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RESEARCH ARTICLE

Posttraumatic stress disorder and posttraumatic cognitions in patients with myocardial infarction

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ABSTRACT

Objective: Myocardial infarction is a life-threatening condition that occurs unexpectedly and can cause posttraumatic stress disorder (PTSD) symptoms. The aim of this study was to investigate the frequency and predictors of PTSD symptoms for patients with myocardial infarction and to investigate the relationship between posttraumatic cognitions and PTSD symptoms.

Method: This study included 152 patients with a history of myocardial infarction. The patients were administered the Impact of Event Scale to assess PTSD symptoms, the Posttraumatic Cognitions Inventory for evaluating negative cognitions about the self and world after the traumatic event, and the Hospital Anxiety Depression Scale for anxiety and depression symptoms. Binary logistic regression analysis was performed to determine factors associated with PTSD symptoms.

Results: Twenty-two (14,5%) patients had clinically significant PTSD symptoms. Having clinically significant PTSD symptoms was associated with the intensity of negative posttraumatic cognitions (negative cognitions about self p=0.010, negative cognitions about the world p<0.001), previous history of mental illness (p=0.028), the severity of pain during an acute myocardial infarction (p=0.038), and the severity of fear of death (p=0.047), which are subjective severity indicators of a heart attack.

Conclusion: In patients with myocardial infarction, close monitoring of high-risk individuals in terms of PTSD symptoms and treatment of those with PTSD may be beneficial in preventing the negative effects of PTSD symptoms on the individuals and the course of the heart attack.

Keywords: Cognition, myocardial infarction, posttraumatic stress disorder

INTRODUCTION

Acute myocardial infarction (AMI) is the most common cause of death due to cardiovascular diseases. However, survival rates have increased in patients with AMI owing to technological developments and innovations in treatment (1). AMI occurs unexpectedly and causes severe psychological distress, accompanied by fear of death, feelings of helplessness, and loss of control (2). Most patients believe that AMI is life-threatening. Posttraumatic stress disorder (PTSD) occurs following direct or indirect exposure to life-threatening traumatic events. AMI can lead to PTSD, and approximately 12% of patients with AMI develop PTSD (3).

The development of AMI-induced PTSD, which is a PTSD that occurs due to the traumatic effect of AMI as a result of perceiving AMI as a life-threatening condition, causes unhealthy daily activities associated with cardiovascular risk factors, impairs compliance

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with cardiological medical therapy and rehabilitation practices, and increases the rehospitalization rate due to cardiac diseases (3–5). In addition, the probability of reoccurrence of acute coronary syndrome and the risk of mortality due to cardiac diseases in patients who develop PTSD after AMI is two times higher than that in patients who do not experience PTSD after AMI (3).

There are inconsistent results regarding risk factors for AMI-induced PTSD. Female and younger patients are more likely to develop PTSD after AMI than male and older patients (6–8). Contrary to these results, some studies did not find a relationship between sex, age, and the possibility of developing PTSD after AMI (9,10). Indicators of the objective severity of AMI, such as plasma creatinine kinase and troponin enzyme levels, number of blocked coronary arteries, and left ventricular ejection fraction, are not related to PTSD development after AMI (7,11,12). However, length of stay in the hospital and exposure to invasive procedures, such as angioplasty and bypass surgery, which are also objective indicators of disease severity, were associated with more PTSD symptoms after AMI (13,14). Psychological stress symptoms, such as fear of death during a heart attack and the feeling of losing control, which are subjective evaluations of patients about AMI, and pain severity during AMI were suggested to be risk factors for PTSD development after AMI (10,15).

Negative posttraumatic cognitions have shown different associations with PTSD symptoms in different trauma types and populations. Negative posttraumatic cognitions were related to PTSD symptoms in refugees with traumatic experiences. It was suggested that this relationship was essentially due to patients' negative cognitions about self and was not linked to negative cognitions about the world (16). Another study of sexual assault victims reported that negative posttraumatic cognitions were related to PTSD symptom severity, and this relationship was valid for all dimensions, such as negative beliefs about the self (NBAS) and negative beliefs about the world (NBAW) and self-blame (17). By its nature, AMI is different from many other types of traumas that cause PTSD. The person is not attacked by another individual or an external factor does not harm the person in AMI. Therefore, the investigation of trauma-related cognitions in AMI-induced PTSD may provide new and original data.

