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Acute Traumatic Stress Screening Can Identify Patients and Their Partners at Risk for Posttraumatic Stress Disorder Symptoms After a Cardiac Arrest

A Multicenter Prospective Cohort Study

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Background: Posttraumatic stress disorder (PTSD) is prevalent in patients who have had a cardiac arrest and their partners. Accordingly, acute traumatic stress screening is recommended, but its association with later PTSD symptoms has never been addressed in postresuscitation settings. **Objective:** The aim of this study was to examine whether acute traumatic stress is associated with PTSD symptoms in patients who have had a cardiac arrest and their partners. **Methods:** This multicenter longitudinal study of 141 patients and 97 partners measures acute traumatic stress at 3 weeks and PTSD symptoms at 3 months and 1 year after resuscitation, using the Impact of Event Scale. Linear regression models were used to evaluate the association between severity of acute traumatic stress and PTSD symptoms and post hoc to explore effects of group (patients/partners), age, and sex on acute traumatic stress severity. We categorized Impact of Event Scale scores higher than 26 at 3 months and 1 year as *clinical severe PTSD symptoms*. **Results:** Higher acute traumatic stress severity is significantly positively associated with higher PTSD symptom severity at 3 months (patients and partners: $P < .001$) and 1 year (patients and partners: $P < .001$) postresuscitation, with the strongest association for women compared with men ($P = .03$). Acute traumatic stress was higher in women compared with men across groups ($P = .02$). Clinical severe PTSD symptoms were present in 26% to 28% of patients and 45% to 48% of partners. **Conclusion:** Experiencing a cardiac arrest may elicit clinical severe PTSD symptoms in patients, but particularly in their partners. Screening patients and partners for acute traumatic stress postresuscitation is warranted to identify those at increased risk of long-term PTSD symptoms.

KEY WORDS: caregivers, family, heart arrest, posttraumatic stress disorders, resuscitation

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Cardiac arrests are a significant cause of global mortality, but survival rates are rapidly increasing because of improvements in advanced resuscitation care.^{1,2} Most prominent is the 4-fold 30-day survival increase in Denmark from 3.9% in 2001 to 16% in 2018.³ Although more lives are saved, patients who have had a cardiac arrest and their partners risk facing severe mental health problems in the aftermath of resuscitation.⁴

A cardiac arrest can have a significant traumatizing effect owing to the unexpected and sudden life-threatening nature of the event, which may elicit feelings of helplessness and loss of control in both the patients⁵ and their partners.⁶ A traumatizing event can elicit severe traumatic stress, which is a disabling syndrome characterized by behaviors and cognitive processes of reexperiencing and avoiding reminders of the event.⁷ Diagnostically, the syndrome is described in *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*, as *acute stress disorder* and when present after 1 month as *posttraumatic stress disorder* (PTSD).⁸ The common reported sequelae of untreated PTSD include somatic and psychiatric comorbidity, impaired quality of life, functional impairments, and suicide,⁹ and the disorder constitutes a significant economic burden for the healthcare system.¹⁰

A systematic review of mental health in patients who have had a cardiac arrest reported clinical severe PTSD symptoms in 21% to 27%.⁴ One study found that 19% were eligible for a PTSD diagnosis,¹¹ a marked increase compared with the 6% to 7% lifetime prevalence in the general population.¹² Notably, a meta-analysis of clinical outcomes of PTSD after an acute coronary syndrome found that clinical severe PTSD symptoms double the risk of recurrence of a new cardiac event and mortality after adjustment for demographic, clinical, and psychosocial risk factors.¹³ Considering the partners to the patients, only a few studies are available, which find clinical severe PTSD symptoms in up to 50%,¹⁴ with those witnessing an out-of-hospital cardiac arrest at marked increased risk.¹⁵ As we have seen, PTSD symptoms are prevalent among patients who have had a cardiac arrest and their partners, and although the symptoms are associated with significant increased disability and mortality, PTSD remains overlooked in postresuscitation settings.⁶

An important risk factor for developing PTSD is the presence of severe acute traumatic stress.¹⁶ Accordingly, in other clinical settings such as the intensive care unit (ICU), it is recommended to screen for acute traumatic stress to prevent the development of PTSD through early targeted psychological and pharmacological interventions.^{17,18} In the ICU, these recommendations pertain not only to the patients but also the families as they are also at risk of developing PTSD.^{19,20}

