Impact of peritraumatic distress on posttraumatic stress disorder symptoms at 6 months after acute coronary syndrome: a prospective cohort study

Tomomi Narisawa a,b,c, Daisuke Nishi d, Ryo Okubo e, Hiroko Noguchi a,c, Kei Hamazaki e, Akihiro Yamashita f, and Yutaka J. Matsuoka a,b,f

*Division of Health Care Research, Center for Public Health Sciences, National Cancer Center Japan, Tokyo, Japan; 1Lifestyle Medicine, Cooperative Graduate Program, The Jikei University Graduate School of Medicine, Tokyo, Japan; 2Department of Human Sciences, School of Distance Learning, Musashino University, Tokyo, Japan; 3Department of Mental Health, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan; 4Department of Public Health, Faculty of Medicine, University of Toyama, Toyama, Japan; 5Department of Psychiatry, National Disaster Medical Center, Tokyo, Japan

**ABSTRACT**

**Background:** Posttraumatic stress disorder (PTSD) symptoms are known to occur after acute coronary syndrome (ACS). Peritraumatic distress has been indicated as a risk factor for PTSD and can be measured by the Peritraumatic Distress Inventory (PDI). However, no studies have yet measured peritraumatic distress after ACS using the PDI to predict PTSD.

**Objectives:** This prospective cohort study examined the impact of peritraumatic distress on PTSD symptoms at 6 months after ACS.

**Methods:** We used the PDI to assess peritraumatic distress in patients treated for ACS at a teaching hospital in Tokyo within 7 days after percutaneous coronary intervention. They were followed up over the next 6 months and were assessed for PTSD symptoms at 6 months using the Impact of Event Scale-Revised. The association between peritraumatic distress and PTSD symptoms was examined by multiple linear regression analysis.

**Results:** The study enrolled 101 ACS patients, and 97 completed the follow-up assessment. PDI total score was an independent predictor of PTSD symptoms after adjustment for potential covariates (β = 0.38; p < 0.01).

**Limitations:** The results were obtained from a single teaching hospital and assessment of PTSD symptoms was questionnaire based.

**Conclusion:** We provide the first evidence that PDI score can predict the development of PTSD symptoms in ACS patients. Assessing peritraumatic distress after ACS with the PDI may be useful for initiating early intervention against PTSD symptoms.

**Impacto del malestar peritraumático en los síntomas del trastorno de estrés postraumático, 6 meses después del síndrome coronario agudo: un estudio de cohorte prospectivo**

**Antecedentes:** Se sabe que síntomas del trastorno de estrés postraumático (TEPT) se pueden presentar después del síndrome coronario agudo (SCA). El malestar peritraumático se ha señalado como un factor de riesgo de TEPT y puede medirse mediante el Inventario de malestar peritraumático (PDI). Sin embargo, ningún estudio ha medido todavía el malestar peritraumático después de un SCA utilizando el PDI para predecir el TEPT.

**Objetivos:** Este estudio de cohorte prospectivo examinó el impacto del malestar peritraumático en los síntomas del TEPT a los 6 meses después del SCA.

**Métodos:** Utilizamos el PDI para evaluar el malestar peritraumático en pacientes tratados por SCA en un hospital universitario de Tokio dentro de los 7 días posteriores a una intervención coronaria percutánea. Fueron seguidos durante los siguientes 6 meses y se evaluaron los síntomas de TEPT a los 6 meses utilizando la Escala de Impacto de Eventos Revisada. La asociación entre malestar peritraumático y síntomas de TEPT se examinó mediante análisis de regresión lineal múltiple.

**Resultados:** El estudio reclutó a 101 pacientes con SCA y 97 completaron la evaluación de seguimiento. La puntuación total del PDI fue un predictor independiente de los síntomas de TEPT después del ajuste de las posibles variables potenciales (β = 0,38; p <0,01).

**Limitaciones:** Los resultados se obtuvieron de un solo hospital universitario y la evaluación de los síntomas del TEPT fueron basadas en un cuestionario.

**Conclusión:** Proporcionamos la primera evidencia de que la puntuación PDI puede predecir el desarrollo de síntomas de TEPT en pacientes con SCA. La evaluación del malestar peritraumático después de un SCA con el PDI puede ser útil para iniciar una intervención temprana contra los síntomas del TEPT.
急性冠状动脉综合征6个月后创伤性精神痛苦对创伤后应激障碍症状的影响：一项前瞻性队列研究

背景：已知创伤后应激障碍(PTSD)症状会在急性冠状动脉综合征(ACS)之后发生。已表明创伤性精神痛苦为PTSD风险因素，但通过创伤性精神痛苦量表(PDI)进行测量。但是，尚无研究使用PDI测量ACS后创伤性精神痛苦来预测PTSD。

目的：本前瞻性队列研究考查了在ACS后6个月时创伤性精神痛苦对PTSD症状的影响。

方法：我们使用PDI评估了在东京一所教学医院中接受ACS经皮冠状动脉介入治疗后7天内患者的创伤性精神痛苦。在接下来的6个月中对他们进行随访，并使用修订版事件影响量表评估期间的6个月时的PTSD症状。通过多元线性回归分析考查了创伤性精神痛苦与PTSD症状之间的关系。

