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RISK FOR EARLY ISCHEMIC EVENT AFTER ACUTE MYOCARDIAL INFARCTION IN WORKING MALES

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Abstract. We attempt to predict ischemic events in the weeks following the hospital discharge after acute myocardial infarction (AMI) in order to aid occupational physicians in taking return-to-work decisions. Included in the study were 1299 AMI patients from 14 coronary care units in Israel who had been employed before hospitalization and were seen after discharge 1, 2, 4, 6, 9 and 12 months after the first AMI. Cardiovascular accidents included death from cardiovascular disease, recurrent infarction or hospitalization due to congestive heart failure or unstable angina. The rate of a first recurrent cardiovascular accident decreased rapidly over the first few weeks. The risk in the third week was still 51 per 1000 person-months, 13.4 (95% CI: 9.2–19.5) times higher than that after 10 weeks when the incidence reached a low steady state. The major predictors in a logistic regression model for an event were: older age, past history of a cerebrovascular event, and congestive heart failure during the course of hospitalization, but the area under the receiver-operator curve was only 64.4%. We conclude that after acute myocardial infarction, the major risk for a recurrent event is a lapse of time from discharge but not other clinical variables. This should be taken into account when considering a proper timing of return-to-work after an acute myocardial infarction.

Key words:
Acute myocardial infarction, Risk factors, Return-to-work, Timing

INTRODUCTION

The appropriate timing of return-to-work (RTW) after acute myocardial infarction (AMJ) is not known. Cardiologists recommend RTW two weeks after the hospital discharge in those doing clerical or modified work, 35 days for manual work, and 56 days for those doing heavy manual work after a negative stress test [1]. Others set 14 days as a minimum number of sick leave days, with an optimum of 42 days for sedentary or light work, 56 days for medium work, 84 days for heavy work, and 112 days for very heavy work [2]. Yet in practice the median time to return to work is 55 days with only few patients returning to work after two weeks [1,2].

Although most experts modify their recommendations according to the degree of physical effort at work, there is no evidence that exercise impairs or facilitates the remodeling of the infarcted area. Work might however, induce recurrent cardiac events, since both acute physical activity [3] and anger [4] have been shown to be associated with acute myocardial infarction. Recurrent events at work after physical effort or emotional stress have been reported [5] and might lead to claims for compensation.

An attempt to predict early mortality (within 30 days for myocardial infarction, including hospitalization) has shown that systolic blood pressure, symptoms of congestive heart failure, location of the infarction, previous

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infarction, height, time to treatment and diabetes are independent predictors [6]. These studies however, have generally included a majority of patients at the age of retirement, and no comparison with the decreasing risk over time has been attempted. This is an important information for physicians who consider the most appropriate time for a patient to return to work.

In this study we attempted to define factors which predict recurrent ischemic events in the first few weeks after acute myocardial infarction in 1299 men from 14 coronary care units in Israel who had been employed before hospitalization.

MATERIALS AND METHODS

Patients were recruited from 14 of 21 coronary care units in Israel between August 1981 and July 1983, and were enrolled in the Secondary Prevention Reinfarction Israeli Nifedipine Trial (SPRINT) [7]. Male and female patients, aged 30–74 years, were eligible if they had the diagnosis of a recent acute myocardial infarction and had survived the hospitalization. Among all hospitalized males, in-hospital mortality ranged from 3.2% in those under 49 years of age to 27.4% in patients aged over 70 years [8].

The presence of one of the following three sets of conditions was used as a basis for making diagnosis:

1. Typical symptoms, elevated serum levels of cardiac enzymes and electrocardiographic findings of either Q/QS with major ST- and/or T-wave abnormalities, dynamic ST depression or elevation, or dynamic T-wave changes, in comparison with 2 recent electrocardiograms.
2. Atypical symptoms, elevated serum levels of cardiac enzymes and 1 of the following Q/QS changes in comparison with 2 recent electrocardiograms: appearance of Q/QS findings in the second electrocardiogram that were not present in the first, or the appearance of major Q/QS findings (Minnesota codes 1.1.1 through 1.17) that were previously only minor (codes 1.2.8 through 1.3.6).
3. Typical symptoms and electrocardiographic findings required under the second set of conditions without enzyme elevations [9].