The European Resuscitation Council recommends being attentive to PTSD in patients and their partners.²¹ Specifically, the council recommends screening patients for acute traumatic stress with the self-report Impact of

Event Scale (IES),²² followed by targeted specialized referral for further examination and treatment. Such a structured procedure has the potential to improve cardiovascular and psychiatric prognoses simultaneously.²³ However, to our knowledge, no studies have addressed whether acute traumatic stress is associated with later PTSD in postresuscitation settings. Considering the high PTSD prevalence in partners, we critically included them in our study to investigate an inclusive screening procedure in postresuscitation settings in line with current recommendations.^{6,19}

We aim to investigate whether acute traumatic stress in the early postresuscitation settings is associated with later PTSD symptoms for up to 1 year, using the IES as a measurement instrument at all time points. Based on the presented literature, we hypothesize that higher acute traumatic stress severity will be positively associated with higher PTSD symptom severity at 3 months and 1 year postresuscitation for both patients and their partners.

Material and Methods

Participants and Study Design

Patients who had an in- or out-of-hospital cardiac arrest (n = 141) and their partners (n = 97) were recruited from the coronary care units and ICUs of 7 hospitals in the Netherlands from April 2007 to December 2010. Inclusion criteria for patients were older than 18 years, survival for more than 2 weeks after the cardiac arrest, address within 50 km from the hospital, and sufficient Dutch language skills. Exclusion criteria were living in residential or institutional care before the cardiac arrest or life expectancy of fewer than 3 months as assessed by the treating physician. We included only the patients' partners or spouses and excluded other types of relatives (n = 14). Partners were included independent of patients and the criteria were older than 18 years and sufficient Dutch language skills. Eligible patients and their partners were invited to participate by the treating physician between 3 and 10 days after the cardiac arrest. Patients without a partner could still participate, but partners could not participate without the patient. If they agreed to participate, both patients and partners had to sign separate informed consent forms.

The participants were part of a large prospective longitudinal cohort intervention trial. A detailed description of the full trial (ISRCTN74835019) has previously been published.²⁴ In our study, the sample consisted only of participants who were randomized to treatment as usual to assess the natural course of acute traumatic stress and PTSD symptoms postresuscitation. The study complied with the Declaration of Helsinki and was approved by the Medical Ethics Committee of Maastricht University Medical Centre and the local committees of the participating hospitals.

Data Collection and Outcomes

All measurements were performed by research assistants trained to administer questionnaires, which were administered at the participants' current location and not by proxy. Data on participants' sex and age were also collected.

The Impact of Event Scale as a Measure of Acute Traumatic Stress and Posttraumatic Stress Disorder Symptoms

The IES is widely used as an empirical measure of traumatic stress or its diagnostic counterpart PTSD symptoms.²⁵ The IES scale consists of 2 subscales reflecting the 2 central PTSD symptom clusters, namely, reexperience (7 "intrusions" items) and avoiding reminders (8 "avoidance" items) of the traumatic event. Higher scores indicate a greater frequency of intrusions and avoidance rated on 4-point frequency scales (0 = not at all, 1 = rarely, 3 = sometimes, and 5 = often) in the past week. The IES has good convergent and discriminant validity and reliability,²⁶ including the Dutch version used in this study.²⁷ In our study, the participants were explicitly instructed to complete the IES in relation to the cardiac arrest, to ensure that we measured traumatic stress specifically related to the cardiac arrest. We measured the internal consistency of the IES with Cronbach's α , with $\alpha = 0.84$ to 0.91 across time points. Our primary outcome is the dimensional IES score, which ranges from 0 to 75. We operationalized the IES score as *acute traumatic stress* when measured 3 weeks postresuscitation and as *PTSD symptoms* when measured 3 months and 1 year postresuscitation. Although categorical cutoffs were not originally intended with the IES, a bulk of research^{18,28} including studies of somatic accidents^{29,30} have concluded that it is a suitable screening instrument, with an IES score higher than 26 reported to be a valid PTSD cutoff. This cutoff has 0.91 sensitivity and 0.71 specificity against the PTSD gold diagnostic standard assessment, the clinician-administered PTSD scale.³⁰ As a secondary outcome, we categorized participants with an IES score higher than 26 as having clinical severe PTSD symptoms.

Statistical Analyses

The IES score is presented using medians, interquartile range (IQR), and range because the scores were positively skewed at the 3-month and 1-year assessments. Means and standard deviations are reported for age and measurement time, whereas percentage is reported for all categorical variables.