结果：研究招募了101位ACS患者，其中97位完成了随访评估。控制潜在协变量后，PDI总分是PTSD症状的一个独立预测因子(β=0.38; p<0.01)。

局限性：结果由一所教学医院获得，PTSD症状的评估基于问卷。

结论：我们首次为ACS后PTSD症状的发展提供了证据。使用PDI评估ACS后的创伤性精神痛苦可能有助于开始针对PTSD症状的早期干预。

1. Introduction

心血管疾病是全球死亡的主要原因。在日本，一项关于心肌梗死的登记研究(AMI)(Takii et al., 2010)报告称，AMI的发病率(每100,000人口)在1979年至2008年间约增长了4倍。尽管心血管疾病的发病率呈上升趋势，但其影响仍然被公众视为重大威胁。拥有心血管疾病的个体可能会经历过度的情绪反应，如恐惧和焦虑(死亡或复发)，愤怒、悲伤，以及与心理创伤后应激障碍(PTSD)相关的压力。PTSD与心脏病事件相关，如心肌梗死、心律失常，以及其动因和后果(Edmondson, Kutz, Shabtai, Solomon, Neumann, & David, 1994)。

急性心肌梗死(ACS)在突然降低血流到心脏的病例中发生。ACS经常伴有严重的胸部疼痛，如隔膜、呼吸困难，或晕厥，这可以是一个灾难性的事件。一项关于在AMI后PTSD的病例对照研究的系统综述(Vilchinsky, Ginzburg, Fait, & Foa, 2017)报告了PTSD在AMI后3到18个月的发病率，范围从3%到21%。

一项针对PTSD在ACS患者中ST-抬高的心肌梗死、非ST-抬高的心肌梗死，或不稳定型心绞痛的元分析研究(Edmondson et al., 2012)发现，5个月后PTSD的症状和情感、抑郁症、焦虑以及对药物非依从性的反应都增加。即使在应用PTSD的评估量表后，仍观察到PTSD的频发和死亡率(Kronish, Edmondson, Goldfinger, Fei, & Horowitz, 2012; Kronish, Edmondson, Li, & Cohen, 2012)。2012年，Kronish等人的研究表明，PTSD的发病率在 sessions risks cardiovascular events and mortality (Kronish et al., 2012, 2012)。因此，ACS的发病率已经明显增加，PTSD症状的发病率在ACS后也在逐年增加。
for ACS, but most research has measured threat retrospectively. In regard to predicting PTSD symptoms based on peritraumatic distress assessed immediately after ACS, there have been no studies conducted in Japan and just four studies conducted in Western countries. Three found that acute stress disorder symptoms immediately after ACS predicted PTSD symptoms at 1 month (Roberge, Dupuis, & Marchand, 2010) or 3 months (Bennett, Owen, Koutsakis, & Bisson, 2002; Whitehead, 2006), and the fourth study found that peritraumatic distress during angiography predicted PTSD at 1 and 6 months (Marke & Bennett, 2013). The degree of peritraumatic distress can be measured by the Peritraumatic Distress Inventory (PDI) (Brunet et al., 2001), a widely used self-report measure. PDI scores have been used to predict PTSD severity following motor vehicle accidents (Guardia et al., 2013), physical trauma such as sustained in vehicular collisions and falls (Bunnell, Davidson, & Ruggiero, 2018), and physical illness such as stroke (Favrole et al., 2013), Stevens-Johnson syndrome, and toxic epidermal necrolysis (Hefez et al., 2019). Despite studies have reported that peritraumatic distress during heart attack is associated with PTSD symptoms (Bennett et al., 2002; Marke & Bennett, 2013), peritraumatic distress measured in those studies was measured using non-standardized scales.

In this study, we examined whether the degree of peritraumatic distress during myocardial infarction in ACS patients, as assessed using the standardized PDI, can predict the development of PTSD symptoms 6 months later. Establishing such a means of prediction would help clinicians initiate early intervention against PTSD symptoms.

2. Materials and methods
2.1. Participants and procedure

We previously conducted a prospective cohort study called ‘CONPAC (Cohort with Nutritional Aspect for Psychiatric Disorder after Acute Coronary Syndrome)’. From that study, we have previously reported the association between polyunsaturated fatty acids and psychiatric disorder at 3 months (Yamashita et al., 2017) and 6 months (Noguchi et al., 2019) after ACS. We analysed the same patients in the present study, but here our focus was prediction of PTSD symptoms after ACS using the PDI. Participants were consecutively admitted to the National Disaster Medical Centre, Tokyo, Japan for ACS between 1 March 2014 and 8 February 2017. ACS was diagnosed if new-onset chest pain occurred with ischaemic electrocardiogram changes (Thygesen, Alpert, & White, 2007).

The inclusion criteria were as follows: age ≥20 years; native Japanese speaker; able to contact us within 7 days of percutaneous coronary intervention (PCI); confirmed to be in a life-threatening condition by a cardiologist and thus be in a stable enough condition to be interviewed; and able to understand the scope of the study and give written consent for study participation. Exclusion criteria were as follows: score on the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975) <24; residing >90 min from the medical centre by train or car; a serious psychiatric condition such as hallucination, delusion, suicidal ideation, or self-harm behaviour; currently undergoing treatment for a psychiatric disorder; and end-stage cancer. Researchers conducted bedside interviews during hospitalization to confirm the inclusion criteria and explained about the study to those who met the criteria, including that participation was entirely voluntary. Those who consented to participate were asked to fill out the PDI (see 2.2. Assessments) before they were discharged. For follow-up, we conducted an interview in a meeting room in our laboratory on the day the patient was visiting the outpatient clinic.