This study aimed to examine the frequency and predictors of PTSD symptoms in patients with AMI and the relationship between posttraumatic cognitions and PTSD symptoms.

The hypothesis of this study was that having a previous mental illness, severely experiencing the subjective severity criteria of AMI, and having more intense posttraumatic dysfunctional beliefs would be associated with clinically significant PTSD symptoms.

METHOD

This study included patients with AMI history who were treated at the outpatient cardiology clinic at Balıkesir University between January 1 and August 30, 2022. Patients aged 18 years and older and who had at least 1 month since the last AMI were informed about the study. A total of 177 patients who volunteered to participate were included in the study. An experienced psychiatrist evaluated the patients. He performed a standard psychiatric examination and reviewed the medical records.

The exclusion criteria were as follows: schizophrenia; bipolar disorder; mental retardation; active alcohol and substance use disorder according to DSM-V; neurological diseases that may affect cognitive abilities (stroke, dementia, head trauma, and cranial operation); traumatic experience that may cause PTSD; hearing and vision problems that would prevent psychiatric interviews and filling in of self-report measurement tools; cognitive impairment (Mini-Mental Test score below 24); and illiteracy.

Twenty-five patients were excluded from the study (3 patients were illiterate, 5 had Mini-Mental Test score below 24, 2 had schizophrenia, 1 had bipolar disorder, 3 had a previous traumatic event that could cause PTSD, cardiac enzyme levels of 5 patients could not be reached, 2 patients had a history of stroke, and 4 filled out the scales incompletely). Finally, this study included 152 patients.

All patients were given detailed information about the study, and informed consent was obtained. Researchers obtained MI-related data of the patients, such as AMI type and plasma troponin enzyme levels, from the medical records.

The Impact of Event Scale (IES) and Posttraumatic Cognition Inventory (PTCI) were used to assess PTSD symptoms and posttraumatic cognition, respectively. The Hospital Anxiety and Depression Scale (HADS) was used to measure anxiety and depression symptoms. Ethical approval was obtained from the Balikesir University Faculty of Medicine Ethics Committee (date: December 22, 2021, number 2021/280).

Measures

Sociodemographic Form

This form obtained demographic and clinical data, including age, sex, number of AMIs, and previous traumatic events that could lead to PTSD. Patients also indicated their subjective evaluations of MI severity, such as "fear of death," "pain intensity," and "feelings of helplessness" at the time of AMI, on a scale ranging from 0 to 10.

Impact of Event Scale

PTSD symptoms were measured using IES-Revised (IES-R). It is a self-report scale consisting of 22 items scored between 0 and 4 (18). Higher scores indicate more severe traumatic stress symptoms. This scale can successfully distinguish patients with PTSD from healthy controls. A total score of 33 and above distinguishes patients with PTSD from those without PTSD and is also used to identify patients with clinically significant PTSD symptoms (18,19). Çorapçıoğlu et al. conducted a Turkish validity and reliability study (20).

Posttraumatic Cognitions Scale

PTCI is a 36-item self-report scale designed to assess trauma-related cognition. Each item is rated on a 7-point scale ranging from 1 (totally disagree) to 7 (totally agree). PTCI consists of three subscales: (a) NBAS, (b) NBAW, and (c) self-blame. This scale determines trauma-related maladaptive cognition. Higher scores indicate a greater level of trauma-related maladaptive cognition (15). Yağcı-Yetkiner conducted a Turkish validity and reliability study. In the Turkish version, items related to NBAS and self-blame were collected under a single factor. The Turkish version of the scale consists of two subdimensions: NBAS and NBAW (21).

Hospital Anxiety and Depression Scale

HADS is a self-report scale that measures the severity of anxiety and depression symptoms. It consists of 14 items scored between 0 and 3. Seven questions evaluate anxiety and depression symptoms separately. Higher scores on the scale indicate more severe anxiety and depression symptoms (22). Aydemir et al. conducted a Turkish validity and reliability study. The cutoff value for anxiety disorders and depression is 7 and 10, respectively, for the Turkish population (23).