Because of the small sample size in the group of participants who stopped the study prematurely, we compared them with participants descriptively, within each group (patients/partners), by median, range, and 95th quantile for age and traumatic stress and by percentage

proportion for sex. To investigate whether a higher acute traumatic stress severity is associated with higher PTSD symptom severity, 4 main analyses were carried out: a separate multiple linear regression with complete case analysis for each group (patients and partners) at each time point (3 months and 1 year postresuscitation). Sex³¹ and age³² were included as covariates.

Second, conditioned on significant associations between acute traumatic stress and PTSD symptoms, a post hoc standard multiple regression model analysis was used to investigate the effects of group (patients or partners), sex, and age on acute traumatic stress severity.

Across the models, violation of the assumption of linearity and residual variance (main analyses: sex; post hoc analysis: sex and group) was checked by inspecting the data. Relevant interaction effects (main analyses: sex and acute IES; post hoc analysis: sex and acute IES, group, and sex) were checked using visual plot inspections and through preliminary regression analyses. Non-parametric bootstrap methods were used to compute 95% confidence intervals and *P* values in the regression models to be robust against a possible violation of the assumption of normally distributed residuals. To account for multiple comparisons, a Bonferroni adjustment for 3 tests per model was made *P* values < 0.05 (two-sided) were considered statistically significant for all analyses and reported adjusted.

Statistical analyses were performed using the software packages SPSS version 25 and R version 3.4.4.

Results

Baseline Characteristics and Proportion With Clinical Severe Posttraumatic Stress Disorder Symptoms

A total of 112 patients (79%) had an out-of-hospital cardiac arrest and 29 patients (21%) had an in-hospital cardiac arrest. Of the 97 partners, 80 were the patient's spouse. The distribution of participants with clinical severe PTSD (IES score >26) was 26% of patients and 48% of partners at 3 months and 28% of patients and 45% of partners at 1 year.

Participants Who Stopped Prematurely and Missing Data

As presented in Figure 1, 22% of the patients stopped participation prematurely because of medical problems, no time or interest, death, or for unknown reasons. For the partners, the 12% who stopped participation prematurely were explained by medical problems, no time or interest, or for unknown reasons. Descriptively comparing the participants who completed the total study with participants who stopped prematurely on the baseline characteristics including age, sex, and acute traumatic stress level (Table 1) revealed no apparent differences.

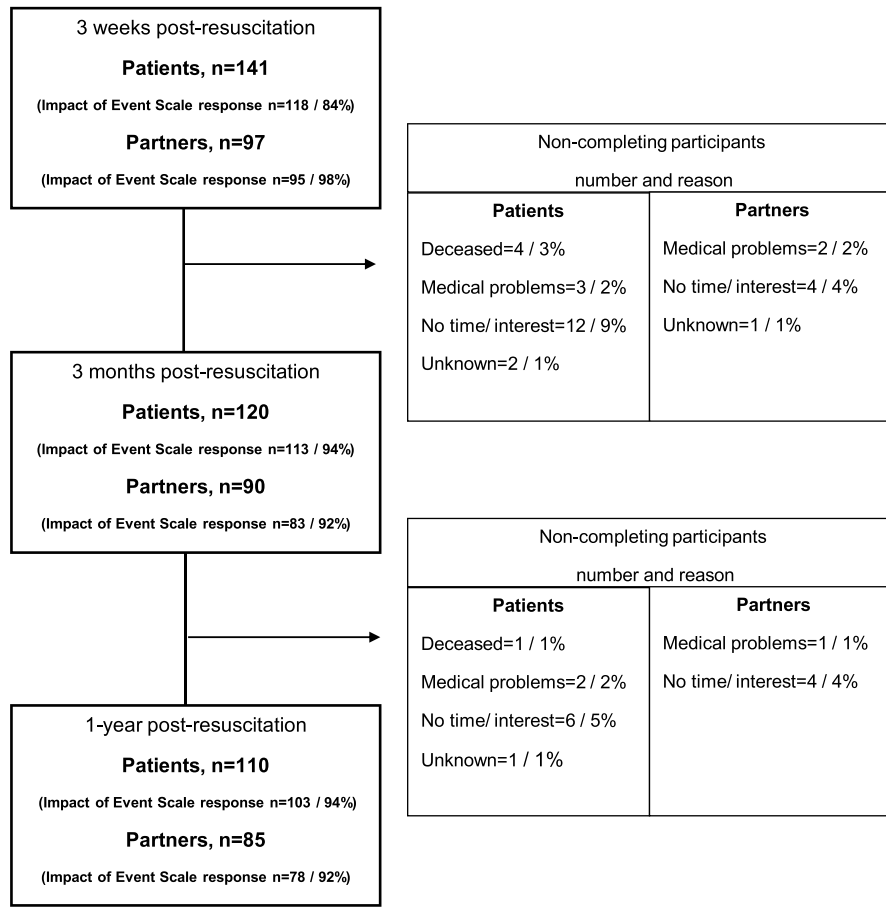


FIGURE 1. Flowchart of participant inclusion and rate and cause of participants who stopped prematurely.

