EFFECTS OF CARDIAC REHABILITATION ON THE EXERCISE CAPACITY AND QUALITY OF LIFE IN PATIENTS WITH MYOCARDIAL INFARCTION

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KEY WORDS : CARDIAC REHABILITATION / MYOCARDIAL INFARCTION / SIX MINUTES WALK TEST / QUALITY OF LIFE

SURANGSRI BOONSOMCHUA: EFFECTS OF CARDIAC REHABILITATION ON THE EXERCISE CAPACITY AND QUALITY OF LIFE IN PATIENTS WITH MYOCARDIAL INFARCTION. THESIS ADVISORS : KIERTIJAI BHURIPANYO M.D., M.Sc. (CLINICAL EPIDEMIOLOGY), PREMCHIT CHAROENKUL B.Sc. (PHYSIOTHERAPY), WATTANA JALAYONDEJA Ph.D. (ERGONOMICS / BIOMECHANICS). 138P. ISBN 974-664-115-8

The purpose of this study was to investigate the effects of the cardiac rehabilitation program on exercise capacity and, quality of life comparing patients who underwent the cardiac rehabilitation program, (study group) and, patients who did not undergo the cardiac rehabilitation program, (control group) following myocardial infarction. Sixty patients, aged between 40 to 75 years old, were initially screened by cardiologists and randomly divided into control (n=30) and study (n=30) groups. Rehabilitation program, included seven steps low intensity exercise, was induced into the study group. Exercise capacity was estimated by six minutes walk test, and quality of life scores were scaled by the Quality of Life after Myocardial Infarction (QLMI) questionnaire during 2 weeks of the follow up period.

After the rehabilitation program, there were significant differences between both six minutes walk distance and total QLMI scores between control and study groups ($p<0.05$). The mean scores of confidence, self-esteem and those of the emotional domain in QLMI were significantly different between control and study groups ($p<0.05$). During the follow up period, the mean values of six minutes walk distance were 265.94 and 314.72 meters ($p =0.002$) in control and study groups respectively. Mean values of total QLMI scores were 110.70 and 126.67 in control and study groups ($p=0.001$) respectively. While the mean values of symptom, restriction, confidence, self-esteem and those of the emotional domain of QLMI scores in control and study groups were 22.70 and 24.06 ($p=0.262$), 15.27 and 17.23 ($p=0.052$), 19.43 and 23.67 ($p=0.000$), 25.33 and 30.30 ($p=0.001$), 28.00 and 31.47 ($p=0.024$) respectively.

In conclusion, cardiac rehabilitation program improves exercise capacity and quality of life in patients after myocardial infarction. Therefore, exercise capacity as well as mental status can be improved when the appropriate rehabilitation program is applied.

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สุรางค์ศรี บุญสมเชื้อ: ผลของการฟื้นฟูสมรรถภาพหัวใจต่อความสามารถในการออกกำลังกายและคุณภาพชีวิตในผู้ป่วยที่มีกล้ามเนื้อหัวใจตาย (EFFECTS OF CARDIAC REHABILITATION ON THE EXERCISE CAPACITY AND QUALITY OF LIFE IN PATIENTS WITH MYOCARDIAL INFARCTION). คณะกรรมการควบคุมวิทยานิพนธ์ : เกียรติชัย ภูริปัญโญ M.D., M.Sc. (CLINICAL EPIDEMIOLOGY), เปรมจิตร เจริญกุล B.Sc., (PHYSIOTHERAPY), วรรธนะ ชลายนเดชะ Ph.D. (ERGONOMICS / BIOMECHANICS). 138 หน้า. ISBN 974-664-115-8

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมการฟื้นฟูสมรรถภาพหัวใจต่อความสามารถในการออกกำลังกายและคุณภาพชีวิตในผู้ป่วยที่มีกล้ามเนื้อหัวใจตายระหว่างผู้ป่วยที่ได้รับโปรแกรม (กลุ่มศึกษา) และผู้ป่วยที่ไม่ได้รับโปรแกรม (กลุ่มควบคุม) จำนวน 60 ราย อายุระหว่าง 40-75 ปี ได้รับการจัดแบ่งออกเป็นกลุ่มควบคุม 30 ราย และ กลุ่มศึกษา 30 ราย โดยวิธีการสุ่ม โดยตัวแปรการศึกษาคือ ความสามารถในการออกกำลังกายจากวิธี การทดสอบการเดิน 6 นาที และคะแนนคุณภาพชีวิตจากการวัดด้วยแบบสอบถาม Quality of Life after Myocardial Infarction (QLMI) ในช่วงติดตามผลสองสัปดาห์

การศึกษานี้พบความแตกต่างกันอย่างมีนัยสำคัญทางสถิติของระยะทางเดิน 6 นาทีและคะแนนรวมของคุณภาพชีวิตระหว่างผู้ป่วยกลุ่มศึกษาและกลุ่มควบคุม ($p<0.05$) โดยผู้ป่วยกลุ่มควบคุมมีขอบเขตของ ความมั่นใจ ความมีคุณค่าในตนเอง และสภาพอารมณ์ แตกต่างอย่างมีนัยสำคัญทางสถิติจากกลุ่มควบคุม ($p<0.05$) ในช่วงติดตามผลสองสัปดาห์พบว่าค่าเฉลี่ยของระยะทางเดิน 6 นาทีในกลุ่มควบคุมและกลุ่มศึกษา คือ 265.94 และ 314.72 เมตร ($p=0.002$) และมีค่าเฉลี่ยของคะแนนรวมของคุณภาพชีวิต คือ 110.70 และ 126.67 ($p=0.001$) ตามลำดับ ในขณะที่ค่าเฉลี่ยของคะแนนคุณภาพชีวิตในขอบเขตของ การตระหนักในอาการ, ข้อจำกัด, ความมั่นใจ, ความมีคุณค่าในตนเอง และสภาพอารมณ์ ของผู้ป่วยกลุ่มศึกษาและกลุ่มควบคุมคือ 22.70 และ 24.06 ($p=0.262$), 15.27 และ 17.23 ($p=0.052$), 19.43 และ 23.67 ($p=0.000$), 25.33 และ 30.30 ($p=0.001$), 28.00 และ 31.47 ($p=0.024$) ตามลำดับ

สรุปผลการศึกษาครั้งนี้พบว่าโปรแกรมการฟื้นฟูสมรรถภาพหัวใจสามารถส่งเสริมความสามารถในการออกกำลังกาย และคุณภาพชีวิตในผู้ป่วยที่มีกล้ามเนื้อหัวใจตาย ดังนั้นสุขภาพทางร่างกายและจิตใจของผู้ป่วยสามารถฟื้นฟูควบคู่กัน ด้วยการฟื้นฟูสมรรถภาพหัวใจเมื่อนำไปประยุกต์ใช้อย่างเหมาะสม

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LIST OF DIAGRAM

LIST OF ABBREVIATIONS AND SYMBOLS

%	Percentage
°F	Degree (Fahrenheit)
>	More than
<	Less than
≥	Equal or more than
×	Multiply
σ	Standard deviation of population
Z_{α}	Type I error
Z_{β}	Type II error
μ	Mean value
ABD	Abduction
ACSM	American College of Sport Medicine
ADD	Adduction
BE	Breathing Exercise
BP	Blood Pressure
CABG	Coronary Artery Bypass Grafting
CABS	Coronary Artery Bypass Surgery
CCU	Cardiac Care Unit
CK-MB	Creatine Kinase – Myocardium Blood-borne isoenzyme

LIST OF ABBREVIATIONS AND SYMBOLS

(Continued)

cm	centimeter
CPK	Creatine Phosphokinase
DBP	Diastolic Blood Pressure
DF	Dorsiflexion
DM	Diabetes Mellitus
E	Extension
ECG, EKG	Electrocardiogram
et al	et alii
EXT ROT	External Rotation
HDL	High Density Lipoprotein
HR	Heart Rate
HT	Hypertension
ICCU	Intermediate Cardiac Care Unit
IHD	Ischemic Heart Disease
INT ROT	Internal Rotation
kg	kilogram
LAD	Left Anterior Descending coronary artery
LCA	Left Circumflex coronary Artery
LDH	Lactic Dehydrogenase
LDL	Low Density Lipoprotein
LVEF	Left Ventricular Ejection Fraction

LIST OF ABBREVIATIONS AND SYMBOLS

(Continued)

m	meter
max	maximum
MET, METs	Metabolic Equivalent Terms
MI	Myocardial Infarction
min	minute
ml	milliliter
mmHg	millimeter of mercury
N, n	Number of subject
NYHA	New York Heart Association
O_2	Oxygen
p	probability or statistical significance
PAOD	Peripheral Arterial Occlusive Disease
PDGF	Plate Derived Growth Factor
PF	Plantarflexion
PTCA	Percutaneous Transluminal Coronary Angioplasty
PVC, PVCs	Premature Ventricular Contraction
QLMI	Quality of Life after Myocardial Infarction
r	Pearson's product Moment Correlation coefficient

LIST OF ABBREVIATIONS AND SYMBOLS

(Continued)

RCA	Right Coronary Artery
ROM	Range Of Motion
RPE	Rating of Perceive Exertion
RR	Respiratory Rate
SA	Sinoatrial node
SBP	Systolic Blood Pressure
SD	Standard Deviation of sample
SF 36	Short Form 36 medical outcome study
$\overline{x}$	Mean
yr, yrs	year

CHAPTER I

INTRODUCTION

Myocardial infarction (MI) is a serious abnormal cardiac function which is the result from partial or total occlusion of one or many coronary arteries. The occlusion is the result of thrombus or atheromatous plaque (1-4). In both cases, the lumen of affected arteries become narrowed; as a result, blood flow to myocardium is decreased. Most of signs and symptoms of MI are usually shown during physical activity as a result of the increases in metabolic demand of cardiac muscles, itself. There are three levels of myocardial damages according to the levels of severity (1, 5, 6, 7). First, ischemia which is defined as the reversible process where the infarcted area can recover. Second, the injured cell that is partially healed, and the normal structure and function may not recover. Third, cell is the necrotic or irreversible cell death stage which is commonly found in left ventricle. In acute stage, the permeability of cell membrane to essential electrolytes is altered. As a result, the contractility of myocardium and cardiac output is diminished. In addition, signs and symptoms such as anxiety, pallor, shortness of breath, diaphoresis, and vomiting will appear (8). There are several risk factors of MI, for example, male over 40 years of age, hypertension, smoking history, obesity, high cholesterol, and stress from lifestyle (1, 5, 9, 10).

It is generally known that the quality of life is usually limited by chronic illness. Patients with MI believe that even minimal physical exertion would cause them

some serious problem such as ventricular aneurysm, rupture, arterial hypoxemia, recurrent MI, and lead to mortality (6). Patients, who are diagnosed as myocardial abnormality, are afraid of exercise. Therefore, they preferably keep their bed rest with minimal activity. For this reason, physical abilities or activity daily living will be restricted. Even though, some patients' angina subside after medical treatment, their cardiac function may not be in the stable condition and some physical activities are inappropriate for them. Risks of morbidity and mortality are doubtful in these patients.

Report obtained from the annual meeting of American Medical Association in 1944 (11) concluded that bed rest in normal individuals as short as 21 days could cause skeletal muscle wasting and increase calcium excretion of myocardium which result in the reduction of stroke volume, and blood pressure. The amount of oxygen supply to the periphery is, therefore, affected. Besides, there are many complications after bed rest such as thrombophebitis, pulmonary embolism, gastrointestinal, urology problems, bone demineralization, muscle wasting, and vasomotor instability may occur (12-14).

Levine and Lown in 1952 (15) first introduced the "armchair treatment" technique for patient with coronary artery disease, instead of bed ridden, physical activity of these patients will be progressively encouraged. There were many subsequent reports indicating the benefit of early mobilization with no signs and symptoms during the shorter period of hospitalization (15-19). Since then, cardiac rehabilitation was introduced as a treatment choice started for patients with myocardial infarction.

Four phases of cardiac rehabilitation program has been defined. Phase I is inhospital patient period. Phase II is convalescence period includes after hospital discharge period. Phase III is supervise ongoing rehabilitation period. Last phase is the unsupervise ongoing maintenance (20). In the approach of cardiac rehabilitation, in general goal is to restore and maintain optimal level of function such as physiologic, psychosocial, vocational, education, and recreation (21,22).

Newman and coworkers in 1952 (13) began the exercise program after MI which included 6 weeks period since admission until discharge. The exercise programs were isometric and isotonic exercise on the first day after bed rest. Early ambulation was allowed at the fourth week, which then was progressed for more walking distance and each exercise repetition. In addition, subject was educated about the occupational activities in the sixth week.

Wenger in 1960 (23) described the 14 steps of gradually progressive activity as the main component of her cardiac rehabilitation program at Grady Memorial Hospital. The appropriate activities of daily living, education or recreational components were introduced to the patients while they stayed in the hospital.

Bloch and coworkers in 1974 (24) modified the cardiac rehabilitation program of Grady Memorial hospital into 9 steps. In this program, the patient will perform active mobilization of ankle, wrist, and respiratory muscle exercises in the first step. In

addition, walking is started in the fifth step. The patients were discharged when they were able to step up three flights of stair without difficulty.

Wenger in 1978 (23) stated that patients with an uncomplicated condition should begin with low level physical activities on the first day after infarction. Therefore, her initial goals of cardiac rehabilitation included: 1) screening to define complications, 2) initiating low level of activities, 3) educating patients and their families and 4) measuring the effectiveness of medications in controlling patient's cardiovascular status during the activities (22).

Devney in 1980 (25) reported that inpatient cardiac rehabilitation program at the Naval Regional Medical Center, San Diego, California, which was consisted of progressive ambulation and patient education. This protocol was planned around 12 day hospital stay for patients with an uncomplicated MI. The patients rested in bed about 3 days in cardiac care unit. After that, they were transferred to intermediate intensive care unit where they started rehabilitation program. On the fifth day, patient were allowed to ambulate around the bed and transfer to bathroom via wheelchair on the seventh day.

Wenger in 1992 (6) improved her cardiac rehabilitation program. The programs consisted of 7 steps of low intensity exercise which started with active and passive range of motion in all extremities in bed. In addition, early ambulation started at the third step with progressive distances on the next steps. Therefore, the patient could

improve their attitude and could be early to discharge from hospital. Besides, cost of hospital expense would be decreased. Finally, this program was taken to be a guideline in therapeutic practice of rehabilitation team (26-28).

Cardiac rehabilitation program after MI has to be adjusted in each patient condition; other factors, for example, different level of education, sociality, vocational situation, ages, and personality must be considered (10). However, there were several factors that limited the cardiac rehabilitation such as patient's participation, result of practice and inadequate follow up (21). In addition, this multifactorial process is designed to limit the adverse physiologic and psychosocial effects of cardiac illness, reduce recurrent infarction or the risk of sudden death and patient's psychosocial encouragement. Goals of the rehabilitation in cardiac patients to enable them to restore their normal or pre-illness life style and to return the patients to a productive, active and satisfying role in society.

The major objectives of medical care include reducing mortality and morbidity, and ensuring optimal health-related quality of life. Quality of life encompasses the ways in which a patient's life is affected by an illness and by varieties of medical care. Therefore, quality of life is an indicator to reflect the patient's sense of well being; physical, emotional, and intellective functions; and abilities to participate with the family, workplace, and their communities (7).

Assessment of quality of life differs from that of the symptomatic appearance of an illness and complication of intervention. For this reason, quality of life is subjective information, which reflects the patient's personal opinion and judgements about general health status, well-being and life satisfaction. In addition, quality of life assessment also reflects the patient's expectation of the outcome from rehabilitation program on the improvements of their physical function (29). In this present study, the assessment on quality of life style will be focussed in each individual.

For symptomatic myocardial infarct patients, the activities are likely to have been restricted by long-term coronary illness, which anticipation about extent of less functional improvement. Thereby, it may be reduced the potential benefits from rehabilitative interventions. Therefore, in the present study, investigation of the quality of life in term of patient's confidence, self-esteem, symptom, restriction and emotion domain results from cardiac rehabilitation will be performed.

Statistics data from Thai Public health (30) showed that death from circulatory system was the first rank as in Western countries (31-32). On the contrary, situation of cardiac rehabilitation in Thailand is absolutely different from the developed countries. There are many patients with MI in Thailand who should receive rehabilitation after this acute illness to improve their quality of life. On the contrary, there are only one report on effectiveness of cardiac rehabilitation program (33).

Tumnong In 1985 (33) studied the effects of cardiac rehabilitation program on exercises and functional capacities after acute MI. These regimens were 9 step low intensity exercise program and education program. The study showed that the patient who received the rehabilitation program had improved exercise and functional capacities. Therefore, cardiac rehabilitation would be important after MI.

Up to now, the study on the effects of exercises in rehabilitation on physical improvement after MI with uncomplicated patients has rarely been conducted. In addition, the physical improvement should parallel with mental recovery. Therefore, the present study tried to conduct exercise rehabilitation program training in patients after uncomplicated MI to investigate the effect on functional capacities with relation to quality of life.

Purpose of the Study

General objective

The purpose of this study was to investigate the effect of the 7 steps low intensity exercise rehabilitation program on exercise capacities and quality of life. The subjects were a control and a study group of post myocardial infarction (MI) patients.

Specific Objectives

1. To determine exercise capacities in term of six minutes walk distance after training.

2. To determine score of quality of life in post MI after training.

Variables of the Study

1. Six minutes walk distances (meters)
2. Quality of Life after Myocardial Infarction (QLMI) scores.

Scope of the Study

1. This study investigated post MI patients who admitted in the cardiac care unit (CCU), Intermediate cardiac care unit (ICCU) and medical units in Siriraj hospital.

2. The study investigated hospital patients and convalescence after hospital discharge period.

3. Independent variables were 7 steps low intensity exercise and education of cardiac rehabilitation programs.

4. Dependent variables were six minutes walk distances and QLMI scores.

Research Hypotheses

1. Six minutes walk distances in the study group was significantly different from the control group.

2. The mean QLMI scores in the study group was significantly different from the control group.

The Advantages of the Study

1. The quality of life will be improved by cardiac rehabilitation program for patients with myocardial infarction.

2. Six minutes walk distance will be used as the exercise planing in rehabilitation for individual patient.

3. To be a guideline for rehabilitation team workers to encourage the qualities of life for cardiac patients.

4. To be a guideline for prospective studies in other conditions of cardiac rehabilitation.

CHAPTER II

LITERATURE REVIEW

2.1 Pathological and Clinical Features of MI

Acute MI is a condition of serious ischemic heart disease (IHD). Causes of ischemic heart disease are as follow: 1) decrease of oxygen supply to myocardium, which consists of two conditions. First is the condition that influences the supply of blood such as atherosclerosis, thromboemboli, coronary artery spasm and collateral blood vessels. Second is the condition that influence the availability of oxygen in the blood such as anemia, shifting of hemoglobin-oxygen saturation by carbon monoxide, and cyanide, 2) increase oxygen demand such as hypertension, valvular stenosis, hyperthyroidism, fever, thiamine deficiency, and catecholamine (34). It is noted that the large majority of patients with MI are secondary to coronary atherosclerosis (3-4, 34).

2.1.1 Mechanism of Atherosclerosis

Atherosclerosis is a disease that can potentially affects the majority of medium and large arteries throughout the body. The most significant abnormality found in the heart is the atherosclerosis of coronary artery. Atherosclerotic changes in the aorta include thickening of the medial layer of artery leading to the weakening of the vessel wall, rupture and aneurysm, where the major change in the coronary atherosclerosis is a stenotic occlusive lesion (22, 34).

Artery consists of three distinct layers (tunicae): intima, media, and adventitia. The intima (inner layer) is lined with endothelial cells and supported by connective tissue. The middle layer (media layer) consists mainly of smooth muscle. The adventitia (outer layer) consists of collagenous elastic fibers and small blood vessels (vasa vasorum). Vein have three layers but the amount of smooth muscle and elastic tissue is considerably less, which most likely produces low pressure in venous system (35).

Based on evidences from animal and human studies, the mechanisms involved with atherosclerotic lesion are totally understood (36-37). There are two primary theories for atherogenesis; lipid infiltration theory (insudation theory), and the endothelial injury theory. The latter has recently been combined with the former to give the total explanation of atherosclerosis in which the atherosclerotic plague has been developed. In addition, there is an evidence to show that the major component of the atherosclerotic plague is related to low density lipoprotein (LDL) cholesterol (34-35). Correspondingly, several factors are responsible for alteration of permeability of the arterial endothelial layer including the alteration of endothelial permeability to lipoprotein and macrophages activity (22, 34).

Injury to arterial endothelial layer allows insudation of several macromolecules such as LDL and fibrinogen. Huper in 1995 (34) suggested that hypoxia and serum carbon monoxide level elevate arterial permeability. Cigarette smoking plays an important role in atherogenesis (35). Hypertension probably result in direct trauma to

the endothelial cells and increasing of angiotensin II. Catecholamine (epinephrine, norepinephrine, serotonin and bradykinin) can be elevated by cigarette smoking, and stress which lead to endothelial injury (34, 35).

