

Chronic Post-traumatic Stress Following a Myocardial Infarction: Prevalence and Detection in Hospital Setting

Christophe Fortin^{1*}, Gilles Dupuis², André Marchand³ and Bianca D'Antono⁴

¹Department of Psychology, Université du Québec à Montréal, Montreal, Quebec, Canada

²Professor, Department of Psychology (C.F., G.D., A.M., B.D.A.), Université du Québec à Montréal, Montreal, Quebec, Canada

³Department of Psychosomatic Medicine (C.F., G.D., B.D.A.), Montreal Heart Institute, Montreal, Quebec, Canada

⁴Psychiatry Department, Université de Montréal (BDA) Montreal, Quebec, Canada

Abstract

Objective: This paper examines the prevalence of chronic Post-Traumatic Stress Disorder (PTSD) after a Myocardial Infarction (MI) and the factors associated its early detection in a hospital setting.

Methods: Of 1344 MI patients admitted to three Canadian hospitals, 474 patients did not meet the inclusion criteria and 370 declined participation in the study; 500 patients consented to participate in the study. A structured clinical interview and questionnaires were administered to patients 48 hours to 14 days post-MI ($M=4SD=2.7$ days) and three months later to assess the prevalence of chronic PTSD and its risk factors.

Results: Respectively 4.4% and 11.1% of the patients met the full and partial diagnostic criteria of chronic PTSD, measured with the Interview from the DSM-IV-TR PTSD module. Using binary logistic regression, both the intensity of anxiety (Beck Anxiety Inventory) (OR=1.05 per unit increase; $p<.05$, 95% CI: 1.00-1.10) and acute stress disorder symptoms (Modified PTSD Symptom Scale) (OR=1.05 per unit increase; $p<.001$, 95% CI=1.03-1.08), measured while in-hospital were associated with the presence of symptoms of PTSD three-months after the MI.

Conclusion: Systematic in-hospital investigation of easily assessable risk factors is recommended in order to improve the detection of chronic PTSD and to prevent its detrimental effects on cardiovascular health.

Keywords: Chronic post-traumatic stress disorder; Myocardial infarction; Prevalence; Risk factor; Detection

Acronyms: MI=Myocardial infarction; PTSD=Post-traumatic stress disorder; DSM-IV-TR=Diagnostic and statistical manual of mental disorders, 4th edition, text revision; SCID-IV-ASD=Structured clinical interview for DSM-IV, acute stress disorder; SCID-IV-PTSD=Structured clinical interview for DSM-IV, post-traumatic stress disorder; MPSS-SR=Modified PTSD symptom scale-self-report; BDI-II=Beck depression inventory, second edition; M-MSSS=Modified medical outcomes study social support survey; BAI=Beck anxiety inventory.

Introduction

Myocardial infarction, given its unpredictable nature and the obvious threat to life it represents, may be perceived as a traumatic event by cardiac patients [1-3]. It is now acknowledged that some patients, following a myocardial infarction, will indeed develop post-traumatic stress disorder symptomatology [1,4-8].

According to the Diagnostic and statistical manual of mental disorders, fourth edition, 4th edition, text revised [9], to be diagnosed with PTSD, a person must display symptoms from three different clusters: avoidance of reminders of the traumatic event; re-experiencing symptoms of the trauma, such as flashbacks; and hyper arousal (i.e., hyper vigilance, persistent heightened level of anxiety). These symptoms must be present for a minimum of one month to meet the criteria of acute PTSD and 3 months for a diagnosis of chronic PTSD.

PTSD can have serious consequences on the health of patients with cardiac disease. Its symptoms are associated with poor cardiovascular risk-factor control [1] and smoking [10]. Traumatized patients are more likely to be non-adherent to prescribed medications [1,2,11,12]. PTSD is also associated with increased heart rate, higher sympathetic but lower parasympathetic control of heart rate activity [2,13] and with altered reactivity of the hypothalamic-pituitary-adrenal axis, all with the potential to affect the cardiovascular system [14].

Despite the general agreement on the adverse consequences of PTSD and the corollary benefits consequent to its detection, information on the predictors of post-MI PTSD is still scarce and conflicting [3]. Despite the reported prevalence, varying from 7% to 30%, data on the predictors of chronic PTSD is even more limited [15-18]. The few studies that investigated the risk factors of chronic PTSD post-MI reported varying and inconsistent predictors. They include a variety of sociodemographic and psychological variables such as younger age, greater symptoms of depression during admission and lower social support [3,4,19]. In addition, the association between PTSD and objective clinical measures such as cardiac enzymes [12,20], left ventricular ejection fraction [2] and factors related to the hospitalization (number of hours in the ER, length of stay in the hospital) have not been clearly demonstrated [3]. Although results from a recent study suggest that patient emotional status, particularly anxiety felt during MI, and subjective perception of the event are good predictors of the development of PTSD symptoms after a myocardial infarction [3], these findings have not been replicated. The same conclusion holds for personal factors, such as a past history of trauma and comorbid mental illness [2]. While depression is associated with the presence of PTSD [1,4] whether the depression is the cause or consequence of PTSD remains unclear. It is possible that the largely documented effect of depression on cardiovascular health are related to the existence of the comorbid PTSD symptoms [2]. Psychiatric

