EFFECT OF CARDIAC REHABILITATION PROGRAMS ON FUNCTIONAL CAPACITY OF POST CORONARY REVASCULARIZATION PATIENT USING SIX MINUTE WALK-TEST

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ABSTRAK

Program rehabilitasi jantung (CRP) sebagai modifikasi latihan dan pengetahuan pasien jantung pasca serangan jantung, penyakit jantung lainnya atau pasca operasi jantung menurunkan risiko kardiovaskular dan efisien dalam manajemen jangka panjang revaskularisasi koroner, namun kurang dimanfaatkan. Tujuannya untuk menganalisis efek fase II CRP pada kapasitas fungsional pasien pasca revaskularisasi koroner menggunakan tes berjalan enam menit yang sederhana dan dapat ditoleransi oleh pasien jantung. Empat puluh tiga pasien pasca revaskularisasi koroner dipilih untuk penelitian ini. Semua pasien memiliki revaskularisasi lengkap dua bulan sebelum pengujian. Sampel ini dialokasikan untuk dua kelompok. Kelompok intervensi (n = 22, rata-rata usia : 58,32 ± 6,98 tahun) menyelesaikan CRP fase II selama 4 minggu tapi kelompok acuan (n = 21, rata-rata usia: 59,00 ± 6,16 tahun) tidak mengikuti latihan. Awalnya, kapasitas fungsional pasien dievaluasi dengan tes berjalan enam menit. Setelah 4 minggu pada fase II CRP, kapasitas fungsional dievaluasi untuk kedua kalinya di setiap kelompok. Data dianalisis menggunakan hubungan uji statistik T-test untuk membandingkan tes pertama dan kedua, sampel bebas uji statistik T-test untuk membandingkan dua kelompok. Peningkatan yang signifikan diamati pada kelompok intervensi dibandingkan dengan kelompok acuan dalam jarak berjalan (419,73 ± 73,80 m vs 307,24 ± 61,99 m, p < 0,001) dan membandingkan uji pada awal dan akhir, perubahan yang signifikan pada kedua kelompok diamati (p < 0,001). Fase II Program Rehabilitasi Jantung secara signifikan meningkatkan kapasitas fungsional dan evolusi yang ditunjukkan oleh uji enam menit berjalan kaki yang mudah, aman, dan murah.(FMI 2014;50:86-91)

***Kata kunci**: rehabilitasi jantung, kapasits fungsional, tes jalan kaki enam menit*

ABSTRACT

Cardiac rehabilitation program (CRP) as modification of excercise and education for cardiac patients recover post heart attact, or other cardiac disease or post cardiac surgery significantly decreased cardiovascular risk and efficiently as longterm management of coronary revascularization but also underutilized. The objective of this study was to analize the effects of fase II CRP on functional capacity of post coronary revascularization patients by using the six minute walk test which is simple and well tolerated test for cardiac patients. Fourty three post coronary revascularization patients were selected for this study. All patients had complete revascularization two month before test. These samples allocated to two groups. Interventional group (n=22, mean age: 58,32 ±6,98 years) completed the fase II CRP for 4 weeks but reference group (n= 21, mean age: 59,00 ±6,16 years) didn't have excercise programs. At the beginning of study, functional capacity of patients was evaluated by six minute walk test. After 4 weeks of fase II CRP, functional capacity was evaluated for the second time in each group. Data were analyzed using paired T test statistic analyzis for comparing first and second six minute walk test and Independent sample T test statistic analyzis for comparing between two groups. A significant improvement was observed in the interventional group compared to the reference group in walking distance (419,73 ±73,80 m vs 307,24 ±61,99 m, p<0.001) and also in comparing pre and post-test, a significant changes in both groups was observed (p<0.001). Fase II Cardiac Rehabilitation program significantly improves functional capacity and this evolution was shown by six minute walk test wich is an easy and safe and low cost test. (FMI 2014;50:86-91)

***Keywords:**cardiac rehabilitation, functional capacity, six minute walk test*

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INTRODUCTION

Coronary Artery Disease (CAD) has become a leading mortality causes worldwide, increased consistently, and become an actual and boundless pandemic. WHO statement in 2009 was, "The greatest human epidemic: Coronary Artery Disease has reached its major proportion and insulting younger subjects. CRP was known to be a significant and important strategy in secondary prevention for morbidity and mortality in patients with heart disease (Adnan et al 2011). Comprehensive CRP maybe an efficient approach to decrease cardiovascular risk and as coronary

revascularization long term management(Pasquali et al 2003).