Blood component also affects atherosclerosis, for example, platelets and monocytes. Platelets tend to adhere to the damaged of arterial initial surface, where platelet aggregation contributes to the progression of the atherosclerotic process (35-36).

Ross in 1973 (37) and 1976 (38) reported that platelet aggregation and eventually degeneration does occur at the site of intimal injury where platelet derived growth factor (PDGF) is released. Furthermore, this PDGF has been shown to stimulate cholesterol synthesis and accumulation of LDL in the smooth muscle cells. For LDL smooth cell proliferation, stimulated by the PDGF is believed to play an important role in the overall pathogenesis of atherosclerosis. Other lipoprotein, high-density lipoprotein or HDL, is also taken into consideration (39). The study showed that HDL cholesterol acts to inhibit the formation of atherosclerotic plaques by: 1) removing cholesterol and cholesterol esters from smooth muscle cell of arterial wall and 2) blocking the atherogenic action of LDL on smooth muscle cells of intima. Therefore, basing on the currently known evidences on the epidemiological studies have consistently shown that the lower HDL cholesterol, the higher risk of coronary disease.

2.1.2 Location of Myocardial Infarcts

Transmural infarction confirm to the distribution of one of the three major coronary arteries as follow: 1) right coronary artery (RCA), occlusion of the proximal portion of this vessel results in an infarct of the posterior basal region of the left ventricle and the posterior third of the interventricular septum (inferior infarcts), 2) left anterior descending coronary artery (LAD), blockage of the LAD artery produces an infarct of the apical anterior and anteroseptal walls of left ventricle, and 3) left circumflex coronary artery, obstruction of this vessel is the least common cause of a myocardial infarct and leads to an infarct of the lateral wall of left ventricle. In addition, infarction may involve predominantly in the subendocardial portion of the myocardium. A subendocardial infarct may circumferentially affect the inner one-third to one-half of the left ventricle (34). Correspondingly, subendocardial infarction generally occurs as a result of hypoperfusion of the heart in disorders such as aortic stenosis, hemorrhagic shock or as a result of hypoperfusion during the course of cardiopulmonary bypass (22, 34-35).

The occlusion of a coronary artery often results in a transmural infarction such as ischemic necrosis that extends from the endocardium to the epicardium. In addition, infarction of the left ventricle is more commonly and extensively found than the right ventricle (22, 35).

2.1.3 Clinical Diagnosis of Acute MI

The onset of acute MI is usually sudden, with severe substernal or precordial crushing pain. In some cases, acute MI is preceded by frequent angina during the day. The diagnosis of acute MI is confirmed by eletrocardiography and the appearance of increased level of certain specific myocardium enzymes in serum, particularly in the lactic dehydrogenease (LDH isoenzymes) and creatine phosphokinase (CPK) (22, 34).

2.1.4 Classification of Severity of MI

Killip and Kimball in 1967 (40) classified the severity of the MI into four groups as the follow: 1) no heart failure, no clinical sign of cardiac decompensation, 2) heart failure in which the diagnostic criteria includes rales of respiratory system, S_3 gallop and venous hypertension, 3) severe heart failure which produces pulmonary edema, 4) cardiogenic shock includes hypotension (systolic blood pressure of 90 mmHg or less) and evidence of peripheral vasoconstriction such as cyanosis, and diaphoresis.

2.1.5 Therapeutic Intervention that Limit Infarct Size

Restoration of arterial blood flow remains the only way to salvage ischemic myocardium. There are several methods to restore blood flow to the affected area as follow: 1) thrombolytic enzymes, such as tissue plasminogen activator or streptokinase which, can be infused intravenously or directly into an obstructed coronary artery, 2) Percutaneous Transluminal Coronary Angioplasty (PTCA) refers to dilatation of a narrowed coronary artery by the inflation of a balloon catheter, and 3) Coronary Artery

Bypass Grafting (CABG), which can restore blood flow to the distal segment of a coronary artery with a proximal occlusion (34-35).

2.2 The Physiological Responses of Exercise in MI Patients

Goals of cardiac rehabilitation is to help patients with MI to achieve optimal physical improvement and psychological readjustment. Appropriate exercise program with safety in order to enhance cardiac efficiency must be considered. It is generally accepted that the physiological response of cardiovascular system depends on type intensity and duration of exercise.

2.2.1 Static or Isometric Exercise

Sustain static efforts produce markedly increase in systolic and diastolic arterial blood pressure with a moderate increase in heart rate and cardiac output. As the total peripheral resistance changes very little in normal subject, vasoconstriction, the primary mechanism of the pressor response, is remarkably activated in patients with severe cardiac dysfunction (41).

There were many studied demonstrated that the magnitude of the cardiovascular response was influenced not only by the relative work load but also by active muscle mass and absolute force development (41-45). These findings were explained by the increase in myocardial contractility. In addition, there were many studies of left ventricular function in patients with heart disease showed that during isometric forearm exercise by handgrip, patients with myocardial dysfunction

responded with the increase in filling pressure than that of normal subjects but were nevertheless unable to maintain normal stroke volume (44-45). In systolic blood pressure may increase by higher than 50 mmHg during handgrip exercise at 30 to 50 percent of maximal voluntary contraction. Meanwhile heart rate is moderately increased, usually less than 25 beats per min at 30 percent of maximal voluntary contraction (43). The short duration of hemodynamic response to isometric exercise is attenuated during the early phases of recovery from MI (46).

Isometric exercise can induce ventricular baroreceptor. To prevent overloading, stretching or deformation of ventricular wall causes negative feedback reflex leading to bradycardia and vasodilation, which is opposite to the normal reflex response to isotonic exercise (45-46). It is unclear that these reflex mechanisms still intacts in MI patients or not. In conclusion, isometric exercise may be not an appropriate exercise regimen for MI patients. Because, they have impairment of myocardial contractility that left ventricular ejection fraction and velocity of fiber shortening are decreased (43-45).

2.2.2 Dynamic or Isotonic Exercise

The characteristic of muscle contraction affects local hemodynamic conditions. There is vasodilation and increased blood flow to skeletal muscle during dynamic exercise while static exercise causes mechanical obstruction of flow leading to local ischemia and also produces large increase in intrathoracic pressure which reduces venous return to the heart (42, 46-48, 115). The metabolic vasodilator working is a

principal of systemic hemodynamic that is exhibited by relationship between norepinephrine levels in plasma and peripheral resistance (42). The different local situations have few impact on systemic hemodynamic as long as the active muscle mass is small. The systemic vascular resistance near resting level and the increase in cardiac output cause a proportional increase in blood pressure during dynamic exercise. Therefore, the pressor response to dynamic and static exercise of small muscle groups is linked to a relative absence of metabolic vasodilations (42, 46-48).

Blomqvist and coworkers in 1981 (46) studied the relationship between active muscle mass and cardiovascular responses during static and dynamic exercise. They examined six healthy young men during submaximal and maximal dynamic exercises with four different modes: one-arm curl, one arm cranking, one leg, and two legs bicycle exercise. The intensities of 25, 50, 75, and 100 percent of muscle group specific maximal oxygen uptake were taken as indices of active mass were used. The result showed that cardiac output and arteriovenous oxygen difference were related to oxygen uptake with non-significant between exercise modes. In addition, active muscle mass was a major and the mode of exercise is a minor determinant in the cardiovascular response (47).

During submaximal workload, arm exercise produces higher heart rate and arterial blood pressure than leg exercise (42). In addition, there were many studied in cardiovascular responses to dynamic exercise (46-48). Lewis and coworker in 1983 (47) studied in the responses to dynamic exercise with different muscle groups in term

of relative and absolute work intensity. The result showed that during exercise at a given muscle group, both plasma norepinephrine and epinephrine increased exponentially in relation to work intensity. Norepinephrine was increased in relation to the increase in oxygen uptake during exercise and related the highest level during maximal dynamic exercise of both legs when total peripheral resistance was minimal. In conclusion, one arm dynamic and static exercise cause only minor changes in norepinephrine and peripheral resistance.

The response of dynamic exercise in cardiac patients had been studied by several investigators. Wahren and Bygdeman in 1971 (48) studied the circulatory adaptation to arm and leg exercise in patients with symptoms of coronary heart disease. In that study, heart rate, peak systolic, mean systolic, diastolic and oxygen uptake correlated with work intensity during arm exercise than that of leg exercise. In conclusion, the differences in cardiovascular adaptation during arm and leg exercise attributed to a lower mechanical efficiency and higher sympathetic outflow during arm exercise. These elements may reflect the involvement of smaller muscle groups and larger associate of static work with back and hip muscles during arm exercise.

Clausen and associates in 1976 (49) analyzed the relationship between the onset of angina and work of the heart between arm and leg exercise. The results showed that pain threshold values for rate pressure product, heart rate, and systolic blood pressure were consistently higher during arm exercise than leg exercise. In addition, effect of three months training on cardiac function showed ten percent

reduction in heart rate at the given work load. On the contrary, the systolic blood pressure was not changed. They suggested that improvement in exercise capacity caused by training could be estimated by the reduction of the relation between pressure product rate and workload.

Schwade and coworkers in 1977 (50) evaluated an exercise test based on arm work in patients with ischemic heart disease and to compare the response of leg and arm work in patient with angina pectoris during arm work but slightly pain during leg exercise. The results showed that heart rate and blood pressure products at the onset of myocardial ischemia and incidence of chest pain, ST segment abnormalities were similar during arm and leg work in 33 patients. However, the mechanical efficiency was significantly lower during arm work, which reflected the higher oxygen uptake at any workload than leg work. In addition, lower mechanical efficiency combined with increase in heart rate and systolic blood pressure during arm work caused high myocardial oxygen demand relative to workload.

Arm exercise showed high myocardial work and systemic energy expenditure. Arm exercise is an effective method if the objective of the test is to investigate myocardial ischemia, but interindividual variations of mechanical efficiency, heart rate, and blood pressure response make it difficult to use arm exercise for valid general estimate of exercise capacity.

2.2.3 Combination between Static and Dynamic Exercise

The combination of dynamic and static exercise is often used in every day life, such as, carrying, pushing, or pulling. There were few studies in normal subjects and patients which indicated that the pressor response to isometric exercise is overlaid on the response to dynamic exercise (51-52).

Kilbom and Persson in 1981 (51) studied the hemodynamic response to combined static handgrip at 20 percent maximal voluntary contraction (MVC) and dynamic leg exercise in normal young male subjects. Result showed that cardiac output was increased 2.3 liter/min or 30 percent at static handgrip and by 1.0 liter/min or 7 percent when handgrip combine the dynamic leg exercise at 100 watts. Either static or combined dynamic exercise did not affect stroke volume. Cardiac output was induced by the heart rate response.

Kerber and coworker in 1975 (52) evaluated the ability of isometric exercise (handgrip) alone or combined with dynamic exercise (treadmill test) to induce myocardial ischemia in 140 coronary patients. Patients performed submaximal treadmill test while carrying a briefcase containing two medical textbooks about 15 pounds. Electrocardiogram, heart rate, and blood pressure were recorded during the test. They found that no significant effect on the incidence of myocardial ischemia. They suggested that the elevated diastolic blood pressure during combine exercise may be the result of the increase in myocardial perfusion which the pressor response becomes less prominent as the intensity of dynamic exercise increases (52).

2.3 The Quality of Life in Cardiac Rehabilitation

The primary indicator of health outcome domain is to define the morbidity, mortality and quality of life in cardiac rehabilitation program. The morbidity and mortality measurement require large multicenter, longitudinal designs, which are not practicable for most cardiac rehabilitation programs (7). On the other hand, the quality of life can be assessed in most individual rehabilitation program. In addition, this primary health indicator requires the patient's assessment of functional status, physical function, psychological well being and social function (7, 29). Therefore, the present study will be focussed on health related to quality of life in MI patients.

Health related to quality of life can be assessed by using generic or disease specific measures. The advantages of generic measurement consists of wide varieties of domain. The major limitation of these instruments is that they do not examine the treatment or adverse effect in detail. In comparison, the disease specific instruments can focus on the problems of defined population at a specific point in a disease process (29).

Wenger et al in 1984 (53) stated that the quality of life may be defined in three major components, functional capacity, perceptions and symptoms. Function capacity was the ability to perform activities of daily life, social, intellectual, emotional and economic. Besides, perceptions reflect person's view and value judgment of general health status, level of well being and satisfaction of life. Similarly, symptom of disease which was induced by illness or reduced by intervention. In addition, these components

may be interrelated. Therefore, quality of life component assumes different importance as indexes of therapeutic efficacy that depends on the characteristic of severity and prognosis of cardiovascular illness.

Jettle and Downing in 1994 (54) demonstrated the usefulness of generic health status measured in patients entering a cardiac rehabilitation program. The instrument of this study was the Short Form 36 (SF 36) medical outcome, generic questionnaire. This questionnaire elevated eight health concepts that included; physical function (10 items), social functioning (2 items), role of limitations due to physical problem (4 items), role of limitations emotional problem (3 items), mental health (5 items), energy/fatigue (4 items), bodily pain (2 items) and general health perception (5 items). This questionnaire also evaluated the patient's perception of change in health of the past year, but was not included in the scoring. The result showed that the patients with cardiac disease had mostly limited performance due to their physical problems. In conclusion, these investigators suggested that the health status can be used as practical measurement tool in clinical setting.

Oldridge et al in 1991 (55) studied the difference between standard generic and specific of health related quality of life instruments. The investigators developed the Quality of Life after acute MI questionnaire (QLMI) to elevate the effectiveness of cardiac rehabilitation program. The original QLMI questionnaire included 97 items that was developed specifically for this study. Among them, 26 items were identified from most frequently and most important aspects included; limitation (symptom and

restrictions) and emotion (emotion function, confidence, and self-esteem). The response options were presented as seven point scales. The questionnaires were obtained at the end of 2 months of rehabilitation program and at 4, 8, 12 months thereafter. The results showed that 2 months intervention was significantly improved in the emotions of the disease specific QLMI of rehabilitation group. However, all measures of health related quality of life in both groups significant improved over the 12 months follow up.

Hillers et al in 1994 (56) proved the reliability and validity of the QLMI questionnaire in 201 patients. The reliability was indicated by Pearson's correlation of the result of 8 and 12 months visits for the five QLMI domains. Correlation obtained from Pearson's reliability test was as follow; symptom = 0.83, restriction = 0.75, confidence = 0.87, self-esteem = 0.85 and emotion function = 0.86. Validity was assessed by calculating the mean score for each patient over 5 visits. Therefore, each patient contributed four data points to this analysis. After that, the correlation of these mean scores were assessed for validity. The result of this study showed that correlation between the QLMI with other measurement provided moderate to strong evidence of its validity between patients following MI to their health related quality of life.

In conclusion, Hillers and colleagues (56) suggested that QLMI questionnaire was a reliable measurement of health related quality of life which was able to discriminate between patients following acute MI to both emotional function and their overall of life quality. In addition, QLMI is sensitive enough to detect treatment effect and require small sample sizes than other available measurements.

2.4 Critical roles of Cardiac Rehabilitation after MI

The beneficial effect of cardiac rehabilitation exercise on exercise tolerance is one of the most clearly favorable outcomes for coronary patient with angina pectoris, MI, Coronary Artery Bypass Surgery (CABS), and for patient with a decreased ventricular ejection fraction (22). Therefore, the patient with uncomplicated MI must receive exercise rehabilitation to improve their health which is related to quality of life (57-58).

2.4.1 Definition of Cardiac Rehabilitation

The World Health Organization in 1997 (59) defined that cardiac rehabilitation as the sum of activity required to ensure cardiac patients the best possible physical, mental, and social conditions therefore they may, by their own efforts, regain as normal as possible in the community and lead to an active life.

Cantwell in 1991 (60) stated that cardiac rehabilitation is the process by which the person with cardiovascular disease including, but not limited to patients with coronary heart disease, is restored to his/her optimal physiologic, psychologic, social, vocational and emotional status.

Horgan and coworker in 1992 (61) defined that cardiac rehabilitation as the process by which patients are restored and to maintain their optimal physiological, vocational, and social status. In addition, it is a multidisciplinary approach to improve

short term recovery and to promote long term changes in lifestyle with correct adverse risk factors.

While myocardial functions in post MI patients decreases, the traditional treatment was to prolong immobilization in bed for preventing more complications. Patients were kept in absolute bed rest for minimum 6-8 weeks, because it was believed that bed rest could decrease the demand of the heart and rapidly improved cardiac function would occur (6). Finally, nitrogen and protein imbalance may occur, this may affect myocardial healing (62). Although, patient would improve their physiological, they could not return to normal activities (63-65).

2.4.2 Effect of Prolong Immobilization

Prolong immobilization can cause many complications. It was proved that prolong bed rest decreased physical work capacity and maximal oxygen uptake (66).

Saltin and coworker in 1968 (12) performed a systemic study of effect bed rest and training on submaximal and maximal performance. They studied in healthy young college students who were subjected to bed ridden for 21 days. Physical work capacity of these subjects decreased 20-25% from initial. In addition, at least 3 weeks of physical training were required to get to the pretest physical capacity in these subjects. Correspondingly, the patients with MI after bed rest have more complications as follow:

Heart rate elevation and orthostatic hypotension

Systemic circulating blood volume begins to decrease within 24 hours and intravascular volume may decrease 700-800 ml within 7-10 days after absolute bed rest. During ambulation or changing of their positions, cardiac patients often encounter with orthostatic hypotension and tachycardia (66).

Decrease in contractility and muscle mass of skeletal muscle

Prolong immobilization results in a decrease in muscular mass and contractilities (12). Strength and efficiency of connective tissue, especially skeletal muscle, may decrease 10-15% within first week after bed rest (67-68). Inefficiently functioned muscle requires more oxygen at the same work rate than trained muscle (68).

Thromboembolic complications

Bed rest causes hypovolemia and increases in blood viscosity, because, the greater reduction in plasma volume than red blood cell mass may cause thromboembolic complications. In addition, evident from radioactive fibrinogen studies indicated that clotting in the leg veins occurred about one-third of MI patients after bed rest (69).

Decrease pulmonary ventilation

There is a decrease in pulmonary ventilation, which is the result of the reduction in lung volume and vital capacity (62).

Psychological impairment

The psychological responses, such as anxiety and depression, may occur in patients with varying severity of acute MI (70). Wishnic and coworker in 1971 (71) suggested that bed rest period may cause weakness, insomnia, and boredom in cardiac patients. In addition, it is during this time that extensive dependency problems may develop.

2.4.3 Goals of Cardiac Rehabilitation

Levine and Lown in 1952 (15) introduced their the arm chair treatment in the acute coronary thrombosis patients. They found that patients, who were progressively rehabilitated by sitting up in arm chair for a few days after admission, decreased risk of thromboembolic. This sitting up protocol can improve some of the psychological aspects. There are several studies (72-75) showed that the patients with uncomplicated condition, who were participated with early ambulation, have less morbidity, mortality, and recurrent infarction.

Patients with uncomplicated MI require the appropriate rehabilitation program, because, they have myocardial contractility impairment that rehabilitation programs for them must strive toward the following goals: 1) to improve the physical fitness with special emphasis on cardiovascular fitness, 2) to reduce the risk and prolong their life anticipate by decreasing the recurrent MI, 3) to help patients and their families to achieve psychological readjustment to new situation, and to assure the optimal recovery after MI so that they can achieve normal work family and social lives (22, 23,

74). Similarly, Harrington and coworker in 1981 (75) suggested that the patient with no complication obtains benefit from early exercises program after MI either with physical or psychologic well being.

2.5 Cardiac Rehabilitation Program and Exercise Capacity

The structure of cardiac rehabilitation program includes screening patients who have complications, initiating low levels of activity, educating patients and their families, measuring the effectiveness of rehabilitation and decrease fear of disease.

2.5.1 Phase of the Patient in Cardiac Rehabilitation

Cardiac rehabilitation is often divided into four periods which is depend on time. In the past, it was defined as: phase I (the period of acute or critical illness usually managed in some form of critical care unit), Phase II (the time of inpatient convalescence), Phase III (the outpatient recovery), and phase IV (long term maintenance) (20).

The American Association of Cardiovascular and Pulmonary Rehabilitation in 1990 (8) classified phase of recovery in rehabilitation as: phase I (in hospital patient period), Phase II (convalescence after hospital discharge), Phase III (supervised ongoing rehabilitation), and phase IV (unsupervised ongoing maintenance).

In this present study, patients with in hospital and after hospital discharge periods were studied. Physiotherapists usually direct at preventing or testing the

sequele of bed rest. Advice for home activities and exercise must be given at pre-discharge and follow up as an outpatient.