***Corresponding author:** Christophe Fortin, Collège Terrebonne, 2505 boul. des Entreprises, Terrebonne, J6S 5S5, Canada, Tel: 1-450-477-6933; Fax: 1-514-987-7953; E-mail: christophe.fortin@collanaud.qc.ca

Received July 01, 2013; Accepted July 23, 2013; Published July 27, 2013

Citation: Fortin C, Dupuis G, Marchand A, D'Antono B (2013) Chronic Post-traumatic Stress Following a Myocardial Infarction: Prevalence and Detection in Hospital Setting. J Depress Anxiety 2: 133. doi:10.4172/2167-1044.1000132

Copyright: © 2013 Fortin C, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

morbidity other than depression should also be considered since it is increasingly being recognized as an important risk factor for post-MI outcome [1] but it remains to be validated as a risk factor of post-MI chronic PTSD.

As Whitehead et al. [4] pointed out, knowledge of the predictive factors and their prevention may diminish the risk of death and ensure a better well being for patients suffering from post-MI PTSD. Moreover, Shemesh et al. [1] advocate that factors that determine vulnerability to post-MI traumatic stress should be clearly identified and could be used to inform and develop treatment options. The potential knowledge transfer to patients recovering from a myocardial infarction can lead them to better understand the mechanism linking psychiatric symptoms to poor outcomes [2] and therefore make them more likely to intervene or to accept intervention on these risk factors. Nevertheless, outside the realm of research, the symptoms of PTSD following a myocardial infarction are often unrecognized and untreated [5,7,8] and the identification of new ways to improve post-MI PTSD detection is important to avoid its negative impact on cardiovascular health [1]. Also important is the time of the investigation. As Rocha et al. [3] pointed out, studies should assess the prevalence of PTSD later than 2 months after the MI, in order to clarify whether the PTSD symptoms post-MI may remit spontaneously and to identify cases of delayed onset PTSD.

Consequently to the issues addressed, the present study prospectively investigates chronic PTSD among post-MI patients. Specifically, this study assesses post-MI patients while in-hospital and 3 months after their coronary event in order to establish: 1) the prevalence of chronic PTSD after a myocardial infarction and 2) the factors associated with its symptomatology for an early detection in hospital setting.

Methods

Participants and procedure

Participants were recruited between June 2002 and April 2005 in three Montreal hospitals. In addition to a confirmed myocardial infarction diagnosis by the treating physicians on the basis of an electrocardiogram and troponin levels, patients had to meet the following criteria for the study: 1) 18 years old or older; 2) sufficient oral and written language skills (French or English); 3) absence of any moderate-to-severe cognitive deficit; and 4) absence of any severe comorbid health problems (e.g.: cancer, AIDS). Eligible patients were identified through the consultation of the medical files in the coronary unit of each hospital. Research assistants with a degree in psychology presented the goals of the study and the research protocol to eligible patients. Patients who refused to participate were not asked any other question (e.g.: socio-demographic information, reason of refusal), since ethic committees prohibited it. Participating patients had to sign a consent form to be part of the study. Before they left the hospital (minimum of 48 hours and maximum of 14 days after the MI; mean=4 ± 2.73 days), a trained interviewer met them to complete the SCID-IV-ASD [21] and to gather sociodemographic and medical information. Additional questionnaires, to be returned at specific times, were given to participants along with a preaddressed prestamped envelope. The patients who did not return their questionnaires at due time were phoned daily until they completed and returned the questionnaires. Patients were contacted 90 days post-MI to complete the same questionnaires, with the exception of the Life Event Stress Scale. Moreover, the SCID-IV-PTSD interview replaced the SCID-IV-ASD. Ethics Committees of the three institutions approved the research protocol in 2002.

Measurement Instruments

Sociodemographic and medical data

This instrument collected participants sociodemographic data (e.g.: age, sex, level of education) and different medical information (e.g.: consultation with a psychologist or psychiatrist, past traumatic events, left ventricular ejection fraction). The questionnaire was designed for the current study.

Structured clinical interview for DSM-IV-acute stress disorder (SCID-IV-ASD) [21]

This measure, based on the DSM-IV diagnostic criteria, is frequently used to diagnose ASD. The previous version (SCID for DSM-III-R) has good concomitant validity ($\alpha=0.69$) with clinicians [22]. The current SCID version indices are comparable or better [23].

