Medical Journal of the
Islamic Republic of Iran

Volume 18
Number 4
Winter 1383
February 2005

STUDY OF THE ASSOCIATION BETWEEN ACTIVITY LEVEL AT ONSET OF SYMPTOMS AND PATIENT OUTCOME OF FIRST ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

This study sought to compare the clinical features and outcome of a first acute myocardial infarction (AMI) with onset of symptoms during or within 30 minutes of exercise, at rest and in bed.

Information collected using a standard questionnaire was used to relate activity at the onset of symptoms and in-hospital outcome in 500 consecutive patients admitted to our heart center with a first AMI between 2000-2002.

Patients with exercise–related onset were more likely to be younger and male. Those with onset in bed were more likely to be older and have a history of stable or unstable angina. By way of comparison between patients whose symptoms began at rest and exercise, those with exercise–related onset had lower in-hospital mortality after adjusting for age and gender [odd's ratio (OR) 0.53, 95% confidence interval (CI) 0.39-0.93 (p= 0.03)]. Compared with patients whose symptoms began at rest, patients with onset in bed had a higher mortality rate [OR 1.42, 95% CI 1.03 – 1.98 (p= 0.028)].

The incidence of moderate or severe left ventricular dysfunction was also lower for exercise – related onset [OR 0.79, 95% CI 0.6-1.01 (p= 0.32-but not statistically significant)] and higher when onset was in bed [OR 1.5, 95% CI 1.2-1.77 (p= 0.039)].

There is an association between activity at onset and outcome of AMI. Differences in pathophysiology or in the population at risk could explain this observation.

MJIRI, Vol. 18, No. 4, 293-296, 2005.

Keywords: Activity, Acute Myocardial Infarction, Outcome.

INTRODUCTION

A circadian variation in the onset of AMI is well described with the highest risk during the first few hours after rising and a lower risk later in the day and night while asleep.[1,3] In addition to this circadian variation, it is known that strenuous exertion can trigger myocardial infarction (MI).[4,5] However the pathophysiology of exercise, nonexercise and sleep – related MI is the same. Although they are likely to share similar mechanisms, it is possible that the relative importance of factors, such as plaque rupture, contribution of coronary vasoconstriction and coagulability, differ for exercise, nonexercise and sleep related MI.[4] Differences in pathophysiology or in the population of patients at risk may influence the outcome of the coronary event. The present

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study investigates this possibility by comparing the clinical features and in-hospital outcome of patients whose symptoms of a first AMI began during exercise, at rest and in bed.

MATERIAL AND METHODS

The study included 500 consecutive patients admitted to our heart center from 2000-2002 with a first AMI. A standard questionnaire that contained information on activity at onset of symptoms, coronary risk factors and outcome was completed. The diagnosis of MI was based on the presence of at least two of the three following criteria: a typical history of chest discomfort lasting >15 minutes, an increase in cardiac enzyme levels to more than two times the upper limit of the normal range and the appearance of Q waves or elevation of characteristic ST segment on serial electrocardiograms (ECGs).

Activity was documented as exercise related (Yes/ No) if the patient was undertaking activity equivalent to or more than 4 metabolic equivalents.[6] Other patients were classified as having symptom onset in bed (at sleeping) or onset at rest.

Analysis and statistics

Patients with symptom onset during or within 30 minutes after end of exercise were compared with those whose symptoms began at rest. Patients whose symptoms began in bed were also compared with those with symptom onset at rest. Study data was statistically analyzed by ANOVA and chi-square tests. We used SPSS 10.0 package for analysis of data. Patients' characteristics and outcome results presented as odds ratios and 95% confidence intervals. P value <0.05 was regarded as statistically significant.

RESULTS

Mean age in patients was significantly different in three groups (P=0.032) and increased age was associated with a decrease in the proportion of patients with exercise – related onset of MI and a greater proportion with symptom onset in bed. There was little age difference in the proportion of patients with symptom onset at rest (Table I).

After adjusting for age, Women were relatively more likely to have onset of symptoms in bed and less likely to have exercise–related onset of symptoms (Table II).

Table I. Activity at onset of symptoms by age group.

Symptom onset	Percent (N=500)	Age Group (Yr) <50	50-59	60-69	>70
Exercise	27.9%	31.1%	32.6%	23.3%	21.2%
In bed	32%	27.9%	26.3%	35.2%	42.3%
At rest	40.1%	41%	41.1%	41.5%	36.5%

Table II. Comparison of patients by activity at onset of symptoms.