The six-minute walking test (6mwt) method is a safe method which does not need expensive appliances and only require walking capability, that weak old people and patients with physical limitation can perform this test (Ghashghaei et al 2010). The 6mwt can be used by cardiologists because this method is simple and easy to perform, and also appropriate to measure functional limitation in evaluating therapeutic effect as well as stratifying prognosis for chronic heart disease patients. Consensus presented in the Australian Journal of Basic and Applied Sciences 2011 suggested that the 6mwt is a simple, safe, cheap, easy to do, walking according to natural capacity, and applicable in clinical setting compared to Cardiopulmonary Exercise Testing (CPET) in measuring peak oxygen uptake (peak VO2) which is the gold standard for aerobic capacity assessment (Adnan et al 2011). However, there has been very few reports regarding beneficial use of this test in the population (Ghashghaei et al 2010, Fiorina et al 2007), including elderly population who underwent cardiac surgery.

The objectives of this research was to evaluate the effectiveness of four-weeks cardiac rehabilitation program (4-WCRP) towards functional capacity in patients after coronary revascularization and to assess the functional capacity of patients after participating in 4-WCRP. Hypothesis of this patient was phase II cardiac rehabilitation affected the functional capacity in patients after coronary revascularization by six minute walk test.

MATERIALS AND METHODS

This study was an analytic prospective observational cohort study with control group. Data were obtained in the outpatient department of Dr. Soetomo Hospital and Husada Utama Hospital Surabaya using appropriate and necessary equipment. Data were collected from October 2012 to April 2013. Subjects of this study were patients underwent complete coronary revascularization (CABG and/or PCI) that came to Cardiovascular Prevention and Rehabilitation Unit at Husada Utama and Dr. Soetomo Hospitals Surabaya, able to walk without assistance, and agreed to participate in this study by signing the informed consent. The exclusion criteria consisted patients underwent coronary revascularization along with valve surgery and/or stroke disease, patients who were contraindicated to 6mwt and cardiac exercise, has pulmonary chronic obstruction disease moderate-severe, suffering chest pain, dyspnea, angina, arythmia, or hypertension, limited range of motion of the extremity

muscles that could prevent walking activity, high risk category in exercise risk stratification. Sample was collected using consecutive sampling.

Cardiac Rehabilitation Program is defined as comprehensive program of exercise, education and behaviour modification that was designed to increase physical condition and emotion of patients with heart disease. These patients underwent phase II after coronary revascularization which started from the day the patients discharged from the hospital until no later than two weeks and treated with 11 series of exercise program for four to six weeks after the revascularization. The phase II performed was according to Guidelines for Exercise Testing and Prescription 2010 which was indicated to CAD patients consisting of general exercise, endurance exercise, and resistance exercise. The treatment was given at least three times a week for 30-60 minutes (5-10 minutes for every warming up and cooling down session, 20-30 minutes of intense exercise) with target of 20-30 times/minutes added from the heart rate during resting period. Duration was increased 10-20% every week (Allen et al 2010).

Functional capacity is the individual's capacity to perform basic daily activity and instrumentation and also an estimation of maximal oxygen uptake when the body was given a certain load that could be expressed with metabolic equivalent (METs). One METs is one unit of basal oxygen consumption that is an equal to 3,5 ml of basal oxygen consumption per kilogram of weight per minute in adults. Functional capacity is estimated by using six minute walk test load as sub maximal test by assessing the six minutes walking distance.