Structured Clinical Interview for DSM-IV, PTSD (SCID-IV-PTSD) and Past PTSD Modules (SCID-IV-PTSD) [21].

These modules enable one to diagnose current PTSD as well as past PTSD that is currently in remission [22,23]. Its psychometric properties are currently unknown.

Modified PTSD symptom scale-self-report (MPSS-SR) [24]

Using this 17-item questionnaire, patients self-report the frequency and the severity of their post-traumatic stress symptoms, on a five-point Likert scale. The total score is obtained by adding the totals of the two scales. It has been validated as a reliable measure of PTSD [25]. Its internal consistency is excellent (frequency, $\alpha=0.92$; severity, $\alpha=0.95$) as is its 5-week test-retest reliability (frequency, $r=0.98$, $p<0.001$; severity, $r=0.98$, $p<0.001$).

Beck depression inventory, second edition (BDI-II) [26]

Based on the DSM-IV criteria, this 21-item self-administered questionnaire is commonly used to assess the symptoms of depression. Its internal consistency ($\alpha=0.92$) and 1-week test-retest reliability ($r=0.93$) are excellent [27].

Beck anxiety inventory (BAI) [28]

The BAI was preferred over other measures of anxiety since it was specifically designed to reduce the overlap between depression and anxiety scales by measuring anxiety symptoms shared minimally with those of depression. It presents excellent internal consistency ($\alpha=0.92$) for adults and good 1-week test-retest reliability ($\alpha=0.75$), as well as good concurrent validity [28]. Its score, on a continuous scale, varies from 0 to 63.

Life events stress scale (LESS) [29]

This inventory is a modified French and English version of the Life Events Stress Scale [30]. The adapted version is a list of ten potential traumatic event experienced in the last six months and their consequential level of stress on the patient. Psychometric properties are currently unknown.

Modified MOS (medical outcomes study) social support survey (M-MSSS) [30]

Adapted from the MOS Social Support Survey [31] the M-MSSS seven-item questionnaire measures perceived social support. The availability of each type of support is rated on a 5 points frequency scale. In previous studies, both French and English versions demonstrated

good internal consistency ($\alpha=0.91$ and $\alpha=0.88$ respectively) and 2-week test-retest reliability ($r=0.90$) [30,32].

Statistical analyses

Descriptive analyses were carried out in order to assess the prevalence and symptomatology of chronic PTSD and to ascertain the participants' characteristics. To identify the factors associated with the presence of chronic PTSD, a binary logistic regression was performed. Independent variables were selected using correlations and *t*-tests ($p<0.05$) applied to a set of clinically and theoretically important variables associated with the intensity of PTSD symptoms, as measured by the MPSS-SR at the 90-days follow-up. Logistic regression on the MPSS-SR score was preferred over the SCID-IV PTSD diagnosis since, from a clinical perspective that aims to identify patients at risk of distress and poor outcomes, post-traumatic stress severity may be a more useful measure than PTSD diagnostic [4]. Moreover, as Rocha et al. [3] pointed out, it is important to be able to identify patients who may be at risk of post-traumatic stress disorder even if they don't have a clinical PTSD. A score of 22 on the MPSS-SR scale was set as the cut point since that score or higher indicates the presence of a symptomatology of PTSD [25].

Results

Participants

Out of the 1344 patients hospitalized for a myocardial infarction between June 2002 and April 2005 in the three recruitment centers, 844 did not participate (474 patients did not meet the inclusion criteria and 370 patients declined participation). Five hundred consented to the study and completed the in-hospital interview but 114 did not return their questionnaires or were unreachable for the 3 months post-MI follow-up interview. Thus, the final sample size is 386 participants (see flow chart for details). Apart from being younger (mean age of 58 versus 61; $t=2.478$; $p<0.05$), there were no other statistically significant differences between the participants who completed the three months follow-up and those who did not. The characteristics of participants who completed the three-months follow-up are presented in table 1.

