

Effects of Early Mobilization Program on the Heart Rate and Blood Pressure of Patients With Myocardial Infarction Hospitalized at the Coronary Care Unit

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Received: September 30, 2014; Revised: December 9, 2014; Accepted: December 13, 2014

Background: Myocardial infarction (MI) is amongst medical emergency situations. Decline of heart rate and blood pressure during the initial days after admission due to myocardial infarction are the main goals of treatment that decrease the pressure on the myocardium.

Objectives: This study was performed to determine the effects of patients early mobilization program on heart rate and blood pressure of patients with MI hospitalized at the coronary care unit (CCU).

Patients and Methods: This study was a clinical trial that was performed on 38 patients with myocardial infarction at the CCU of Shahid Beheshti hospital of Babol. Samples were selected using purposive sampling and were randomly allocated into experimental and control groups. Patients in the experimental group, within 12 - 18 hours after admission to the CCU, were mobilized with a specified program while in the control group, patients got out of bed on the basis of routine care within 48 hours after admission. Heart rate and blood pressure was measured every six hours during the first and third day of admission and were compared between the two groups.

Results: In the experimental group, mean heart rate during the first day was 82.16 ± 13.83 and on the third day was 75.37 ± 9.73 . In the control group, mean heart rate during the first day was 70.67 ± 13.76 and on the third day was 73.84 ± 12.69 . The difference between the mean heart rates of the first and third day was 6.79 ± 11.2 for the experimental group and -3.16 ± 7.3 for the control group. The findings showed that there was a significant difference between differences of mean heart rate during the first and third days in the two groups ($P = 0.003$). Analysis showed that there was no significant difference between changes of mean systolic blood pressure ($P = 0.1$) and diastolic blood pressure ($P = 0.11$) on the first and third day, in the two groups.

Conclusions: This study showed that the early mobilization program could reduce heart rate. Therefore, based on the results of this study, use of the early mobilization program in the treatment and care program of patients with myocardial infarction is suggested.

Keywords: Heart Rate; Blood Pressure; Myocardial Infarction; Early Ambulation; Coronary Care Units

1. Background

Recently, cardiovascular diseases have become the most common cause of death in the world (1). Statistics during the year 2008 showed that ischemic heart diseases cause over 17 million deaths in the world (2). It is predicted that by 2020, ischemic heart disease would cause 25 million deaths, annually (3). In Iran, cardiovascular disease is also a major cause of death, so that statistics showed that 38% of all deaths and 23.4% lost days of life are due to cardiovascular disease (4).

Acute Myocardial Infarction (AMI) is a medical emergency situation that must be treated as soon as possible. One of the most important medical interventions in myocardial infarction is prevention of the extension of myocardial damage and reduction in the size of infarction. This is important to obtain considering the reduction of

the oxygen demand of myocardium. Therefore, decrease heart rate and bed rest are important interventions for patients with AMI (5).

Despite major medical advances over the past two decades, mortality after AMI is striking, therefore, the need for safe and effective treatment is felt for patients with acute myocardial infarction that have survived. Bed rest and immobilization in the early hours is one of the strategies for effective surveillance and treatment recommended for acute myocardial infarction (6).

Although bed rest decreases the workload of the heart and avoids disruption of the myocardial perfusion as well as being a method for its repair, yet long-term immobilization may lead to specific side effects that prolong the process of patient's recovery and discharge. Immobi-

lization has many complications such as thromboemboli (7). Immobility in the body could increase the risk of impairment in any system. The severity of the damage depends on age, general health of the patient, and duration of immobilization (8). A short bed rest (for 2 - 5 days) not only reduces muscle functional capacity, but also reduces muscle mass and strength and changes the distribution of body fluids (9).

The cardiovascular system is also affected by immobilization. Three major changes that result from immobilization are orthostatic hypotension, increased cardiac workload, and thrombus formation. In immobilized patients, there is decreased circulating fluid volume, pooling of blood in the lower extremities, and decreased autonomic response. These result in decreased venous return, central venous pressure, stroke volume, and a drop in systolic blood pressure when the client stands. Increased cardiac workload is demonstrated by rate changes. Prolonged bed rest increases the resting heart rate from four to fifteen beats per minute. When the immobilized client is asked to do physical activity, this increased rate is more pronounced. As the workload of the heart increases, so does its oxygen consumption. The heart therefore works harder and less efficiently during prolonged rest (10).