Statistical analysis was performed by using the independent t-test to compare the6mwd difference between case and control group, and paired t-test to compare the difference of 6mwd between before and after 6mwtin each group. Level of significance used was <0.05, with power of 80%. The whole process of analysis used the SPSS software.

RESULTS

Forty three subjects recruited in this research were divided into two groups, group I (agreed to perform CRP for 6 weeks) and group II (as control, did not agree to perform CRP). The samples were patients completed coronary revascularization at Dr. Soetomo Hospital and Husada Utama Hospital Surabaya fulfilled inclusion criteria. History taking and physical examination was done. Then, analysis of data after six minute walk test was done. Subjects baseline characteristics based on

clinical factors, gender, and Body Mass Index (BMI) are presented in Table 1 below.

Table 1. Baseline characteristics of subjects based on clinical factors, gender, and body mass index(n=43)

Characteristics	n(%) or mean ± SD Group	
	I (n=22)	II(n=21)
Gender		
- Male	18 (81.8)	17 (81.0)
- Female	4 (18.2)	4 (19.0)
Age	58.32 ± 6.98	59.00 ± 6.16
- < 54 years	5 (22.7)	4 (19.0)
- 55 – 64 years	14 (63.6)	13 (61.9)
- 65 – 74 years	3 (13.6)	4 (19,0)
First 6mwt BMI (kg/m^2)	25.56 ± 3.20	23.10 ± 2.16
Second 6mwt BMI(kg/m^2)	25.44 ± 3.04	23.33 ± 2.12

Majority of subjects were male with range of age was between 55-64 years. Subjects' mean of age in group I was 58.32 ± 6.98years, while in group II was 59± 6.16years. The BMI mean at first assessment in group I was 25.56 ± 3.20 kg/m2 and at second assessment decreased to 25.44 ± 3.04 kg/m2. Mean while in group II there was an increase of BMI found from 23.10 ± 2.16 kg/m2to 23.33 ± 2.12 kg/m2. Subjects characteristics based on risk factors were also assessed, and are presented as Table 2.

Table 2. Characteristics of subjects based on risk factors (n=43)

Risk factors	n (%) Group	
	I (n=22)	II (n=21)
Hypertension	14 (63.6)	9 (42.9)
Diabetes Mellitus	7 (31.8)	7 (33.3)
Smoking	7 (31.8)	13 (61.9)
Stress	12 (54.5)	6 (28.6)
Dyslipidemia	13 (59.1)	13 (61.9)
Inactivity	8 (36.4)	5 (23.8)
Obesity	6 (27.3)	2 (9.5)
Family history of CAD	7 (31.8)	2 (9.5)

Most of subjects in group I had hypertension (63.6%), stress (54.5%) and dyslipidemia (59,1%). Meanwhile, in group II, majority risk factors were smoking (61.9%) and dyslipidemia (61.9%).

Completed coronary revascularization underwent by subjects in this study was categorized into CABG and PCI stent. Prior to the procedure, patients were catheterized and categorized as single, double, or triple vessel disease, and or left main disease. Most subjects both in group I and II received CABG, with catheterization result showed triple vessel disease (Table 3).

Table 3. Characteristics of subjects based on revascularization type (n=43)

Types	n (%) Group	
	I (n=22)	II (n=21)
Revascularization		
- CABG	15 (68.2%)	12 (57.1%)
- PCI stent	7 (31.8%)	9 (42.9%)
Catheterization		
- SVD	4 (18.2%)	2 (9.5%)
- DVD	5 (22.7%)	3 (14.3%)
- TVD	8 (36.4%)	9 (42.9%)
- DDVD + LMD	2 (9.1%)	1 (4.8%)
- TVD + LMD	2 (9.1%)	5 (23.8%)
- SVD + LMD	1 (4.5%)	1 (4.8%)

All subjects in both groups underwent the first 6mwt at the beginning of study, and second 6mwt at the end of the study. Results of these findings are presented in Table 4 below.

