DEMOGRAPHIC AND MEDICAL PREDICTORS OF THE ONSET OF POST-MI DEPRESSION

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Abstract

INTRODUCTION: Depression is common amongst post-myocardial infarction (MI) patients and it has been associated with adverse clinical events in these patients. Post-MI depression has also been shown to be an independent risk factor for mortality. However, many questions about risk factors of post-MI depression remain unanswered. The purpose of this study was to identify the medical and demographic predictors of post-MI depression, in so far these are routinely available during MI hospitalization.

METHODS: 176 consecutive patients admitted to the CCU wards following MI were selected based on the inclusion and exclusion criteria. Baseline measures were conducted during hospitalization using a standardized history that included questions about demographic characteristics and medical information, and all patients were underwent a physical examination. Severity of MI index was assessed by a cardiologist using the Killip Class. Also CPK levels were measured on admission and over the 2 subsequent days as additional measures of the severity of MI. The diagnosis of depression (including major and minor depression) at three months after MI was assessed using a standardized, semistructured research interview by a psychiatrist and a clinical psychologist. This interview provided DSM-IV diagnoses based on the patients' psychiatric symptoms.

RESULTS: The findings showed that 46/6% suffered from post-MI depression three months following MI. In multivariable analysis, beta-blocker (OR 2.987; CI 1.254-7.116), history of depressive disorders (OR 2.838; CI 1.271-6.340), log max CPK (creatinine phosphokinase value) (OR 2.410; CI 1.075-5.404), and age <60 (OR 2.652; CI 1.061-6.626) were factors significantly associated with post-MI depression. This predictive model also yielded 74.4% maximum predictive efficiency with 67.1% sensitivity and 80.9% specificity rates respectively, for differentiating those with and those without high risk for developing post-MI depression.

CONCLUSIONS: Beta-blocker, history of depressive disorders, log max CPK (creatinine phosphokinase value), and age comprise demographic and medical predictors for post-MI depressive symptoms. Thus, considering the above model, clinicians may able to identify MI patients with a high risk for subsequent development of depression so that these patients may be targeted for screening and potentially for psychosocial intervention. The association found between depression and creatinine phosphokinase (CPK) value begs the questions why two seemingly unrelated conditions should be related, and what mediators or common biological pathways could link the two phenomena.

Keywords: Depression, myocardial infarction, demographic and medical predictors.

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Introduction

Depression is more common among myocardial infarction (MI) patients than in the general population.[1,2] Previous studies have showed that depression leads to psychological and physical morbidity[3,4] and complicates medical management by resulting in higher rates of complications, longer length of hospitalization,[5] higher risk of suicide,[7] higher social and economic costs per illness episode,[8,9] poor quality of life[10] in the year post-MI and lower attention to cardiac rehabilitation programs.[11] Also Post-MI depressive symptoms have been shown to be an independent risk factor for mortality,[6] comparable in strength to left ventricular (LV) function[1,12] and poor health status.[13]

A review of several recent studies showed that pre-MI vital exhaustion,[1] history of depressive disorder,[1,14,15]

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female gender,[1,14] poor ejection fraction,[1,11,16] and longer hospital stay,[1] younger age,[11,14,15] hypercholesterolemia,[11] the use of calcium channel blockers at discharge,[11] social isolation, having marked non-health difficulties and lack of a close confidant[14] were independent predictors of the development of postdischarge depression.

For example, in a recent study Van Melle found that factors associated with depression were younger age, hypercholesterolemia, the use of calcium channel blockers at discharge, and left ventricular ejection fraction.[11] The derived predictors were tested in the validation sample. The final model yielded two clinical predictors, i.e. younger age and severe LV dysfunction, which correctly predicted post-discharge depression status in 82.9% of the MI patients. They suggested that during hospitalization for MI, it is possible to identify MI patients with a high risk for subsequent development of depression.[11]

However, the risk factors for the development of depression in patients with MI may be diverse. Although previous studies reported clinical correlates of in-hospital depressive complaints, the predictors of a depressive disorder following MI have not been thoroughly investigated. The present study aimed to identify the medical and demographic risk factors of post-MI depression, in so far as these are routinely available or can be easily obtained during MI hospitalization.