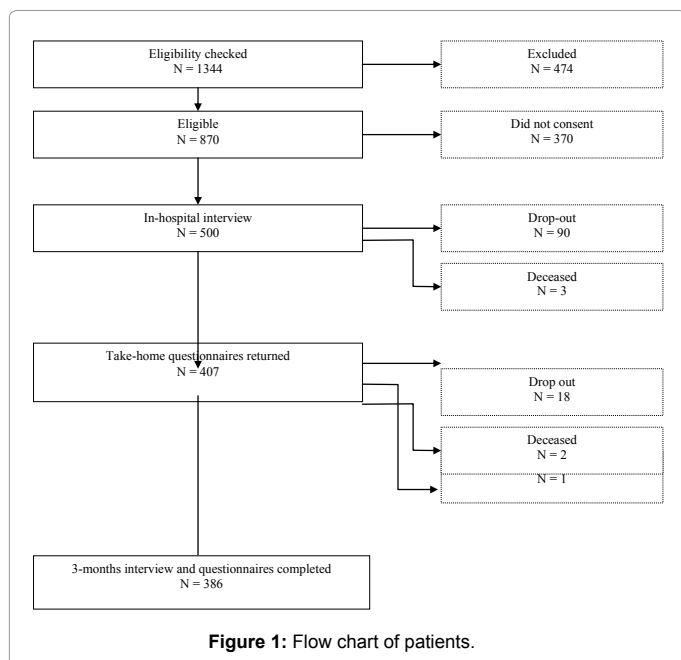


Figure 1: Flow chart of patients.

	N (%)	M (SD)
Sex (men)	295 (76.4)	
Age		58 (11)
Education ≥ college or equivalent	154 (39.9)	
Annual income <\$30,000	265 (70.4)	
Working	212 (54.9)	
Engaging in physical activity	214 (55.4)	
History of MI	57 (14.8)	
History of cardiovascular disease (other than MI)	290 (75.1)	
Family history of cardiovascular disease	280 (72.5)	
Smoking	97 (25.1)	
Alcohol (consumption ≥ 1 drink/week)	173 (44.8)	
Social support (M-MSSS, total/28)		21.33 (6.7)
Stress level related to life events (LESS, total/5)		1.7 (1.4)
Anxiety (BAI, total/63)		9 (8.6)
Depression (BDI-II, total/63)		8.6 (7.6)
Low intensity symptoms (11-19/63)	57 (14.8)	
Moderate-to-high intensity symptoms (20-63/63)	36 (9.3)	
Ejection fraction		0.49 (11)

Table 1: Participants' characteristics.

Prevalence of chronic PTSD and symptomatology

Out of the 386 participants who completed the *Structured Clinical Interview for DSM-IV PTSD* three months after their MI, 17 meet the criteria for chronic PTSD, hence a prevalence of 4.4%. The average score on the MPSS-SR is 12.6 (SD=16.8). Sixty-six patients (17.1% of sample) met or exceeded the clinical cut-off score of 22, indicating the presence of a moderate symptomatology. The symptoms on the ASD and PTSD modules of the SCID-IV and the score on the MPSS-SR at both evaluation times are presented in table 2.

Chronic PTSD's symptomatology early detection in hospital setting

Variables that met the univariate analyses criteria were retained as independent variables for the binary logistic regression. The order of entry of each variables and blocks in the regression equation follows Victoria et al. [33] recommendations for epidemiological analyses. Specifically, information regarding the first block is commonly gathered from the patient medical file while the information from the second block is obtained with a quick chat with the patient or his/her family. Depression (block #3) is a common medical condition and its symptoms are easily observed while anxiety (block #4) is a more subtle psychological condition to assess. Finally, the intensity of symptoms of post-traumatic stress (block #5) while in-hospital was introduced in the last step to avoid masking the effect of the other independent variables.

The variables entered in each step of the binary logistic regression analysis and their respective contributions to the total variance at each step are presented in table 3.

In the first block ($R^2=0.133$), *sex*, *past MI* and *other health problems* reported by patients (e.g.: osteoporosis) are statistically significant predictors of the intensity of chronic PTSD symptomatology. In the second block ($R^2=0.194$), *sex* loses its statistical significance, while the

	N (%)	M (SD)
Post-MI hospitalization		
ASD (SCID-IV-ASD)		
Clinical diagnosis (criteria A, B, C, D and E met)	10 (2.6)	
Partial diagnosis (criterion A met and 1 symptom of B, C, D or E)	22 (5.7)	
MPSS-SR (total/119)		14.8 (15.8)
Presence of symptomatology (≥ 22/119)	75 (21.6)	
3 month post-MI follow-up		
Chronic PTSD (SCID-IV-PTSD)		
Clinical diagnosis (criteria A, B, C and D met)	17 (4.4)	
Partial diagnosis (criterion A met and 1 symptom of B, C and D)	43 (11.1)	
Perceived threat and fear, helplessness or horror (criterion A met: 2/2 symptoms)	167 (43.3)	
Re-experiencing (criterion B met: ≥ 1/5 symptoms)	93 (24.1)	
Avoidance and blunting of general reactivity (criterion C met: ≥ 3/7 symptoms)	43 (11.1)	
Autonomic hyperactivation (criterion D met: ≥ 2/5 symptoms)	93 (24.1)	
MPSS-SR (total/119)		12.6 (17)
Presence of symptomatology (≥ 22/119)	66 (17.1)	

Table 2: Prevalence and symptomatology of ASD and chronic PTSD.