The Ethics Committee of the National Disaster Medical Centre (2013–42) approved the study protocol. Written informed consent for study participation was obtained within 7 days of PCI. From the medical records and the questionnaire we asked participants to answer, we extracted baseline demographic and medical characteristics such as age, sex, highest educational attainment, psychiatric history, psychiatric family history, and Killip class indicating ACS severity. Peritraumatic distress was assessed using the standardized PDI within 7 days after PCI. We then performed follow-up over the next 3 and 6 months and assessed posttraumatic stress response (PTSD symptoms) using the standardized Impact of Event Scale–Revised (IES-R) at 3 and 6 months after PCI. The study conformed to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (von Elm et al., 2007).

2.2. Assessments

Peritraumatic distress was assessed using the Japanese version of the 13-item PDI (Brunet et al., 2001). Total score ranges from 0 to 52, with each item scored on a 5-point Likert scale (0 = not at all, 1 = slightly true, 2 = somewhat true, 3 = very true, and 4 = extremely true). Internal consistency, concurrent validity, and test–retest reliability have been confirmed for the Japanese version of the PDI (Nishi et al., 2009).

PTSD symptoms were assessed using the IES-R (Weiss, 2004). Total score ranges from 0 to 88. This self-report questionnaire investigates the occurrence
PTSD symptoms experienced in the previous week and comprises 22 items regarding re-experiencing, avoidance, and hyperarousal (i.e., the three most common PTSD symptoms according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition [DSM-IV]). The validity and reliability of the Japanese version of the IES-R has been confirmed (Asukai et al., 2002).

2.3. Statistical analysis

To examine the association between the PDI and PTSD symptoms, we used multiple linear regression analysis with IES-R total score as the dependent variable and PDI total score as the independent variable. We adjusted for the following potential covariates that have been previously identified as risk factors for PTSD: age, sex, psychiatric history, Psychiatric family history, highest educational attainment (Epstein, Fullerton, & Ursano, 1998; Schlenger et al., 2002), and Killip class. In addition, bivariate regression analysis was conducted to determine the relationship of PTSD symptoms with PDI total score and with PDI individual item scores.

Relationships between the dependent and independent variables were expressed as a regression coefficient (beta weight) with 95% confidence interval (95% CI). A p-value of less than 0.05 was considered to indicate statistical significance. SPSS statistical software version 25 for Windows (SPSS, Tokyo, Japan) was used for all data analyses.

3. Results

PCI was used to assess 280 patients, 104 of whom did not meet the inclusion criteria. Of 176 patients approached to participate in the CONPAC study, 100 participated, 71 declined, and 4 withdrew consent. At the follow-up, three participants did not respond. Thus, we enrolled 101 ACS patients, with 97 completing the follow-up assessment (Figure 1). Demographic characteristics of these 97 patients are shown in Table 1. Mean age was 63.4 ± 11.1 (range, 36–87) years and 84 were men (85.7%).

Severity of heart disease was assessed as Killip class grade 1 in 91 (92.9%). PDI was administered 4.0 days (SD = 2.1) after ACS, with an average score of 14.1 (standard deviation [SD] = 9.7, 0–39). The IES-R was

Figure 1. Enrolment flowchart of the CONPAC study. ACS, acute coronary syndrome; PCI, percutaneous coronary intervention.
administered 3.8 days (SD = 2.1) after ACS, with an average IES-R score of 6.5 (SD = 9.2, 0–44) 6 months after ACS.

PDI total score was an independent predictor for PTSD symptoms after adjustment for covariates (beta = 0.38, 95% CI, 0.19–0.57; p < 0.01; Table 2). The value of R-squared for the multiple linear regression model was 0.22 at 6 months.

The results of bivariate regression analysis are shown in Table 3 for each of the 13 PDI items. At the follow-up assessment, significant predictors of PTSD symptoms were item 1 (beta = 2.80, 95% CI = 1.23–4.37; p = 0.001), item 4 (beta = 2.95, 95%, 1.52–4.38; p ≤ 0.001), item 5 (beta = 2.42, 95% CI, 0.86–3.99; p = 0.003), item 6 (beta = 2.16, 95% CI = 0.26–4.07; p = 0.026), item 8 (beta = 3.36, 95% CI, 1.27–5.45; p = 0.002), and item 10 (beta = 1.63, 95% CI, 0.36–2.89; p = 0.012).

4. Discussion

This is the first study to show that PTSD symptoms can be predicted by measuring peritraumatic stress immediately after ACS in Japanese subjects. To our knowledge, this is also the first study to predict later PTSD symptoms in ACS using the standardized PDI, with 6 of the 13 PDI items helping to predict such symptoms at 6 months after ACS.