Materials and methods

The present work was part of a study on prediction of post-MI depression, a prospective study of risk factors of depression following MI. The study was approved by the Research Council of Behavioral Sciences Research Center of Isfahan University of Medical Sciences. Informed consent was obtained from all patients and the study protocol conformed to the ethical guidelines of the Vice Chancellery for Research of Isfahan University of Medical sciences.

225 consecutive patients with MI admitted to the CCU wards of nine hospitals in Isfahan, Iran, over a 5-month period were screened for this study. Patients were eligible if they met at least two of three criteria: 1) chest pain for at least 20 minutes, 2) creatinine phosphokinase (CPK) value twice higher than normal or more, and 3) the presence of new pathological Q wave on the electrocardiogram in at least two leads. Patients were excluded if they had a life expectancy of less than 1 year because of comorbid non-cardiac disease (e.g., malignancies), had poor cognitive functions, had major psychiatric disorders, were unable to speak or read Persian, had visual and/or auditory problems that precluded participation, had an MI during hospital admission for other reasons (except angina pectoris), could not be scheduled for follow-up visits in a participating hospital, or died before they could be approached or could decide about participation. Of the 225 patients meeting the criteria, at 3 months after hospitalization, 11 patients had died, 10 patients had undergone bypass surgery, 6 patients were unavailable, 6 refused to be interviewed, 7 had myocardial reinfarction during the first three months after discharge, 3 experienced traumatic events during the first 3 months after discharge and 6 had other psychiatric disorders (4 had severe major depression at the time of MI and 2 had bipolar disorder). At three months post-MI, the sample consisted of 176 post-MI patients who could be visited by clinical psychologist or psychiatrist. The mean age of the sample was 55.9 years (SD=10.05).

At baseline, all patients completed a standardized history that included questions about demographic characteristics, as well as social and economic factors; they also underwent a physical examination. Medical data were obtained from medical records.

Demographic characteristics included age at the time of MI, gender, marital status, achieved level of education and socioeconomic status. Education was categorized in three levels: low, representing primary school; medium, representing lower vocational training or secondary school; high, representing higher vocational training or university degree. Socioeconomic status was assessed using the criteria based on current employment of subject or last job if retired, accommodation, area of residence, income and education level. Socioeconomic status was categorized in three levels: low, medium and high.

Severity of MI index was assessed using the Killip Class. This is a brief scale (scored 1-4) rating left ventricular function based on the presence of pulmonary rales, S3 gallop rhythm and peripheral hypoperfusion. High scores represent worse left ventricular function.[15] We also included CPK levels (measured on admission and over the 2 subsequent days) as additional measures of the severity of MI.

The diagnosis of depression (including major and minor depression) At three months after MI was assessed using a standardized, semistructured research interview. This interview provided DSM-IV diagnoses based on the patients' psychiatric symptoms. The patients were interviewed by a psychiatrist and a

clinical psychologist. Then the clinicians made their judgment of the presence of "clinical depression" on the basis of the DSM-IV criteria by the interview for each patient.

Baseline demographic and medical variables were compared between subjects who did and did not develop depression over the three months of follow-up. Chi-squared test was used for categorical variables and the Student's t-test was used for continuous variables.

Logistic regression was used to define the independent association between the candidate predictor variables and three-month depression status. P values less than 0.05 were considered as statistically significant.

Results

Of the 231 eligible patients completing baseline assessments 176 subjects were included in the study and of those, 82 patients (46.6%) suffered from post-MI depressive symptoms at three months following MI. The mean age of subjects was 55.9 (SD=10.053) years with 148 (84%) being males.

Table 1 compares the baseline characteristics of those subjects with and those without a significant burden of depressive symptoms at three-month follow-up.

TABLE 1. Comparison of baseline characteristics between those with and those without significant depressive symptoms at three months post-MI.