2.5.2 Contraindication to Exercise for Inpatient Program

The inpatient cardiac rehabilitation program should begin as soon as the patient condition is considerably stable. Depending on the type of patients, it is usually within two to four days for uncomplicated MI patient. The following contraindications to exercise have been used as guidelines for the inpatient program (76). The suggested contraindications to exercise have been modified for inpatients from recommendations of the American College of Sports Medicine (ACSM) (see in Table 2.1) (77).

Table 2.1 Contraindications and precaution to exercise for cardiac patient from ACSM 1986 (77)

Clinical Signs and Symptoms for Inpatient Cardiac Rehabilitation		
Absolute Contraindications	**Relative Contraindications**	**Precaution**
1. Patients on bed rest with motion restrictions 2. Prolonged or unstable angina pectoris 3. Recent acute MI and unstable condition 4. Resting diastolic BP over 110 mmHg or resting systolic BP over 200 mmHg 5. Inappropriate BP response: orthostatic or exercise-induced and patient symptomatic. 6. Severe atrial or ventricular dysrhythmias 7. Second or third degree heart block 8. Recent embolism, either systemic or pulmonary 9. Thrombophlebitis 10. Dissecting aneurysm 11. Fever greater than 100°F; for the patient in the critical care area, 102°F 12. Excessive sternal movement contraindication for upper extremity and trunk ROM exercises 13. Uncompensated heart failure 14. Active pericarditis (primary) or myocarditis 15. Severe aortic stenosis (>50 mmHg gradient) and idiopathic hypertrophic subaortic stenosis 16. Acute systemic illness	1. Resting diastolic BP over 100 mmHg or resting systolic BP over 180 mmHg 2. Inappropriate increase in BP with exercise 3. Hypotension 4. Moderate aortic stenosis (25 to 50 mmHg gradient) 5. Compensated heart failure 6. Significant emotional stress 7. Pericarditis associated with myocardial revascularization surgery 8. Resting S-T segment depression (> 3mm) 9. Uncontrolled diabetes 10. Neuromuscular, musculoskeletal, or arthritic disorders that would prevent activity 11. Excessive incisional drainage 12. Sinus tachycardia greater than 120 beats/min at rest 13. New ECG changes after surgery or MI that are indicative or suggestive of fresh infarct 14. Ventricular aneurysm 15. Symptomatic anemia (hematocrit < 30 percent)	1. Condition disturbances a. Left bundle-branch block b. Wolff-Pakinson-White syndrome c. Lown-Ganong-Levine syndrome d. Bifascicular block 2. Controlled dysrhythmias 3. Fixed-rate pacemaker 4. Mitral valve prolapse 5. Angina pectoris and other manifestations of coronary insufficiency 6. Electrolyte disturbance 7. Cyanotic heart disease 8. Marked obesity (20 percent above desirable body weight) 9. Renal, hepatic, and other metabolic insufficiency 10. Moderate to severe pulmonary disease 11. Intermittent claudication

Wenger in 1979 (21) stated that patients with uncomplicated symptom in coronary care units (CCU) could begin low level physical activity as early as the first day after MI. In addition, general guidelines for activities in CCU were set at low level intensity of exercise, which then progressed according to work demand with the selected active arm and leg exercises designed primarily to maintain muscle tone and joint mobility. Patients were allowed to do self-care activities.

In normal situation, diabetes mellitus patients are instructed to exercise at low and moderate intensity because appropriate exercise can decrease blood glucose concentration and a low insulin dosage may be required (78). Therefore, exercise in MI patients with diabetes mellitus who are under appropriate control or have only slightly hyperglycemic is not a contraindication. In addition, the exercise program in the present study is dynamic. Systolic blood pressure may slightly increase which diastolic blood pressure may or may not or slightly increase. In conclusion, MI patients with hypertension who are under appropriate controlled could do exercise with precautions.

2.5.3 Classification of Physical Capacity by Energy Expenditure

Energy expenditure is directly related to oxygen consumption. Oxygen consumption is often expressed in multiples of basal resting requirements (Metabolic EquivalenTs, METs), the MET is a unit of basal oxygen consumption equal to approximately 3.5 ml of O_2 / Kg / min (79). This value is the oxygen requirement to maintain the resting state that can be compared with the other physical activities. Therefore, it is the useful reference to advise physical activity for patients.

Functional physical capacity is defined by the New York Heart Association (NYHA) on simple four class scales, which assess symptoms of fatigue, palpitations, breathlessness and angina (20). In addition, the classification of physical capacity of cardiac patients from NYHA is demonstrated in Table 2 (80).

Table 2.2 Classification of Physical Capacity by New York Heart Association (80)

Class	Physical capacity	MET
1	Patients who have no symptoms of any kind with ordinary physical activity	≥ 7
2	Patients who are comfortable at rest but have symptoms with ordinary physical activity	5 - 6
3	Patients who are comfortable at rest but have symptoms with less than ordinary activity	3 - 4
4	Patients who have symptoms at rest	1 - 2

Wenger in 1978 (23) suggested that cardiac patients in acute illness phase were permitted to do low level intensity exercise i.e., 1-2 METs. These activities were isotonic activities such as self-care, self-feeding, sitting in bed, or in a bed side chair. In addition, active and passive arm and leg exercises were performed.

Pollock in 1985 (26) stated that the intensity of exercise for inpatient after MI should be within 2 to 3 METs level. Besides, the activities should slowly increase and include a graduated exercise or mobilization program. Before discharge, the patients were able to do to their own activities of daily living, and able to walk up one flight of stairs (5 METs) without symptom (81). In addition, Wenger in 1979 (21) suggested that the patients who responded to physical activity in convalescent phase could be recommended regarding return to work, for example, the patient who walked 3 to 3.5

miles per hour (mph) without difficulty was achieving 4 to 5 METs of work, required by most sedentary desk jobs.

2.5.4 Evaluation Prior to Exercise Prescription

Generally, physical fitness is the result of exercise training. Therefore, physical evaluation is needed for cardiac inpatients. Post MI or postoperative patients who are clinically stable and begin the progressive activities must be evaluated before, during, and post exercise.

Haskell in 1978 (82) stated that there was the varieties of medical conditions considered as contraindications to exercises. These could be determined by a cardiovascular-oriented medical evaluation including history, physical examination and 12 leads electrocardiogram. Exercise will start when patients are not in the absolute contraindications to exercise (Table1). Furthermore, patient evaluation should elicit information, by interview or questionnaire, respected to patient's exercise needs, interests, abilities, and previous habits. This information is important for exercise program and success of long-term exercise habits.

Saltin et al in 1968 (12) and Winslow et al in 1980 (28) stated that the information of cardiac patients before exercise include medical history, risk factors, and current and post activity level (12, 28). This information classified patients by activity progression.

Grady Memorial Hospital and Emory University School of Medicine in Atlanta Georgia (6, 23) established general guidelines for cardiac patients during the stage of low intensity early ambulation (1 to 2 METs). They found that: 1) heart rate response was less than 120 beats/min or 15 to 20 beats/min above the resting heart rate in patients receiving beta-adrenergic blocking drug, 2) no chest discomfort, dyspnea, palpitations, or exercise fatigue, 3) no appearance of arrhythmia, 4) no displacement of ST which indicates myocardial ischemia and 5) no decrease in systolic blood pressure of more than 10 to 15 mmHg. On the other hand, the general response to exercise is an increased in systolic blood pressure. If the ECG appearance falls in systolic blood pressure it indicates the ischemic ventricular dysfunction.

Winslow et al in 1980 (28) and Sivarajan et al in 1977 (83) described indications to postpone or stop an exercise session in cardiac patients which included: 1) signs and symptom of marked pallor, cyanosis, cold sweat, ataxia, faintness, inappropriate breathlessness, chest discomfort, exercise fatigue, 2) heart rate; resting heart rate of over 100 beats/min, increase in heart rate greater than 20 beats/min with exercise, decrease or no change in heart rate with increasing work load, 3) displacement ST segment of greater than 1 mm from isoelectric line, 4) dysrhythmia; frequent premature ventricular contractions, supraventricular tachycardia, second or third degree atrioventricular block, and 5) blood pressure; resting blood pressure greater than 160/95 mmHg, increase in systolic blood pressure with increasing workload, change in diastolic blood pressure of more than 20 mmHg.

Exercise increases the circulation to meet the demands of physical activity. Therefore, the amount of blood is pumped by the heart, usually expressed as l/min, is termed as cardiac output. In addition, cardiac output depends on rate of pumping (heart rate) and the amount of blood ejected with each stroke (stroke volume). It is computed according to the following equation: Cardiac Output = Heart Rate x Stroke Volume (84). Practically, it is difficult to measure the stroke volume during activities. Therefore, heart rate is often used as a measure of cardiac work (85-86).

Heart rate usually increases because of an increase in sympathetic activity and decreased in vagal activity through the activation of sino-atrial (SA) node during exercise. Such activation is directly related to oxygen uptake of the body (86). Cardiac performance is different among individuals. In addition, maximum heart rate (HRmax) defined as 200 minus ages of individual was varied in age, gender, and fitness level of individual (84). People preferably consider themselves as average fitness level. To achieve the optimal physiological benefit and to reduce risk, cardiac patient should exercise at submaximal intensity, for example at approximately 60 to 80 percent of maximum oxygen uptake or 70 to 85 percent of maximum heart rate (82). The simplicity of target heart rate is preferably used as criteria to terminate exercise test (84).

Flores and Zohman in 1993 (87) suggested the benefit of exercise at 40 to 50 percent of maximum oxygen uptake was similar to that of higher intensity. Two judging methods to define an effective intensity are conversational exercise level and

Borg Rating of Perceived Exertion (RPE) scale (87). The conversational exercise level is the adequate intensity which induce a training effect and allows the patient to talk without excessively out of breath. Thus, if the patients are able to answer such question during their exercises, they are probably not exercising hard enough. Borg RPE scale, another method to describe exercise intensity is a linear scale of ratings from 6 to 20 which is a valid indicator of physical exertion (8) (Table 3).

Table 2.3 Used of Rating of Perceive Physical Exertion (RPE) Scales Indicate Exercise Intensity

6
7------Very, very light
8
9------Very light
10
11-----Fairly light
12
13-----Somewhat hard
14
15-----Hard
16
17-----Very Hard
18
19-----Very, very Hard
20

In the present study, exercise will be terminated if one of the following criteria of: a) changes in heart rate about 20 beat/min above resting heart rate, b) RPE of 11 to 12, and c) abnormal signs and symptoms, are reached.

2.5.5 Evaluation of physical capacity by exercise testing

Observation of the physiologic response to exercise is the standard goal to evaluate the disability. This can be performed by either submaximal or exhaustive protocol. The instrument for exercise testing is usually a treadmill or a cycle ergometer. However, laboratory tests seem unlikely suitable with cardiac rehabilitation program and may require expensive equipments. There are two alternative categories of field test which are popular among physiotherapists and athletic coaches (8).

The first type of selected field exercise test was the 12 minute running test developed to assess the military personnel fitness. This testing protocol was adapted to assess the respiratory patient by walking along a hospital corridor (8). Butland et al in 1982 (88) were compared walking distance of two, six, and twelve minute walk test in chronic respiratory patients. There was similar correlation between heart rate and walking distance of these tests which indicated that the tests reflect the measurement of exercise tolerance. However, the variation of two, six, and twelve minute walk test were 23.4, 26.0, and 29.6 meters, respectively. It probably indicates that three tests were similar measures of exercise tolerance. The shorter of the test is easier for both patient and investigator, and are reproducible. Therefore, six minute walk may represent a sensible compromise (88).

The second type of selected field exercise test impose a pace on the patients which reduce the effect of motivation. In addition, an endurance walking test guides the patient to walk at a faster pace for an unlimited distance and measure the time and

walking distance. Leger and Lambert in 1982 (8) attempted to combine the nature of incremental laboratory tests and the the six minute walk test by a shuttle walk test. In addition, the subjects run between two cones 20 meters apart with the pace that was determined by a series of audio signals. Singh et al in 1992 (89) developed a shuttle walking test for patients with lung disease. The shuttle distance was reduced to 10 meters and the pace increments altered to provide a comfortable start where the heart rate was recorded during all exercise tests with a telemetry device. Eventhough, the maximal heart rates were significantly higher for the shuttle-walking test than the six minutes walk test. The result showed that there was a significant relation between the walking distance in the six minute walking test and the shuttle walking test ($p = 0.68$).

Lipkin et al in 1986 (90) found that eventhough the maximal oxygen consumption was related in a curvilinear to distance walked in all patients during six minutes walk test, distance from six minutes walk test in chronic heart failure patients was significantly lower than that of normal subjects. Thus, the six minutes walk test is useful for assessing exercise capacity in patient with congestive heart failure. Distance ambulated during six minutes walk test of less than 300 meters also used to predict the occurrence of death and hospital re-admission of patients with heart transplantation within the next months, Cahalin et al in 1996 (91). Montgomery et al in 1998 (92) reported the test-retest reliability of either total distance or step taken to complete a six minutes walk test from peripheral arterial occlusive disease (PAOD) patients with high reliability coefficients ($r = 0.94$, $r = 0.90$, respectively).

In conclusion, the six minutes walk test has been used to assess exercise capacity in cardiopulmonary patients. This test is clinically useful because it is as reliable as testing with cycle ergometer (93) and treadmill (90). In addition, this test is a natural simple human locomotion which are reliable and inexpensive measurement of exercise ability, a predictor of morbidity and mortality, and less anxiety producing than other tests. Therefore, the six minute walk test may be an important test for assessing the exercise limitation of patients with acute MI because these population are assessed in short term after intervention.

CHAPTER III

MATERIALS AND METHODS

3.1 Subjects

The subjects in this study were patients who were admitted in cardiac care unit (CCU), intermediate cardiac care unit (ICCU) and medical wards at Siriraj hospital, Mahidol University. Their ages ranged from 40 to 75 years. The patients were randomly divided into exercise and control groups.

3.1.1 Inclusion Criteria

Cardiac patients were included in this study if they: -

- were diagnosed at subacute myocardial infarction (MI) without complications (116).
- had age range from 40 to 75 years old.
- able to understand verbal instruction.
- did not have percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass grafting (CABG) treatment.

With the exception of diabetes mellitus, patients had to be under medical control, which could be included in this study.

3.1.2 Exclusion Criteria

Cardiac patients were excluded in this study if they: -

1. had one of these complications of acute myocardial infarction as follows:-

- Ventricular tachycardia or fibrillation

- Rapid supra-ventricular dysrhythmia

- Second or third degree atrioventricular block

- Persistent sinus tachycardia (≥100 beats/min)

- Pulmonary edema

- Cardiogenic shock

- Persistent hypertension (diastolic blood pressure > 100 mmHg, systolic blood pressure > 150 mmHg)

- Heart failure

- Left ventricular ejection fraction (LVEF) < 30%

3. had verbal, hearing or neurological system deficits.

4. had any musculoskeletal problems which affected the walking ability.

The study protocol was explained to the subjects by the researcher. An informed consent form was completed by each subject. This study was approved by a committee on Human Rights Related to Research Involving Human Subjects of Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok.

3.2 Design of the Study

This study was a randomly controlled clinical trial.

3.3 Instrumentation and Data Collecting Forms

3.3.1 Instrumentation

The instruments in this study included:

1. Stethoscope

   (HM-3002, HICO Medical Company limited, Japan)

2. Mercury sphygmomanometer

   (HM 1100, HICO Medical Company limited, Japan)

3. Standard stop watch (ALBA® SW01-X002, Japan)

4. Measurement tape

5. Cardiac rehabilitation program (Appendix A)

3.3.2 Data collecting Forms

Quality of Life after Myocardial Infarction (QLMI) questionnaire

The questionnaire in this present study was the quality of life after myocardial infarction (QLMI). The original paper of this instrument was constructed with 97 items, which used to elevate the effect of cardiac rehabilitation program on the quality of life with renabilitation after acute myocardial infarction (55). Among these, there were 26 items, which identified most frequently used and as important in disease-specific QLMI questionnaire with 5 factors aggregated into 2 dimensions: limitations (including restrictions and symptoms) and emotion (including emotional function, confidence and self-esteem).

In present study, the improved QLMI questionnaire was used for evaluation the effect of cardiac rehabilitation on the quality of life (Appendix C). Therefore, QLMI consisted of 26 items (Appendix B) with five domains as follows:

Table 3.1 Five Domains in the Quality of Life after Myocardial Infarction

Domain	Items *
Symptom	6, 9, 14, 17, 20
Restriction	12, 15, 18, 21
Confidence	3, 19, 22, 24, 26
Self-esteem	2, 11, 13, 16, 23, 25
Emotion	1, 4, 5, 7, 8, 10

Note: * refers to Appendix B.5

The researcher interviewed all recruited subjects in this study during the followed up periods.

Indirect data collecting

Initial data, including general characteristic, medical history, risk factors of MI, medications, electrocardiogram, echocardiographic and laboratory report, were obtained from medical treatment records. (Appendix B).

General data collection

General data collection, which included the vital signs, signs or symptoms and Rating Perceive Exertion (RPE) scores at rest and post exercise stages in rehabilitation during the hospital periods, were assessed and recorded with the designed form (Appendix B).

Six minute walk test evaluation

A six-minute walk test evaluation form was used for recording walk distance when patients performed the test. Six minutes walk distance was quantified in meters by calculate numbers of round laps in which patients could walk. In addition, this form was used to record the vital signs, signs or symptoms and RPE of pre and post six minutes walk test (Appendix B).

3.4 Procedures

The procedures of this study consisted of four sections.

Firstly, physicians and the researcher selected subjects who was subacute myocardial infarction phase, from cardiac care units according to the inclusion and exclusion criteria of this study. Then these subjects were randomly classified into study and control groups by the researcher before the study began.

Secondly, the researcher created good relationship with patient in both groups. In the study group, the principle and method of cardiac rehabilitation program were explained. After that, informed consent form was signed. In addition, subjects in control group were asked to participate in the study. Consent form was individually signed likewise. After that, the researcher reviewed patient's history from their medical records.

Thirdly, the study group received exercise rehabilitation program, which also included education. Prior to exercise vital signs, signs or symptoms and RPE were

assessed. The physical conditions of the patients were observed throughout the exercise period. If the patients did not have any contraindications, abnormal signs and symptoms, the exercise and data collection were continually recorded until the completion of protocol. On the contrary, if the patients had signs and symptoms, which were contraindications of exercise, the exercise would not be performed. Subject was informed to feel free to terminate exercise when he/she felt that he/she could no longer continue such exercise. The numbers of exercise steps in the study was evaluated from patient's performance by the ability to complete exercise program, which was progressed (Appendix A). In the same fashion, physical conditions of the control group were recorded during hospital admission.

Two weeks post discharged, the researcher reevaluated the exercise capacities by six minutes walk test and interviewed patients' quality of life with the QLMI questionnaire.

3.4.1 Measurement of six minute walk test

Six minutes walk test performed along a 10.72 meters, along the hospital hallway. This distance was marked and a chair was placed at each end. All patients understood the purpose, method, and use of the six minute walk test. Patients were instructed to walk form end-to-end at their own selected speed while attempting to cover as much distance as possible in the period of six minutes. Before the test, patients were allowed to try the six minutes walk test once for familiarization. Afterward, they sat on the chair for about twenty minutes until resting condition was achieved. Meanwhile, the vital signs, signs or symptoms and RPE were recorded.

After that, six minutes walk test was started. During walking test, the researcher stood within 10.72 meters distance and called out the time for every 2 minutes. In addition, the researcher encouraged the patients every 1 minute in a standard fashion (while facing the patient and using one of the two phrases "You are doing well" or "Keep up the good work") (94). Moreover, patients were allowed to stop and rest during the test, but were instructed to resume walking as soon as able. After six minutes passed, patients were instructed to stop walking. The six minutes walk distance was measured to the nearest meter (or nearest of foot), while the vital signs or symptoms and RPE were continuously recorded.

3.4.2 Measurement of the Quality of Life after Myocardial Infarction

All patients in this study received five color cards, which represented response options (Appendix B). The researcher explained the definition of each scale of all cards. After that, the researcher interviewed all patients, starting with the researcher interviewed each item of QLMI questionnaire, while the patient considered the answer by response option scales. Afterwards, the patient gave the answer to the researcher. Finally, scores from item 1 to 26 were recorded, which total times took about twenty minutes through the protocol. In conclusion, the study protocol was presented by block diagram as follow.