We confirmed here that PTSD symptoms related to a life-threatening physical condition could be predicted, as could PTSD symptoms in individuals who had experienced a vehicular accident (Nishi et al., 2010) and in disaster rescue medical workers (Kawashima et al., 2016; Nishi et al., 2012). The PDI

Table 2. Results of multiple linear regression analysis with PDI at 6 months as the dependent variable (n = 97).

| Variables | n | % | Mean | SD | Median | Range |
|-----------|---|---|------|----|--------|-------|
| PDI per 1 point | 97 | - | 14.2 | 9.7 | 13.0 | 0–39 |
| Covariates | | | | | | |
| Age per 1 year | - | - | 63.4 | 11.1 | 64.0 | 36–87 |
| Women | 83 | 85.6 | - | - | - | - |
| History of psychiatric illness | 7 | 7.2 | - | - | - | - |
| Family history of psychopathology | 15 | 15.5 | - | - | - | - |
| Highest educational attainment | | | | | | |
| Junior high school | 14 | 14.4 | - | - | - | - |
| High school | 42 | 43.3 | - | - | - | - |
| Junior or technical college | 16 | 16.5 | - | - | - | - |
| University or higher | 25 | 25.8 | - | - | - | - |
| Killip class | | | | | | |
| 1 | 91 | 93.8 | - | - | - | - |
| 2 | 3 | 3.1 | - | - | - | - |
| 3 | 1 | 1.0 | - | - | - | - |
| 4 | 2 | 2.1 | - | - | - | - |
| Outcome | | | | | | |
| IES-R at 6 months | 97 | - | 6.5 | 9.3 | 3.0 | 0–44 |

Table 3. Results of univariate regression analysis (n = 97).

| Item description | Mean (±SD, range) | Beta (95% CI) | R square | p value |
|------------------|------------------|---------------|-----------|---------|
| 1. I felt helpless to do more | 0.97 (±1.1, 0–4) | 2.80 (1.23, 4.37) | .12 | ≤.001 |
| 2. I felt sadness and grief | 1.33 (±1.2, 0–4) | 1.18 (−0.35, 2.70) | .02 | .129 |
| 3. I felt frustrated or angry I could not do more | 1.03 (±1.2, 0–4) | 0.58 (−0.94, 2.10) | .01 | .450 |
| 4. I felt afraid for my safety | 1.43 (±1.2, 0–4) | 2.95 (1.52, 4.38) | .15 | .000 |
| 5. I felt guilt that more was not done | 0.93 (±1.2, 0–4) | 2.42 (0.86, 3.99) | .09 | .003 |
| 6. I felt ashamed of my emotional reactions | 0.67 (±1.0, 0–4) | 2.16 (0.26, 4.07) | .05 | .026 |
| 7. I felt worried about the safety of others | 1.33 (±1.3, 0–4) | 0.60 (−0.84, 2.04) | .01 | .407 |
| 8. I had the feeling I was about to lose control of my emotions | 0.63 (±0.9, 0–3) | 3.36 (1.27, 5.45) | .10 | .002 |
| 9. I had difficulty controlling my bowel and bladder | 0.21 (±0.7, 0–4) | 2.40 (−0.14, 5.22) | .03 | .093 |
| 10. I was horrified by what happened | 1.7 (±1.4, 0–4) | 1.63 (0.36, 2.89) | .06 | .012 |
| 11. I had physical reactions like sweating, shaking, and pounding heart | 1.57 (±1.5, 0–4) | 0.81 (−0.41, 2.03) | .02 | .190 |
| 12. I felt I might pass out | 0.97 (±1.3, 0–4) | 0.37 (−1.05, 1.78) | .00 | .610 |
| 13. I felt I might die | 1.43 (±1.4, 0–4) | 1.04 (−0.25, 2.34) | .03 | .111 |
| Total | 14.14 (±9.7, 0–39) | 0.30 (0.12, 0.48) | .10 | .002 |

CI, confidential interval. 
R², coefficient of multiple correlation, index of goodness in the model.
was originally designed to explore PTSD Criterion A2 in DSM-IV, which requires fear, helplessness, or horror at the time of the event. Absence of peritraumatic distress has been shown to be a strong indicator of absence of PTSD (Nishi et al., 2009). In a meta-analysis by Thomas et al. (Thomas, Saumier, & Brunet, 2012), peritraumatic distress was significantly correlated with PTSD symptoms in 18 studies. These previous studies and our results indicate a strong association between peritraumatic distress and PTSD symptoms in patients who have experienced a traumatic event, including those caused by physical illness. To clarify this, further studies are required.

We administered the PDI at 3.9 days (SD = ±2.1, 1–10) after ACS. The meta-analysis of PDI and the course of PTSD symptoms (Thomas et al., 2012) showed that regression slopes decreased (numerically or significantly) for separate meta-regressions on results of studies that administered the PDI within or after 1 month of a traumatic event. Recall and memory bias becomes worse as time passes after a traumatic event, so it becomes more difficult to recall emotions accurately. Therefore, it seems important that the PDI be administered as soon after a traumatic event as possible.

One study found that almost 25% of participants who developed PTSD (criteria B–F) did not experience fear, helplessness, or horror but experienced other intense peritraumatic distress experiences such as worry about others, frustration, and physical symptoms during or just after injury (O’Donnell, Creamer, McFarlane, Silove, & Bryant, 2010). Furthermore, it was suggested that removing Criterion A2 from DSM-IV (American Psychiatric Association, 1994) would make diagnosing PTSD easier without a substantial increase in the number of qualified diagnoses (Karam et al., 2010). Criterion A2 was subsequently omitted from DSM-5 (American Psychiatric Association, 2013). However, peritraumatic distress remains an important risk factor for PTSD and being able to assess such distress immediately after a traumatic event is clinically meaningful. Because the prevalence of meeting diagnostic thresholds based on other criteria is significantly higher in the presence of Criterion A2 than in its absence, it has been suggested that A2 be reconceptualized as a risk factor for PTSD (Karam et al., 2010). The advantage of the PDI that explores A2 is that it can be completed quickly and soon after a traumatic event. Also, those who develop PTSD without meeting A2 include individuals amnestic to their peritraumatic emotional experience (O’Donnell et al., 2010). Amnesia can occur after traumatic brain injury due to physical injury or dissociation due to physical and sexual violence, but amnesia is unlikely to occur after ACS. Therefore, assessing degree of peritraumatic distress using the PDI would be helpful for identifying ACS patients at risk of developing PTSD symptoms.