Baseline Characteristics	Depressed at three months (n =82)	Not depressed at three months (n =94)	P value
Age (<60 years) n (%)	61 (74.4%)	57 (60.6%)	0.05
Gender (female) n (%)	17 (20.7%)	11 (11.7%)	0.102
Education n (%)			
High	3(3.7%)	14(14.9%)	0.013
Medium	19(23.2%)	28(29.8%)	
Low	60(73.2%)	52(55.32%)	
Marital status: married n (%)	70 (85.4%)	86 (91.5%)	0.202
Socio-economic status, n (%)			
High	5(6.1%)	18(19.1%)	0.002
Medium	24(29.3%)	38(40.4%)	
Low	53(64.6%)	38(40.4%)	
History of depressive disorders (%)	38(46.3%)	21(22. 3%)	0.001
History of heart disease (%)	33(40.2%)	24(25.5%)	0.037
History of MI (%)	31(37.8%)	22(23.4%)	0.038
Killip class, n (%)			
I	16(19.5%)	27(28.7%)	0.031
II	34(41.5%)	49(52.1%)	
III	29(35.4%)	17(18.1%)	
IV	3(3.6%)	1(1.06%)	
Beta-blocker, n (%)	66(80.4%)	59(62.8%)	0.01
History of hypertension, n (%)	24(29.3%)	30(31.9%)	0.706
Alcohol abuse, n (%)	10(12.2%)	5 (5.3%)	0.103
Diabetes, n (%)	24(29.3%)	26 (27.6%)	0.813
History of smoking, n (%)	46(56.1%)	43 (54.7%)	0.171
Hypercholesterolemia, n (%)	32(39.02%)	44 (46.8%)	0.298
Log max CK (mean)	2.86	2.76	0.197
Drug abuse, n (%)	19(23.2%)	12 (12.8%)	0.071
Duration of admission (in days) (Mean)	5.37	5.64	0.40

$P \leq 0.05$

TABLE 2. Summary of results of multivariable logistic regression model of predictors of depressive symptoms at three months post-MI.

Predictors	Beta	Wald Chi-Squared	P value	Odds ratio	95% CI
Beta-blocker	1.094	6.107	0.013	2.987	1.254-7.116
History of depressive Disorders	1.043	6.474	0.011	2.838	1.271-6.340
Log max CK	0.880	4.561	0.033	2.410	1.075-5.404
Age (<60 years)	0.975	4.353	0.037	2.652	1.061-6.626

CI= confidence interval

Significant univariate predictors were age >60 (74.4% vs. 60.6%, P=0.05), low level of education (73.2% vs. 55.32%, P=0.013), low socio-economic class (64.6% vs. 40.4%, P=0.002), a history of depressive disorders (46.3% vs. 22. 3%, P=0.001), a history of heart disease (40.2% vs. 25.5%, P=0.037), a history of MI (37.8% vs. 23.4%, P= 0.038), Killip class >II (39% vs. 19.19%, P=0.031) and beta-blocker use (80.4% vs. 62.8%, P=0.01). No other statistically significant differences were found between the two groups on characteristics at baseline.

By multivariable logistic regression analysis, beta-blocker (OR 2.987; CI 1.254-7.116), history of depressive disorders (OR 2.838; CI 1.271-6.340), log max CPK (creatinine phosphokinase value) (OR 2.410; CI 1.075-5.404), and age <60 (OR 2.652; CI 1.061-6.626) were all independent predictors of the development of depressive symptoms (Table 2). No other demographic or medical risk factors were associated with the onset of depressive symptoms.

The resulting model had a c-statistic of 0.744, indicating moderately good discriminative ability. The Hosmer-Lemeshow statistic for the model was 5.565 (P=0.696), indicating good fit for the model across the range of predicted probabilities.

This predictive model also yielded 74.4% maximum predictive efficiency with 67.1% sensitivity and 80.9% specificity, respectively, for differentiating those with and those without high risk for developing post-MI depression.

Discussion

The objective of this study was to identify the medical and demographic factors associated with the development of depression in post-MI patients in order to predict which MI patients need extra attention during their rehabilitation period with respect to their psychological recovery.

Although post-MI depression is increasingly considered as an important risk factor for impaired prognosis, its predictors have not been described thoroughly. This study differs in its methodology from other studies that examine risk factors of depression in MI patients. Previous studies[17-19] have mostly concerned depression at the time of MI or immediately following MI.

The findings should be interpreted in respect of three limitations. First, because the main objective in this study was to evaluate the influence of medical and demographic risk factors on post-MI depression, some potential predictors like psychosocial and personality factors were not considered in the analysis. It is likely that detailed measures of psychosocial and personality factors would have added to the explanation of post-depression. Second, because of exclusive criteria (including poor cognitive functions, inability to read, visual or auditory problems, and inability to attend follow-up visits) the non-participants were older and more often female. A third limitation is the retrospective assessment of history of depressive disorder which might have been biased by current post-MI depression.

Considering these limitations, we found four independent predictors of the development of depressive symptoms: beta-blocker use, history of depressive disorders, log max CPK and age <60.