Patients requiring calcium antagonists therapy were excluded from the trial. Other exclusion criteria were the presence of Prinzmetal's variant angina, non-coronary heart disease, previous cardiac surgery or pacemaker implantation, severe pulmonary hypertension, uncontrollable congestive heart failure preceding the recent AMI, persistent hypotension (systolic blood pressure (SBP) < 90 mmHg), complete left bundle-branch block or Wolff-Parkinson-White syndrome, cerebrovascular accident, malignant disease, renal or hepatic failure, alcoholism or psychiatric disorder, and known sensitivity to Nifedipine.

Patients were asked to sign an informed consent form after receiving a detailed explanation of the operational procedures and principles of the study, and particulars regarding the follow-up visits and potential side-effects.

Of the 3706 age-eligible males in the 13 recruitment centers, 1816 (49%) males were randomized. The major causes for exclusion were inability to cooperate, or refusal to sign the consent form (37.1%) and the need for treatment with calcium antagonists (Nifedipine or Verapamil) (12.6%). Eleven percent of age-eligible patients were excluded because of failure to fulfill SPRINT criteria for AMI.

Of the 1816 men, 1299 (71.5%)) had worked full-time before the hospitalization and were included in this study. They were younger, with a lower prevalence of hypertension, diabetes mellitus, previous myocardial infarction (MI) or cardiovascular accident (CVA), and peripheral vascular disease then reported for the entire cohort [8,9]. Yet their hospital course with regard to the area of infarction, degree of enzyme elevation, and the finding of either congestive heart failure or serious arrythmias was similar to that in the cohort as a whole [8,9]. In the study group there were 586 (45.1%) workers under 55 years of age.

Follow-up visits were scheduled 1, 2, 4, 6, 9 and 12 months after the first AMI for all patients, including those who dropped out from the study protocol. Cardiovascular accident included death from cardiovascular disease, recurrent infarction or hospitalization because of congestive heart failure or unstable angina.

RESULTS

There were 1299 male patients who worked before hospitalization. The mean duration of hospitalization was 12

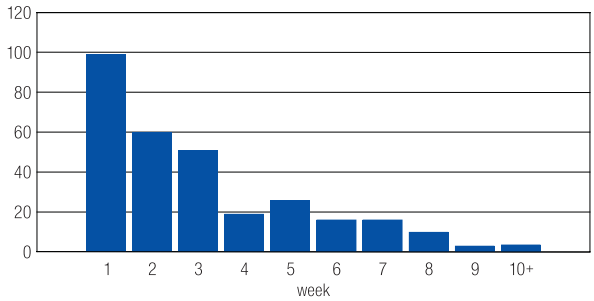

Fig. 1. Cardiovascular events (events per 1000 person-months) in the weeks following acute myocardial infraction.

days. The rate of a first recurrent cardiovascular accident decreased rapidly over the first four weeks (Fig. 1), decreased slowly over the subsequent 4 weeks, and then was only 3.6 per 1000 person-months over the next 10 months. The risk in the third week was 51 per 1000 person-months, 13.4 (95% CI: 9.2–19.5) times higher than that after 10 weeks. Even in the 7th week, the risk was still 4.3 times the risk after 10 weeks (95% CI:, 2.54–7.20).

Of the 141 accidents in the first year, 76 (53.9%) occurred in the first month, with the rate of 58.5 per 1000 person-months. The major predictors for an accident were: older age, past history of a cerebrovascular accident, and congestive heart failure during the course of hospitalization (Table 1). The past history of previous myocardial infarction was negatively associated with a recurrent event. The ability to predict an event during the first month after discharge was limited. On multivariate analysis, all these factors significantly added to the model, but the area under the receiver-operator curve (ROC) was only 64.4%. (Table 2). During the first month the rate of accidents in the younger group (under 55 years of age) was nearly half of that observed in those aged 55 years or more (46.1/1000 person months vs 76.9/1000 person-months). After eliminating those with the past history of CVA or chronic heart failure (CHF) during the course of hospitalization the rate of these events was reduced to 40.1 and 59.8 per 1000 person-months, respectively. This is still much higher than the lowest observed risk of accidents (3.6 per 1000 person-months), occurring in and subsequent to the 9th post-discharge week. If we took the low-risk workers (544 workers aged under 55 years, without the history of CHF during hospitalization or past CVA), their risk during the third week was still 51 per 1000 person-months, and during the 7th and 8th week the risk was still 11.1 per 1000 person-months compared to a subsequent risk after 9 weeks which was similar to that of the entire cohort (3.8 events per 1000 person-months).