STUDY PROTOCOL

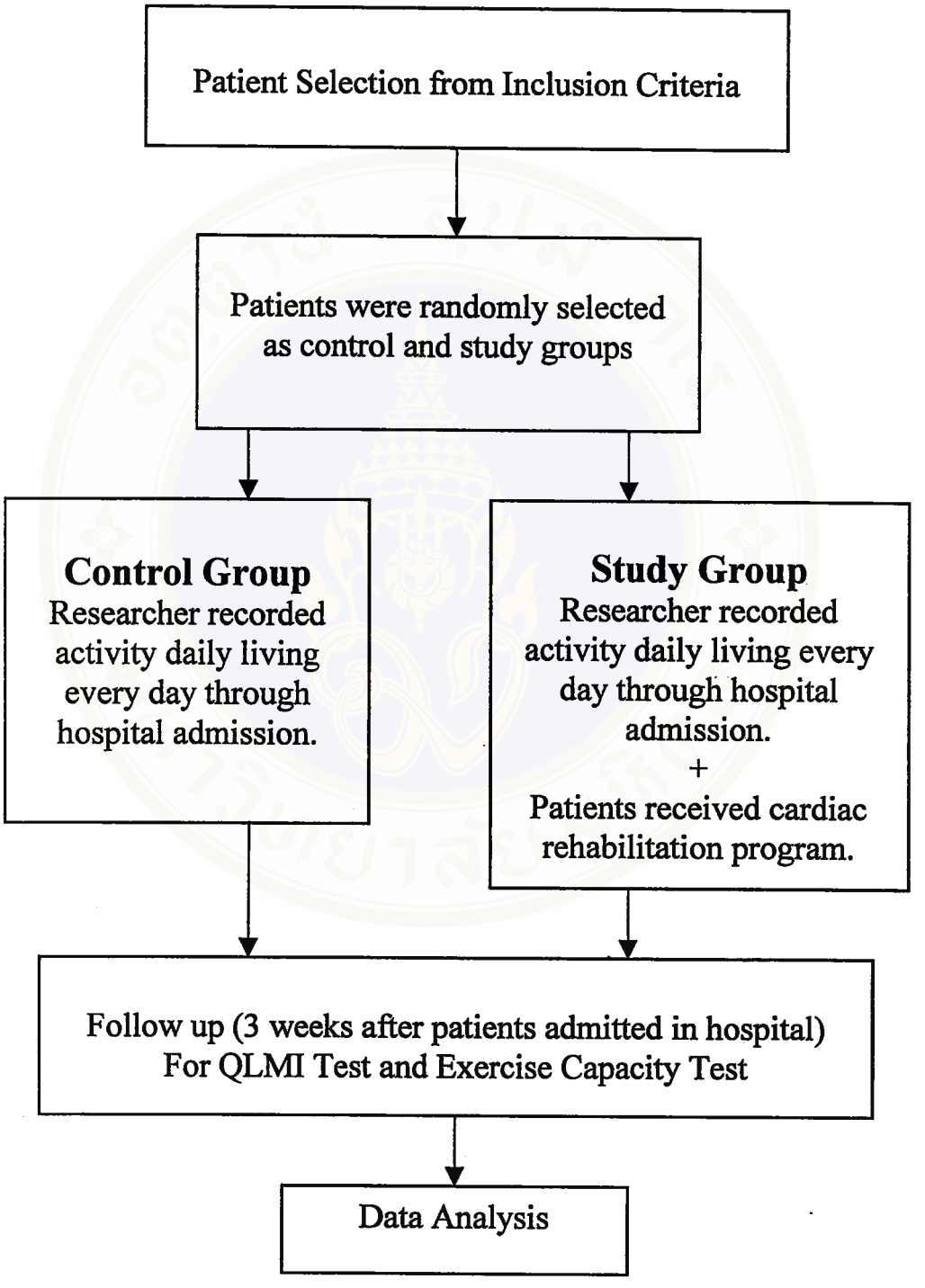

Diagram 3.1: The study Protocol of Randomized Control Clinical Trial

3.5 Statistical Analysis

The statistical analysis of the data was performed by SPSS 7.0 for Windows. The statistical significance for all analysis was set up at $p<0.05$ level.

1. Kolmogorov-Smirnov Goodness of fit test was used for test normal distribution in the values of the six minutes walk distance and total and each domain of QLMI scores.

2. Chi-square test or Fisher's exact test was performed where it is necessary to determine the difference in the qualitative data obtained from general and clinical characteristics between control and study groups.

3. Unpaired t-test or Mann-Whitney U test was performed where it is necessary to determine the difference in the mean values of the quantitative general characteristics data, six minutes walk distance and QLMI scores between control and study groups.

CHAPTER IV

RESULTS

Sixty patients, who were diagnosed of myocardial infarction (MI) without complications by cardiologist from Siriraj Hospital, participated in this study. All MI patients were randomly divided into two groups, control and study groups, patients in control groups (n=30) received only medical and nursing care while study group (n=30) received the additional cardiac rehabilitation program. The results of present study were presented in to categories follows: -

- General and clinical characteristics of patients between control and study groups prior to the study.

- Comparison of heart rate (HR), respiratory rate (RR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and rating of perceived exertion (RPE) scores, signs and symptoms alterations between pre and post seven steps low intensity of patients in study group.

- Comparison of mean values of six minutes walk distance between control and study groups after cardiac rehabilitation program.

- Comparison of mean value differences on HR, RR, SBP, DBP, RPE, signs and symptoms alteration between pre-and post-six minutes walk test between control and study groups.

- Comparison of mean values of quality of life after myocardial infarction (QLMI) scores between control and study groups after cardiac rehabilitation program.

4.1 General and Clinical Characteristics between Control and Study Groups

The general characteristics data were normal distribution except inpatients and follow up periods of study group, which were tested by Kolmogorov-Smirnov one sample test. Comparison between two groups, there were no statistically significant differences of ages, weight, height, ($p>0.05$ from Independent t-test), and inpatient and follow up periods ($p>0.05$ from Mann-Whitney U test). The patient characteristics in this study were presented in Appendix F.

In this study, patients were mostly males. The qualitative of general and clinical characteristics data were no statistically difference ($p>0.05$) between two groups of patients (Table 4.1). There were the topmost risk factors of MI in these subjects, hypertension (HT), diabetes mellitus (DM) and cigarette smoking habit, respectively. Similarly, sedentary lifestyles with lowers than college education and married status were mostly found in these patients. Myocardial wall infarction, anterior wall mostly was occurred in both groups which three persons in study group had two myocardial wall infarction. However, the percentage of left ventricular ejection fraction (LVEF) was similar in two groups.

Physical activities of daily living were similarly level in both groups of patient during hospital admission which cardiologists were similarly classified the physical capacities as class I and II by NYHA (80) before hospital admission in both groups. In addition, the medications were commonly betablockers and nitrates groups for both control and study groups before exercise test.

Table 4.1 Comparison of Qualitative General and Clinical Characteristics Data between Control (n=30) and Study (n=30) Groups

Characteristics Data	Case Number		p-value
	Control	Study	
Gender: -			
- Male	24	22	0.541[c]
- Female	6	8	0.541[c]
Occupational : -			
- Sedentary	10	9	0.781[c]
- Laborer	6	5	0.738[c]
- House-keeper	6	9	0.371[c]
- Other	8	7	0.765[c]
Education level : -			
- Equal or above bachelor degree	13	9	0.283[c]
- Below bachelor degree	17	21	0.332[c]
Status : -			
- Married	23	24	0.754[c]
- Divorce	1	0	0.500[f]
- Separated	2	3	0.323[f]
- Widowhood	1	1	0.508[f]
- Single	3	2	0.323[f]
Risk factors of MI			
- HT	13	15	0.604[c]
- DM	10	12	0.592[c]
- Hyperlipidemia	3	4	0.288[f]
- Dyslipidemia	2	4	0.238[f]
- Smoking habit	14	13	0.795[c]
- Family history	3	4	0.288[f]
- Alcohol intake	4	3	0.288[f]
- Aging	5	6	0.738[c]
Location of myocardial wall Infarction: -			
- Anterior	11	11	1.000[c]
- Anteroseptal	5	4	0.264[f]
- Anterolateral	5	7	0.518[c]
- Inferior	9	11	0.583[c]
Previous experience of MI: -			
- Yes	6	5	0.738[c]
- No	24	25	0.738[c]
LVEF (%): -			
- 30-50	13	14	0.795[c]
- Over 50	14	12	0.602[c]
- Not available	3	4	0.288[f]

Note: c = p-value from Chi-square Test, f = p-value from Fisher's exact Test, MI = Myocardial Infarction, HT = Hypertension, DM = Diabetes Mellitus, LVEF = Left Ventricular Ejection Fraction

4.2 Comparison of HR, RR, SBP, DBP, RPE Scores, Signs and Symptoms Alterations between Pre and Post Seven Steps Low Intensity Exercise of Patients in the Study Group

After receiving cardiac rehabilitation program, all patients in the study complete exercise on every step. None of the subjects showed increase in HR above 20 beats/min. The mean differences of HR between pre and post exercise were 2.84 to 15.16 beats/min in these patients. Likewise, mean differences of RR increased within 0.50 to 2.83 breath/min in these patients. Mean SBP differences increased within 0.77 to 4.17 mmHg. In additions, mean DBP differences declined from 0.07 to 0.36 mmHg while increased 0.07 to 0.17 mmHg in some patients. Correspondingly, mean RPE difference scores increased from 1.03 to 2.86. All values were presented in table 4.2 which signs and symptoms of any patients were not found throughout the study.

Table 4.2 Comparison of HR, RR, SBP, DBP and RPE Scores Alterations between Pre and Post Seven Steps Low Intensity Exercise in Study Group (n=30)

Variables	Mean values ± Standard deviation						
	Step1	Step2	Step3	Step4	Step5	Step6	Step7
HR: -							
- pre	72.63± 10.77	71.60± 10.57	72.37± 10.53	72.10± 10.33	71.43± 10.94	71.97± 10.74	71.67± 10.56
- post	75.47± 4.67	76.13± 9.78	81.00± 10.19	83.47± 10.12	83.43± 11.02	86.00± 11.00	86.83± 10.89
MD	2.84	4.53	8.63	11.37	12.00	14.03	15.16
RR: -							
- pre	20.57± 4.05	19.90± 3.35	20.17± 3.04	20.60± 2.69	20.53± 2.15	19.93± 2.26	19.67± 2.68
- post	21.07± 3.85	20.40± 3.17	21.13± 2.27	21.67± 2.78	23.27± 2.00	22.33± 1.90	22.50± 2.78
MD	0.50	0.50	0.96	1.07	2.74	2.40	2.83
SBP: -							
- pre	128.40± 13.21	129.57± 13.43	129.03± 12.93	126.93± 10.64	128.10± 9.99	128.43± 9.43	129.80± 7.65
- post	130.53± 13.40	133.73± 12.81	132.07± 12.40	129.33± 10.74	131.57± 8.89	129.20± 7.91	130.53± 7.30
MD	2.13	4.16	3.04	2.40	3.47	0.77	0.73
DBP: -							
- pre	82.90± 11.82	80.40± 8.68	80.67± 8.04	81.07± 7.53	81.60± 7.09	82.47± 6.80	82.93± 6.86
- post	82.73± 12.10	80.57± 8.10	80.60± 8.04	81.00± 7.24	81.67± 7.11	82.13± 6.87	82.57± 6.93
MD	0.17	0.17	0.07	0.07	0.07	0.34	0.36
RPE:-							
- pre	7.30± 1.24	6.87± 0.78	7.30± 0.99	7.27± 1.11	7.37± 1.19	7.07± 0.94	7.23± 0.97
- post	8.33± 1.35	9.07± 0.95	8.80± 1.45	9.43± 1.55	9.80± 1.42	9.93± 1.51	9.93± 1.51
MD	1.03	2.20	1.50	2.16	2.43	2.86	2.70

Note: Pre = Pre exercise, Post = Post exercise, HR = Heart Rate, RR = Respiratory Rate, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, RPE = Rating of Perceive Exertion, MD = Mean Differences

4.3 Comparison of Mean Values of Six Minutes Walk Distance between Control and Study Groups

Six minutes walk distance was tested at approximately the third week after patient admission in the hospital. Tables 4.3 showed the comparison of six minutes walk distance between control and study groups. The results revealed that there were statistically differences ($p<0.05$) of six minutes walk distance between the two groups.

Table 4.3 Independents t-test and p-value of Six Minute Walk Distance between Control (n=30) and Study (n=30) Groups

Groups	Six Minutes Walk Distance (meter)			
	Mean ± SD	Range	t	p-value [a]
Control	265.94±37.53	182.72-364.95	3.223	0.002 *
Study	314.72±73.90	184.62-514.96		

Note: * = Statistically significant at p<0.05, a = p-value from Independent t-test

4.4 Comparison of Mean Value Differences on HR, RR, SBP, DBP, RPE Scores, Signs and Symptoms of Pre-and Post-Six Minutes Walk Test between Control and Study Groups

During six minutes walk test, all patients in both groups could walk independently. There were statistically significant difference ($p<0.05$) in mean difference values of RPE scores between control and study groups. All variables were increased after the test in both groups. First of all, mean differences of HR and RR were 26.03, 25.50 and 13.46, 13.27 for control and study groups, respectively. Similarly, SBP and DBP mean differences were 2.54, 2.63 and 0.00, 0.87 for control

and study group, respectively. Mean difference of RPE scores were 4.56 and 2.60 for control and study groups, respectively. The results of mean values were showed in the table 4.4.

Table 4.4 Comparison of Mean Value Differences on HR, RR, SBP, DBP and RPE Scores of Pre-and Post-Six Minutes Walk Test between Control (n=30) and Study (n=30) Groups

Variables	Control		Study		p-value
	Mean±SD	Mean Difference	Mean±SD	Mean Difference	
HR: -					
- Pre	74.40±5.96	26.03	76.03±6.13	25.50	0.610 [t]
- Post	100.43±7.38		101.53±6.57		
RR: -					
- Pre	19.37±1.81	13.46	19.73±1.98	13.27	0.528 [t]
- Post	32.83±3.69		33.00±2.45		
SBP: -					
- Pre	127.53±5.70	2.54	129.60±5.76	2.63	0.660 [u]
- Post	130.07±5.69		132.23±6.01		
DBP: -					
- Pre	87.53±4.60	0.00	83.80±6.65	0.87	0.781 [u]
- Post	87.53±4.80		84.67±6.38		
RPE: -					
- Pre	6.47±0.63	4.56	6.67±0.84	2.60	0.000 [t*]
- Post	11.03±1.45		9.27±1.05		

Note: Pre = Pre exercise, Post = Post exercise, HR = Heart rate, RR = Respiratory Rate, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, RPE = Rating of Perceive Exertion, t = p-value from Independent t-test, u = p-value from Mann-Whitney U test, * = Statistically significant at $p<0.05$

There were statistically significant difference ($p<0.05$) in symptom of leg and thigh fatigue between the control and study groups (Table 4.5). After the six minutes walk test, leg and thigh fatigue were complained in eight patients from the control group and two patients from study group. Exertional dyspnea with diaphoresis occurred in these patients from the control group and two patients from the study

group. Consequently, when these patients rested; all signs and symptom disappeared. Also, the other signs and symptoms were not found in the present study.

Table 4.5 Comparison of Signs and Symptoms after Six Minutes Walk Test Between Control (n=30) and Study (n=30) groups

Signs and Symptoms	Case Number		p-value
	Control	Study	
Leg and thigh fatigue	8	2	0.037
Exertional dyspnea with diaphoresis	3	2	0.323

Note: c = p-value from Chi-square test, f = p-value from Fisher's exact test, * = Statistically significant at p<0.05

4.5 Comparison of Mean Values of Total and Five Domains Quality of Life after Myocardial Infarction (QLMI) Scores between Control and Study Groups

The health related quality of life, which was examined by QLMI scores in this present study. The result showed that there was statistically significant difference (p <0.05) of total QLMI scores between control and study (Table 4.6).

Table 4.6 Independent t-test and p-value of Total QLMI Scores in Control (n=30) and Study (n=30) Groups

Groups	QLMI Scores			
	Mean±SD	Range	t	p-value [a]
Control	110.70±16.56	90-142	3.392	0.001 *
Study	126.67±19.76	92-150		

Note: * = Statistical significant at p<0.05, a = p-value from independent t-test, QLMI = Quality of life after myocardial infarction

Among the five domains scores, there were statistically differences ($p<0.05$) of confidence, self-esteem and emotion domain scores. There were no statistically differences of restriction domain scores between the both groups. The results were presented in table 4.7 and figure 4.1 as below.

Table 4.7 Independent t-test and p-value of Five Domains QLMI Scores in Control (n=30) and Study (n=30) Groups

Domains	QLMI scores			
	Mean±SD	Range	t	p-value [a]
Symptom:				
Control	22.70±4.76	12-31	1.134	0.262
Study	24.06±4.10	12-32		
Restriction:				
Control	15.27±3.43	10-22	1.990	0.052
Study	17.23±4.19	7-27		
Confidence:				
Control	19.43±3.09	14-24	4.454	0.000 *
Study	23.67±4.19	15-32		
Self-esteem				
Control	25.33±5.39	15-35	3.435	0.001 *
Study	30.30±5.80	13-39		
Emotion:				
Control	28.00±4.22	22-37	2.317	0.024 *
Study	31.47±7.03	14-40		

Note: * = Statistically significant at $p<0.05$, a = p-value from Independent t-test, QLMI = Quality of Life after Myocardial Infarction

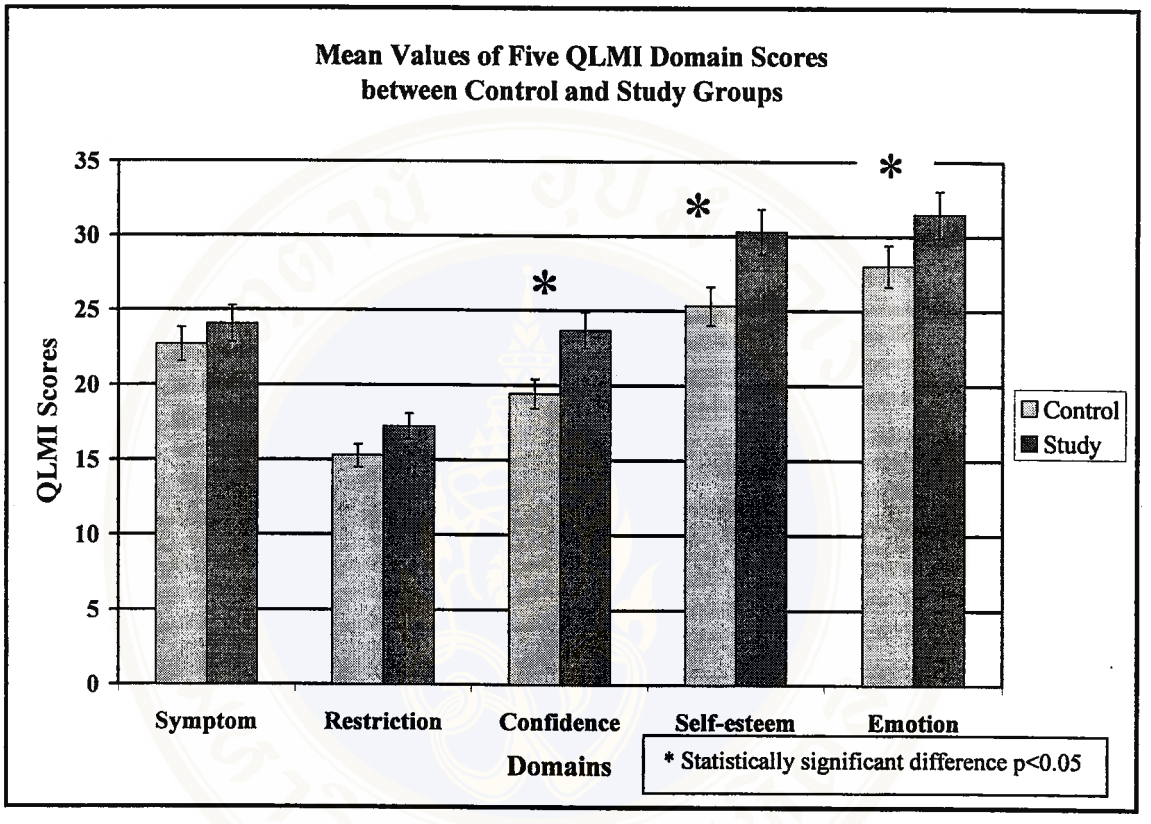

Figure 4.1 Mean Value and Standard deviation of Five Domains Score between Control and Study Groups

CHAPTER V

DISCUSSION

This investigation was designed to determine the effect of cardiac rehabilitation program on exercise capacity and quality of life in patients with uncomplicated myocardial infarction. With the stratified and parallel group design was randomized in the control and study groups. Exercise capacity was determined by six minutes walk test while health-related quality of life was measured by Quality of Life after Myocardial Infarction (QLMI) questionnaire adapted from Oldridge and coworkers in 1991 (55).

There were no statistically differences ($p>0.05$) between the control and study group on any subject's characteristics. These characteristics were ages, weight, height, inhospital and follow up periods. Besides, there were no differences on general characteristics concerning gender, risk factor of cardiovascular disease, educational level, occupation and status in both groups of patients. In the same way, clinical characteristics were not different between the control and study groups. Therefore, baseline characteristics of patients in both groups were similar which would not be the cause of the differences in all investigated parameters in this present study.