Early mobilization of patients can be effective in prevention of these complications. Early movement of non-cardiac patients has been practiced for many years. Several studies have shown that in surgical wards, patients' early mobilization after any surgery is very effective in reducing the side effects, and causes a feeling of satisfaction in patients (11). Other studies have also shown that early mobilization of patients after coronary angiography is not only safe and doesn't increase vascular complications resulting from angiographic, but also increases patient's comfort (12, 13).

After acute myocardial infarction, despite the expansion and enhancement of care patterns, a significant group of patients still traditionally remain in bed for a long time and prefer to be sedentary and have a passive role. Since patients with acute myocardial infarction are at a high risk of death during the first week, it is important to determine the relative effects of early mobilization as part of the initial treatment after AMI. Although some studies had shown that early mobilization could reduce the mortality of AMI by 15%, these effects are not clear (14).

It is believed that in the absence of complications, patients with myocardial infarction without ST-segment elevation need not be confined to bed for more than 12 hours, unless they are hemodynamically compromised (15).

According to some studies, it has been supposed that in patients with myocardial infarction, shorter rest periods can be safer than longer rest periods. Cortes et al. (2009) showed that the early mobilization of patients after AMI, could reduce mortality. However, researchers recommended that further studies are needed (14). Results of some studies suggested that early rehabilitation during the acute phase of myocardial infarction could reduce

the adverse effects of long-term bed rest and reduce the length of hospitalization (6, 7).

Early mobilization is a simple and widely applicable intervention for patients with acute myocardial infarction that may be more effective than other interventions for sustaining life and reducing the mortality rate of patients. Early mobilization programs have recently been developed by nurses (as members of the cardiac rehabilitation team at the hospital) that have not only improved cardiovascular health results, but also improved the patient's mental status before discharge from the hospital (14).

2. Objectives

Due to the positive effects of early rehabilitation programs and physical activity in improving the hospitalized patients' status, the purpose of this study was to determine the effects of an early mobilization program on heart rate and blood pressure of patients with AMI.

3. Patients and Methods

This study was a clinical trial that was performed during the year 2012. In this study, 38 patients, with myocardial infarction that were admitted to the Coronary Care Unit (CCU) of a hospital in Babol city, were selected. The inclusion criteria were as follows; age of less than 75 years old, absence of hemodynamic compromise, absence of atrioventricular block grade II and III, no cardiac complications after AMI, absence of acute psychiatric disorders and movement disorders. The sample size was estimated on the basis of the formula of sample size estimation, with a confidence coefficient of 95% and a test power of 80%; a sample size of at least 24 was estimated, but for more accuracy, sampling was continued until 38 subjects were selected (19 patients in the experimental group and 19 patients in the control group).

In this study, amongst the available patients, individuals with the inclusion criteria were selected by the purposive sampling method, and were randomly allocated to two groups: experimental and control groups. In addition, to control age and sex variables, the randomized block design was used. Thus for age, two states (≤ 60 years and > 60 years) and for sex, two states (male and female) were considered.

In this study, data were collected using two questionnaires. One questionnaire collected the patient's demographic data (including age, sex, education level, weight, disease background, type of stroke, and patient MI area), and other questionnaire registered the blood pressure and heart rate of the patients. Blood pressure and heart rate of all patients were recorded from the time of admission by a monitoring device (Nihon Kohden device, BSM-2351K models, made in Japan) connected to the patients; these parameters were recorded every six hours and their means were compared on the first and third day.

Ethical considerations were regarded in this study, so that sampling began after obtaining permission from

the ethics committee of Semnan University of Medical Sciences and the hospital and CCU ward authorities. The researcher referred to the relevant ward and selected patients who were suitable for inclusion in the sample. After introducing himself to the samples, the researcher gave them adequate explanation about the research objectives, methods, voluntary participation in the study, and confidentiality of their information. The questions were answered and a written consent was obtained for participation in the study.