After discharge, 20 (1.5%) workers returned to work within 2 weeks, 97 (7.5%) within 4 weeks, and 418 (32.2%) within 8 weeks. There was only one recurrent event over a one month period after RTW in those who returned to work within 8 weeks (2.4 events per 1000 person-months). This occurred in a 54 year-old blue-collar worker who was hospitalized with acute inferior wall myocardial infarction. He was a smoker and was treated for hypertension. His hospital course was not complicated except for a run of ventricular tachycardia and he was discharged after 13 days with only anti-hypertensive medication. Four days later, he returned to his job entailing light to moderate physical effort, and after 17 working days, he had unstable angina and was rehospitalized.

DISCUSSION

The major finding of our study is that the risk for a recurrent cardiovascular accident after acute myocardial infarction decreases rapidly over the first 9 weeks after discharge from the hospital. Even in the 7th or 8th week, the risk is still around 3 times the stable low rate which occurs after the 9th week. Thus, even if physical work or mental stress at work does not increase the risk for a recurrent event, the worker is at increased risk if he returns to work within the first month. The accepted clinical risk factors were poor predictors of early recurrent events, and none of the low risk subgroups could be identified with an earlier obtainment of the stable low risk.

Our findings should be interpreted with caution. They were obtained in workers at the pre-thrombolytic treatment age, and during a period when the incidence of cardiovascular disease mortality was still decreasing. Also the inclusion criteria selected lower risk patients. Although it has been found that thrombolysis improves survival, still over 50% of deaths and recurrent ischaemia are reported to occur within the first 30 days [10,11]. Early events

Table 1. Any cardiovascular event within 30 days after hospital discharge

Variable	Any event n = 76 (%)	Other n = 1223 (%)	Relative risk with 95% CI	p-value
Mean age	56.7 ± 7.5	54.1 ± 8.4		0.0218
History				
Angina before AMI	34 (45)	492 (40)	1.11 (0.86–1.44)	0.437
Hypertension	31 (41)	464 (38)	1.07 (0.81–1.42)	0.620
Diabetes mellitus	17 (22)	205 (17)	1.33 (0.86–2.07)	0.208
Cigarette smoking	46 (60)	674 (55)	1.10 (0.91–1.33)	0.357
Peripheral vascular disease	1 (1.3)	34 (2.8)	0.47 (0.07–3.41)	0.444
Past MI	5 (6.6)	179 (14)	0.45 (0.19–1.06)	0.051
Past CVA	3 (4.0)	11 (0.9)	4.39 (1.25–15.40)	0.013
In-hospital				
CHF on admission	16 (21)	217 (18)	1.19 (0.75–1.86)	0.466
CHF during course	21 (28)	148 (12)	2.28 (1.58–3.38)	0.001
Anterior MI	39 (51)	564 (46)	1.11 (0.89–1.40)	0.378
Serious arrhythmia				
Cardiac arrest	0	6 (0.5)	–	0.541
VT	16 (21)	255 (21)	1.01 (0.64–1.58)	0.966
VF	4 (5.3)	48 (3.9)	1.34 (0.50–3.62)	0.564
Enzymes > 4x normal				
CPK	41 (54)	755 (62)	0.87 (0.71–1.08)	0.176
LDH	11 (14)	138 (11)	1.28 (0.73–2.26)	0.397
Aspartate amino-transferase	40 (53)	547 (45)	1.18 (0.94–1.47)	0.179
Demographic data				
Origin Western/other	51 (67)	791 (65)	1.04 (0.88–1.22)	0.667
Work				
Sitting at work	27 (36)	440 (36)	0.99 (0.72–1.35)	0.937
RTW within 1 month	2 (2.6)	32 (2.6)	1.01 (0.25–4.12)	0.994
Medications				
Anti angina	28 (37)	451 (37)	1.00 (0.74–1.35)	0.995
Anti CHF	4 (5.3)	105 (8.6)	0.61 (0.23–1.62)	0.311
Quit smoking	36 (47)	582 (48)	0.99 (0.78–1.27)	0.970