5.1 HR, RR, SBP, DBP, RPE Scores, Signs and Symptoms Alterations between Pre and Post of Seven Steps Low Intensity Exercise in Study Group

In this study, the seven steps low intensity exercise was modified from Wenger and coworker in 1992 (6). This program was the gradual progressive intensity, which controlled by multiple of basal rating requirements. The present study found that ranges of mean differences increasing of heart rate (HR), respiratory rate (RR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and rating of perceived exertion (RPE) were 2.84-15.16 beats/min, 0.50-2.83 breath/min, 0.77-4.16 mmHg, 0.07-0.36 mmHg, 1.03-2.86 scores between resting and post exercise of seven steps, respectively. These values were still in normal range, which indicated no signs and symptoms of ischemic ventricular dysfunction or inadequacy of cardiac output to the demand. Therefore, the seven steps low intensity exercise program was appropriately applied for patients with uncomplicated myocardial infarction (MI) in the present study. The finding of this study supported the previous studies (75, 95) that stated the effects of dynamic exercise on hemodynamic responses of cardiac patients.

Harrington and colleagues in 1981 (75) evaluated a program for the treatment and rehabilitation of the early post MI patients with and without complications which the values of early monitoring as maximal HR (>100 beats/min) were equally split between the complicated and uncomplicated MI patients groups. Kellermann in 1992 (95) reported that there was no deterioration after short-term exercise training, which had been observed in patients with endiastolic pressure above 20 mmHg and ejection fraction below 45 percentages.

All steps of exercise training in the present study were low intensity dynamic and breathing exercise which subjects performed the lower before the upper extremity exercises. This protocol differed from the previous studies, which there were no reported in the detail of the sequences of each step on cardiac rehabilitation program (6. 13, 24, 25). Because, muscles mass affected hemodynamic responses in cardiac patients which large muscles were higher mechanical efficiency than the small muscles mass (46, 48). Blomqvist and coworker in 1981 (46) reported the relationship between HR and oxygen uptake was inversely proportional to active muscle mass. In addition, Wahren and Bygdeman in 1971 (48) reported HR, oxygen uptake, and mean SBP and DBP correlated more with work intensity during arm exercise than that of leg exercise in patients with coronary heart disease. Therefore, the sequence of upper and lower extremities was also considered on exercise program. Hemodynamic responses after the sequence of leg and arm exercises were considerably safe which all patients may not develop the abnormal signs and symptoms throughout this study.

Duration of seven steps low intensity exercise in this study had average of 4.77 and 4.43 days for in-hospital interval in control and study groups, respectively, which was short duration than the previous studies (24, 25, 33). Bloch and colleagues in 1974 reported active exercise of all extremities and respiratory muscle exercise which mean duration of hospitalization was 21.3 days for study and 32.8 days for the control group. Devney in 1980 (25) reported the ambulating exercise that 10-12 days and 14 to 21 days were ranges of in-hospital periods for patients with uncomplicated and complicated MI, respectively. Thumnong and coworker in 1985 (33) reported that early ambulating exercise were 6 and 7 days for the study and control groups which

subjects in study group were higher exercise and functional capacity than subjects in control group. Although, exercise program in the present study was short duration and similarly in-hospital interval in both groups, patients in the study group had longer six minutes walk distance than control group. Indeed, the difference of time average staying in hospital resulted from the inclusion criteria of the patients who enrolled to the rehabilitation program.

In this study, patients were selected in subacute phase after myocardial infarction without complications; therefore, they had early ambulation with safety. These results corresponded with the previous studies (6, 96). Wenger and coworker in 1992 (6) stated that the safety of early ambulating and discharging from the hospital depended on the appropriate selection after acute MI. In addition, Jitpraphai and Kantaratanakul in 1996 (96) reported that the safety of exercise program was 5 to 7 days for patients with acute uncomplicated myocardial infarction.

5.2 Walking Ability after Cardiac Rehabilitation Program

The results in this study (Table 4.3) indicated that cardiac rehabilitation program improved the exercise capacities after three weeks in MI patients which six minutes walk distance represented exercise capacity that corresponded with the previous studies (91-92, 97-98). Meyer and coworker in 1997 (97) reported the maximum of six minutes walk distance improved by 65% from baseline of patients with severe chronic heart failure at three weeks after training. Montgomery et al in 1998 (92) concluded that the six minutes walk test was highly reliable measurement, which were related to the functional and hemodynamic severity of patients with

peripheral arterial occlusive disease. In addition, O'Keeffe and colleagues in 1998 (98) reported that six minutes walk test were reproducible and responsiveness measures of cardiac and elderly patients. Lastly, six minutes walk distance less than 300 meters was predicted on increased likelihood of death or hospital admission of patients with advance heart failure which were reported by Cahalin and colleagues in 1996 (91).

The different finding of six minutes walk distances in the present study may be due to effects of skeletal adaptation (99, 100-103). The effects of short-term exercise program after MI considerably improved in physical work capacities which showed significant difference in number of patients (Table 4.5) who complained leg and thigh fatigue in study group less than the control group. Improvement of skeletal muscle training in MI patients may be due to either the local or systemic adaptation. Local adaptation can be explained by considerably vascular portion of active muscles increasing due to the dilation of local arterioles to tissue's metabolic requirement while maintaining an appropriate blood pressure throughout the exercise (99, 101). Another possibility would be the improvement of mitochondrial adenosine triphosphate (ATP) generating capacity and oxygen uptake (100, 103). Systemic adaptation included rapid adjusted in blood flow that affected the entire the cardiovascular system (99, 104). Therefore, muscle training produced local aerobic capacity increasing and demand on the myocardium reducing (99, 100-104).

5.3 Vital Signs and RPE Scores Alterations by Six Minutes Walk Test between Control and Study Groups

This study indicated no significant difference in mean difference of HR, RR, SBP and DBP between control and study groups after six minutes walk test (Table 4.4). These values differed from the finding of previous studies (105-108). Leizorovicz and coworker in 1991 and Bethell et al in 1990 (106) reported that HR and blood pressure were reduced for given work intensity in MI patients after exercise training. Blumenthal and colleagues in 1988 (107) and Worcester and coworker in 1993 (108) reported that reductions in HR and SBP for a given work load following three to four month of regular exercise training. The different findings of HR and blood pressure alterations may be due to the timing of exercise session. Early exercise program after MI, most of the training effects occurred in the first six to eight weeks (109, 110). The minimum length of a program might be six weeks (111), but was generally eight weeks (108), and some may last twelve weeks (106, 107). Leon and colleagues in 1990 recommend a minimum of two to three-month supervised exercise and ideally a six months period to have the maximum benefit. The present study focused in three weeks of training because this phase was myocardium repairing, and outcome measures were in the first part of cardiac rehabilitation which used to progression for the out patient phase.

For RPE alterations in this study found significant differences between the control and study groups (Table 4.4) which related to leg and thigh fatigue differences (Table 4.5) between two groups after six minutes walk test. These results indicated that the perceptual of RPE scores was most closely correlated with physiological

response (110, 97). Although, both groups of patients were taking medications that restricted heart rate response to exercise as beta blockade, patients in control group complained of leg and thigh fatigue higher than study group. In addition, the maximum RPE mean value were 9.27 (very light) and 11.03 (fairly light) in the study and control group, respectively (Table 4.4) which differed from the previous studies (89, 91, 97). Singh and coworker in 1992(89) reported that the maximum of Borg scales (10-point scale) was 7 (very strong) for six minutes walking test in patients with chronic airway obstruction. Cahalin et al in 1996 (91) reported that mean values of maximum RPE scores (10-point scale) was 3.4 (moderate to somewhat strong) for six minutes walk test in patients with advance heart failure. Lastly, Meyer and colleagues in 1997 (97) reported that mean values of dyspnea index from Borg scales were 11 (fairly light) and 10.5 (somewhat fairly light) for six minutes walk test at baseline and after training in patients of New York Heart Association (NYHA) class II and III, respectively. The difference of findings might be due to cardiac condition and specific disease, which affected the physical capacity.

5.4 Potential Clinical Applicability of Six Minute Walk Test

The assessment of submaximal capacity with time has been incorporated into studies of new therapeutic agents for patients with cardiopulmonary disease (8, 88-92). In addition, six minutes walk test was used as one of exercise testing for cardiac patients (90, 97). Previous studies reported six minutes walk distances, which were strongly related to oxygen consumption in patients with chronic heart failure or advance cardiac transplantation that safely performed also (90, 91).

Indeed, the investigator in this study encouraged the patient for every minute in a standard fashion of six minutes walk test as recommended by Bittner and coworker in 1993 (94). Therefore, all patients tried to walk for the maximum distances with their own selected speed. Likewise, walking test was familiarly activity-liked daily life. Therefore, all patients could have less anxiety or stress from exercise capacities. Overall, both groups of patients could complete the test without complications during the process.

The attractive features of six minutes walk test, included ease of administration, low expensive and ease of specific instructions, are preferably selected in this study. It is possible that the further extension studies of the six minutes walk test might identify a threshold for distance as part of evaluation for outpatient cardiac rehabilitation. For some reason, formal submaximal exercise testing is not available in many rehabilitation centers.

5.5 Quality of Life after Myocardial Infarction (QLMI) Scores between Control and Study Groups

This study demonstrated the significance in total QLMI scores between the control and study groups (Table 4.6). These results indicated the role of cardiac rehabilitation program that improved quality of life after MI patients at three weeks of rehabilitation. The finding of this study corresponded with the previous studies (7, 57, 104). Pashkow and Dafoe in 1993 (7) reported that exercise training enhanced the patient's ability to maintain an independent life style. Finlayson in 1997 (104) reported primarily of exercise is to motivate patients to resume their previous level of activity.

Spertus and coworker in 1994 (57) reported mean quality of life scores measured by Seattle Angina Questionnaire (SAQ) scores changed significantly between before and after angioplasty. Therefore, the results in the present study could be an important and relevant outcome measure in clinical trial or quality assurance program.

For five domains score in this study, there were significant differences in patient's confidence, self-esteem and emotional domains between the control and study groups at three weeks of rehabilitation (Table 4.7). The differences of confidence scores may be resulted anxiety decreasing by behavior counseling and exercise completely, which they could deal with their heart problem as chest pain or discomfort when occurred and felt sure as to exercise capacity or physical activity in the recovery period. This study supported the previous studies (7). Pashkow and Dafoe in 1993 (7) stated that exercise training in cardiac rehabilitation was prominently improved in psychological status with less fear and depression, and greater self-confidence.

The results showed self-esteem differences between both groups (Table 4.7), which indicated that when patients able to do performed some physical activity, like low intensity exercise, this would be less burden on their families. Consequently, they felt no burden on others and less worthless or inadequate which corresponded with previous studies (61). Horgan and colleagues in 1992 (61) reported that some psychological benefits as self-esteem and confidence might be obtain by physical conditioning and education counseling of individual and group of rehabilitation program.

The emotion domain, present study found significant difference in scores between the control and study groups (Table 4.7, Figure 4.1) which indicated patients in study group feel relax and free of tension at recovery periods greater than the patients in control group. Education counseling as MI causes and prevention of recurrent MI calm the patients with less depression, which they were happier, satisfied or pleased with their personnel life. These results corresponded with previous studies (55, 112).

Period of rehabilitation was reported to play a role in the quality of life. Oldridge and coworker in 1991 (55) reported that exercise conditioning and behavioral counseling after acute myocardial infarction was associated with recovery in emotional domain at eight weeks of rehabilitation. In addition, Newton and colleagues in 1991 (112) stated that an exercise-based appeared to reduce the depression in twenty-two MI patients compared with a control group at 10 weeks of rehabilitation period. Although, the follow up period in this study was shorter than above the previous studies, results in this clinical trial could be an important and quality assurance rehabilitation program.

The non-significant difference between control and study groups (Table 4.7, Figure 4.1) for symptom and restriction domains in the present study was differed from the results obtained from previous studies (9, 55, 113). Vermeulen and coworker in 1983 (9) reported the rehabilitation program influenced on the reduction of symptom or angina pectoris with five years of follow up periods. In addition, Oldridge et al in 1991 (55) and Engblom et al in 1997 (113) reported there were significant

improvement in symptom such as greater of QLMI scores, reduced chest pain or breathlessness of MI patients in rehabilitation group. Similarly, the restriction of physical activity such as exercise was reduced from rehabilitation course. The different finding of these domains might be due to the difference in the follow up period of measurement and intervention, which obtained to patients. In addition, symptom levels were likely in both groups when measured by patient felling; may resulted of the same medication as beta blockade in recovery period which no appeared abnormal symptoms such as chest pain, breathlessness, headache during daily activities. Although, patients in study group had higher QLMI scores than the control group, there were no significant differences in restriction domain scores; may resulted in, mostly of patients in this study no previous experienced heart attacked during MI. This factor may reflect judgements about their restriction of physical activities, which affected their health status in recovery phase. Overall, adaptation of symptoms and restriction domains may be extended to the follow up periods, which must continue the rehabilitation for optimum, the quality of life in MI patients. These results supported the previous studies (7, 53).

Pashkow and Dafoe in 1993 (7) stated that patients who had experience of heart attack might develop their adjustment processes, which could aid in the development of more adaptive coping strategy. Lastly, Wenger and colleagues in 1984 (53) stated that exercise or recreational therapy altered the outcome measurable, which should be defined by the relationship, the impact of symptoms domain between survival duration and physiologic improvement of circulatory system.

CHAPTER VI

CONCLUSION

Less exercise tolerance and psychosocial impairment are caused by chronic illness, which are typically found in patients with myocardial infarction (MI). Therefore, these patients should be continuously received appropriate cardiac rehabilitation to improve exercise tolerance and psychosocial functions. When patients understand self-care, this leads to the decreasing of risk factor of MI and survival increment. Patients with MI improve their exercise capacity with less muscle fatigue and health relating to quality of life after 3 weeks of training.

Even though, the alteration of cardiac function was not changed. Exercises training in the present study affected two major physiological adaptations. Skeletal muscles became more tolerate to fatigue (Table 4.6) while subjects, themselves, felt that they could sustain longer working period (Table 4.7).

For the psychological effects of cardiac rehabilitation, each domain of quality of life after myocardial infarction (QLMI) scores were statistically significant differences ($p<0.05$) in confidence, self-esteem and emotion function scores between control and study groups. Although, there were no significant differences in symptom and restriction domains of QLMI scores of both groups, cardiac rehabilitation developed quality of life on the another way.

Further Study

This study was designed to follow patients within 3 weeks period. The further study should be continuously follow up myocardial infarcted patients for long-term period after discharge from hospitals. Furthermore, all personnel in cardiac rehabilitation teams should know the program and work closely together.

Design of experiment in the further study should correlate pathophysiologic measures such as changes in atherosclerosis, blood chemistry, myocardial contractility or ventricular wall motion abnormalities, and myocardial perfusion or myocardial ischemia. In addition, physical capacity difference of cardiac patients should be considered for the eligible criteria of the further study.

The application of cardiac rehabilitation program should be considered in elderly persons, who are not active as young persons. Therefore, physiotherapist must consider or elevate the individual ability to arrange a safety program for patients.

Six minutes walk test should be applied for exercise capacity test in cardiac patients with other conditions who receive medical intervention such as percutaneous transluminal coronary angioplasty (PTCA), coronary artery bypass grafting (CABG) or heart valve replacement. In addition, the hallway should be extended to the length of walkway, which is comfortable for testing. Similarly, it is interesting to study in other phases of cardiac rehabilitation which outcome is behavior changing or return to their work after rehabilitation.

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APPENDIX A

Cardiac Rehabilitation Program for Myocardial Infarction Patient

A.1 The Purpose of Cardiac Rehabilitation Program

1. To improve the exercise capacities in term of six minutes walk distance.

2. To improve the quality of life in term of patient's symptoms, restriction, confidence, self-esteem and emotion domains.

A.2 The Principle of Cardiac Rehabilitation Program

1. The patients received cardiac rehabilitation program step by step that include active exercise and education. This program was modified from Wenger and coworker in 1992 (6), started in first step that was energy expenditure of less than 2 metabolic equivalents (METs). The number of exercise step in the present study would be mainly evaluated from patient's performance, which would be processed one to two steps per day during the patients' admission. Finally, cardiac rehabilitation program was explained to all patients.

2. Before and during exercise, cardiologists and a physiotherapist would evaluate the subjective and objective of physical assessment (76), electrocardiograph (EKG) monitoring and interview patients. Exercise would be immediately stopped when cardiac patients have one of those signs or symptoms as following:

A.2.1 Physical evaluation:-

- Pallor
- Cyanosis
- Diaphoresis
- Dyspnea
- Systolic blood pressure increases than 40 mmHg or decrease than 10 mmHg
- Diastolic blood pressure alteration than ± 20 mmHg

A.2.2 Subjective evaluation:-

- Nausea and vomiting
- Chest pain or discomfort
- Dizziness
- Syncope
- Fatigues or weakness
- Headache

A.2.3 Abnormal EKG monitoring (110):-

- Bigeminy premature ventricular contractions (PVCs)
- Rates greater than 6 PVCs per minute
- Difference pattern of PVCs
- Continues PVCs greater than 2 PVCs
- R wave on T wave
- Paroxysmal atria tachycardia
- Second degree a-v block or third degree a-v block
- ST segments depression or elevation greater than 2 mm.

Table A.1 Inpatient Cardiac Rehabilitation Program for MI Patients Modified from Wenger et al in 1992 (6)

First step exercise [1-1.5 METs]	**Education**
Active assisted exercise both sides of lower and upper extremity in supine position with EKG monitoring in CCU or ICCU as Follow:- - ankle DF, PF, eversion and inversion (10 times) - knee F (5 times) - hip F, Abd, Add, Ext Rot, Int Rot (5 times) - combine joint of all fingers F and E (10 times) - wrist F and E (10 times) - elbow F, E, pronation and supination (10 times) - shoulder F, Ext Rot, Int Rot and elevation (5 times) - abdominal and lower costal BE (10 times)	Brief reviewed of CRP in terms of the principle and method
Second step exercise [1.5-2 METs]	**Education**
1. Active assisted exercise both sides of lower and upper extremity in supine position with EKG monitoring in CCU or ICCU as Follow:- - ankle DF, PF, eversion and inversion (20 times) - knee F (10 times) - hip F, Abd, Add, Ext Rot, Int Rot (10 times) - combine joint of all fingers F and E (20 times) - wrist F and E (20 times) - elbow F, E, pronation and supination (20 times) - shoulder F, Ext Rot, Int Rot and elevation (10 times) - abdominal and lower costal BE (10 times) 2. Sitting on side of the bed 10 min with foot support	Explained to patients about the orientation in CCU, ICCU and personal emergencies, social service aid as need

Note: DF = Dorsiflexion, PF = Plantarflexion, F = Flexion, E = Extension, ABD = Abduction, ADD = Adduction, Int Rot = Internal Rotation Ext Rot = External Rotation, BE = Breathing Exercise, METs = Metabolic EquivalenTs (1 MET = 3.5 ml/kg/min of oxygen uptake), CCU = Cardiac Care Unit, ICCU = Intermediate Cardiac Care Unit, min = minute

Table A.1 Inpatient Cardiac Rehabilitation Program for MI Patients Modified from Wenger et al in 1992 (6) (Continued)

Third step exercise [2-3 METs]	**Education**
1. Active exercise both sides of lower and upper extremity in sitting position with foot support and EKG monitoring in CCU or ICCU as Following:- - ankle DF, PF, eversion and inversion (20 times) - knee F (20 times) - hip F, Abd, Add, Ext Rot, Int Rot (20 times) - combine joint of all fingers F and E (20 times) - wrist F and E (20 times) - elbow F, E, pronation and supination (20 times) - shoulder F, Ext Rot, Int Rot and elevation (15 times) - abdominal and lower costal BE (10 times) 2. Slow walking about 30 meters in the room	1. Conversation and answered the question to patient about their illness 2. To suggested the physical activities after physician permissions 3. Conversation about the reasons and ward environment for transfer planing from ICCU or CCU 4. Evaluated patient's knowledge in terms of cause of MI, factors to induce abnormal signs and symptoms, prevention of recurrent heart attack and the method of relief chest discomfort by themselves
Fourth step exercise [3-4 METs]	**Education**
1. Active exercise both sides of lower and upper extremity in sitting position with foot support as Follow:- - ankle DF, PF, eversion and inversion (20 times) - knee F (20 times) - hip F, Abd, Add, Ext Rot, Int Rot (20 times) - combine joint of all fingers F and E (20 times) - wrist F and E (20 times) - elbow F, E, pronation and supination (20 times) - shoulder F, Ext Rot, Int Rot and elevation (20 times) - abdominal and lower costal BE (10 times) 2. Slow walking about 60 meters in the room or hospital corridor	1. Researcher instructed pulses checking to the patient 2. Suggested the education about cardiac function, blood supply to myocardium and causes of myocardial infarction 3. Instructed about location, duration of stable and unstable angina with the method of relief chest discomfort by themselves