Table 4.Characteristics of subjects based on 6mwd assessment (n=43)

Assessment	Mean ± SD Group	
	I	II
First 6mwd (m)	330.73 ± 74.86	272.51 ± 59.74
Second 6mwd (m)	419.73 ± 73.80	307.24 ± 61.99
Difference of 6mwd (m)	89.00 ± 59.59	34.72 ± 20.99
Predicted difference of first and second 6mwd (%)	82.73	56.98

Mean of 6mwd between before and after study were increased in both group. However, greater increase of 6mwd was found in group I compared to group II. Predicted difference also showed similar result. In order to testing the hypothesis, paired sample t-test was used to analyze the difference of 6mwd between before and after the 6mwt in group I and II. Results are presented in Table 5.

Tabel 5. Difference of first and second6mwd in group I and II

Group I				Group II			
6mwd	Mean	T	p	6mwd	Mean	t	p
First	330.73	7.005	0.000	First	272.51	7.583	0.000
Second	419.73			Second	307.24		

As shown on the Table 5, difference of first and second 6mwd both in group I and II were statistically significant (p<0.001). The difference was shown to be an increase, in which greater improvement was found in subjects who agreed to undertake phase II cardiac rehabilitation program. The difference of 6mwd at beginning and the end of study between group I and II was also assessed in this study (Table 6). Difference was shown to be statistically significant (p<0,001), in

which greater mean of difference was found in group I compared to group II.

Table 6.The 6mwd difference between group I and II

6mwd difference	Mean	t	P
Group I	89.00	4.019	0.000
Group II	34.72		

DISCUSSION

Age, gender, height, and body mass index determine walk test performance in healthy population. A CRP program conducted in Alabama University hospital in Birmingham (UAB) resulted that the worst walk test was found in elderly, women, and non-white subjects. Diabetes was also concluded as an indicator of poor walk test performance, yet official report had not been published. It was also suggested that better walk test performance does not related with diagnosis at the time the test was performed and left ventricle ejection fraction (Bittner 2007).

In this research, the majority of patients were male, with age ranging between 55 to 64 years. The BMI of subjects in group I decreased as much as 0.4% before and after study. In contrary, the BMI in group II was found to be increased. Majority of subjects in group I had hypertension and dyslipidemia as their risk factors of CAD, while in group II were smoking and dyslipidemia as the major risk factor.

The CRP in UAB resulted that most patients who performed CRP had an increase in the six minute walk distance (6mwd). Among 471 patients, there were 82% who experienced increase in 6mwd with mean distance was 397 meters and mean incline was 61.5 meters. In a study conducted in Britain, it was reported that patients underwent CRP had an increase in 6mwt from 314.5 ± 75 m to become 377 ± 78 m after receiving 6 weeks of training (Bittner 2007). Similar result was also found in this study which showed a greater increase in 6mwd among patients received the CRP (group I) compared to group II.

The walk distance at the beginning apparently is the strongest indicator for walk distance after the CRP. In an multivariate analysis few years earlier, age was inversely correlated to the percentage of walk distance difference, whereas male gender, high clinical risk score, percentage of exercise intensity difference during CRP, increase of chronotropic response during walk test, symptoms occurred during walk test follow up, and patients' self-report regarding their activity level, are independent predictors in the raising of six minute walk test (Bittner 2007).

A study consisted of 1370 heart surgery patients who registered in the CRP (67% underwent CABG) in a health centre in Italy showed that the first 6mwt was positively correlated with gender (p<0.001), but negatively correlated with age (p<0.0001) and diabetes mellitus (p=0.0014). In a subgroup of 348 patients received second 6mwt after CRP, the 6mwd increased significantly from 281 ± 90 m to 411 ± 107 m (p<0.001). After the CRP, a relatively increase of exercise tolerance was found to be greater in older female (>75 years old) compared to younger male (<65 years old), +33% vs+24% (p=0.01). There were 85% of patients that showed >10% of increase in 6mwd between two tests and considered as pure increase due to intervention therapy consequences. Patients who did not experience >10% of increase at the end of test had better exercise tolerance (64% vs 54% from the predictive value) and lesser morbidity. Patients with low functional capacity at the beginning (<45% of predictive value) showed higher functional capacity after CRP compared to patients with better walk performance (+31%vs +25%, p<0,001) (Fiorina et al 2007).Our study was an observational study, in which the 6mwt result was presented as absolute numbers either in metre or percentage of the predictive value according to suggestion by the American Thoracic Society Guidelines for 6mwt.