The following PDI items helped to predict later PTSD symptoms: “1. I felt helpless to do more”, ‘4. I felt afraid for my safety’, ‘5. I felt guilt that more was not done’, ‘6. I felt ashamed of my emotional reactions’, ‘8. I had the feeling I was about to lose control of my emotions’, and ‘10. I was horrified by what happened’. Three previous studies (Bunnell et al., 2018; Nishi et al., 2012, 2010) have examined which PDI items contribute to predicting PTSD symptoms (Table 4), and in all three studies and the present study, items 1, 6, and 8 were significant predictors of PTSD symptoms. Previous studies have reported that cognitive state such as total helplessness during the event (Başoglu, Şalıcıoğlu, & Livanou, 2002) and loss of control (Simeon, Greenberg, Knutelska, Schmeidler, & Hollander, 2003) during the peritraumatic period predict later PTSD symptoms. Based on these results, helplessness and difficulty in controlling emotions during traumatic events are thought to be strong predictors of PTSD symptoms. It has been reported that early intervention such as trauma-focused cognitive-behavioural therapy (CBT-T), cognitive therapy without exposure and eye movement desensitization and reprocessing (EMDR)) for people with PTSD symptoms after psychological trauma is

| Table 4. Comparison between the CONPAC study and previous studies regarding the prediction of posttraumatic stress disorder symptoms using the Peritraumatic Distress Inventory items. |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|
| Item description               | CONPAC          | Nishi 2010      | Nishi 2012      | Bunnell 2018    |
| 1. I felt helpless to do more  | ✓               | ✓               | ✓               | ✓               |
| 2. I felt sadness and grief   | ✓               | ✓               | ✓               | ✓               |
| 3. I felt frustrated or angry I could not do more | ✓               | ✓               | ✓               | ✓               |
| 4. I felt afraid for my safety | ✓               | ✓               | ✓               | ✓               |
| 5. I felt guilt that more was not done | ✓               | ✓               | ✓               | ✓               |
| 6. I felt ashamed of my emotional reactions | ✓               | ✓               | ✓               | ✓               |
| 7. I felt worried about the safety of others | ✓               | ✓               | ✓               | ✓               |
| 8. I had the feeling I was about to lose control of my emotions | ✓               | ✓               | ✓               | ✓               |
| 9. I had difficulty controlling my bowel and bladder | ✓               | ✓               | ✓               | ✓               |
| 10. I was horrified by what happened | ✓               | ✓               | ✓               | ✓               |
| 11. I had physical reactions like sweating, shaking, and pounding heart | ✓               | ✓               | ✓               | ✓               |
| 12. I felt I might pass out   | ✓               | ✓               | ✓               | ✓               |
| 13. I felt I might die        | ✓               | ✓               | ✓               | ✓               |

CONPAC, Cohort with Nutritional Aspect for Psychiatric Disorder after Acute Coronary Syndrome.
effective in alleviating the symptoms (Roberts et al., 2019). The result of this study might be useful for earlier screening.

5. Limitations

Although our study presents new findings, there are some limitations. First, because this study was conducted at a single hospital in Tokyo, multicenter studies are also required to confirm generalizability. Second, participants in our study included mostly males with Killip class 1. Therefore, the prevalence of PTSD and the prediction of PTSD symptoms by PDI in more severe ACS patients may differ from these results. Third, ‘being diagnosed with a life-threatening illness’ such as ACS was included in DSM-IV as Criterion A2 but is no longer included in DSM-5. This raises the question of whether the PTSD symptoms detected of this study can be referred to as ‘PTSD’ symptoms when following DSM-5 criteria. However, because experts vary in their opinions of PTSD Criterion A2 (Friedman, 2013; Roberts et al., 2019), whether physical diseases will be included in any re-established Criterion A2 depends on how the DSM will be revised in future. Therefore, screening for peritraumatic distress and preventing PTSD symptoms after ACS would be beneficial to patients. In addition, PTSD symptoms were assessed using the self-administered IES-R in this study, which raises concerns about the accuracy of symptom assessments. However, the reliability and validity of the Japanese version of the IES-R for evaluating PTSD symptoms is reported to be comparable to that of the Clinician-Administered PTSD Scale for DSM-IV (Asukai et al., 2002). To generalize our findings, it will be necessary to conduct a large-scale study with a larger number of facilities and participants.

6. Conclusion

We examined the first time worldwide the use of the PDI to predict PTSD in patients with ACS. We confirmed that PTSD symptoms could be predicted by PDI score after adjusting for covariates. PDI items 1, 4, 5, 6, 8, and 10 were significant predictors of PTSD symptoms at 6 months. We also suggest that to predict PTSD symptoms, it may be important that PDI measurements be made within 7 days of the traumatic event. Based on these findings, evaluating peritraumatic distress using PDI at an early stage after an ACS episode is expected to contribute to early detection of PTSD symptoms and early intervention.