Note: DF = Dorsiflexion, PF = Plantarflexion, F = Flexion, E = Extension, ABD = Abduction, ADD = Adduction, Int Rot = Internal Rotation Ext Rot = External Rotation, BE = Breathing Exercise, METs = Metabolic EquivalenTs (1 MET = 3.5 ml/kg/min of oxygen uptake), CCU = Cardiac Care Unit, ICCU = Intermediate Cardiac Care Unit, min = minute

Table A.1 Inpatient Cardiac Rehabilitation Program for MI Patients Modified from Wenger et al in 1992 (6) (Continued)

Fifth step exercise [4-5 METs]	**Education**
1. Active exercise both sides of lower and upper extremity in sitting position with foot support as Follow:- - ankle DF, PF, eversion and inversion (20 times) - knee F (20 times) - hip F, Abd, Add, Ext Rot, Int Rot (20 times) - combine joint of all fingers F and E (20 times) - wrist F and E (20 times) - elbow F, E, pronation and supination (20 times) - shoulder F, Ext Rot, Int Rot and elevation (20 times) - abdominal and lower costal BE (10 times) 3. Slow walking about 120 meters in the room or hospital corridor. 4. Couple steps exercise 2 min with patient's speed	Conversation about characteristic of activities of daily living and work, and to suggested the appropriately work or activities to patient in recovery period
Sixth step exercise [5-6 METs]	**Education**
1. Active exercise both sides of lower and upper extremity in sitting position with foot support as Follow:- - ankle DF, PF, eversion and inversion (20 times) - knee F (20 times) - hip F, Abd, Add, Ext Rot, Int Rot (20 times) - combine joint of all fingers F and E (20 times) - wrist F and E (20 times) - elbow F, E, pronation and supination (20 times) - shoulder F, Ext Rot, Int Rot and elevation (20 times) - abdominal and lower costal BE (10 times) 5. Slow walking about 250 meters in the room or hospital corridor 6. Couple steps exercise 5 min with patient's speed	1. Suggested the education about the prevention of cardiac disease in terms of coronary risk factors and control in smoking cessation, hypertension, nutrition and give way of stress 2. Suggested the education about home exercise

Note: DF = Dorsiflexion, PF = Plantarflexion, F = flexion, E = extension, ABD = Abduction, ADD = Adduction, Int Rot = Internal Rotation Ext Rot = External Rotation, BE = Breathing Exercise, METs = Metabolic EquivalenTs (1 MET = 3.5 ml/kg/min of oxygen uptake), CCU = Cardiac Care Unit, ICCU = Intermediate Cardiac Care Unit, min = minute

Table A.1 Inpatient Cardiac Rehabilitation Program for MI Patients Modified from Wenger et al in 1992 (6) (Continued)

Seventh step exercise [6-7 METs]	Education
1. Active exercise both sides of lower and upper extremity in sitting position with foot support as Follow:- - ankle DF, PF, eversion and inversion (20 times) - knee F (20 times) - hip F, Abd, Add, Ext Rot, Int Rot (20 times) - combine joint of all fingers F and E (20 times) - wrist F and E (20 times) - elbow F, E, pronation and supination (20 times) - shoulder F, Ext Rot, Int Rot and elevation (20 times) - abdominal and lower costal BE (10 times) 7. Slow walking about 500 meters in the room or hospital corridor 8. Walking up and down 1 flight of stair	1.Researcher evaluated patient's knowledge as following: - - cause of MI, factors to Induce abnormal signs and symptoms, prevention of recurrent heart attack and the method of relief chest discomfort by themselves - home exercise - prevention of cardiac disease in term of coronary risk factors and control in smoking cessation, hypertension, nutrition and give way of stress 3. Conversation about the physician follows up after discharge from hospital 4. Discussion and feedback of progression to patient before discharge

Note: DF = Dorsiflexion, PF = Plantarflexion, F = flexion, E = extension, ABD = Abduction, ADD = Adduction, Int Rot = Internal Rotation Ext Rot = External Rotation, BE = Breathing Exercise, METs = Metabolic EquivalenTs (1 MET = 3.5 ml/kg/min of oxygen uptake), CCU = Cardiac Care Unit, ICCU = Intermediate Cardiac Care Unit, min = minute

APPENDIX B

B.1 INFORMED CONSENT FORM

แบบฟอร์มหนังสือยินยอม

วันที่_____

ข้าพเจ้า_____อยู่บ้านเลขที่_____

ซอย_____หมู่_____ถนน_____แขวง/ตำบล_____

เขต/อำเภอ_____จังหวัด_____

ได้ทราบรายละเอียดของโครงการวิจัยเรื่อง "ผลของการให้โปรแกรมการฟื้นฟูผู้ป่วยอย่างมีแบบแผนต่อความสามารถในการออกกำลังกาย และคุณภาพชีวิต ในผู้ป่วยกล้ามเนื้อหัวใจตายที่ไม่มีภาวะแทรกซ้อน" โดยข้าพเจ้าจะได้รับการดูแลรักษาทางกายภาพบำบัด โดยการใช้โปรแกรมการฟื้นฟูผู้ป่วยโรคหัวใจอย่างมีแบบแผน ในช่วงที่พักรักษาตัวที่โรงพยาบาลศิริราช และ จะได้รับการประเมินความสามารถในการออกกำลังกาย ด้วยการเดิน 6 นาที ร่วมกับวัดคุณภาพชีวิตภายหลังที่ออกจากโรงพยาบาลแล้ว 2 สัปดาห์โดยการสัมภาษณ์ ในการวิจัยครั้งนี้ข้าพเจ้าจะอยู่ในความดูแลของแพทย์และนักกายภาพบำบัด ซึ่งเป็นผู้ควบคุมวิทยานิพนธ์และผู้ดำเนินการวิจัย

ข้าพเจ้าเข้าใจวัตถุประสงค์ของการศึกษา ตลอดจนประสิทธิภาพและความปลอดภัยของการศึกษาเป็นอย่างดี และได้พิจารณาว่าการศึกษานี้ จะเป็นประโยชน์ต่อมนุษยชาติและต่อการสาธารณสุขของประเทศไทย ข้าพเจ้ามีความยินดีที่จะเข้าร่วมการศึกษาดังกล่าว ข้าพเจ้ามีสิทธิ์ที่จะบอกเลิกการร่วมในการศึกษาเวลาใดก็ได้ และการบอกเลิกการศึกษาครั้งนี้ จะไม่มีผลกระทบต่อการให้การรักษาพยาบาลแต่อย่างใด

ข้าพเจ้าได้รับทราบและได้ซักถามผู้วิจัยจนหมดข้อสงสัยโดยตลอดแล้ว และยินดีเข้าร่วมในการวิจัย จึงได้ลงลายมือชื่อไว้เป็นหลักฐานต่อหน้าพยาน

ลงชื่อ.....ผู้ยินยอม ลงชื่อ .....ผู้ดำเนินการวิจัย

(.....) (.....)

ลงชื่อ .....พยาน

(.....)

B.2 INDIRECT EVALUATION AND PLAN

Name.....Hospital no.....

Age.....yrs Sex..... Height.....cm Weight.....kg

address.....

Phone no.....Occupation.....

Medical diagnosis.....

Medical history.....

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Risk factor ☐ hypertension ☐ diabetes mellitus ☐ hyperlipidemia

☐ smoking ☐ family history ☐ dyslipidemia

☐ alcohol intake ☐ aging ☐ .....

Medical dosage and frequency

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.....

.....

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EKG

Date	Interpretation

Echocardiographic report

Date	Interpretation

Laboratory report

Date	CPK (U/L)	CK-MB (U/L)	Date	CPK (U/L)	CK-MB (U/L)

B.3 GENERAL DATA COLLECTION FORM

Name.....Date.....

Exercise stage.....

Measurement	Resting stage	Post exercise
Heart rate (beats/min)		
Blood pressure (mmHg)		
Respiratory rate (breaths/min)		
Rating of perceive exertion		
Signs and symptoms		

Note.....

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B.4 SIX MINUTES WALK TEST EVALUATION

Name.....

Group.....No..... Date.....

Measurement	Resting stage	Post test
Heart Rate (beats/min)		
Blood Pressure (mmHg)		
Respiratory Rate (breath/min)		
Rating of Perceive Exertion		
Signs and Symptoms		

	1	2	3	4	5	6	7	8	9	10
NUMBER OF CYCLE										

1 Cycle = 10.72 m

Total Distance.....

Note.....

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.....

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B.5 QUALITY OF LIFE AFTER

MYOCARDIAL INFARCTION QUESTIONNAIRE

Name_____

Group_____ **No**_____ **Date**_____

This questionnaire is designed to find out how you have been feeling during the last 2 weeks. The questions that you will be asked all relate to problem or feelings those patients often have after a hart attack. You will be asked about some of the symptoms you may have experienced how tried you have been feeling and how your mood has been.

1. How much time during the last two weeks have you felt frustrated, impatient or angry? Please indicate how often you have felt frustrated, impatient or angry by choosing one of the following options: (Blue card .....)
2. How often during the last two weeks have you felt worthless or inadequate? (Blue card .....)
3. In the last two weeks, how much time did you feel very confident and sure that you could deal with your heart problem? (Yellow card .....)
4. In general how much of the time did you feel discouraged or down in the dumps during the last two weeks? (Blue card .....)
5. How much of the time during the last two weeks did you feel relaxed and free of tension? (Yellow card .....)
6. How often during the last two weeks have you felt worn out or low energy? (Blue card .....)

7. How happy, satisfied, or pleased have you been with your personal life during the past two weeks? (Gray card .....)
8. How often during the last two weeks have you felt restless, or as if you were having difficulty trying to calm down? (Blue card .....)
9. How much shortness of breath have you experienced during the last two weeks while doing your day-to-day physical activities? (Green card .....)
10. How often during the last two weeks have you felt tearful, or like crying? (Blue card .....)
11. How often during the last two weeks have you felt as if you are more dependent than you were before the heart attack? (Blue card .....)
12. How often during the last two weeks have you felt you were unable to do your usual social activities, or social activities with your family? (Blue card .....)
13. How often during the last two weeks have you felt as if other no longer have the same confidence in you as they did before the heart attack? (Blue card .....)
14. How often during the last two weeks have you experienced chest pain while doing your day-to-day activities? (Blue card .....)
15. How often during the last two weeks have you felt your heart problem limited or interfered with sexual intercourse? (Blue card .....)
16. How often during the last two weeks have you felt unsure of yourself or lacking in self-confidence? (Blue card .....)
17. How often during the last two weeks have you been bothered by aching or tired legs? (Blue card .....)
18. During the last two weeks how much have you been limited in doing sports or exercise as a result of your heart problem? (Pink card .....)

19. How often during the last two weeks have you felt apprehensive or frightened? (Blue card .....)
20. How often during the last two weeks have you felt dizzy or lightheaded? (Blue card .....)
21. During the last two weeks how much have you been restricted or limited as a result of your heart problem: (Pink card .....)
22. How often during the last two weeks have you felt unsure as to how much exercise or physical activity you should be doing? (Blue card .....)
23. How often during the last two weeks have you felt as if you are no longer a real man/woman: (Blue card .....)
24. How often during the last two weeks have you felt as if your family is being overprotective towards you? (Blue card .....)
25. How often during the last two weeks have you felt as if you were a burden on others? (Blue card .....)
26. How often during the last two weeks have you felt as if you could manage your chest pain or discomfort when, or if, it occurred? (Yellow card .....)

แบบสอบถามคุณภาพชีวิตสำหรับผู้ป่วยกล้ามเนื้อหัวใจตาย

แบบสอบถามนี้ใช้สำหรับประเมินคุณภาพชีวิตผู้ป่วยกล้ามเนื้อหัวใจตาย ในระยะ 2 สัปดาห์ ภายหลังที่ออกจากโรงพยาบาล ซึ่งเกี่ยวข้องกับปัญหา และความรู้สึกของผู้ป่วยเรื่องโรคหัวใจ โดยผู้ป่วยจะได้รับการสัมภาษณ์ถึงอาการ ความรู้สึก และสภาวะของอารมณ์ ดังนี้ ช่วง 2 สัปดาห์ที่ผ่านมานี้ คุณรู้สึกว่า.....

ชื่อ.....กลุ่ม.....เลขที่.....

1. คุณรู้สึกเบื่อหน่าย โกรธ หรือหมดหวัง มากแค่ไหน B☐
2. คุณรู้สึกว่าไม่มีความสามารถในการทำงาน หรือ ไร้ค่า บ่อยแค่ไหน B☐
3. บ่อยแค่ไหนที่คุณรู้สึกมั่นใจและแน่ใจว่าคุณเข้าใจวิธีการลดอาการเจ็บหน้าอกที่เกิดขึ้นได้ Y☐
4. คุณรู้สึกท้อแท้ หรือกำลังใจลดลง มากแค่ไหน B☐
5. คุณรู้สึกผ่อนคลาย และคลายความเครียดจากช่วงที่อยู่โรงพยาบาล มากแค่ไหน Y☐
6. บ่อยแค่ไหนที่คุณรู้สึกอ่อนเปลี้ย เพลียแรง B☐
7. คุณมีความสุข หรือพอใจ ในสุขภาพของคุณมากเท่าไร Gray ☐
8. บ่อยแค่ไหนที่คุณรู้สึกกังวลเรื่องสุขภาพ หรือยากลำบากเพื่อลดความกังวลนั้น B☐
9. คุณมีหายใจหอบเหนื่อย มากน้อยเพียงใดขณะทำกิจวัตรประจำวัน Green☐
10. คุณรู้สึกเศร้า หรืออยากร้องไห้ บ่อยแค่ไหน B☐
11. บ่อยแค่ไหนที่คุณรู้สึกต้องพึ่งพาผู้อื่นมากขึ้นเมื่อเทียบกับก่อนเป็นโรคหัวใจ B ☐
12. บ่อยแค่ไหนที่คุณรู้สึกไม่สามารถเดินทางออกนอกบ้าน เพื่อทำกิจกรรมทางสังคมได้ตามปกติ เนื่องจากปัญหาสุขภาพ B☐
13. บ่อยแค่ไหนที่คุณรู้สึกว่าคนรอบข้างมีความมั่นใจในตัวคุณไม่มากเท่าก่อนเป็นโรคหัวใจ B ☐
14. บ่อยแค่ไหนที่คุณมีอาการเจ็บหน้าอกขณะทำกิจวัตรประจำวัน B ☐
15. บ่อยแค่ไหนที่คุณรู้สึกว่าปัญหาโรคหัวใจจำกัด หรือ รบกวน การมีเพศสัมพันธ์ B ☐
16. บ่อยแค่ไหนที่คุณรู้สึกไม่มีความมั่นใจในตนเอง B ☐
17. บ่อยแค่ไหนที่คุณมีอาการปวดเมื่อยขา B ☐
18. เมื่อคุณเป็นโรคหัวใจ คุณต้องจำกัดการออกกำลังกาย หรือเล่นกีฬามากแค่ไหน P ☐
19. คุณรู้สึกกลัว หรือตกใจ เมื่อออกกำลังกายหรือทำกิจกรรม บ่อยแค่ไหน B ☐
20. คุณรู้สึกเวียนศีรษะ ตาลาย หรือหน้ามืด บ่อยแค่ไหน B ☐
21. จากการเป็นโรคหัวใจ คุณรู้สึกว่าถูกบังคับหรือถูกจำกัดกิจกรรมมากแค่ไหน P ☐
22. บ่อยแค่ไหนที่คุณรู้สึกไม่แน่ใจถึงความสามารถในการออกกำลังกายและทำกิจกรรม B ☐
23. บ่อยแค่ไหนที่คุณรู้สึกงง หรือ ใจลอย B ☐
24. บ่อยแค่ไหนที่คุณรู้สึกว่า สมาชิกในครอบครัวของคุณดูแลปกป้องคุณมากเกินไป B ☐
25. บ่อยแค่ไหนที่คุณรู้สึกว่า คุณเป็นภาระต่อผู้อื่น B ☐
26. บ่อยแค่ไหนที่คุณรู้สึกว่าคุณสามารถลดอาการเจ็บหน้าอกได้ Y ☐

B.6 RESPONSE OPTIONS

BLUE CARD

1	2	3	4	5	6	7
All Of The Time	Most Of The Time	A Good Bit Of The Time	Some Of The Time	Little Of The Time	Hardly Any Of The Time	None Of The Time

YELLOW CARD

1	2	3	4	5	6	7
None Of The Time	A Little Of The Time	Some Of The Time	A Good Bit Of The Time	Most Of The Time	Almost Of The Time	All Of The Time

GRAY CARD

1	2	3	4	5	6	7
Very Dissatisfied , Unhappy Most Of The Time	Generally Dissatisfied, Unhappy	Somewhat Dissatisfied, Unhappy	Generally Satisfied, Pleased	Happy Most Of The Time	Very Happy Most Of The Time	None Of The Time

GREEN CARD

1	2	3	4	5	6	7
Extreme Shortness Of Breath	Very Short Of Breath	Quite A Bit Of Shortness Of Breath	Moderate Shortness Of Breath	Some Shortness Of Breath	A Little Shortness Of Breath	No Shortage Of Breath

PINK CARD

1	2	3	4	5	6	7
Extremely Limited	Very Limited	Limited Quite A Bit	Moderately Limited	Somewhat Limited	Limited a Little	Not Limited

ทางเลือกเพื่อตอบแบบสอบถาม

บัตรสีฟ้า

1	2	3	4	5	6	7
ตลอดเวลา	ส่วนใหญ่	ค่อนข้างมากครั้ง	บางครั้ง	น้อยครั้ง	ค่อนข้างไม่มี	ไม่มี

บัตรสีเหลือง

1	2	3	4	5	6	7
ไม่มี	น้อยครั้ง	บางครั้ง	ปานกลาง	ส่วนใหญ่	ค่อนข้างตลอดเวลา	ตลอดเวลา

บัตรสีเทา

1	2	3	4	5	6	7
ไม่พอใจมาก, ส่วนใหญ่ไม่มีความสุข	โดยทั่วไปไม่พอใจ, ไม่มีความสุข	ค่อนข้างไม่พอใจ, ไม่มีความสุข	โดยทั่วไปพอใจ	ส่วนใหญ่มีความสุข	ส่วนใหญ่มีความสุขมาก	มีความสุขตลอดเวลา

บัตรสีเขียว

1	2	3	4	5	6	7
หายใจหอบ, ถี่มากที่สุด	หายใจหอบ, ถี่มาก	หายใจหอบ, ถี่ พอประมาณ	หายใจหอบ, ถี่ปานกลาง	หายใจหอบ, ถี่บางครั้ง	หายใจหอบ, ถี่น้อยครั้ง	ไม่มีหายใจหอบ, ถี่

บัตรสีชมพู

1	2	3	4	5	6	7
ถูกจำกัดมากที่สุด	ถูกจำกัดมาก	ถูกจำกัดค่อนข้างมาก	ถูกจำกัดปานกลาง	ถูกจำกัดบางครั้ง	ถูกจำกัดน้อยครั้ง	ไม่ถูกจำกัด

APPENDIX C

Improving of Quality of Life after Myocardial Infarction (QLMI) Questionnaire

The QLMI questionnaire in this study was improved by researcher for Thai population. Therefore, languages were improved for clear transmission. After that, the questionnaire was tested in ten MI patients. The suggestion will be use for improve the questionnaire. Finally, the alteration of questionnaire was consulted with well qualified person, who were two lecturers in the School of Physiotherapy Faculty of Medicine Siriraj Hospital, Mahidol University, two cardiologists, eight physiotherapists, four nurses and one educator.

Furthermore, QLMI questionnaire was improved from the suggestion of qualified persons.