History of depressive disorders and age <60 identified as the risk factors by this study have individually been associated with depression in other studies. The finding that a history of depression was a strong predictor of post-MI depression at 3 months is consistent with previous research.[1,14,15] Lesperance et al.[15] found that people with a history of previous major depression were more likely to be depressed after infarction both in hospital and after discharge. They argued that most efforts in settings with limited psychiatric resources should be directed toward post-MI patients with a history of depression. Also the findings demonstrated that age was the only demographic variable to contribute to the model; individuals aged 60 years and above were significantly less likely to have depression at 3 months compared

with those aged less than 60 years. The finding that younger patients were more likely to be depressed at 3 months is consistent with results of previous studies conducted by Lesperance et al., Van Melle et al. and Schrader et al.[15,11,20]

The findings suggest that the use of beta-blockers was associated with the development of depression. Beta-blockers are believed to potentially cause depression. The results of this study support this belief and may advise cardiologists to prescribe medications other than beta-blockers for post-MI patients. This finding is consistent with the results of Van Melle et al.[11]

This study demonstrated a relationship between log max CPK and development of depressive symptoms during the first 3 months after MI. Creatine phosphokinase (CPK) is an enzyme found in skeletal muscle, cardiac muscle, and the brain. This enzyme is an indicator for the diagnosis of an acute MI. With the exception of after-cardiac surgical procedures, the degree and the duration of CPK elevation in serum approximates the extent of an acute myocardial infarction, although a variety of factors may affect the reliability of such an index.[21]

Although the number of studies on the effects of post-MI depression is rapidly increasing,[16] the majority of studies have not assessed log max CPK. As far as we, know only Spijkerman et al.[1] examined the association between log max CPK and post-MI depression; they found a trend towards significance ($0.05 > P < 0.10$) for log max CK.

It has been documented that the more the extent of MI, the more severe LV dysfunction.[21] Van Melle et al. showed for the first time that LVEF (left ventricular ejection fraction), as assessed shortly after MI, is also prospectively associated with the development of depression in the year following MI. Their observed association with LVEF held true for both the rate of depressive disorder (3-12 months post-MI) and the severity of depressive symptoms (during hospitalization and 3 months post-MI). Importantly, this relationship remained significant after adjustment for other known covariates of depression, including the presence of heart failure upon hospitalization for MI. Bagherian et al.[22] demonstrated a relationship between LV dysfunction and development of depressive symptoms during the first three months after MI. Although it is generally accepted that depression is independently associated with a worse cardiac prognosis, controversy persists on whether this association is a reflection of cardiac disease severity.[16]

As Van Mell et al. has explained mechanisms for the relationship between LV dysfunction and the presence of depressive symptoms, two pathways could be assumed for the mechanisms underlying the association between severity indices of MI (including log max CK and LVEF) and development of post-MI depression: 1) the psychological pathway, and 2) the biological pathway.[16] First, the relationship might be due to higher re-hospitalization rate,[23] more co-morbidity,[24] poor quality of life as a result of worse overall health status,[25] worse social functioning,[26] and more non-employment.[24] These factors can lead to increased risk of depression. Alternatively, the association between severity indices of MI and depression might be the result of biological processes accompanying LV dysfunction.[27, 28] It has been proposed that the increased cytokine levels in CHF (congestive heart failure), such as interleukin-1, interleukin-6, and tumor necrosis factor-alpha, play a mediating role in the development of depression.[16,29]

The resulting model was able to correctly predict the post-MI depression status in 75.3% of the patients. In other words, 75.3% of the patients identified by our model as having a high risk for developing depression developed depression during follow-up. Also, almost 73.8% of the patients identified by our model as not having a high risk for developing depression did not develop depression during follow-up. Therefore, the strength of this model lies in both the good negative and positive predictive values. In light of the results of this study and those of others[1, 11, 14-16] the best prediction may come from a model using medical, demographic and psychiatric data (e.g. history of depressive disorders).

This study has several implications. First, depression screening may be warranted for MI patients with the risk factors included in the model. This screening should probably be serial in nature (i.e. repeated over time). Furthermore, patients with the depression risk factors identified in this study may be targets for psychological interventions. Future studies should be conducted to determine whether or not targeted psychological intervention for these patients can reduce the incidence of depression and improve outcomes.

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