Funding

This cohort study was originally supported by an Intramural Research Grant (27-3-2) for Neurological and Psychiatric Disorders from the National Center of Neurology and Psychiatry. This work was supported in part by a Grant-in-Aid for Scientific Research B from the Japan Society for the Promotion of Science [17H04253] and the SENSHIN Medical Research Foundation. The funding agencies had no role in the design and conduct of the study; data collection; data management; analysis; interpretation of the data; review or approval of the manuscript; and decision to submit the manuscript for publication; Japan Society for the Promotion of Science [17H04253].

Note

1. Abbreviations: ACS, acute coronary syndrome; AMI, acute myocardial infarction; CDI-PTSD, cardiac-disease-induced posttraumatic stress disorder; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders; IES-R, Impact of Event Scale–Revised; PCI, percutaneous coronary intervention; PDI, Peritraumatic Distress Inventory; PTSD, posttraumatic stress disorder.

Acknowledgments

We thank Kyoko Akutsu for managing the study data.

Author contributions

YJM conceived and managed the entire research project. TN, HN, AY and YJM collected baseline and follow-up data. TN, DN, RO, HN and YJM analyzed and interpreted the data. TN drafted the manuscript. DN, RO, HN, KH, and YJM critically revised the manuscript for important intellectual content. YJM obtained funding. All authors read and approved the final manuscript.

Conflict of interest

Dr Matsuoka received speaker fees from Suntory, Pfizer, Mochida, Eli Lilly, Morinaga Milk and NTT Data and is conducting collaborative research with SUSMED. The other authors have no conflicts of interest to declare.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Disclosure statement

Matsuoka received speaker fees from Suntory, Pfizer, Mochida, Eli Lilly, Morinaga Milk and NTT Data and is conducting collaborative research with SUSMED. The other authors have no conflicts of interest to declare.
Funding

This cohort study was originally supported by an Intramural Research Grant (27-3-2) for Neurological and Psychiatric Disorders from the National Center of Neurology and Psychiatry. This work was supported in part by a Grant-in-Aid for Scientific Research B from the Japan Society for the Promotion of Science [17H04253] and the SENSIN Medical Research Foundation. The funding agencies had no role in the design and conduct of the study; data collection; data management; analysis; interpretation of the data; review or approval of the manuscript; and decision to submit the manuscript for publication; [Japan Society for the Promotion of Science [17H04253].

ORCID

Tomomi Narisawa http://orcid.org/0000-0001-9774-875X
Daisuke Nishi http://orcid.org/0000-0001-9349-3294
Ryo Okubo http://orcid.org/0000-0002-1254-1926
Hiroko Noguchi http://orcid.org/0000-0002-6785-820X
Kei Hamazaki http://orcid.org/0000-0003-0456-6805
Akihiro Yamashita http://orcid.org/0000-0001-8276-1548
Yutaka J. Matsuoka http://orcid.org/0000-0002-8690-8129

References

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC: Author.

Asukai, N., Kato, H., Kawamura, N., Kim, Y., Yamamoto, K., Kishimoto, J., Miyake, Y., & Nishizono-Maher, A. (2002). Reliability and validity of the Japanese-language version of the impact of event scale-revised (IES-R-J): Four studies of different traumatic events. The Journal of Nervous and Mental Disease, 190(3), 175–182.

Basoglu, M., Salcioglu, E., & Livano, M. (2002). Traumatic stress responses in earthquake survivors in Turkey. Journal of Traumatic Stress, 15(4), 269–276.

Bennett, P., & Brooke, S. (1999). Intrusive memories, post-traumatic stress disorder and myocardial infarction. British Journal of Clinical Psychology, 38(4), 411–416.

Bennett, P., Owen, R. L., Koutsakis, S., & Bisson, J. (2002). Personality, social context and cognitive predictors of post-traumatic stress disorder in myocardial infarction patients. Psychology & Health, 17(4), 489–500.

Brunet, A., Weiss, D. S., Metzler, T. J., Best, S. R., Neylan, T. C., Rogers, C., Fagan, J., & Marmar, C. R. (2001). The peritraumatic distress inventory: A proposed measure of PTSD criterion A2. American Journal of Psychiatry, 158(9), 1480–1485.

Bunnell, B. E., Davidson, T. M., & Ruggiero, K. J. (2018). The peritraumatic distress inventory: Factor structure and predictive validity in traumatically injured patients admitted through a Level I trauma center. Journal of Anxiety Disorders, 55, 8–13.

Chung, M. C., Dennis, I., Berger, Z., Jones, R., & Rudd, H. (2011). Posttraumatic stress disorder following myocardial infarction: Personality, coping, and trauma exposure characteristics. The International Journal of Psychiatry in Medicine, 42(4), 393–419.

Dinenberg, R. E., McCaslin, S. E., Bates, M. N., & Cohen, B. E. (2014). Social support may protect against development of posttraumatic stress disorder: Findings from the heart and soul study. American Journal of Health Promotion, 28(5), 294–297.

