Early Phase II Comprehensive Cardiac Rehabilitation after Acute Myocardial Infarction

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Background: Cardiac rehabilitation is beneficial for patients after ST-segment elevation myocardial infarction (STEMI). However, most institutes perform outpatient training phase (phase II) of post-MI cardiac rehabilitation after 2-4 weeks. To evaluate the possibility of performing cardiac rehabilitation with an earlier schedule after STEMI.

Methods: We conducted a series of early phase II cardiac rehabilitation starting from 5-7 days after STEMI, including the training group (n = 28) and the control group (n = 42).

Results: The results showed an improved mental component summary of the SF-36 questionnaire after 6 months in the training group. No adverse event was noticed during this early phase II training.

Conclusions: Cardiac rehabilitation after STEMI might be started earlier than previously thought for clinical use or further research.

Key Words: Acute myocardial infarction ● Cardiac rehabilitation ● Exercise training ● Mental health

INTRODUCTION

Cardiac rehabilitation (CR) following ST-segment elevation myocardial infarction (STEMI) is reported to reduce mortality,[1-3] improve exercise tolerance, and health related quality of life (HRQoL).[4,5] However, most outpatient CR units started the training phase CR (phase II CR) 2 to 4 weeks after STEMI.[1,4,6-8] We hypothesized that an earlier comprehensive CR program would provide more benefit for these patients. Therefore, we invited all patients with STEMI to participate in an early phase II CR program within 5 to 7 days after onset, and observed the effect of early intervention on exercise capacity and HRQoL.

METHODS

Subjects

This study was performed in a tertiary center. We started a collaborated team work of early CR program since 2007, and this study included patients who had been consulted for early CR after STEMI from 2007 till 2015 (n = 105). All these patients had received inpatient rehabilitation training and education about cardiovascular risk factors from a team consisting of physicians, nurses, nutritionists, and physical therapists. Patients with cerebrovascular diseases, severe orthopedic disorders, advanced heart failure (functional class IV), severe valvular diseases, or uncontrolled arrhythmia were excluded. Seventy patients were finally enrolled for analysis after exclusion. Informed consent was obtained from all patients before CR. The study was approved by the Institutional Review Board at the Veterans General Hos-

pital-Kaohsiung [15-CT7-05(150423-1)].

Training protocol

All of the 70 patients were invited to participate in the CR program immediately after discharge (i.e. 5-7 days after STEMI). Twenty-eight patients agreed to participate in the CR program, while the other 42 patients refused because of the following reasons: (1) poor accessibility (n = 39) and (2) not interested in exercise training (n = 3). The two groups both underwent exercise tests and SF-36 questionnaires before discharge as baseline (t0), at 8 weeks (t1) and at 6 months follow-up (t2). The control patients were told to gradually increase activity level at home and to cease high risk lifestyle, including smoking and high fat diet, etc.

Comprehensive cardiopulmonary rehabilitation program

The patients in CR group attended 50-minute exercise sessions 3 times a week. Each session had warm-up, cycling, and cool-down components. During the first week, exercise intensity was set at 40-50% heart rate reserve as determined by the baseline exercise test, and gradually increased to 50-60% heart rate reserve in the following weeks. During all exercises, each participant was monitored by electrocardiography and pulse oximetry under the supervision of a physical therapist.

Cardiopulmonary exercise tests

All patients were tested using Metamax 3B (Cortex Biophysik Co., Germany) consisting of a bicycle ergometer, a gas analyzer and an electrocardiography monitor. Patients peddled on an upright bicycle ergometer to assess oxygen consumption at peak exercise (peakVO$_2$) and at anaerobic threshold (AT VO$_2$). Exercise began with an intensity of 0W workload for a 1-minute warm-up, followed by incremental loading using a ramp protocol (10 W/min) until exhaustion. The patients were tested with the Ramp Bruce protocol, following the guideline of the American College of Sports Medicine.[9] All patients completed the test safely.