Statistical Analysis

Data were evaluated using the Statistical Package for the Social Sciences for Windows v.22.0 (SPSS, Inc., Chicago, IL, USA). Descriptive statistics were presented as the mean±standard deviation, frequency distribution, and percentage. Normal distribution was tested using the Kolmogorov–Smirnov test. The Mann–Whitney U test was used to analyze continuous variables. The Chi-squared test and Fisher's exact test were used to analyze categorical variables. Spearman's correlation analysis was used to evaluate the correlations between PTSD symptom severity and various clinical variables. A binary logistic regression analysis was performed to determine the variables that are associated with clinically significant PTSD symptoms (predicting significant PTSD symptoms). Statistical significance was set at $p<0.05$.

Table 1: Sociodemographic and clinical data of participants (n=152)

	Mean (SD)/n (%)
Age/year	61.7 (8.4)
Gender/male	128 (84.2%)
Marital status/married	127 (83.6%)
Education/year	7.0 (2.4)
History of mental illness/yes	19 (12.5%)
Number of AMI	
1	136 (89.5%)
>1	16 (10.5%)
Type of AMI	
STEMI	116 (76.3%)
Non-STEMI	36 (23.7%)
Troponin level at first admission	131.6 (460.1)
Length of hospital stay (days)	5.9 (4)
Pain intensity	4.3 (2.2)
Fear of death	4.5 (2.0)
Helplessness	4.3 (1.9)
IES	19.5 (16.1)
IES ≥ 33	22 (14.5%)
PTCI	83 (34.1)
PTCI-NBAS	58.2 (26.6)
PTCI-NBAW	24.7 (11.5)
HADS-D	5.8 (3.5)
HADS-A	5.9 (3.6)

n: Number; SD: Standard deviation; AMI: Acute myocardial infarction; STEMI: AMI with ST elevation; Non-STEMI: AMI without ST elevation; IES: Impact of Event Scale; PTCI: Posttraumatic Cognition Inventory; NBAS: Negative beliefs about the self; NBAW: Negative beliefs about the world; HADS-D: Hospital Anxiety Depression Scale Depression; HADS-A: Hospital Anxiety Depression Scale Anxiety.

RESULTS

A total of 152 patients were included, of whom 128 (84.2%) were men with a mean age of 61.7 (SD: 8.4)

Table 2: Sociodemographic and clinical data of patients with and without clinically significant PTSD symptoms

n=152	IES <33 n=130 Mean (SD)/n (%)	IES ≥33 n=22 Mean (SD)/n (%)	p
Age/year	61.5 (8.4)	62.9 (8.6)	0.512[a]
Gender/male	109 (86.4%)	19 (83.8%)	0.765[b]
Marital status/married	110 (84.6%)	17 (77.3%)	0.390[b]
Education/year	7.07 (2.41)	6.95 (2.73)	0.604[a]
History of mental illness/yes	11 (8.5%)	8 (36.4%)	**<0.001[a]**
Number of AMI			0.607[b]
1	117 (90.0%)	19 (86.4%)	
>1	13 (10.0%)	3 (13.6%)	
Type of AMI			0.512[b]
STEMI	98 (75.4%)	18 (81.8%)	
Non-STEMI	32(24.6%)	4 (18.2%)	
Troponin level at first admission	130.7 (462.4)	137.0 (457.9)	0.969[a]
Length of hospital stay (days)	5.8 (3.7)	6.2 (5.2)	0.602[a]
Pain intensity	3.9 (2.0)	6.45 (2.3)	**<0.001[a]**
Fear of death	4.3 (1.9)	5.8 (2.0)	**0.001[a]**
Helplessness	4.1 (1.8)	5.2 (2.2)	**0.049[a]**
IES	14.2 (8.3)	50.5 (16.4)	**<0.001[a]**
PTCI Total	73.4 (26.8)	139.5 (4.4)	**<0.001[a]**
PTCI-NBAS	51.8 (23.2)	96.1 (5.1)	**<0.001[a]**
PTCI-NBAW	21.6 (8.9)	43.4 (7.02)	**<0.001[a]**
HADS-D	5.3 (3.2)	8.7 (4.0)	**0.001[a]**
HADS-A	5.6 (3.6)	7.8 (3.6)	**0.004[a]**

a: Mann–Whitney U test; b: Chi-squared test; n: Number; SD: Standard deviation; AMI: Acute myocardial infarction; STEMI: AMI with ST elevation; Non-STEMI: AMI without ST elevation; IES: Impact of Event Scale; PTCI: Posttraumatic Cognition Inventory; NBAS: Negative beliefs about the self; NBAW: Negative beliefs about the world; HADS-D: Hospital Anxiety Depression Scale Depression; HADS-A: Hospital Anxiety Depression Scale Anxiety. Statistically significant values were written as bold.