In the experimental group, the patient's early mobilization, which was designed by the researchers and based on reliable sources (5, 15), was performed as follows:

First phase: during this phase the patient, after 12 - 18 hours of admission to the hospital, was moved from lying to sitting position. Following a control of heart rate and blood pressure, in the absence of hemodynamic abnormalities (systolic blood pressure < 100 mmHg and heart rate < 55 beat per minute) and arrhythmias with direct supervision of a researcher, the patient could hang his leg for five minutes, and then got back to the sleeping position.

Second phase: at least three hours after the first phase and resting in bed, following control of heart rate and blood pressure, in the absence of hemodynamic and arrhythmias abnormalities, with direct supervision of a researcher, after hanging his legs, if there was no problem, the patient was allowed out of bed and sat for five minutes on the chair next to the bed and then went back to bed and rested.

Third phase: 24 hours after admission, following control of heart rate and blood pressure, in the absence of problems, under the direct supervision of a researcher, the patient was allowed to sit for 10 minutes on the chair next to the bed.

Fourth phase: at least three hours after the third phase under the direct control and supervision of the researcher, and in the absence of problems, the patient stood for 10 minutes besides his bed, walked and got back to his bed again.

Fifth phase: at least three hours after the fourth stage, after controlling vital signs and absence of problems, under the direct supervision of the researcher, the patient walked beside his bed for five minutes and then under the direct control of the researcher the patient walked in the CCU ward for ten minutes (ten steps out and ten steps back) and got back to his bed again.

Sixth phase: 48 hours after admission, the patient in the

absence of problems and under the direct supervision of the researcher, first walked besides his bed for five minutes and then walked around the cardiac intensive care unit for ten minutes (ten steps out and ten steps back) and got back to his bed again.

Seventh phase: at least three hours after the sixth stage, under the direct supervision of the researcher and in the absence of problems, the patient walked for 15 minutes as far as he could bear, around the CCU ward (20 steps out and 20 steps back) and got back to his bed again.

Eighth phase: at least three hours after the previous step, this step was repeated as the seventh step, and if there were no problems in terms of movement, the patient was left in a rest position.

In the control group, patients' mobilization as the ward routine schedule was done 48 hours after admission with the help and supervision of the researcher as follows: on the third day, in the absence of problems, patients were initially transferred from their bed to a chair next to the bed and sat on the chair for a period of five to ten minutes. If there were no problems, they walked besides their bed for five to ten minutes and then went back to their bed. This was repeated twice a day, and the patients were resting during the day on their bed. On the fourth day after admission, in the absence of problems, patients initially walked beside their bed for 15 minutes, and if there were no problems, they walked around the CCU ward for 15 minutes and were then left to rest.

Data analysis was performed with the SPSS software V.16. Descriptive and inferential statistical methods were used. Kolmogorov-Smirnov test (to check data normalization) and independent t-test (to evaluate the difference between means) were used. Data analysis was performed at a significance level of $P < 0.05$.

4. Results

This study included 38 patients with myocardial infarction who were divided to experimental and control groups. Data analysis showed that the patients in the two groups matched in terms of educational level and history of disease. Findings showed that the difference between mean heart rate on the first and third day in the experimental group was 6.79 ± 11.2 , and in control group was -3.16 ± 7.3 (Table 1). The independent t-test showed that there was a significant difference between mean heart rate of experimental and control groups during the first and third day of admission ($P = 0.003$).

Table 1. Mean Heart Rate of Patients Before and After Intervention and Their Changes ^a

	Test	Control	P Value
Heart rate			
Before the intervention (first day)	82.16 ± 13.83	70.76 ± 13.76	0.015
After the intervention (third day)	75.37 ± 9.73	73.84 ± 12.69	0.68
The difference between, before and after intervention	6.79 ± 11.2	-3.16 ± 7.3	0.003

^a Data are presented as Mean \pm SD.