Table 2. Logistic regression model to predict any CVA event within 30 days after a first myocardial infarction. (76 CVE events and 1223 other events are included in this analysis)

Prognostic factor	Parameter estimate	Standard error	Risk ratio	95% CI	p-value
Age (10 years increment)	0.324	0.152	1.38	1.03–1.86	0.0328
Past MI	-1.080	0.479	0.34	0.13–0.87	0.0240
Past CVA	1.648	0.684	5.20	1.36–19.87	0.0160
CHF during course	1.022	0.275	2.78	1.62–4.76	0.0002

occur, in those with either a non-q wave or q-wave MI [12], and in those with and without myocardial ischemia detected by ambulatory ECG monitoring on the 5th post infarction day, regardless of the fact whether the patient receives thrombolysis or not [13]. Also, the inclusion criteria make our study relevant to the working population.

Thus it is likely that our results can be extrapolated to current post-myocardial infarction employed patients.

We have no explanation of the negative association found between the past history of myocardial infarction and ischemic events during the first month. Other studies have revealed that a previous MI is a risk factor for early mortality [6,14]. However, our patients were selected by employment and surviving the hospitalization. Return-to-work after the first MI probably identifies healthier post MI patients. Gill et al. [13] found that in patients who survived for at least five days and who had ambulatory monitoring, a prior MI did not predict death, nonfatal MI, or unstable angina or a combination of those end points over a 1 year follow-up period. Also, since the multivariate model had a poor predictive value, it is possible that the negative association might have been a chance finding.

The high rate of recurrent events in the first few weeks after acute myocardial infarction does not mean that early return-to-work is not advisable. There is no evidence that physical effort interferes with the remodeling of the infarcted heart. In the only randomized controlled trial available, recommendations for RTW within 35 days in those with a non-ischemic, symptom limited treadmill test, and within 42 days in those with up to 0.2 mV of ST depression after proper control with anti-ischemic drugs resulted in return to work after a median of 51 days compared to 75 days in patients receiving usual care [14]. The authors found no increased cardiac events and none of the 27 recurrent cardiac events in 201 patients during a 6-month follow-up related to work. In this study, however, the effect of the exercise testing on ensuring the optimal outcome remains unclear. In our study, only 20 (1.5%) workers returned to work within 2 weeks, 97 (7.5%) within 4 weeks, and 418 (32.2%) within 8 weeks. Over a follow-up period of 418 person-months, there was only one recurrent event in this selected group (2.4 events per 1000 person-months). This event was not associated with work, and did not result in an acute myocardial infarction. However, the selection process which resulted in these workers returning to work is unclear, and randomized controlled clinical trials with very early return-to-work are warranted. Such a study is ethical, because early return to work is presently recommended, but its effects on morbidity and mortality are uncertain.

Cardiologists are concerned about workers returning to heavy manual work. Most recommendations on return-to-work take into consideration the degree of physical exertion at work, with longer sick leave recommended for those who are manual laborers [1,2]. This approach appears prudent, but also needs confirmation. It might be that the patient should be allowed to return-to-work, and limitations should only be those imposed by symptoms. Possibly a gradual increase in working hours would be a good experimental approach to see how much physical exertion the patient can tolerate. Although physical activity has been shown to trigger myocardial infarctions [3], these events are relatively uncommon (less than 4%), and have been shown to decrease in those who are more physically fit. It is uncertain what effect physical and psychological stresses at work have on the incidence of recurrent events in the first few weeks after hospital discharge.

Neither results of early exercise testing, nor ambulatory monitoring were available in our study. The detection of myocardial ischemia by ambulatory monitoring (but not findings on echocardiography or exercise testing) has been shown to have predictive value over and above the clinical evaluation of congestive heart failure and chest pain, and other relevant clinical variables [13,15]. The major predictors were however, the clinical evaluation, and it is unlikely that such testing would substantially change our findings.

We conclude that early after acute myocardial infarction, the major risk for a recurrent event is a lapse of time from discharge but not other clinical variables. This information should be taken into consideration in the return-to-work recommendations, but randomized clinical trials are needed to determine the optimal time for returning-to-work after acute myocardial infarction.

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