years; 116 (76.3%) had ST-elevation AMI (STEMI), and 36 (23.7%) had non-ST-elevation AMI (non-STEMI). Sociodemographic and clinical data are presented in Table 1.

Patients with and without clinically significant PTSD symptoms were divided into two groups according to their IES scores (cutoff value 33). Twenty-two patients (14.5%) had clinically significant PTSD symptoms (IES was 33 and above).

"Pain severity," "fear of death," "feeling of helplessness," HADS-depression, HADS-anxiety, PTCI-total, NBAS and NBAW scores, and the proportion of individuals with a previous history of mental illness were significantly higher in patients with significant PTSD symptoms than those without PTSD symptoms. There were no significant differences in terms of troponin values, number of AMI, and length of hospital stay, which are the objective criteria of MI, in patients with and without significant PTSD symptoms (Table 2).

The results of the correlation analysis between PTSD symptom severity (IES scores) and "pain severity," "fear of death," "feeling of helplessness," anxiety, and depressive symptom scale scores are presented in Table 3.

A binary logistic regression analysis was performed to determine the variables that are associated with clinically significant PTSD symptoms. In the regression analysis, significant PTSD symptoms were included as dependent variables, and variables that were significant in univariate analyses, including previous mental illness, severity of pain, fear of death, HADS-depression score, PCI-NBAS, and PCI-NBAW, were included as independent variables. The dependent variable has two categories. Having clinically significant PTSD symptoms was coded as "1" and not having clinically significant PTSD symptoms was coded as "0." Factors associated with having

Table 3: Correlation analysis for PTSD symptom severity (IES) and related factors

	IES	Pain intensity	Fear of death	Helplessness	PTCI-T	PTCI-NBAS	PTCI-NBAW	HADS-D	HADS-A
IES	1								
Pain intensity	**0.225****	1							
Fear of death	**0.269***	0.115	1						
Helplessness	0.136	**0.222****	0.014	1					
PTCI-T	**0.405***	**0.251****	0.077	**0.286****	1				
PTCI-NBAS	**0.410****	**0.241****	0.092	**0.274****	**0.954*****	1			
PTCI-NBAW	**0.339****	**0.212****	0.084	**0.210****	**0.680****	**0.468****	1		
HADI-D	**0.214****	0.093	0.016	0.121	0.141	0.108	**0.196***	1	
HADI-A	0.115	0.083	**0.200***	0.068	0.105	0.231	0.102	0.075	1

*: P<0.05; **: P<0.001; AMI: Acute myocardial infarction; IES: Impact of Event Scale; PTCI: Posttraumatic Cognition Inventory; NBAS: Negative beliefs about the self; NBAW: Negative beliefs about the world; HADS-D: Hospital Anxiety Depression Scale Depression; HADS-A: Hospital Anxiety Depression Scale Anxiety. Statistically significant values were written as bold.

Table 4: Logistic regression analysis for variables associated with having significant PTSD symptoms

Variables	Wald	p	Exp (B)	95% CI – Exp (B)	
				Lower	Upper
History of previous mental illness*	1.146	**0.028**	1.881	0.195	18.152
Pain intensity	3.319	**0.038**	1.529	1.024	2.228
Fear of death	2.920	**0.047**	1.769	0.920	3.403
HADI-Depression	2.004	0.157	1.183	0.918	1.492
PTCI-NBAS	6.686	**0.010**	1.467	1.097	1.962
PTCI-NBAW	15.366	**<0.001**	1.361	1.116	1.587