Edmondson, D., Richardson, S., Falzon, L., Davidson, K. W., Mills, M. A., & Neria, Y. (2012). Posttraumatic stress disorder prevalence and risk of recurrence in acute coronary syndrome patients: A meta-analytic review. PLoS One, 7(6), e38915.

Epstein, R. S., Fullerton, C. S., & Ursano, R. J. (1998). Posttraumatic stress disorder following an air disaster: A prospective study. American Journal of Psychiatry, 155, 934–938.

Favrolo, P., Jehel, L., Levy, P., Descombes, S., Muresan, I.-P., Manicafic, M.-J., & Alamowitch, S. (2013). Frequency and predictors of post-traumatic stress disorder after stroke: A pilot study. Journal of the Neurological Sciences, 327(1–2), 35–40.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-mental state”: A practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research, 12(3), 189–198.

Friedman, M. J. (2013). Finalizing PTSD in DSM-5: Getting here from there and where to go next. Journal of Traumatic Stress, 26(3), 548–556.

Friedman, M. J., Resick, P. A., Bryant, R. A., & Brewin, C. R. (2011). Considering PTSD for DSM-5. Depression and Anxiety, 28(9), 750–769.

Gao, W., Zhao, J., Li, Y., & Cao, F.-L. (2015). Post-traumatic stress disorder symptoms in first-time myocardial infarction patients: Roles of attachment and alexithymia. Journal of Advanced Nursing, 71(11), 2575–2584.

Ginzburg, K., Ein-Dor, T., & Solomon, Z. (2010). Comorbidity of posttraumatic stress disorder, anxiety and depression: A 20-year longitudinal study of war veterans. Journal of Affective Disorders, 123(1–3), 249–257.

Guarida, D., Brunet, A., Duhamel, A., Ducrocq, F., Demarty, A. L., & Vaiva, G. (2013). Prediction of trauma-related disorders: A proposed cutoff score for the peritraumatic distress inventory. The Primary Care Companion to CNS Disorders, 15. https://doi.org/10.4088/PCC.12101406

Guler, E., Schmid, J.-P., Wiedemar, L., Saner, H., Schnyder, U., & Känel, R. V. (2009). Clinical diagnosis of posttraumatic stress disorder after myocardial infarction. Clinical Cardiology, 32(3), 125–129.

Hefez, L., Zaghib, K., Shidian, E., Valevre-Allanore, L., Allain, M., Duong, T. A., Colin, A., Belliver, F., Romano, H., De Prost, N., Chazelas, K., Chosidow, O., Wolkenstein, P., & Ingen-Housz-Oro, S. (2019). Post-traumatic stress disorder in Stevens-Johnson syndrome and toxic epidermal necrolysis: Prevalence and risk factors. A prospective study of 31 patients. British Journal of Dermatology, 180(3), 1206–1213.

Husain, S. A., Edmondson, D., Kautz, M., Umland, R., & Kronish, I. M. (2018). Posttraumatic stress disorder due to acute cardiac events and aversive cognitions towards cardiovascular medications. Journal of Behavioral Medicine, 41(2), 261–268.

Karam, E. G., Andrews, G., Bромет, E., Petukhova, M., Ruscio, A. M., Salamoun, M., Sampson, N., Stein, D. J., Alonso, J., Andrade, L. H., Angermeyer, M., Demyttenaere, K., De Girolamo, G., De Graaf, R., Florescu, S., Gureje, O., Kaminer, D., Kottov, R., Lee, S.
Lépine, J.-P., Medina-Mora, M. E., Oakley Browne, M. A., Posada-Villegas, J., Sagar, R., Shalev, A. Y., Takeshima, T., Tomov, T., & Kessler, R. C. (2010). The role of criterion A2 in the DSM-IV diagnosis of posttraumatic stress disorder. Biological Psychiatry, 68(5), 465–473.

Kawashima, Y., Nishi, D., Noguchi, H., Usuki, M., Yamashita, A., Koido, Y., Okubo, Y., & Matsuoka, Y. J. (2016). Posttraumatic stress symptoms and burnout among medical rescue workers 4 years after the great east Japan earthquake: A longitudinal study. Disaster Medicine and Public Health Preparedness, 10(6), 848–853.

Kronish, I. M., Edmondson, D., Goldfinger, J. Z., Fei, K., & Horowitz, C. R. (2012). Posttraumatic stress disorder and adherence to medications in survivors of strokes and transient ischemic attacks. Stroke, 43(8), 2192–2197.

Kronish, I. M., Edmondson, D., Li, Y., & Cohen, B. E. (2012). Post-traumatic stress disorder and medication adherence: Results from the mind your heart study. Journal of Psychiatric Research, 46(12), 1595–1599.

Kutz, I., Shabtai, H., Solomon, Z., Neumann, M., & David, D. (1994). Post-traumatic stress disorder in myocardial infarction patients: Prevalence study. The Israel Journal of Psychiatry and Related Sciences, 31, 48–56.

Marke, V., & Bennett, P. (2013). Predicting post-traumatic stress disorder following first onset acute coronary syndrome: Testing a theoretical model. British Journal of Clinical Psychology, 52(1), 70–81.

Nishi, D., Koido, Y., Nakaya, N., Sone, T., Noguchi, H., Hamazaki, K., Hamazaki, T., & Matsuoka, Y. (2012). Peritraumatic distress, watching television, and posttraumatic stress symptoms among rescue workers after the great east Japan earthquake. PloS One, 7(4), e35248.