Groups / Variable	Exercise vs. onset at rest			Onset in bed vs. onset at rest		
	Percent	OR (95% CI)	P value	Percent	OR (95% CI)	P value
Female	42/23	1.9(077-2.81)	0.031	31/23	1.3(0.71-1.91)	0.09
Current smoker	59/53	1.1(0.62-1.43)	0.67	55/53	1.06(0.77-1.18)	0.81
Diabetes	12.6/17	0.58(0.41-1.22)	0.040	19/17	1.1(0.68-1.4)	0.90
Hypertension	37/46	0.76(0.54-0.9)	0.044	52/46	1.6(0.68-2.03)	0.047
Hyperlipidemia	45/43	1.1(0.6-1.4)	0.83	48/43	1.21(0.55-1.61)	0.70
Familial history	20/18	1.18(0.85-1.55)	0.73	19/18	1.13(0.87-1.27)	0.87
Stable angina	38/39	0.97(0.79-1.32)	0.99	42/39	1.42(1.03-1.69)	0.039

OR= Odds ratio CI= Confidence interval

Table III. Association between activity at onset of symptoms and outcome.

Groups / Variable	Exercise vs. onset at rest			Onset in bed vs. onset at rest		
	Percent	**OR (95% CI)**	**P value**	**Percent**	**OR (95% CI)**	**P value**
Q wave MI	58/69	0.59(0.61-1.01)	0.041	74/69	1.2(0.98-1.42)	0.21
Heart failure with EF <40%	33/38	0.79(0.6-1.01)	0.32	49/38	1.5(1.2-1.77)	0.039
In-hospital mortality	4.9/9	0.53(0.39-0.93)	0.030	17.4/9	1.42(1.03-1.98)	0.028

OR= Odds Ratio CI= Confidence interval EF= Ejection fraction

Also after adjusting for age and gender the proportion of patients who were current smokers or had recognized hypercholesterolemia, diabetes or family history of cardiovascular disease were similar for those with symptoms onset during or after exercise, at rest and in bed (Table II). Patients with symptom onset in bed were more likely to have a past history of stable angina or recent unstable angina but less likely to have a history of hypertension (Table II).

A similar proportion of patients with symptom onset on exercise and at rest had a history of stable or unstable angina (Table II).

Q wave infarction was less frequent in patients with exercise – related onset than those with onset at rest or in bed (Table III).

The odds ratio for in-hospital death for exercise-related onset compared with onset of rest was 0.53 (95% CI 0.43 to 0.97) and for onset in bed compared with onset at rest was 1.42 (95% CI 1.09-1.9) and both of them were significantly different (p= 0.03 and 0.02 respectively) (Table III).

Patients with symptom onset in bed had the highest in-hospital mortality rate (Table III). The proportion of patients who developed moderate and severe heart failure (LVEF<40%) was lowest for exercise – related onset (p= 0.32) and highest when onset of symptoms was in bed (p=0.039) (Table III).

DISCUSSION

Although exercise is the trigger factor for MI, but those patients had less extension of coronary artery involvement and better prognosis. This conclusion is consistent with the observation from the thrombolysis in MI (TIMI II) study[7] that patients with exercise-related onset MI were less likely to have multivessel disease and more likely to have a single coronary artery after thrombolysis. Conversely patients with onset of symptoms in bed are more likely to be older and have a history of stable or unstable angina, suggesting more extensive vascular disease or a preexisting unstable lesion and therefore a lower threshold for abrupt coronary occlusion.

Information on the routine amount of physical activity of participants was not available. Patients with exercise related onset may be habitually more active and therefore have a greater exposure to both the risks and benefits of exercise[4,8,9] Gohlke and co-workers and O'connor et al. in their randomized trials of cardiac rehabilitation observed that regular exercise reduces the risk of fatal more than nonfatal MI.[10,11]

In the present study patients whose symptoms of MI began during or shortly after physical activity had both lower in-hospital mortality and less cardiac failure than those whose symptoms began at rest, similar to Tofler's study. The highest mortality and incidence of heart failure occurred in patients whose symptoms began in bed. The observation that the outcome of MI is influenced by the activity at the onset of symptoms has not been made in earlier studies.[1,5]

Differences in the pathophysiology of exercise and nonexercise – related MI are possible. The lower incidence of Q wave MI in patients with exercise – related onset would be consistent with more rapid coronary reperfusion because of spontaneous thrombolysis and relief of coronary vasoconstriction induced by exercise.[12] Other potentially protective mechanisms such as ischemic preconditioning[13] or the warm – up effect[14] could be influenced by activity before coronary occlusion, that Kbrier et al[13] and Stewart et al[14] reported these important mechanisms in their details.

CONCLUSION

Our findings indicate that there is an association between activity at the onset and outcome of AMI, and the highest mortality and incidence of complications occurred in patients whose symptoms began in bed. Further studies are needed to gain a better understanding of the reasons for the difference observed and their po-

tential relevance to the prevention and management of ischemic heart disease.

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