*: Reference (0=no, 1=yes); p: Statistical significance level; Exp (B): Odds ratio; 95% CI: 95% confidence interval; PTCI: Posttraumatic Cognition Inventory; NBAS: Negative beliefs about the self; NBAW: Negative beliefs about the world; HADS-D: Hospital Anxiety Depression Scale Depression. Statistically significant values were written as bold.

clinically significant PTSD symptoms were tried to be determined by binary logistic regression analysis. Owing to the necessity of obtaining independent variables from different data sources and the multicollinearity between PTCI-total and PTCI-NBAS [multicollinearity was considered when the correlation coefficient score between potential independent variables was above 0.8 in bivariate analysis (24)], only PTCI-NBAS and PTCI-NBAW were determined as independent variables. PTCI-total was not included in the regression model. Our model was valid (Hosmer–Lemeshow test χ^2=1.985, df=8, p=0.981), and the binary logistic regression was significant overall (Omnibus test χ^2=94.654, df=5, p<0.001).

As a result of the regression analysis, negative posttraumatic cognitions (PTCI-NBAS and PTCI-NBAW), "severity of pain" at the time of MI, severity of "fear of death," and having a previous mental illness were associated with having clinically significant PTSD symptoms in patients with AMI (Table 4).

DISCUSSION

In this study, we investigated the frequency and predictors of clinically significant PTSD symptoms and the relationship between PTSD symptoms and posttraumatic cognition in patients with AMI. Fourteen percent of patients with MI history had clinically significant PTSD symptoms. As maladaptive cognition about trauma (AMI) intensified, PTSD symptom severity also increased. There was a significant relationship between clinically significant PTSD symptoms and negative posttraumatic cognitions (negative cognitions about the self and world), previous history of mental illness, and subjective severity markers of AMI including "pain severity" and "fear of death severity." In addition, these variables were predictors of significant PTSD symptoms.

The prevalence rate of PTSD after AMI was between 4% and 32% in a meta-analytic review (3). This wide range varies depending on the methods and measurement tools used for PTSD diagnosis

(semistructured interviews or self-report instruments), cutoff value of the scales, sample size, and duration after the PTSD assessment. In studies using self-report scales, the average rate of PTSD in AMI survivors was 16% (3,25). In this study, we used the self-report scale (IES), and 14% of patients had clinically significant PTSD symptoms. PTSD prevalence in the general population is between 0.56% and 6.67% (26). The rate of PTSD symptoms in patients with MI, which is higher than the general population average, can be interpreted as an important finding, indicating that clinicians working with this patient group should have a higher PTSD awareness.

This study found that the rate of clinically significant PTSD symptoms after MI was higher in patients with a history of mental illness than in those without. In addition, a history of mental illness was a predictive factor for the development of significant PTSD symptoms in AMI survivors. Various studies have reported that having a history of mental illness and admission to a psychiatrist or psychologist, exposure to a life-threatening traumatic event before AMI, and having previously experienced PTSD for different reasons are features that predict the occurrence of PTSD symptoms after AMI (6,25,27). Alexithymia and anxious attachment are also associated with the development of PTSD after AMI (9). Therefore, a history of mental illness and psychological sensitivity to the mental illness can be considered risk factors for the development of PTSD symptoms after AMI. Careful and close follow-up of AMI survivors with a previous mental illness and a history of traumatic experiences before AMI, in terms of PTSD development, may be beneficial in reducing the negative impact of PTSD on the individual's life and the course of cardiac diseases.

In this study, "pain severity" and "fear of death," which are subjective severity indicators of AMI perceived by patients, were related to PTSD symptom severity. PTSD symptom severity was not associated with markers such as troponin level, number of AMI, and length of hospital stay, which are objective indicators of AMI. Many studies have shown that PTSD development is not associated with objective severity indicators of AMI, including plasma creatinine kinase and troponin enzyme levels, CRP level, number of occluded coronary vessels, left ventricular ejection fraction, number of AMI, and length of hospital stay (7,11,12,28,29). Conversely, few studies have reported a relationship between PTSD and the number of previous AMIs and length of hospital stay (13,30). It has been suggested that the severity of pain during the traumatic experience (AMI), feeling of coming face-to-face with death, fear, dissociative symptoms, and perception of MI as a fatal threat by the patient, which are the subjective severity indicators of AMI perceived by the patients, are associated with PTSD development after AMI (7,15,25,28). Life-threatening traumatic experiences are necessary for PTSD development. However, all individuals exposed to trauma do not develop PTSD. The severity of the threat perceived by the individual and the perception of danger are crucial for PTSD development; increasing the severity of the threat perceived by the patient increases the likelihood of PTSD (31). The results of our study are in line with these findings. It can be said that the subjective severity of AMI and threat perception perceived by the patient are more important than the objective severity perception for AMI-induced PTSD development.