Block	Variables	STEP 1			STEP 2			STEP 3			STEP 4			STEP 5		
		R ²	.133			.194			.308			.353			.411	
		Odd ratio	C.I. (95%)	p	Odd ratio	C.I. (95%)	p	Odd ratio	C.I. (95%)	p	Odd ratio	C.I. (95%)	p	Odd ratio	C.I. (95%)	p
	Age	0.98	.948-1.004	0.105	0.99	.963-1.024	0.659	0.99	.961-1.026	0.666	0.989	.957-1.023	0.525	0.989	.955-1.023	0.514
	Sex	0.52	.267-.996	0.049 *	0.52	.260-1.054	0.070	0.58	.274-1.208	0.144	0.56	.261-1.203	0.137	0.476	.214- 1.057	0.068
1	History of referral to psychologist or psychiatrist	1.85	.945-3.621	0.073	1.28	.612-2.683	0.510	0.97	.430-2.180	0.937	0.834	.357-1.948	0.675	0.822	.339-1.993	0.665
	Past-MI	2.17	1.176-3.992	0.013 *	2.22	1.185-4.142	0.013 *	1.87	.971-3.601	0.061	1.628	.841-3.152	0.148	1.299	.661-2.555	0.448
	Otherhealthproblems	2.07	1.089-3.935	0.026 *	1.98	1.018-3.844	0.044 *	1.99	1.059-4.111	0.045 *	2.19	1.038-4.621	0.04 *	2.044	.932-4.483	0.074
	Perceived social support	-	-	-	0.97	.926-1.012	0.158	1.00	.953-1.056	0.906	1.001	.949-1.057	0.957	1	.946- 1.058	0.999
2	Intensity of stressful events	-	-	-	1.06	.784-1.439	0.699	0.92	.658-1.294	0.642	0.916	.647-1.296	0.619	0.96	.673-1.370	0.821
	Number of stressful events	-	-	-	1.34	1.07-1.675	0.011 *	1.24	.961-1.585	0.099	1.245	.964-1.609	0.094	1.208	.928- 1.573	0.161
3	Intensity of depression (BDI-II)	-	-	-	-	-	-	1.12	1.071-1.177	0.000 ***	1.084	1.030-1.141	0.002 *	1.024	.964-1.004	0.445
4	Intensity of anxiety (BAI)	-	-	-	-	-	-	-	-	-	1.072	1.029-1.118	0.001 **	1.048	1.004-1.095	0.034 *
5	Intensity of ASD (MPSS-SR)	-	-	-	-	-	-	-	-	-	-	-	-	1.054	1.025-1.083	0.000 ***

*p>.05; **p>.01; ***p>.001

Table 3: Risk factors associated with the presence of symptomatology of chronic PTSD 3 months after myocardial infarction.

number of stressful events becomes a statistically significant predictor. In block #3, the intensity of depression combines with other health problems, the only two significant predictors remaining, for a total variance explained of 30.8%. The intensity of anxiety, added as the fourth block, increases the explained variance by 4.5%. The final model (R²=0.411) consists of only two predictors: the baseline measure of the intensity of anxiety (OR=1.05 per unit increase; p<.05, 95% CI: 1.00-1.10), the only significant predictor left from precedent blocks and the intensity of acute stress disorder symptoms (OR=1.05 per unit increase; p<.001, 95% CI=1.03-1.08), added in the fifth block.

The non-significant independent variables excluded in the univariate analyses were introduced in an additional step (not included in table 3) in the binary logistic regression analysis to test their contribution. They remained non-statistically significant.

Discussion

Prevalence of PTSD

Data from the current study indicates that respectively 4.4% and 11.1% of the patients met the criteria for full and partial chronic PTSD

diagnosis three months after a myocardial infarction. Results from previous studies suggest a higher prevalence of clinical PTSD [15-18]. However, most of the previous studies used self-report questionnaires, which are less restrictive in diagnosing PTSD, while this study used a structured interview (SCID-IV-PTSD). We believe this methodological difference can partially account for the low occurrence of chronic PTSD in our study. A closer look at criterion A of the PTSD diagnosis can explain furthermore the low prevalence of chronic PTSD. To meet this criterion, the patient has to experience an event during which his life or physical integrity or that of another person is threatened and must have a reaction of fear, helplessness or horror. Although a myocardial infarction is a life threatening event, only 43% of patients met this diagnostic criterion in our study. Thus, the impact of the MI as a potentially traumatic event might be subjectively experienced as a less intense threat to life than other types of events [8].

Even in the absence of a clinical PTSD diagnosis, the detrimental effect of PTSD symptoms on cardiovascular prognosis and healthy habits are well documented [1,2,11,12]. In our study, more than 1 of 10 patients (11.1%) met the criteria for a partial chronic PTSD diagnosis, underlining the necessity to integrate a PTSD measure in the medical post-MI follow-up routine.