Measurement Time and Assessment of Model Assumptions

After the cardiac arrest, acute traumatic stress was measured after a mean (SD) of 24 (11) days and PTSD symptoms were measured after a mean (SD) of 98 (15) days and 374 (15) days, respectively.

No violation of linearity or variance of residuals was found in the regression models. No significant interaction effect of relevant variables (sex and acute IES) was found at the 3-month follow-up (patients: $P = .40$; partners: $P = .07$) or 1-year follow-up (patients: $P = .10$; partners:

$P = .63$). The residuals were not normally distributed, and thus, bootstrapping was used in all models.

Primary Outcome: The Association Between Impact of Event Scale Score at 3 Weeks and Impact of Event Scale Score at 3 Months and 1 Year Postresuscitation

For patients who had a cardiac arrest and their partners, a higher IES score at 3 weeks was significantly positively associated with a higher IES score at 3 months and 1 year postresuscitation (Table 2 and Table 3). The strength of

TABLE 1 Baseline Characteristics of Participants Completing the Full Study and Those Who Stopped Prematurely

Group	N	Male	Age			Impact of Event Scale			
			Median	Min–Max	95Q	Median	Min–Max	95Q	
Patients	Participants	110	80%	60.0	37–89	78	15	0–60	47
	Noncompleters	31	85%	67.5	40–86	85	19	0–63	60
Partners	Participants	85	12%	57.0	24–79	76	33	0–62	53
	Noncompleters	12	16%	57.0	32–80		40	0–61	

Table showing for each group (patients and partners) the number of participants in each group, gender distribution, and median age with minimum to maximum (Min–Max) age and 95 quantiles (95Q), together with the median, 95Q, and the range for age and the Impact of Event Scale questionnaire at 3 weeks.

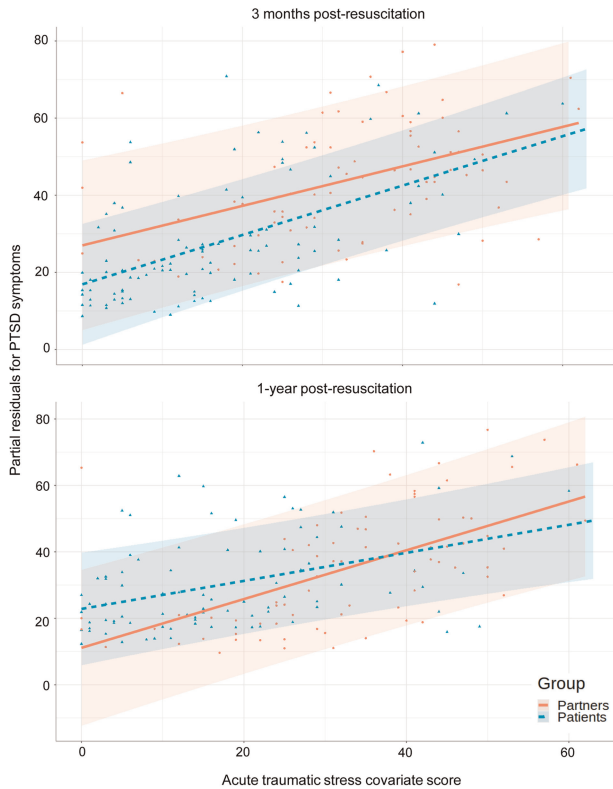


FIGURE 2. Partial regression plots of the association between the severity of acute traumatic stress and PTSD symptoms in patients who have had a cardiac arrest and their partners.

the association decreased over time for patients and increased over time for partners (Figure 2).

Sex and Age Effects on Impact of Event Scale Associations

For patients, sex significantly affected the IES score at 1-year follow-up, with a stronger association for women compared with men (see Table 3). No significant sex effect was evident in the previous 3-month assessment. For the partners, sex did not significantly affect the IES score at the 3-month or 1-year assessments (see Table 3). No significant effect of age was observed.