APPENDIX D

Results of Pilot Study

Table D.1 General Characteristics of Subjects from the Pilot Study (N=20)

Characteristic Data	Control group			Study group		
	n	Mean ± SD	Range	n	Mean ± SD	Range
Gender :-						
- Male	9	-	-	8	-	-
- Female	1	-	-	2	-	-
Age (yr)		58.10±11.53	43-74		57.30±11.54	42-75
Body Weight (kg)		67.90±7.69	52-77		63.40±8.85	47-76
Height (cm)		170.20±7.38	160-180		163.00±5.44	157-175
Risk factors of MI :-						
- HT	6	-	-	3	-	-
- DM	6	-	-	4	-	-
- Hyperlipidemia	1	-	-	1	-	-
- Dyslipidemia	1	-	-	1	-	-
- Smoking	3	-	-	5	-	-
- Alcohol intake	1	-	-	1	-	-
- Family history	1	-	-	-	-	-
Inpatients periods (day)	-	4.20±0.79	3-6	-	4.10±0.74	3-5
Follow up periods (day)	-	14.30±0.67	13-15	-	14.10±0.74	13-15

Note : DM = Diabetes Mellitus, HT = Hypertension, MI = Myocardial Infarction

Table D.2 Clinical Characteristics of Subjects in Control and Study Groups

Characteristic Data	Control group (n=10)	Study group (n=10)
Location of myocardial wall infarction :-		
- Anterior	3	4
- Inferior	4	6
- Anterolateral	1	-
- Anteroseptal	2	1
Previous experience of MI :-		
- Yes	3	2
- No	7	8
LVEF (%):-		
- 30-50%	4	5
- >50%	5	3
- Not available	1	2

Note : LVEF = Left Ventricular Ejection Fraction

Table D.3 Independent t-test and p-value of Six Minutes Walk Distances in Control and Study Groups

Group	Six Minutes Walk Distance (m)			
	Mean ± SD	Range	t	p value[a]
Control (n=10)	268.39±53.05	182.72 - 364.95	0.564	0.580
Study (n=10)	284.17±70.84	184.62 - 429.02		

Note : a = p-value from independent t-test, statistically significant at p<0.05

Table D.4 Independent t-test and p-value of Total QLMI Scores in Control And Study Groups

Group	QLMI scores			
	Mean ± SD	Range	t	p value[a]
Control (n=10)	102.40 ± 9.58	94-126	1.552	0.138
Study (n=10)	116.10 ± 26.23	62-150		

Note: a = p-value from independent t-test, statistically significant at p<0.05

Table D.5 Independent t-test and p-value of Five Domains Of The QLMI Scores in Control and Study Groups

Domains	QLMI scores			
	Mean ± SD	Range	t	p values [a]
Symptom				
Control (N=10)	19.30±3.34	12-23	1.788	0.091
Study (N=10)	22.60±4.79	12-28		
Restriction				
Control (N=10)	14.60±3.10	10-21	1.045	0.310
Study (N=10)	16.00±5.56	7-27		
Confidence				
Control (N=10)	18.90±2.56	15-22	1.549	0.139
Study (N=10)	21.60±4.88	15-30		
Self esteem				
Control (N=10)	22.10±5.24	16-34	1.971	0.064
Study (N=10)	27.50±6.90	13-38		
Emotion				
Control (N=10)	27.50±4.25	24-37	0.033	0.974
Study (N=10)	27.40±8.57	14-37		

Note: a = p-value from independent t-test, statistically significant at $p<0.05$

APPENDIX E

Calculation of the Sample Size

Sample Size

From pilot study, the sample size for the present study was calculated by mean values of self-esteem scores from the quality of life after myocardial infarction (QLMI) questionnaire. The following equation was used to calculate the sample size (114).

$$N = 2\ \frac{[\ (Z_\alpha + Z_\beta)\ \sigma\ ]^2}{[\ \mu_1 - \mu_2\ ]^2}$$

N = Sample size for each patient group

σ = Standard deviation of self-esteem domain in study group = 6.90

Z_α = Type I error when setting level equal to 5% ($\alpha = 0.05$), so $Z_\alpha = 1.96$

Z_β = Type II error when setting power of testing equal to 20% ($\beta = 0.2$), so $Z_\beta = 0.84$

$\mu_1 - \mu_2$ = The difference between mean of self-esteem scores for control and study group in pilot study = 5.40

$$N = 2\ \frac{[\ (1.96 + 0.84)\ (6.90)\ ]^2}{[\ 27.50\text{-}22.10]^2} = 25.60 \text{ or } 26$$

Therefore, 26 patients were needed in each group for the present study.

APPENDIX F

Raw Data of Experiment

Table F1.1 General Characteristics of Subjects in the Control Group (n=30)

No	Gender	Status	Age (yrs)	Weight (kg)	Height (cm)	Risk factor	In hospital (day)	Follow up (day)	Occupation	Educational level
1	M	Married	71	75	180	DM	6	15	Boxer	< Bachelor
2	F	Married	62	68	162	HT and dyslipidemia	4	14	Cook	< Bachelor
3	M	Divorce	57	60	170	Smoking	4	14	Transport worker	< Bachelor
4	M	Separated	46	77	178	DM and HT	4	15	Businessman	≥ Bachelor
5	M	Married	74	65	169	DM, HT and hyperlipidemia	5	14	House keeper	≥ Bachelor
6	M	Married	50	70	178	DM, HT, smoking and alcohol intake	4	15	Trader	≥ Bachelor
7	M	Married	46	74	170	DM	3	14	Accountant	≥ Bachelor
8	M	Married	43	52	161	Smoking and family history of MI	4	14	Transport worker	< Bachelor
9	M	Widowhood	61	65	160	HT	4	13	Educator	≥ Bachelor
10	M	Married	71	73	174	DM and HT	4	15	Fortune-teller	≥ Bachelor

Note: DM = Diabetes Mellitus, HT = Hypertension, MI = Myocardial Infarction, ≥ = Equal or more than, < = Less than

Table F1.1 General Characteristics of Subjects in the Control Group (n=30) (Continued)

No	Gender	Status	Age (yrs)	Weight (kg)	Height (cm)	Risk factor	In hospital (day)	Follow up (day)	Occupation	Educational level
11	M	Married	71	72	160	Smoking and aging	5	15	House keeper	≥ Bachelor
12	M	Married	54	80	182	HT, hyperlipidemia and smoking	6	18	Trader	≥ Bachelor
13	M	Married	71	78	168	HT, DM and aging	6	15	Gardener	< Bachelor
14	M	Married	70	78	185	Smoking	4	14	Laborer	< Bachelor
15	M	Single	56	80	165	S moking	5	14	Transport worker	< Bachelor
16	M	Married	48	63	158	DM and HT	4	14	Government official	≥ Bachelor
17	M	Married	58	60	159	DM	4	15	Mechanic	≥ Bachelor
18	M	Married	69	53	174	Smoking and family history of MI	6	16	Gardener	< Bachelor
19	F	Separate	46	46	155	Dyslipidemia	5	14	Educator	≥ Bachelor
20	M	Married	65	55	157	HT and aging	5	14	Salesman	< Bachelor

Note: DM = Diabetes Mellitus, HT = Hypertension, MI = Myocardial Infarction, ≥ = Equal or more than, < = Less than

Table F1.1 General Characteristics of Subjects in the Control Group (n=30) (Continued)

No	Gender	Status	Age (yrs)	Weight (kg)	Height (cm)	Risk factor	In hospital (day)	Follow up (day)	Occupation	Educational level
21	M	Married	46	42	148	Smoking and family history of MI	7	15	Electrician	≥ Bachelor
22	M	Married	64	61.5	157	Alcohol intake	6	13	Employee	< Bachelor
23	M	Married	59	59	156.5	Alcohol intake and smoking	4	17	Guard	< Bachelor
24	F	Married	58	62	153.5	HT	4	15	House keeper	< Bachelor
25	F	Married	66	41	160	Smoking and aging	5	15	Trader	< Bachelor
26	M	Single	49	43	168	Smoking	4	15	Cook	< Bachelor
27	M	Married	64	61.5	154	HT and smoking	6	14	Officer	≥ Bachelor
28	F	Married	60	40	155	DM, HT and aging	5	14	House keeper	< Bachelor
29	M	Married	63	47	161.5	Alcohol intake and smoking	6	15	Gardener	< Bachelor
30	F	Single	52	38.5	144	Hyperlipidemia	4	16	Trader	< Bachelor

Note: DM = Diabetes Mellitus, HT = Hypertension, MI = Myocardial Infarction, ≥ = Equal or more than, < = Less than

Table F1.2 General Characteristics of Subjects in the Study Group (n=30)

No	Gender	Status	Age (yrs)	Weight (kg)	Height (cm)	Risk factor	In hospital (day)	Follow up (day)	Occupation	Educational level
1	M	Married	50	55	158	DM and smoking	4	14	Trader	< Bachelor
2	F	Married	74	47	157	Dyslipidemia	5	15	House keeper	< Bachelor
3	M	Married	55	58	160	Hyperlipidemia	5	15	Typist	< Bachelor
4	F	Married	44	60	162	HT	4	14	Trader	< Bachelor
5	M	Separated	52	76	165	Smoking	4	15	Engineer	≥ Bachelor
6	M	Married	64	70	175	DM, HT and smoking	4	13	Officer	≥ Bachelor
7	M	Married	42	69	160	Alcohol intake and smoking	4	13	Carpenter	< Bachelor
8	M	Married	75	68	165	DM and HT	5	14	Fisherman	< Bachelor
9	M	Single	53	60	160	DM	3	14	Trader	< Bachelor
10	M	Separated	64	71	168	Smoking	3	14	Trader	< Bachelor

Note: DM = Diabetes Mellitus, HT = Hypertension, MI = Myocardial Infarction, ≥ = Equal or more than, < = Less than

Table F1.2 General Characteristics of Subjects in the Study Group (n=30) (Continued)

No	Gender	Status	Age (yrs)	Weight (kg)	Height (cm)	Risk factor	In hospital (day)	Follow up (day)	Occupation	Educational level
11	F	Married	57	85	160	DM and dyslipidemia	5	15	House keeper	< Bachelor
12	F	Married	64	58	159	HT	5	15	Gardener	< Bachelor
13	M	Married	54	59	160	HT, dyslipidemia, smoking and family history of MI	4	14	Trader	< Bachelor
14	F	Married	67	60	162.5	HT and aging	4	14	Cook	< Bachelor
15	M	Married	42	62	166	DM, HT and dyslipidemia	4	15	Electrician	≥ Bachelor
16	M	Married	56	59	153	Alcohol intake and smoking	5	15	Trader	< Bachelor
17	M	Married	63	59.5	166	DM, HT and aging	6	15	Judge	≥ Bachelor
18	M	Separated	57	49	168.5	Aging	4	14	Teacher	≥ Bachelor
19	F	Married	64	56	159	Hyperlipidemia and aging	5	14	Trader	≥ Bachelor
20	M	Married	65	75	166.5	Smoking	4	17	Gardener	< Bachelor

Note: DM = Diabetes Mellitus, HT = Hypertension, MI = Myocardial Infarction, ≥ = Equal or more than, < = Less than

Table F1.2 General Characteristics of Subjects in the Study Group (n=30) (Continued)

No	Gender	Status	Age (yrs)	Weight (kg)	Height (cm)	Risk factor	In hospital (day)	Follow up (day)	Occupation	Educational level
21	M	Single	41	50	156	Smoking and alcohol intake	4	15	Gardener	< Bachelor
22	M	Married	57	40	157	Smoking and family history of MI	4	14	Trader	≥ Bachelor
23	M	Widowhood	65	50	164	HT and hyperlipidemia	5	15	House keeper	≥ Bachelor
24	F	Married	46	52	156	DM, HT and family history of MI	4	17	House keeper	≥ Bachelor
25	M	Married	71	46	165	Smoking and aging	3	15	Employee	< Bachelor
26	M	Married	57	59.5	156.5	DM and HT	4	13	Cobbler	< Bachelor
27	M	Married	74	58.5	167	DM, HT, hyperlipidemia and family history of MI	6	14	Cook	< Bachelor
28	M	Married	59	49	169	DM, HT and smoking	5	13	House keeper	< Bachelor
29	F	Married	51	58	147	HT and smoking	5	14	Officer	< Bachelor
30	M	Married	60	52	158	DM, HT and aging	6	14	House keeper	< Bachelor

Note: DM = Diabetes Mellitus, HT = Hypertension, MI = Myocardial Infarction, ≥ = Equal or more than, < = Less than

Table F 2.1 Clinical Characteristics of Subjects in Control Group (n=30)

No	Location of myocardial wall infarction				Previous experience of MI		LVEF (%)		
	Anterior	Anteroseptal	Anterolateral	Inferior	Yes	No	30-50	>50	Not available
1			✓		✓		✓		
2	✓					✓	✓		
3	✓					✓	✓		
4		✓				✓			✓
5				✓	✓			✓	
6				✓		✓		✓	
7		✓				✓	✓		
8				✓		✓		✓	
9	✓				✓			✓	
10				✓		✓		✓	
11	✓					✓	✓		
12			✓			✓			✓
13	✓					✓		✓	
14			✓			✓	✓		
15	✓					✓	✓		

Note: MI = Myocardial Infarction, LVEF = Left Ventricular Ejection Fraction

Table F 2.1 Clinical Characteristics of Subjects in Control Group (n=30) (Continued)

No	Location of myocardial wall infarction				Previous experience of MI		LVEF (%)		
	Anterior	Anteroseptal	Anterolateral	Inferior	Yes	No	30-50	>50	Not available
16				✓		✓	✓		
17			✓			✓		✓	
18			✓		✓		✓		
19	✓					✓	✓		
20				✓		✓	✓		
21		✓			✓			✓	
22		✓				✓		✓	
23				✓		✓	✓		
24	✓					✓		✓	
25	✓					✓	✓		
26	✓					✓		✓	
27				✓	✓		✓		
28	✓					✓		✓	
29		✓				✓			✓
30				✓		✓		✓	

Note: MI = Myocardial Infarction, LVEF = Left Ventricular Ejection Fraction

Table F 2.2 Clinical Characteristics of Subjects in Study Group (n=30)

No	Location of myocardial wall infarction				Previous experience of MI		LVEF (%)		
	Anterior	Anteroseptal	Anterolateral	Inferior	Yes	No	30-50	>50	Not available
1	✓					✓	✓		
2				✓		✓			✓
3			✓	✓		✓		✓	
4				✓		✓			✓
5				✓		✓		✓	
6	✓					✓	✓		
7	✓				✓		✓		
8				✓	✓			✓	
9	✓					✓	✓		
10				✓		✓	✓		
11	✓					✓		✓	
12				✓		✓	✓		
13	✓					✓		✓	
14			✓	✓	✓		✓		
15	✓		✓		✓		✓		

Note: MI = Myocardial Infarction, LVEF = Left Ventricular Ejection Fraction

Table F 2.2 Clinical Characteristics of Subjects in Study Group (n=30) (Continued)

	Location of myocardial wall infarction				Previous experience of MI		LVEF (%)		
No	Anterior	Anteroseptal	Anterolateral	Inferior	Yes	No	30-50	>50	Not available
16		✓				✓		✓	
17			✓			✓		✓	
18			✓			✓	✓		
19				✓		✓		✓	
20		✓				✓	✓		
21	✓					✓	✓		
22		✓				✓	✓		
23	✓					✓		✓	
24			✓		✓			✓	
25	✓					✓	✓		
26			✓			✓		✓	
27		✓				✓	✓		
28				✓		✓		✓	
29	✓					✓			✓
30				✓		✓			✓

Note: MI = Myocardial Infarction, LVEF = Left Ventricular Ejection Fraction

Table F 3.1 Heart Rate between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	80	84	82	86	80	88	84	94	85	97	84	97	83	99
2	76	78	74	76	73	82	73	84	75	85	72	86	70	88
3	64	66	60	68	61	71	64	77	64	75	62	75	61	75
4	60	61	60	67	64	75	63	73	62	72	60	73	65	78
5	70	70	74	79	70	77	74	87	70	81	72	84	70	85
6	66	69	69	72	65	73	68	78	68	81	66	80	65	80
7	82	84	90	93	91	98	90	101	90	102	90	103	94	108
8	57	61	57	61	58	67	57	66	55	67	59	71	55	70
9	75	79	75	80	77	88	70	81	74	87	70	82	70	84
10	61	63	61	65	64	72	64	74	60	72	62	74	60	75
11	68	68	64	69	66	74	66	79	60	74	65	78	60	75
12	72	74	70	76	74	84	74	85	75	87	80	92	82	99
13	64	66	64	69	65	75	65	79	66	79	65	79	64	78
14	56	62	55	62	54	62	55	65	58	70	60	75	60	73
15	76	81	70	78	72	83	72	82	74	86	70	82	72	88

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.1 Heart Rate between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30) (Continued)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
16	64	66	60	68	61	70	62	76	60	71	66	80	68	84
17	56	57	59	62	55	64	55	68	55	68	60	76	65	82
18	76	79	78	81	75	83	74	87	74	84	72	87	70	84
19	68	72	64	68	66	74	62	73	60	71	60	72	60	73
20	84	85	82	85	88	97	85	95	88	101	88	102	88	103
21	95	96	90	92	91	99	90	100	94	106	95	110	90	107
22	80	84	77	81	77	84	80	92	80	94	82	98	80	93
23	88	92	80	85	80	88	80	91	80	91	81	98	80	95
24	92	98	92	96	90	98	91	103	90	102	92	107	91	107
25	72	74	70	73	75	83	71	83	70	84	70	86	72	88
26	60	65	60	66	66	76	65	79	63	76	60	77	62	79
27	81	84	78	82	79	88	77	87	70	82	71	86	70	86
28	76	80	77	80	76	83	75	87	71	83	70	86	70	87
29	72	77	70	74	70	79	70	81	70	81	70	87	70	85
30	88	89	86	90	88	95	87	97	82	94	85	97	83	97

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.2 Respiratory Rate between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	18	18	20	20	20	22	16	16	20	22	22	22	20	22
2	16	16	16	16	18	20	20	20	24	26	20	22	20	22
3	20	20	22	22	22	22	24	24	20	24	16	20	22	24
4	20	20	18	18	18	20	20	20	20	24	22	22	20	24
5	20	22	16	16	16	18	18	20	20	22	20	22	22	26
6	24	26	24	24	24	24	26	26	26	28	22	22	26	28
7	16	18	20	20	18	20	22	22	18	22	18	20	18	20
8	22	22	20	20	20	20	22	22	18	20	16	20	16	20
9	24	22	22	22	20	22	20	20	20	22	20	22	20	22
10	15	18	15	16	20	22	20	20	22	26	20	22	18	20
11	24	24	22	24	24	24	24	26	22	24	20	22	22	24
12	20	20	20	20	20	20	16	20	18	22	18	20	16	22
13	20	22	20	20	22	24	20	20	18	20	16	22	14	15
14	18	18	18	18	18	20	20	22	22	24	22	24	22	20
15	16	16	16	16	18	20	24	26	22	24	20	26	20	26

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.2 Respiratory Rate between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30) (Continued)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
16	24	24	28	28	24	24	16	18	16	20	18	20	22	21
17	20	20	18	18	18	20	20	20	20	22	22	20	20	20
18	16	16	16	18	18	20	18	18	20	24	20	22	20	22
19	12	14	20	20	15	18	16	16	20	22	20	22	16	20
20	22	22	18	20	20	20	22	20	20	20	20	24	18	22
21	28	28	24	24	24	22	24	24	22	24	22	24	20	24
22	20	20	20	22	20	22	20	22	22	22	22	20	20	26
23	20	20	20	22	24	22	20	22	20	24	20	24	22	24
24	30	30	24	24	24	24	20	24	20	26	22	26	20	22
25	22	22	24	24	24	24	20	24	18	22	18	24	18	23
26	20	20	16	18	16	18	20	22	20	24	18	22	20	24
27	24	22	24	24	24	24	22	24	24	24	24	24	24	26
28	26	28	24	24	24	24	24	26	20	24	24	26	22	26
29	24	26	16	16	16	18	24	24	20	24	16	20	16	18
30	16	18	16	18	16	16	20	22	24	26	20	24	16	22

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.3 Systolic Blood Pressure between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	90	90	100	110	110	114	112	114	100	108	108	110	110	112
2	110	112	100	108	100	106	102	106	108	114	100	106	112	110
3	120	120	126	130	100	108	130	134	132	136	130	128	124	126
4	140	140	140	146	144	150	140	142	130	134	136	136	132	130
5	130	132	136	140	136	134	140	142	132	134	140	142	136	136
6	130	134	128	128	128	126	126	126	130	136	136	134	140	138
7	110	110	100	106	110	116	106	106	120	128	120	122	130	132
8	144	142	142	144	142	150	130	132	126	126	120	126	132	134
9	114	114	120	124	124	128	120	120	128	132	129	130	130	130
10	134	134	138	142	142	146	136	138	130	132	132	130	136	136
11	130	132	130	136	132	138	132	136	132	136	130	132	138	136
12	136	136	140	142	144	148	138	140	136	140	136	138	130	130
13	126	134	136	140	128	130	120	126	124	130	126	130	132	130
14	142	144	144	150	130	134	128	128	132	136	130	132	132	132
15	140	144	142	148	138	140	140	142	145	146	140	136	138	138