Factors associated with the presence of chronic PTSD symptomatology

Although the variables from the first three blocks lose their statistical significance as predictors of the severity of chronic PTSD symptoms in the full model, they remain relevant variables to investigate. The results from the regression analysis, supported by our clinical experience, lead us to think that in a step-by-step investigation, these variables may lead to an early detection of chronic PTSD. For instance, the detection of sociomedical variables available through the patient medical file, such as the presence of past MI, other health problems and being a woman, should raise a flag on the vulnerability for chronic PTSD. These indicators could alert the medical staff to other key risk factor associated with chronic PTSD. The nurse or physician, with simple questions to the patient or her/his family, can verify if the patient has had any stressful event (e.g.: death of close person, retirement) in the last six months. As the number of stressful events increases, the predisposition of the patients to develop chronic PTSD symptomatology rises proportionally. One possible explanation for this increased vulnerability relates to the psychological toll exacted on the person as a result of emotionally-taxing life situations experienced in the past, leaving the patient vulnerable to new events, such as a MI. If the patients have experienced a number of stressful life events, a mental health professional should be involved in the patient evaluation to ascertain the presence and intensity of depression. This is particularly important, since the intensity of depressive symptoms, combined with commonly assessed sociomedical variables, is strongly associated with the presence of chronic PTSD symptoms. This result supports the finding of Roberge et al. [7], who observed that the intensity of depression is a good predictor of PTSD 1-month following a MI. Moreover, this result emphasizes the importance of evaluating post-MI depression. Studies indicate that even low intensity symptoms can have meaningful negative repercussions on cardiovascular morbidity and mortality [34,35]. However, patients screening should not stop with the assessment of symptoms of depression, as is frequently done, as patients with PTSD may be overlooked as well as its potential detrimental effect on health [4]. We propose that a comprehensive evaluation of a patient cardiovascular health should incorporate a general anxiety measure. This belief is supported by our results since the addition of such a

measure adds statistically significant predictive power to the detection of chronic PTSD. Finally, we believe a thorough investigation of one's risk to develop chronic PTSD symptomatology would not be complete without the evaluation of the intensity of ASD symptoms while in-hospital. Our results demonstrate that ASD symptoms are the measure that best predicts the development of chronic PTSD symptoms three months after a MI. These findings are in line with those of Ginzburg et al. [36-38] and Roberge et al. [8], who demonstrated that acute stress disorder symptomatology is associated with the development of PTSD symptoms after a MI. Since PTSD symptoms have been demonstrated to adversely affect the cardiovascular prognosis [39-41], their early detection should be a prime concern for the treating physician or cardiologist.

The introduction of the level of ASD symptom in the regression model yields unexpected results. Its addition leaves the BAI score as a significant predictor of chronic PTSD symptomatology while it render statistically non-significant the contribution of the depression score. This suggests an important shared variance between ASD symptomatology and depression while the patient is in-hospital and may lead to an erroneous diagnosis and treatment of depression, overlooking the development of the PTSD. Although the final model explains more than 40% of the variance, the odd ratio associated with the significant predictors is small. However, when considering the range and average score on each anxiety measure, the pertinence of assessing these variables remains, as they significantly increase the probability of detecting the development of PTSD symptomatology. The amount of unexplained variance in the final model underlines the necessity for future researches to better understand the etiology of chronic PTSD and to identify its predictive factors. The confounding symptoms of depression and ASD while in-hospital call for further investigations to establish proper diagnosis procedure and consequential treatment for post-MI patients. Future studies, demonstrating the incapacitating impact of post-MI chronic PTSD on patient daily functioning and health as well as its toll on the health care system, should be undertaken to sensitize health care specialists and patients to PTSD.

Methodological limitations

The use of a structured interview to assess the diagnosis and prevalence of post-MI chronic PTSD and the identification of predictors of PTSD symptomatology using a large sample of patients were strengths of this multicenter prospective study. However, it presents limitations that reduce the generalization of the results. The high rate of refusal (43%) raises questions regarding the generalizability of our results to a general post-MI population. However, the low participation rate might be in part attributable to patients who declined to take part in the study to avoid being reminded of the MI in an interview [16]. The low prevalence of chronic PTSD obtained with the SCID-IV-PTSD led us to use the MPSS-SR cut-off score to establish the predictive factors of chronic PTSD. Even if we have empirical evidence to support this decision, the use of the clinical interview tool based solely on the DSM-IV-TR criteria would have been more desirable and may have led to different results. Finally, more than 1 in 5 patients dropped-out of the study. Although no differences on sociodemographic and psychological variables were found between patients who completed the 90-days follow-up and those who did not, it may have led, among other things, to erroneously estimate the "true" prevalence of PTSD post-MI.