We found a relationship between the intensity of negative posttraumatic cognitions and PTSD symptom severity in AMI survivors. As the negative cognitions that emerged after the traumatic experience intensified, PTSD symptom severity increased. In addition to the PTCI total score, the NBAS and NBAW subscales were also associated with PTSD symptom severity. Moreover, both the NBAS and NBAW subscales were also predictors of significant PTSD symptoms. Posttraumatic cognitions have been studied in various types of traumas. The severity of PTSD symptoms was associated with negative posttraumatic cognitions in patients who had an occupational accident. This relationship was valid for both NBAS and NBAW subdimensions, but self-blame subdimensions did not differ from those of healthy controls (32). Another study showed that negative posttraumatic cognitions were a predictive factor for PTSD symptom severity and suicidal thoughts in veterans. This predictive feature was valid only for the NBAS subdimension (33). Posttraumatic negative cognitions play an important role in the development and maintenance of PTSD (34–36). Individuals exposed to trauma and developing PTSD have more dysfunctional posttraumatic cognitions than individuals exposed to trauma who do not develop PTSD (34). Foa et al. suggested that how individuals perceive traumatic experiences significantly affects their PTSD development (34,37). Examination of catastrophic beliefs related to AMI and its consequences in patients with risk factors for PTSD development and psychoeducation about treatment

and prognosis of AMI in patients with salient maladaptive beliefs may be beneficial in reducing the potential effects of dysfunctional negative cognitions on the emergence of PTSD symptoms.

This study had several limitations. Although individuals with traumatic experiences that could lead to PTSD before AMI were excluded, the cross-sectional nature of the study made it difficult to establish a causal relationship. This study was carried out with a relatively limited number of patients who were admitted to a tertiary hospital; therefore, generalization of the results to the entire population of patients with AMI is not possible. We evaluated clinically significant PTSD symptoms with a self-report measurement tool. Using structured clinical interview instruments (e.g., Clinician-Administered PTSD Scale, Posttraumatic Symptom Scale-Interview Version for DSM-5) for PTSD assessment in patients with AMI may provide more precise results for PTSD diagnosis and related factors. In addition, this study has not evaluated the effects of various invasive procedures, including bypass surgery and pacemaker implantation, which may affect the development of PTSD symptoms. Prospective studies with a larger sample size, which also examine the effect of invasive procedures that may lead to PTSD and follow patients from the acute phase of MI, will provide a stronger causal relationship.

In conclusion, PTSD symptoms are more common in patients with AMI than in the general population. PTSD development in AMI survivors increases the probability of recurrence of acute coronary syndrome, rehospitalizations, and mortality rates due to cardiac diseases. Survivors with a history of mental illness, severe pain during trauma (AMI), perceiving AMI as a life-threatening condition, experiencing severe subjective severity indicators of AMI, and intense maladaptive negative cognitions about trauma (MI and its consequences) have a higher risk of developing PTSD. Close monitoring of these high-risk individuals with regard to PTSD development may be beneficial for the early detection and treatment of possible PTSD symptoms. Immediate detection and treatment of PTSD symptoms may be beneficial in preventing the adverse effects of PTSD on the course of AMI in survivors. In addition, examination of negative posttraumatic cognitions and detection of maladaptive beliefs in patients with PTSD symptoms after AMI may facilitate the determination of therapeutic targets for effective psychological treatments, such as cognitive behavioral therapy.

Contribution Categories		Author Initials
Category 1	Concept/Design	R.G.T., N.D.
	Literature review	N.D.
	Data analysis/Interpretation	R.G.T., N.D.
Category 2	Drafting manuscript	R.G.T., N.D.
	Critical revision of manuscript	R.G.T.
Category 3	Final approval and accountability	M.B., F.O.
Other	Supervision	R.G.T., N.D.

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