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.3 Systolic Blood Pressure between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30) (Continued)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
16	114	116	110	114	112	114	110	112	110	116	114	118	110	112
17	110	114	112	114	110	112	114	114	120	124	126	128	128	130
18	146	148	140	146	142	142	130	136	126	131	130	134	128	130
19	134	138	140	148	136	136	134	134	130	132	126	130	130	132
20	128	132	128	130	126	130	130	132	134	138	130	132	126	128
21	120	126	122	128	124	128	126	126	124	126	124	124	126	128
22	126	128	124	126	126	128	110	116	116	118	120	122	128	130
23	138	138	140	142	142	144	130	134	132	134	134	132	136	138
24	140	144	146	146	140	142	136	140	140	142	142	140	140	138
25	114	116	126	130	130	136	134	136	142	144	136	136	132	134
26	140	142	136	140	138	140	128	130	134	136	130	128	128	130
27	140	142	135	138	135	136	130	134	132	134	132	130	130	132
28	136	138	140	144	142	144	140	142	142	144	140	136	134	134
29	138	140	136	140	130	132	130	132	128	130	130	126	132	134
30	132	136	130	132	130	130	126	130	128	130	126	128	134	136

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.4 Diastolic Blood Pressure between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	60	60	62	64	64	64	66	66	68	68	66	64	70	70
2	70	70	70	70	72	70	70	72	72	72	74	74	72	72
3	70	68	72	74	72	72	74	76	74	74	72	72	74	74
4	82	80	80	80	80	80	82	84	80	80	78	78	76	76
5	70	70	74	74	70	70	76	78	76	76	78	78	78	78
6	80	80	80	80	80	80	84	84	82	82	80	80	82	80
7	70	70	70	70	72	72	74	74	74	74	78	78	74	76
8	94	94	92	90	92	92	94	94	90	90	92	90	94	94
9	72	70	74	74	74	74	72	70	70	70	72	72	74	74
10	92	90	90	90	90	90	92	90	94	94	90	90	92	90
11	71	70	82	82	82	82	80	82	80	80	86	86	90	88
12	88	88	80	80	82	82	84	82	80	80	82	82	84	80
13	84	84	82	84	80	80	86	86	82	82	80	80	82	82
14	100	100	88	88	82	84	86	86	86	86	84	84	82	80
15	100	100	84	86	86	86	80	80	82	82	80	80	84	84

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.4 Diastolic Blood Pressure between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30) (Continued)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
16	74	74	70	72	70	72	72	72	74	74	80	80	86	86
17	76	76	70	74	74	74	70	72	72	72	82	80	80	82
18	100	100	100	100	98	98	94	94	92	92	92	92	90	90
19	90	90	86	84	86	86	86	86	84	84	90	90	92	92
20	70	70	70	70	74	74	76	74	78	78	80	82	86	86
21	82	82	80	80	84	84	82	80	82	82	82	80	80	80
22	76	76	72	72	74	74	76	76	80	80	78	78	74	70
23	92	92	90	90	92	92	92	90	90	90	92	92	90	90
24	100	100	86	86	80	82	82	80	84	84	90	90	92	92
25	70	70	84	82	80	80	80	80	84	84	86	84	90	90
26	100	100	92	92	94	94	90	92	94	92	94	94	90	91
27	80	80	80	81	82	82	80	82	84	84	84	82	84	84
28	88	88	80	80	84	80	82	80	86	86	82	82	80	80
29	90	92	82	80	82	80	80	80	82	84	80	80	80	80
30	96	98	90	88	88	88	90	88	92	94	90	90	86	86

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.5 Rating of Perceive Exertion (RPE) between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30)

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	7	7	7	8	7	8	6	7	6	9	6	8	6	8
2	6	7	7	8	6	7	7	8	7	8	8	9	6	9
3	8	9	6	9	7	8	6	8	6	9	8	11	6	9
4	6	6	7	8	7	8	7	10	7	10	8	10	8	10
5	9	9	8	8	7	9	7	9	7	8	7	13	8	11
6	8	8	6	9	7	7	8	10	8	10	8	10	8	9
7	8	9	7	10	6	7	6	11	6	11	6	9	7	8
8	10	11	8	10	7	8	8	12	8	9	6	8	6	11
9	6	8	8	9	6	9	6	9	8	9	6	9	7	9
10	7	9	7	10	9	9	8	12	8	11	6	8	6	12
11	8	8	6	8	7	11	7	10	6	8	8	12	8	9
12	7	7	7	9	8	12	8	10	8	12	6	11	6	13
13	7	7	7	10	8	10	6	7	9	10	8	10	7	10
14	6	6	6	10	7	8	8	10	9	9	9	13	8	10
15	7	7	7	11	8	9	8	11	7	8	7	9	6	12

Note: Pre = Pre exercise, Post = Post exercise

Table F 3.5 Rating of Perceive Exertion (RPE) between Pre and Post Seven Steps Low Intensity Exercise of Subjects in Study Group (n=30) (Continued).

No	First step		Second step		Third step		Fourth step		Fifth step		Sixth step		Seventh step	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
16	9	9	8	10	9	10	9	8	9	12	8	12	8	12
17	8	8	7	9	8	9	7	10	7	9	8	12	7	9
18	8	9	7	9	9	8	9	12	10	12	7	9	6	10
19	6	9	7	9	7	10	7	9	6	12	7	11	8	11
20	6	9	6	9	6	7	7	9	6	10	7	8	8	9
21	6	8	6	10	7	8	7	11	8	9	8	9	8	9
22	8	8	6	11	7	9	8	7	7	11	7	10	6	9
23	9	9	8	10	6	7	6	8	7	10	6	9	9	10
24	6	8	6	8	9	10	10	9	7	8	6	8	7	10
25	6	8	8	8	9	12	6	9	7	8	6	12	8	13
26	7	8	8	9	7	11	9	11	10	12	8	10	9	11
27	7	8	6	8	7	9	7	8	7	9	8	9	8	13
28	10	11	6	8	7	8	6	11	6	10	6	9	7	10
29	7	12	6	8	6	7	6	7	6	12	6	10	7	10
30	6	8	7	9	8	9	8	10	8	9	7	10	8	10

Note: Pre = Pre exercise, Post = Post exercise

Table F 4.1 Six Minutes Walk Distance of Subjects in Control Group (n=30)

No	Six Minutes Walk Distance (meters)	No	Six Minutes Walk Distance (meters)
1	332.95	16	236.07
2	182.72	17	246.67
3	235.84	18	214.63
4	258.17	19	300.76
5	289.70	20	290.10
6	245.66	21	278.72
7	225.99	22	268.70
8	289.86	23	300.36
9	364.95	24	225.57
10	258.02	25	280.50
11	214.96	26	300.36
12	268.46	27	272.37
13	293.15	28	282.84
14	282.60	29	236.14
15	257.40	30	244.08

Table F 4.2 Six Minutes Walk Distance of Subjects in Study Group (n=30)

No	Six Minutes Walk Distance (meters)	No	Six Minutes Walk Distance (meters)
1	343.55	16	429.60
2	204.41	17	375.70
3	273.36	18	365.18
4	184.62	19	279.10
5	300.98	20	311.73
6	257.50	21	514.96
7	310.99	22	289.99
8	429.02	23	343.48
9	300.77	24	386.67
10	236.46	25	354.43
11	365.00	26	311.13
12	268.60	27	204.58
13	279.42	28	322.10
14	257.83	29	258.14
15	400.96	30	274.26

Table F 4.3 Heart Rate, Respiratory Rate, Blood Pressure and Rating of Perceive Exertion between Pre and Post of Six Minutes Walk Test of Subjects in Control Group (n=30)

No	Heart Rate (beats/min)		Respiratory Rate (breath/min)		Blood Pressure (mmHg)				Rating of Perceive Exertion	
					Pre		Post			
	Pre	Post	Pre	Post	SBP	DBP	SBP	DBP	Pre	Post
1	65	89	17	39	120	82	124	80	6	12
2	72	95	20	36	120	80	126	82	6	11
3	80	114	20	38	122	90	120	92	6	12
4	82	118	22	34	130	90	134	90	7	11
5	74	108	20	36	126	86	130	86	6	11
6	80	104	18	35	136	96	138	96	7	12
7	72	95	20	36	124	90	128	90	7	12
8	68	100	16	21	120	86	120	88	6	8
9	70	95	16	32	126	86	128	84	6	8
10	75	102	18	30	130	90	132	88	7	9
11	82	106	20	34	120	80	124	80	6	10
12	80	99	20	36	134	90	136	92	6	11
13	68	95	20	35	132	88	132	84	6	10
14	75	93	20	30	130	84	134	84	6	10
15	62	86	18	32	130	94	136	92	6	10

Note: Pre = Pre six minutes walk test, Post = Post six minutes walk test, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure

Table F 4.3 Heart Rate, Respiratory Rate, Blood Pressure and Rating of Perceive Exertion between Pre and Post of Six Minutes Walk Test of Subjects in Control Group (n=30) (Continued)

No	Heart Rate (beats/min)		Respiratory Rate (breath/min)		Blood Pressure (mmHg)				Rating of Perceive Exertion	
					Pre		Post			
	Pre	Post	Pre	Post	SBP	DBP	SBP	DBP	Pre	Post
16	78	100	16	30	128	88	130	86	7	12
17	82	108	18	34	128	80	132	80	8	12
18	69	96	18	30	136	86	138	84	7	10
19	70	97	20	29	132	90	136	88	8	13
20	74	105	20	30	130	94	134	94	6	12
21	84	108	22	33	130	86	130	88	6	11
22	80	106	22	34	126	90	134	90	6	14
23	76	101	20	30	120	82	126	84	7	12
24	70	96	20	36	120	96	124	96	6	12
25	66	93	19	33	128	90	130	92	6	10
26	82	108	20	32	136	84	134	84	7	12
27	80	106	17	28	132	88	130	88	7	12
28	76	103	20	34	138	90	140	90	7	13
29	70	92	22	38	120	80	122	80	6	9
30	70	95	22	30	122	90	120	94	6	10

Note: Pre = Pre six minutes walk test, Post = Post six minutes walk test, SBP = Systolic Blood Pressure, DBP = Diastolic blood pressure

Table F 4.4 Heart Rate, Respiratory Rate, Blood Pressure and Rating of Perceive Exertion between Pre and Post of Six Minutes Walk Test of Subjects in Study Group (n=30)

No	Heart Rate (beats/min)		Respiratory Rate (breath/min)		Blood Pressure (mmHg)				Rating of Perceive Exertion	
					Pre		Post			
	Pre	Post	Pre	Post	SBP	DBP	SBP	DBP	Pre	Post
1	68	92	19	29	120	70	122	70	6	10
2	73	91	21	32	122	70	120	72	6	9
3	70	97	20	34	120	70	120	74	6	9
4	66	94	22	34	130	82	132	80	7	9
5	82	103	22	34	136	80	138	80	8	9
6	80	99	20	34	138	82	140	82	8	10
7	84	114	20	32	130	80	134	80	7	11
8	86	114	20	31	132	96	136	94	7	12
9	72	102	20	30	130	80	134	80	8	10
10	76	103	16	30	140	90	143	94	6	10
11	74	100	20	36	140	92	144	92	7	10
12	74	98	19	33	130	84	130	86	6	8
13	74	99	22	34	130	80	136	86	9	10
14	70	104	20	34	130	80	134	80	6	8
15	71	101	20	36	136	80	136	80	6	8

Note: Pre = Pre six minutes walk test, Post = Post six minutes walk test, SBP = Systolic Blood Pressure, DBP = Diastolic blood pressure

Table F 4.4 Heart Rate, Respiratory Rate, Blood Pressure and Rating of Perceive Exertion between Pre and Post of Six Minutes Walk Test of Subjects in Study Group (n=30) (Continued)

No	Heart Rate (beats/min)		Respiratory Rate (breath/min)		Blood Pressure (mmHg)				Rating of Perceive Exertion	
					Pre		Post			
	Pre	Post	Pre	Post	SBP	DBP	SBP	DBP	Pre	Post
16	73	95	20	36	120	88	124	88	6	8
17	69	89	19	37	130	82	130	84	6	9
18	66	97	20	32	130	92	132	90	7	8
19	85	108	22	34	132	90	134	90	6	8
20	86	112	22	36	128	90	130	90	7	8
21	77	105	22	36	128	86	132	84	6	10
22	70	96	20	35	130	90	132	92	8	9
23	71	95	16	28	126	90	130	92	6	9
24	78	111	19	35	132	88	136	90	6	9
25	84	108	15	30	134	88	136	90	6	9
26	81	103	19	34	120	80	124	82	7	11
27	80	102	15	29	130	90	132	90	6	10
28	78	105	20	32	120	80	126	84	7	10
29	81	103	20	31	130	84	134	84	6	9
30	82	106	22	32	134	80	136	80	7	8

Note: Pre = Pre six minutes walk test, Post = Post six minutes walk test, SBP = Systolic Blood Pressure, DBP = Diastolic blood pressure

Table F 5.1 The Quality of Life after Myocardial Infarction Scores of Subjects in Control Group (n=30)

Item / No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	4	3	4	4	3	2	4	6	5	4	3	5	4	4	2	2	4	2	5	4	4	4	3	4	2	4
2	5	5	2	4	4	4	3	4	5	4	2	2	2	6	2	3	4	3	4	4	3	4	7	3	3	2
3	6	5	3	4	4	5	3	4	4	4	4	3	4	4	4	4	4	5	5	5	4	4	7	4	3	4
4	4	5	4	4	5	4	4	3	4	4	3	3	3	4	3	5	4	5	5	4	4	5	4	3	4	5
5	5	5	4	4	4	4	5	4	5	4	2	2	3	5	2	4	4	3	4	5	4	4	4	3	3	4
6	7	4	2	4	5	3	4	3	4	4	2	4	4	4	2	3	4	3	4	6	5	3	5	4	2	3
7	6	5	3	5	5	3	3	3	3	6	2	2	2	4	1	4	5	4	4	3	7	3	3	3	4	3
8	6	4	4	4	3	4	3	3	4	7	2	4	5	3	3	4	2	5	6	5	5	2	3	4	2	4
9	6	5	4	6	7	2	6	7	3	5	5	5	6	2	5	6	3	6	4	2	5	5	6	4	6	5
10	5	3	3	6	5	3	5	6	3	6	2	4	2	4	4	2	3	4	4	4	4	4	3	3	4	4
11	5	6	4	7	6	5	4	4	5	6	4	4	6	6	5	5	5	4	5	7	6	5	7	5	4	5
12	6	5	2	5	5	5	4	6	5	7	4	3	4	6	3	5	6	3	4	7	4	4	6	5	4	4
13	6	6	4	6	6	6	5	7	6	7	4	4	6	6	4	6	6	4	5	7	5	4	6	6	6	4
14	5	4	4	5	6	7	4	5	5	5	4	4	4	5	3	3	6	4	5	7	4	4	7	5	5	3
15	5	5	2	7	5	5	4	5	7	7	6	6	5	7	5	7	6	4	6	5	6	6	6	4	6	3

Table F 5.1 The Quality of Life after Myocardial Infarction Scores of Subjects in Control Group (n=30) (Continued)

Item / No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
16	5	5	2	4	4	4	4	4	3	5	4	4	3	5	2	5	6	3	3	5	2	4	6	4	7	3
17	6	5	2	4	3	4	3	4	5	5	3	2	4	5	2	5	5	3	4	4	3	3	5	4	2	2
18	5	5	3	4	5	5	4	4	5	6	4	6	6	7	5	4	6	4	6	7	5	5	7	5	4	5
19	6	6	5	5	4	5	4	5	6	6	6	5	5	5	7	6	5	5	5	7	5	4	4	4	5	4
20	6	4	5	5	4	3	5	7	6	5	4	6	6	6	4	4	5	4	5	5	4	4	4	5	4	4
21	7	6	5	5	6	5	5	6	5	5	7	5	5	5	6	5	5	5	6	5	4	4	6	5	5	4
22	6	6	5	5	4	5	5	4	5	4	3	4	5	5	5	5	5	5	5	5	4	5	4	5	4	4
23	4	4	3	4	4	3	3	4	4	4	3	2	3	3	3	4	5	4	4	3	3	4	4	4	4	4
24	6	5	4	5	4	4	4	4	4	5	4	4	3	5	2	4	4	3	4	5	4	4	4	3	3	2
25	4	5	2	4	3	4	4	4	5	5	2	4	3	5	2	4	4	3	4	6	4	4	7	3	3	2
26	4	4	4	5	4	4	3	4	3	4	4	4	4	4	3	4	4	3	4	5	4	4	5	4	3	3
27	5	4	3	4	4	3	5	5	3	4	2	4	3	4	3	3	3	3	3	4	4	4	4	3	3	4
28	5	4	3	3	3	3	4	3	4	4	3	2	2	5	3	3	3	3	4	4	3	4	5	3	3	4
29	4	4	4	4	4	4	3	3	4	4	3	3	3	3	2	4	4	5	4	3	4	4	4	4	4	3
30	5	5	2	5	4	4	4	4	6	5	4	2	4	6	7	5	3	3	2	4	4	3	5	4	3	3

Table F 5.2 The Quality of Life after Myocardial Infarction Scores of Subjects in Study Group (n=30)

Item / No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	6	7	6	6	5	4	4	4	5	7	4	6	6	6	3	5	5	4	6	6	6	7	5	6	6	5
2	6	6	5	7	7	4	4	5	5	7	3	4	4	5	4	5	4	3	4	6	5	6	7	4	4	5
3	7	7	3	7	7	4	5	4	3	7	4	7	7	7	4	4	4	7	7	7	4	7	7	3	4	7
4	4	4	4	5	2	4	3	4	5	4	4	3	4	5	3	4	4	3	4	5	4	2	5	4	4	2
5	5	5	4	6	5	4	5	5	3	6	2	4	4	4	2	3	4	3	5	6	3	4	6	4	4	4
6	2	2	4	1	4	1	4	1	3	2	1	1	2	2	1	3	3	3	3	3	2	1	4	4	1	4
7	2	4	3	3	3	6	3	4	5	2	4	5	5	5	4	5	6	5	3	6	5	4	4	3	5	4
8	6	6	5	4	7	6	7	7	5	6	6	6	6	4	6	7	5	7	5	5	6	6	6	4	7	5
9	3	4	3	4	3	5	3	4	5	4	4	7	4	6	7	3	4	7	4	5	6	4	4	5	4	4
10	4	5	4	4	4	3	4	5	3	5	5	2	6	4	2	5	4	3	4	3	3	4	4	4	5	4
11	7	4	6	6	6	5	6	7	5	7	5	5	4	5	6	5	4	6	7	6	7	6	5	7	4	6
12	6	5	4	7	7	6	5	6	7	6	5	5	6	6	2	6	5	4	5	5	4	5	5	4	6	4
13	5	7	5	5	4	4	4	5	4	5	7	5	5	5	4	4	5	4	6	4	5	5	4	5	5	5
14	3	3	4	4	4	4	3	4	3	4	3	6	3	5	3	4	5	3	4	4	6	5	5	6	4	5
15	6	6	4	6	5	5	5	6	6	6	5	5	5	6	4	6	6	4	4	7	5	4	6	6	6	4

Table F 5.2 The Quality of Life after Myocardial Infarction Scores of Subjects in Study Group (n=30) (Continued)

Item / No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
16	5	4	4	5	4	3	3	3	4	4	4	4	5	3	3	4	4	4	5	5	4	4	5	4	4	4
17	5	7	4	4	5	4	6	6	4	6	7	5	7	5	2	6	6	4	5	6	5	5	7	5	5	5
18	6	6	6	5	6	6	5	6	5	5	5	4	5	5	7	5	5	5	5	6	5	7	6	7	6	6
19	5	7	5	7	6	4	6	6	4	6	7	5	6	5	4	6	6	4	5	6	4	6	5	6	6	6
20	6	6	6	5	6	4	7	7	4	7	6	6	5	4	3	6	5	4	5	6	5	5	7	5	7	5
21	6	6	5	7	7	3	6	6	4	5	7	6	6	4	3	6	5	4	5	5	4	5	5	5	5	5
22	5	5	5	6	7	4	7	7	5	7	6	6	5	4	3	5	4	5	5	4	4	5	5	6	5	6
23	7	6	7	6	7	5	6	6	5	5	7	4	5	7	5	5	6	5	7	5	6	6	5	5	4	5
24	6	5	6	6	5	4	5	5	5	4	5	5	5	4	2	5	5	5	4	5	5	4	4	4	5	4
25	7	3	3	4	4	3	4	4	4	4	2	4	4	4	4	3	4	3	5	5	5	3	5	4	4	4
26	6	5	4	6	7	4	7	7	5	7	5	5	5	5	3	5	5	5	5	5	5	4	6	5	6	5
27	6	5	4	6	5	5	6	5	5	5	5	3	5	5	3	5	7	4	4	7	4	5	6	5	6	5
28	5	5	4	5	4	5	5	5	4	5	7	4	7	4	3	7	6	4	4	4	4	4	6	4	5	4
29	5	7	5	7	7	6	7	7	6	6	6	4	5	5	1	5	5	4	5	5	4	5	5	5	5	4
30	7	5	4	5	5	6	6	5	7	7	5	6	6	7	4	5	6	4	5	6	5	5	5	6	6	5

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