medications, showed a significant decrease in hs-CRP, but the control group, which did not perform home exercise training, did not. This suggests that cardiac rehabilitation through home exercise training has an impact on the level of hs-CRP. In particular, the decrease in hs-CRP would have the effect of reducing the recurrence of acute myocardial infarction in patients who had undergone percutaneous coronary intervention (PCI) through a significant decrease in hs-CRP.

Our results suggest that home exercise training is advantageous for patients with acute myocardial infarction who have undergone PCI. More clinical applications and studies of home exercise training are needed in the future.

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