Table 2. Mean Systolic Blood Pressure of Patients on the First and Third Day of Hospitalization and Their Changes ^a

Group	Test	Control	P Value
systolic blood pressure			
First day	125.32 ± 20.95	124.8 ± 18.14	0.93
Third day	110.11 ± 14.48	120.63 ± 12.48	0.02
The difference between first and third day	15.21 ± 20.86	4.15 ± 19.93	0.1

^a Data are presented as Mean ± SD.

Table 3. Mean Diastolic Blood Pressure of Patients on the First and Third Day of Hospitalization and Their Changes ^a

Group	Test	Control	P Value
Diastolic blood pressure			
First day	78.89 ± 14.39	76.16 ± 12.89	0.54
Third day	71.68 ± 9.27	76.68 ± 9.15	0.1
The difference between first and third day	7.21 ± 15.93	- 0.52 ± 13.19	0.11

^a Data are presented as Mean ± SD.

Results showed that the difference of mean systolic blood pressure between first and third day of admission in the experimental group was 15.21 mmHg and in the control group was 4.15 mmHg. Independent t-test results showed that there was no significant difference between mean systolic blood pressure of the two groups on the first and third day of admission ($P = 0.1$) (Table 2). Table 3 suggests that the difference of mean diastolic blood pressure on the first and third day of admission was 7.21 mmHg for the experimental group and - 0.52 mmHg for the control group. Independent t-test showed that there was no significant difference in mean diastolic blood pressure of the two groups on the first and third day of admission ($P = 0.11$).

5. Discussion

In general, different pharmacologic and non-pharmacologic approaches are used to prevent complications caused by long-term hospitalization of patients with AMI. Patient rehabilitation and early mobilization are non-pharmacological and safe strategies that prevent complications of patients related to bed rest. This study was performed in line with these goals to determine the effects of early mobilization on the heart rate and blood pressure of patients with AMI admitted to the CCU ward.

Regarding the research objectives on determining mean heart rate of patients with MI in the early mobilization group and the control group and the comparison of these two, the results showed that there was a significant difference between mean heart rate during the first and third day of the experimental and control groups. Dashti (2012) investigated the effects of selected exercise training on body composition and heart rate, and their results were consistent with this study indicating a decrease in heart rate in the experimental group after intervention (16). Another study by Legramante et al. (2007) investigating the effect of resistance exercise on heart rate

recovery in coronary artery patients showed that after completion of exercise sessions, heart rate reduction in the experimental group was significantly higher than the control group (17). The results of the study by Kargarfard et al. (2005) titled "the effect of a cardiac exercise rehabilitation program on the level of variations of silent ischemia and ejection fraction in patients with myocardial infarction" showed that heart rate before rehabilitation of high-risk patients in the resting phase was 92.93 bpm while after cardiac rehabilitation it significantly decreased to 80.27 bpm (18). In a study by Genc et al. (2012) titled "study of hemodynamic and respiratory responses to early mobilization of critically ill obese patients", the results showed that heart rate before and after movement was significantly different, so that heart rate was reduced after movement (19).

Other studies confirmed the results of this study. Nevertheless, the results of some studies were in contrary with the findings of our study. Rowe et al. (2010) in relation to the impact of early mobilization after myocardial infarction showed that heart rate on the fourth day was 70 ± 10 bpm in the experimental group and 70.13 bpm in the control group. The mean heart rate of patients in the experimental group on the fourteenth day was 64.12 bpm while this was 65.12 bpm for the control group with the difference being statistically significant (20).

Reduced heart rate related to early mobilization occurs by mechanisms that are not fully known, but it seems that training increases parasympathetic nerve activity while it reduces sympathetic nerve activity (21). Also some previous studies claim that this decrease could be the result of an increase in cardiac output, enhancement of oxygen transport and increased stroke volume (22). In these studies, the reduction in heart rate during the first minute of recovery period in patients of the experimental group indicates possible improvement in the patient's autonomic nervous system activity. This effect is

probably related to the effects of cardiac rehabilitation period on balance of sympathetic and parasympathetic nervous system. Decrease in heart rate during the recovery period leads to factors influencing mortality in cardiac patients (23). Exercise is effective in reducing heart rate at the resting position and increases the efficiency of the heart. According to various studies, arrival of greater blood volume and increased cardiac contractility in pumping blood due to regular exercises (endurance, strength and motor) may be a reason for decreased heart rate at rest position (24). Normally, during activity and exercise, heart rate is higher than usual. Moreover, secondary response reduces the activity of vagal tone and as a result increases sympathetic activity. After exercise and training, parasympathetic nerves react and reduce sympathetic activities, which together improve heart rate at resting position. During the first minute after exercise and activity heart rate returns to its first state and this is called the recovery heart rate (15).