HRQoL

General HRQoL was measured using the Chinese (Taiwan) version of the Medical Outcome Study 36-item Short Form Survey (SF-36). The SF-36, a standardized, generic instrument measuring HRQoL, has been validated in the general Chinese-Taiwan population,[10,11] and also in the heart disease populations.[12-14] The SF-36 consists of 36 items divided into two categories: the physical component summary (PCS) and the mental component summary (MCS). The MCS score were formed by 4 subscales: vitality, social functioning, role-emotional, and mental health, while the PCS score by the other 4 subscales: physical functioning, role-physical, bodily pain, and general health. Both MCS and PCS scores have been standardized using a linear T-score transformation to ensure a mean of 50 and a standard deviation of 10.[15]

Statistical analysis

Pearson chi-square tests and independent t-tests were used to compare the between-group data at t0, t1, and t2, while the intra-group change in relation with time was compared with paired t-tests. A p value of less than 0.05 was regarded as statistical significant. All statistical analyses were conducted with SPSS® version 19.

RESULTS

The baseline characteristics of the two groups were shown in Table 1. The mean age of the CR group and the control group were 59.5 ± 11.5 (mean ± SD) and 58.4 ± 13.0 years old, respectively. We found no significant differences in all baseline characteristics.

No any adverse event was found while performing early CR program. The change of MCS and PCS were shown in Figure 1. The MCS improved with time in the CR group, while worsened with time in the control group, leading to a significant difference (p < 0.05) at 6 months. Besides, one of the subscales of PCS, bodily pain, was significantly greater for the CR group (p < 0.05) at t2 (Figure 2). Otherwise, no significant between-group difference was found for peakVO$_2$ and AT VO$_2$ at all time.

In the previous study,[16] patients with diabetes seemed to gain less benefit from CR. As for the subgroup analysis in this study, the change of peak VO$_2$ among trained diabetic patients [from 3.22 Metabolic Equivalent of Tasks (METs) to 4.31 METs] and trained non-diabetic patients (from 3.29 METs to 4.55 METs) showed no significant difference. The similar trend but non-significant re-

Table 1. Clinical characteristics

Variable	Control group (n = 42)	CR group (n = 28)	p value
Age (years, mean ± SD)	59.5 ± 11.5	58.4 ± 13.0	0.703
Male/female (n)	38/4	26/2	0.727
Body weight (kgw)	67.28 ± 7.19	68.53 ± 10.69	0.562
BMI (kg/m^2)	25.05 ± 2.42	25.21 ± 3.41	0.821
Anterior MI/inferior MI*	28/14	17/11	0.611
Killip II or III (n)	25	14	0.450
Peak creatine kinase (IU/L)	2713 ± 2901	3262 ± 2812	0.446
LVEF (%)	46.5 ± 6.5	44.9 ± 8.6	0.422
No. of coronary arteries with ≥ 50% stenosis (n)	1.88 ± 0.86	1.93 ± 0.83	0.831
Systemic hypertension	50%	54%	0.652
Diabetes mellitus	36%	29%	0.601
Dyslipidemia	48%	43%	0.726
Smoking	57%	54%	0.325
Medications			
Aspirin	98%	97%	0.770
Clopidogrel	100%	100%	1.000
Beta-blocker	91%	93%	0.727
ACEI	93%	93%	1.000
Statin	69%	64%	0.678
Predischarge exercise test			
Rest HR (bpm)	74.9 ± 12.0	74.6 ± 11.9	0.903
AT VO$_2$ (ml/kg/min)	8.65 ± 2.24	8.51 ± 1.51	0.724
Peak exercise			
VO$_2$ (ml/kg/min)	11.23 ± 3.05	11.45 ± 2.07	0.737
HR (bpm)	101.3 ± 14.3	103.2 ± 13.8	0.588
SBP (mmHg)	140.7 ± 21.9	141.5 ± 28.6	0.898