Nishi, D., Matsuoka, Y., Noguchi, H., Sakuma, K., Yonemoto, N., Yanagita, T., Homma, M., Kanba, S., & Kim, Y. (2009). Reliability and validity of the Japanese version of the peritraumatic distress inventory. General Hospital Psychiatry, 31(1), 75–79.

Nishi, D., Matsuoka, Y., Yonemoto, N., Noguchi, H., Kim, Y., & Kanba, S. (2010). Peritraumatic Distress Inventory as a predictor of post-traumatic stress disorder after a severe motor vehicle accident. Psychiatry and Clinical Neurosciences, 64(2), 149–156.

Noguchi, H., Okubo, R., Hamazaki, K., Yamashita, A., Narisawa, T., & Matsuoka, Y. J. (2019). Serum polyunsaturated fatty acids and risk of psychiatric disorder at 6 months after acute coronary syndrome: A prospective cohort study. Prostaglandins, Leukotrienes and Essential Fatty Acids, 149, 18–23.

O’Donnell, M. L., Creamer, M., McFarlane, A. C., Silove, D., & Bryant, R. A. (2010). Should A2 be a diagnostic requirement for posttraumatic stress disorder in DSM-V? Psychiatry Research, 176(2–3), 257–260.

Ofzag, S., Yuksel, S., Shen, F., Ozdemiroglu, F., Kurt, R., Ofzag, H., & Kascioglu, E. (2014). Does illness perception predict posttraumatic stress disorder in patients with myocardial infarction? Niroo Psiykiyati Arjivi, 51(2), 103–109.

Roberge, M.-A., Dupuis, G., & Marchand, A. (2010). Post-traumatic stress disorder following myocardial infarction: Prevalence and risk factors. Canadian Journal of Cardiology, 26(5), e170–5.

Roberts, N. P., Kichuner, N. J., Kenardy, J., Lewis, C. E., & Bisson, J. I. (2019). Early psychological intervention following recent trauma: A systematic review and meta-analysis. European Journal of Psychotraumatology, 10(1), 1695486.

Rocha, L. P., Peterson, J. C., Meyers, B., Boutin-Foster, C., Charlson, M. E., Jayasinghe, N., & Bruce, M. L. (2008). Incidence of posttraumatic stress disorder (PTSD) after myocardial infarction (MI) and predictors of PTSD symptoms post-MI—a brief report. The International Journal of Psychiatry in Medicine, 38(3), 297–306.

Schlenker, W. E., Caddell, J. M., Ebert, L., Jordan, B. K., Rourke, K. M., Wilson, D., Thalji, L., Dennis, J. M., Fairbank, J. A., & Kulk, R. A. (2002). Psychological reactions to terrorist attacks. JAMA, 288, 581.

Simeon, D., Greenberg, J., Knutelska, M., Schneider, J., & Hollander, E. (2003). Peritraumatic reactions associated with the world trade center disaster. American Journal of Psychiatry, 160(9), 1702–1705.

Takii, T., Yasuda, S., Takahashi, J., Ito, K., Shiba, N., Shirato, K., Shimokawa, H., & On Behalf of the Miyagi-Ami Study, I. (2010). MITYAGI-AMI study investigators. Trends in acute myocardial infarction incidence and mortality over 30 years in Japan. Circulation Journal, 74(1), 93–100.

Thomas, E., Saumier, D., & Brunet, A. (2012). Peritraumatic distress and the course of posttraumatic stress disorder symptoms: A meta-analysis. The Canadian Journal of Psychiatry, 57(2), 122–129.

Thygensen, K., Alpert, J. S., & White, H. D. (2007). Joint ESC/ACCF/AHA/WHF task force for the redefinition of myocardial infarction. Universal definition of myocardial infarction. Journal of the American College of Cardiology, 50(22), 2173–2195.

Vilchinsky, N., Ginzburg, K., Fait, K., & Foa, E. B. (2017). Cardiac-disease-induced PTSD (CDI-PTSD): A systematic review. Clinical Psychology Review, 55, 92–106.

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gotzsche, P. C., Vandebroucke, J. P., & Initiative, S. (2007). The strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. Annals of Internal Medicine, 147(8), 573–577.

Von Kanel, R., Baumert, J., Kolb, C., Cho, E. Y. N., & Ladwig, K.-H. (2011). Chronic posttraumatic stress and its predictors in patients living with an implantable cardioverter defibrillator. Journal of Affective Disorders, 131(1–3), 344–352.

Weiss, D. S. (2004). The impact of event scale-revised. In J. P. Wilson & T. M. Keane (Eds.), Assessing psychological trauma and PTSD: A practitioner’s handbook (2nd ed., pp. 168–189). New York: Guilford Press.

Whitehead, D. L. (2006). Post-traumatic stress disorder in patients with cardiac disease: Predicting vulnerability from emotional responses during admission for acute coronary syndromes. Heart, 92(9), 1225–1229.

Yamashita, A., Noguchi, H., Hamazaki, K., Sato, Y., Narisawa, T., Kawashima, Y., Usuki, M., Nishi, D., Yoshimasu, H., Horikawa, N., & Matsuoka, Y. J. (2017). Serum polyunsaturated fatty acids and risk of psychiatric disorder after acute coronary syndrome: A prospective cohort study. Journal of Affective Disorders, 218, 306–312.