It should be kept in mind that describing a walk distance as an absolute number in meter and percentage of the predictive value can provide clinical relevance (The American Thoracic Society 2002). The same walk distance, for instance 250 meters, for an 80 years old male patient is the lowest limit or normal functional capacity, but it may be a huge decline in 45 years old active male. Study by Craciun suggested that 6mwd is lower in old female. Moreover, it is shorter during heart surgery then after myocardial infarction attack. It is hypothesized that few other factors such as long period of bed rest could be a contributor. Majority of patients (85%) experienced significant tolerance after 2 weeks of rehabilitation at hospital. Patients who did not experience >10% increase during the second 6mwd had better exercise tolerance (64% vs 54% of predictive value) and also less comorbidity. It can be summarized that they might need less intensive exercise (Craciun et al 2010). In our research most patients (81.4%) experienced 6mwd increase >10% from the first 6mwt, in which the greatest increase was achieved in group I (111.48%) while in the group II was 5.04%.

Patients who had low functional capacity baseline or predictive value (<45%) had the greatest increase in the second 6mwd (the end of CRP). This emphasized the importance of intensive physical program, in this case CRP, which the main point is for patients with many

comorbidity (Craciun et al 2010). Moreover, distance or walk performance was also found to be determined by the AACVPR (American Association of Cardiovascular and Pulmonary Rehabilitation) risk of stratification. This stratification was categorized as of low, moderate, and high which would be determined by clinicians based on left ventricle function, dysrhythmia, severity of basic disease, ischemia symptoms, and functional capacity and hemodynamic response from exercise maximum test if available. Walk performance is defined by patients' self-assessment of their physical activity, and psychological function based on SF-36 questioner (Bittner 2007). In this research, 93% patients had 6mwd increase of >45% from the prediction value. The increase of predicted value of subjects in group I was greater than in group II, mostly occurred in men.

Nilsson had showed that walk distance raises significantly in treatment group after following a 4 months program compared to control group (Nilsson et al 2008). Meanwhile, other studies had suggested that resistance exercise could increase muscle strength and exercise capacity which were assessed by 6mwt (Jankowska et al 2008). Other studies also stated that combination of aerobic and resistance exercise were more effective in increasing exercise tolerance, decreasing muscle exhaustion, as well as decreasing neuromuscular impairment in men with CAD (Gayda et al 2009, Fleg 2007, Levinger et al 2005). In our study, it had been shown that there was a significant increase of 6mwd between group I which received CRP and group II which did not (p<0.001). This result supported the theory mentioned above that CRP provides benefit for patients with CAD.

Similar to other exercise tests, a patient's performance does not depend entirely on his exercise capacity but also motivation. Yet, there is no objective assessment to measure whether patient would show their best in the 6 minute walk test (Bittner 2007). Therefore, this issue could be a weakness in this study. Also, we did not compare the result of 6mwt with other reference such as maximum exercise test with uptake oxygen measurement, and did not investigate the effect of medical therapy given to patients.

CONCLUSION

In this study we found that there was a significant difference in terms of functional capacity between before and after 6mwt in CAD patients after coronary revascularization, both in subjects who agreed to perform cardiac rehabilitation and those who did not. However, greater improvement was found in subjects who agreed to perform cardiac rehabilitation. Other finding was a significant difference in terms of functional capacity increase at the end of study between subjects underwent cardiac rehabilitation and those who did not. We suggest for future study to analyze the effectiveness of cardiac rehabilitation with other outcomes such as mortality and morbidity that relates with CAD.

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