Conclusion

Using the SCID-IV-PTSD, data indicates a 4.4% prevalence of post-MI chronic PTSD three months after the event. When considering a

partial diagnosis with the same structured interview, prevalence rises to 11.1%. This study identifies predictive factors of chronic PTSD accordingly to each step of a realistic evaluation procedure – from the first consultation of the patient medical file to a thorough investigation. From a clinical point of view, while patients are in the hospital after a MI, this is an ideal occasion to perform the initial identification of post-traumatic symptoms and at-risk patients. Since PTSD may develop over time and if not detected and appropriately treated, it may lead to long-term psychological distress for many patients [5], early detection can lead to beneficial repercussions, like improve adherence to aspirin and in a substantial reduction of cardiovascular risk factors [2].

Acknowledgments

Financial support for this study was provided by grants from the Canadian Institutes of Health Research (CIHR) and the Montreal Heart Institute's research Fund.

References

- Shemesh E, Koren-Michowitz M, Yehuda R, Milo-Cotter O, Murdock E, et al. (2006) Symptoms of posttraumatic stress disorder in patients who have had a myocardial infarction. *Psychosomatics* 47: 231-239.
- Cotter G, Milo-Cotter O, Rubinstein D, Shemesh E (2006) Posttraumatic stress disorder: a missed link between psychiatric and cardiovascular morbidity? *CNS Spectr* 11: 129-136.
- Rocha LP, Peterson JC, Meyers B, Boutin-Foster C, Charlson ME, et al. (2008) Incidence of posttraumatic stress disorder (PTSD) after myocardial infarction (MI) and predictors of PTSD symptoms post-MI—a brief report. *Int J Psychiatry Med* 38: 297-306.
- Whitehead DL, Perkins-Porras L, Strike PC, Steptoe A (2006) Post-traumatic stress disorder in patients with cardiac disease: predicting vulnerability from emotional responses during admission for acute coronary syndromes. *Heart* 92: 1225-1229.
- Jones RC, Chung MC, Berger Z, Campbell JL (2007) Prevalence of post-traumatic stress disorder in patients with previous myocardial infarction consulting in general practice. *Br J Gen Pract* 57: 808-810.
- Chung MC, Berger Z, Jones R, Rudd H (2008) Posttraumatic stress and comorbidity following myocardial infarction among older patients: the role of coping. *Aging Ment Health* 12: 124-133.
- Roberge MA, Dupuis G, Marchand A (2008) Acute stress disorder after myocardial infarction: prevalence and associated factors. *Psychosom Med* 70: 1028-1034.
- Roberge MA, Dupuis G, Marchand A (2010) Post-traumatic stress disorder following myocardial infarction: prevalence and risk factors. *Can J Cardiol* 26: e170-175.
- American Psychiatric Association (2000) *Diagnostic and Statistical Manual of Mental Disorders*, Text revision. (4th edn), American Psychiatric Association, Washington, DC.
- Shemesh E, Keshavarz R, Leichtling NK, Weinberg E, Mousavi A, et al. (2003) Pediatric emergency department assessment of psychological trauma and posttraumatic stress. *Psychiatr Serv* 54: 1277-1281.
- Shemesh E, Yehuda R, Milo O, Dinur I, Rudnick A, et al. (2004) Posttraumatic stress, nonadherence, and adverse outcome in survivors of a myocardial infarction. *Psychosom Med* 66: 521-526.
- Ginzburg K, Solomon Z, Koifman B, Keren G, Roth A, et al. (2003) Trajectories of posttraumatic stress disorder following myocardial infarction: a prospective study. *J Clin Psychiatry* 64: 1217-1223.
- Lakusic N, Fuckar K, Mahovic D, Cerovec D, Majsec M, et al. (2007) Characteristics of heart rate variability in war veterans with post-traumatic stress disorder after myocardial infarction. *Mil Med* 172: 1190-1193.
- Yehuda R (2002) Post-traumatic stress disorder. *N Engl J Med* 346: 108-114.
- Sheldrick R, Tarrier N, Berry E, Kinsey J (2006) Post-traumatic stress disorder and illness perceptions over time following myocardial infarction and subarachnoid haemorrhage. *Br J Health Psychol* 11: 387-400.
- Bennett P, Brooke S (1999) Intrusive memories, post-traumatic stress disorder and myocardial infarction. *Br J Clin Psychol* 38: 411-416.
- Bennett P, Owen RL, Koutsakis S, Bisson J (2002) Personality, social context and cognitive predictors of post-traumatic stress disorder in myocardial infarction patients. *Psychology & health* 17: 489-500.