Post hoc Analyses: Group, Sex, and Age Effects on the Impact of Event Scale Score at 3 Weeks

The post hoc analysis showed that across patients and partners, women had higher acute traumatic stress scores than men did ($b = 8.82$, $SE = 3.03$, 95% confidence interval [CI] = 2.83–14.80, $\beta = 0.23$, $adj. P = .01$) (female patients: median = 26, IQR = 24; female partners: median = 34, IQR = 20; male patients: median = 14, IQR = 20; male partners: median = 34, IQR = 24). No association with group ($b = 7.03$, $SE = 3.06$, 95% CI = 1.0–13.06, $\beta = 0.24$, $adj. P = .06$) or with age ($b = -0.17$, $SE = 0.08$, 95% CI = -0.33 to -0.01, $\beta = -0.13$, $adj. P = .12$) was observed after adjustment for multiple comparisons.

Discussion

Higher Acute Traumatic Stress Severity Is Associated With Higher Posttraumatic Stress Disorder Symptom Severity up to 1 Year Postresuscitation

Our aim was, for the first time, to examine whether acute traumatic stress severity is associated with PTSD symptom severity among patients who have had a cardiac arrest and their partners. Acute traumatic stress and PTSD symptoms were measured with the IES, a feasible screening instrument recommended in postresuscitation settings. We found that higher acute traumatic stress is associated with higher PTSD symptom severity at 3 months and 1 year postresuscitation in both patients and partners. In fact, acute traumatic stress severity, age, and sex explained 21% to 35% of the variance in PTSD symptoms postresuscitation.

Our findings align with earlier studies of victims of severe physical trauma³³ and assault¹⁸ reporting that PTSD was most prevalent after severe highly acute traumatic stress. Importantly, our results support recommendations from The European Resuscitation Council to use the IES to screen patients who have had a cardiac arrest to refer to organized systematic follow-up programs, with the

TABLE 2 Number of Participants, Sex Distribution, Age, and Impact of Event Scale Score for Patients and Partners Over the Course of 1 Year

Time	Group	N	Male	Age	Impact of Event Scale	
				Median (IQR)	Median (IQR)	Min–Max
3 weeks	Patients	118	86%	60 (17)	16 (21)	0–63
	Partners	95	11%	58 (15)	33 (20)	0–62
3 months	Patients	113	86%	60 (15)	10 (25)	0–62
	Partners	83	12%	59 (15)	25 (28)	0–69
1 year	Patients	103	86%	60 (17)	10 (25)	0–60
	Partners	78	11%	58 (15)	23 (29)	0–65

Table showing the number of participants with an Impact of Event Scale (IES) observation for each group (patients and partners) together with sex distribution (%) and median with interquartile range (IQR) for age and IES level with a range at 3 weeks, 3 months, and 1 year after a cardiac arrest. Abbreviation: Min–Max, minimum to maximum.

TABLE 3 Standard Multiple Linear Regression Models for the Association Between Severity of Acute Traumatic Stress and Posttraumatic Stress Disorder Symptoms in Patients and Partners Postresuscitation

	<i>b</i>	SE <i>b</i>	β	Adj. <i>P</i>	95% CI
Patients					
3 months					
Constant	16.90	7.90			1.22 to 32.57
IES acute	0.64	0.10	0.56	<.001	0.44 to 0.84
Age	-0.19	0.12	-0.14	0.33	-0.43 to 0.04
Sex	-2.86	4.15	-0.06	1.48	-11.10 to 5.37
1 year					
Constant	22.83	8.51			5.89 to 39.76
IES acute	0.42	0.11	0.37	<.001	0.21 to 0.64
Age	-0.27	0.13	-0.19	0.12	-0.54 to -0.01
Sex	12.56	4.66	0.25	0.03	3.29 to 21.82
Partners					
3 months					
Constant	27.00	11.04			5.00 to 49.01
IES acute	0.51	0.12	0.44	<.001	0.27 to 0.75
Age	-0.32	0.15	-0.22	0.12	-2.15 to 0.04
Sex	0.24	5.39	0.01	2.88	-10.50 to 10.98
1 year					
Constant	11.11	11.77			-12.36 to 34.58
IES acute	0.73	0.13	0.57	<.001	0.48 to 0.99
Age	-0.25	0.15	-0.15	0.33	-0.55 to 0.06
Sex	1.79	6.14	0.04	2.31	-10.44 to 14.03