* Anterior MI, anterior and anteroseptal wall myocardial infarction; Inferior MI, inferior and posterior wall myocardial infarction; ACEI, angiotension-converting enzyme inhibitor; AT, anaerobic threshold; BMI, body mass index; CR, cardiopulmonary rehabilitation; HR, heart rate; LVEF, left ventricular ejection fraction; SBP, systolic blood pressure; SD, standard deviation; VO$_2$, oxygen uptake.
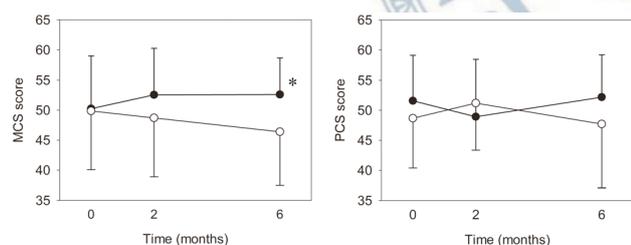
Figure 1. *Mental component summary scores and physical component summary scores for the cardiac rehabilitation group and the control group. Solid circle, cardiac rehabilitation group; Hollow circle, control group; * p < 0.05.*

sult probably comes from a small sample size.
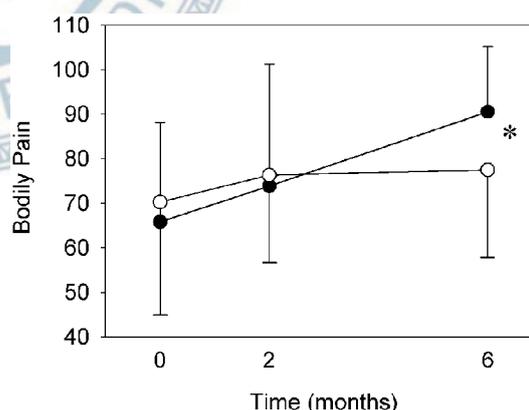
Figure 2. *Bodily pain score for the cardiac rehabilitation group and the control group. Solid circle, cardiac rehabilitation group; Hollow circle, control group; * p < 0.05.*

DISCUSSION

This study, to the best of our knowledge, represents the earliest (5-7 days after STEMI) supervised CR among

current reports. No adverse event was found during such an early CR program.

Many studies had discussed the benefit of CR after

STEMI.[4,6,17] In these studies, the patients started CR at about 2 weeks after STEMI. However, due to better accessibility of revascularization and caring quality nowadays, patients of STEMI presented very low mortality,[18,19] and required shorter hospitalization recently. We hypothesized that if the patients started the CR program earlier, they might recover better because of the following reasons: First, the patients' misperceptions and negative beliefs could be modified early in the recovery process;[20] second, the patients might be more amenable to behavioral changes during the immediate days after a major threat.[20] We did not find any adverse effects caused by this early CR program. Therefore, the STEMI patients might be able to receive CR programs earlier than previously reported.

The improvement of mental health after the comprehensive CR program might be attributed to both of the exercise training and the education in our program. Exercise improves mental health through the secretion of endorphin.[21] The education helped the patient monitor himself, encounter with stress, and reduce the fear of recurrence. The benefits from this 8-week training program could sustain for up to 6 months, supporting the efficacy and efficiency of the concept of early comprehensive CR.

Interestingly, although there was no significant between-group difference in PCS, the CR group had a significantly greater improvement in one of the subscales of PCS, the bodily pain, than the controls at 6 months. The improvement in this measure might be due to the education program, in which we explained to the patients about the differences of cardiac- and non-cardiac related chest pain and various symptoms they might encounter. Their awareness might reduce their worry, and then reduce the perception of bodily pain. In a study of illness-perception in STEMI patients, Petrie et al found that a less reported bodily pain might be due to a lower level of worry in their intervention group.[20]

The limitation of this study included the small sampling size, and the non-randomization design. The reason of non-significant improvement of peakVO2 and AT VO2 for CR group might be due to the exclusion of complicated cases. Because the patients enrolled had relatively preserved exercise capacity, the benefit from training might be limited. Since there was no adverse event caused by this early CR, more complicated pa-

tients might be included for research in the future.

CONCLUSIONS

An early ambulatory hospital-based comprehensive CR program, starting within 5 to 7 days after STEMI, was effective in improving mental health related quality of life and bodily pain in patients following STEMI.

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DECLARATION OF CONFLICT OF INTEREST

All the authors declare no conflict of interest.

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