- Bennett P, Conway M, Clatworthy J, Brooke S, Owen R (2001) Predicting post-traumatic symptoms in cardiac patients. *Heart Lung* 30: 458-465.
- Pedersen SS, van Domburg RT, Larsen ML (2004) The effect of low social support on short-term prognosis in patients following a first myocardial infarction. *Scand J Psychol* 45: 313-318.
- Tedstone JE, Tarrier N (2003) Posttraumatic stress disorder following medical illness and treatment. *Clin Psychol Rev* 23: 409-448.
- First M, Spitzer R, Gibbon M, Williams J (1997) *Structured clinical interview for DSM-IV - clinical version (SCID-CV)*. American Psychiatric Press, Inc., Washington, DC.
- Hovens JE, Falger PRJ, Op den Velde W, Schouten EGW, Groen JHM et al. (1992) Occurrence of posttraumatic stress disorder among Dutch World War II resistance veterans according to the SCID. *Journal of Anxiety Disorders* 6: 147-157.
- Rogers R (2001) *Handbook of Diagnostic and Structured Interviewing*. The Guilford Press, New-York.
- Falsetti S, Resnick H, Resick P, Kilpatrick D (1993) The modified PTSD symptom scale: a brief self-report measure of PTSD. *Behavior Therapy* 16: 161-162.
- Guay S, Marchand A, Iucci S, Martin A (2002) Validation de la version québécoise de l'Échelle modifiée des symptômes du trouble de stress post-traumatique auprès d'un échantillon clinique. *Revue Québécoise de Psychologie* 23: 257-269.
- Steer RA, Clark DA, Beck AT, Ranieri WF (1999) Common and specific dimensions of self-reported anxiety and depression: the BDI-II versus the BDI-IA. *Behav Res Ther* 37: 183-190.
- Beck A, Steer R, Brown G (1996) *Manuel de l'inventaire de dépression de Beck*. (2nd edn) Harcourt Brace & Company Toronto, Canada.
- Steer RA, Clark DA, Beck AT, Ranieri WF (1999) Common and specific dimensions of self-reported anxiety and depression: the BDI-II versus the BDI-IA. *Behav Res Ther* 37: 183-190.
- Hurst MW, Jenkins CD, Rose RM (1978) The assessment of life change stress: a comparative and methodological inquiry. *Psychosom Med* 40: 126-141.
- Czajkowski SM, Terrin M, Lindquist R, Hoogwerf B, Dupuis G, et al. (1997) Comparison of preoperative characteristics of men and women undergoing coronary artery bypass grafting (the Post Coronary Artery Bypass Graft [CABG] Biobehavioral Study). *Am J Cardiol* 79: 1017-1024.
- Sherbourne CD, Stewart AL (1991) The MOS social support survey. *Soc Sci Med* 32: 705-714.
- Anderson D, Bilodeau B, Deshaies G, Gilbert M, Jobin J (2005) [French-Canadian validation of the MOS Social Support Survey]. *Can J Cardiol* 21: 867-873.
- Victoria CG, Huttly SR, Fuchs SC, Olinto MT (1997) The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *Int J Epidemiol* 26: 224-227.
- Frasure-Smith N, Lespérance F (2008) Depression and anxiety as predictors of 2-year cardiac events in patients with stable coronary artery disease. *Arch Gen Psychiatry* 65: 62-71.
- Frasure-Smith N, Lespérance F (2010) Depression and cardiac risk: present status and future directions. *Heart* 96: 173-176.
- Ginzburg K (2006) Life events and adjustment following myocardial infarction: a longitudinal study. *Soc Psychiatry Psychiatr Epidemiol* 41: 825-831.
- Ginzburg K (2006) Comorbidity of PTSD and depression following myocardial infarction. *J Affect Disord* 94: 135-143.
- Ginzburg K, Solomon Z, Dekel R, Bleich A (2006) Longitudinal study of acute stress disorder, posttraumatic stress disorder and dissociation following myocardial infarction. *J Nerv Ment Dis* 194: 945-950.
- Lachance Fiola, Dupuis J, Antono G D, Marchand A, White M (2013) Post-traumatic stress disorder and myocardial infarction: impact on cardiovascular complications. *International Journal of Victimology* 11: 111-119.

-
40. Dirkzwager AJ, van der Velden PG, Grievink L, Yzermans CJ (2007) Disaster-related posttraumatic stress disorder and physical health. *Psychosom Med* 69: 435-440.
41. Kubzansky LD, Koenen KC, Spiro A 3rd, Vokonas PS, Sparrow D (2007) Prospective study of posttraumatic stress disorder symptoms and coronary heart disease in the Normative Aging Study. *Arch Gen Psychiatry* 64: 109-116.

This article was originally published in a special issue, **Posttraumatic Stress Disorder** handled by Editor(s). Dr. Gautham Ullah, MC Master University, Canada