The reason for increased heart rate in the control group could be due to greater stress due to prolonged bed rest. As a result of physiological responses to stress, epinephrine, and norepinephrine levels increase and this leads to increased heart rate and blood flow to muscles. This increase has some risks for the patient, including an increase in myocardial oxygen demand caused by increased activity of the heart (25). Anxiety is one of the most common psychological reactions that all humans typically experience during their life. Anxiety increases heart rate, breathing and blood pressure (26). In general, in people with anxiety, autonomic nervous system is overactive, which causes increased heart rate and change in respiratory rate (27).

The results of the current study showed that there was no significant variation in the meansystolic blood pressure between the first and third day for the experimental and control groups. Also, there was no significant difference between mean diastolic blood pressure of the experimental and control groups on the first and third day. Results of other studies in this field confirm the results of this study. The study of Genc et al. (2012) on hemodynamic and respiratory responses to mobility in patients with severe obesity showed that there was no difference in systolic and diastolic blood pressure during the resting phase before and after movement (19). Also, in a study by Mohamadi (2006) entitled "clinical trial of progressive muscle relaxation on vital signs of patient with heart attack", the results showed that systolic and diastolic blood pressure changes before and after intervention in the two groups was not statistically significant (28).

Findings of other studies in this field are inconsistent with the results of this study; a study by Naghibi (2008) entitled "the effect of a combined training program on hemodynamic responses in male patients with coronary artery disease", the results showed that the difference between systolic and diastolic blood pressure and heart rate before and after intervention was statistically significant

(29). In another study by Shabani (2011), the results showed that after completion of the rehabilitation period, systolic blood pressure was reduced by 11.1%, and diastolic blood pressure at rest by 14.7% in the experimental group, with the difference being statistically significant (30). The reason for the difference between these results and our results may be due to differences in duration of cardiac rehabilitation and selection of orthopedic patients as the control group against patients with heart disease as the experimental group in other studies.

A study performed by Hosseiny (2007) was in line with our study in terms of changes in systolic blood pressure, while it was inconsistent with our results in terms of diastolic blood pressure (31). The reason for the difference between the results of this study and our results could be due to the lack of a control group for comparison and inclusion of individuals who had a history of hypertension.

It seems that differences in race, gender, inclusion criteria for sample selection, and the intensity and duration of exercise also cause differences in results; for example, in another study by Stewart (2005), the results showed that changes in mean systolic blood pressure of the experimental group was not statistically significant but changes in mean diastolic blood pressure was statistically significant (32). Differences between our results and previous studies are probably due to differences in sample selection, duration of rehabilitation programs, and recovery program in combination with diet; the patients in this study were middle-aged with mild hypertension and had a rehabilitation period of six month.

One of the limitations of this study was that, due to certain circumstances and contribution of only one heart specialist, sampling of various hospitals was not possible; therefore, it is recommended to conduct further comprehensive studies in more hospitals in the future to present a better comparison and picture of the impact of this type of intervention.

Based on the results obtained from this study, it could be concluded that an early mobilization program reduces heart rate, and thus myocardial muscle strain in patients with AMI. Based on the results of this study, it can be suggested that nurses should consider using this program in patient care and treatment programs.

Acknowledgements

This paper was extracted from the thesis of Mr. Hassan Ali Jafarpoor, a graduate student in critical care nursing at Semnan University of Medical Sciences. This study was an approved research project (No. 389) from Semnan University of Medical Sciences, thus the researchers would like to thank all the authorities of Semnan University of Medical Sciences for providing permission to conduct this research and financial support. Also, the collaboration of the CCU ward staff of Babol Shahid Beheshti Hospital is greatly acknowledged. Furthermore, we thank all patients with heart disease who participated in this research.

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