Number of bootstrap in each model: 10,000; sex: male = 0, female = 1. Adj. *P* is the Bonferoni-adjusted *P* value, *b* is unstandardized β , SE *b* is the standard error for unstandardized β , and β is standardized β . N patients at 3 months = 98 and at 1 year = 86. N partners at 3 months = 82 and at 1 year = 77. Patients—3 months: adjusted $R^2 = 0.332$, $F_{3, 94} = 17.10$; 1 year: adjusted $R^2 = 0.281$, $F_{3, 82} = 12.08$. Partners—3 months: adjusted $R^2 = 0.208$, $F_{3, 78} = 8.46$; 1 year: adjusted $R^2 = 0.338$, $F_{3, 73} = 14.44$.

Abbreviations: IES acute, Impact of Event Scale 3 weeks after cardiac arrest; 95% CI, 95% confidence interval.

potential to prevent PTSD,¹⁷ a new cardiac event, and mortality.²³ We further argue that partners must be included equally in acute traumatic stress screening and follow-up programs in line with current recommendations.^{4,6,19,34} The implementation of these necessary screening procedures is urgent in light of the rapidly increasing survival rate after cardiac arrests.

It is, however, critical to note that other traumatic stress trajectories also are evident, importantly the development of PTSD in the absence of acute traumatic stress response.¹⁶ Systematic follow-up is necessary to not overlook patients and partners with late-onset PTSD symptoms as recommended by The European Resuscitation Council.³⁵

Attention to the Partners of Patients Who Have Had a Cardiac Arrest

Our results suggest that a survived cardiac arrest elicits more severe and longer-lasting PTSD symptoms in partners compared with the patients, in line with earlier preliminary findings.¹⁴ The relatives presented with a considerably higher average acute traumatic stress response above that of the patients with increasing strength of the association with PTSD symptom severity over time. In fact, 45% of partners presented with clinical severe PTSD symptoms 1 year postresuscitation compared with 28% of the

patients, in agreement with earlier reported prevalence rates.^{4,14} Compared with the partners, patients had marked lower severity of both acute traumatic stress and PTSD symptom severity, and their association decreased over time, which is the most common stress trajectory after a potentially traumatic event.¹⁶ These findings highlight that partners may be the primary traumatized persons in postresuscitation settings.

This difference in both PTSD symptom severity and duration between patients and partners might be a result of the difference in trauma exposure.⁷ The partners often characterize the event with feelings of panic, unreality, and with a sense of seeing their spouse dying,³⁶ which are all trauma perceptions related to a high risk of developing PTSD.³⁷ For the patients, because of insufficient cerebral blood supply during the cardiac arrest,³⁸ they do not experience the actual cardiac arrest event, which might be protective for the development of PTSD. Also, the partners in postresuscitation settings can experience high caregiver strain, which is associated with increased emotional distress.³⁴

Attention to Women in Postresuscitation Settings

For both patients and partners, we found that women showed significantly higher acute traumatic stress severity

What's New and Important

- After a cardiac arrest, the severity of acute traumatic stress is linked to long-term PTSD symptom severity in the patients and their partners.
- Patients who have had a cardiac arrest and their partners should be screened for acute traumatic stress.
- After a cardiac arrest, partners compared with patients and women compared with men are at higher risk for long-term PTSD.

compared with men. Acute traumatic stress in female patients was significantly associated with stronger PTSD symptom severity 1 year postresuscitation compared with men. These results are in accordance with current literature reporting women to be at 2-fold risk for PTSD compared with men,³¹ accentuating the need for more research focusing on women in postresuscitation settings.

Limitations

Our measure of acute traumatic stress and PTSD symptoms was based on a self-reported questionnaire producing subjective severity estimates and do not allow for the diagnosis of acute stress disorder or PTSD within the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*. In addition to the IES, future studies should include a psychiatric diagnostic interview to ensure an objective and standardized postresuscitation traumatic stress measure permitting a diagnostic evaluation of the population. This would further allow for actual psychometric evaluation of the IES as a screening instrument not only for PTSD but also for acute stress disorder in postresuscitation settings. For this purpose, researchers may consider using the revised version, IES-R, in future studies as it has been shown to exhibit enhanced predictive validity and sensitivity for PTSD.²⁹

Our results generalize to patients who have had a cardiac arrest and who are living independently and their partners. Our cohort might reflect the least vulnerable patients and partners in light of the exclusion of patients living in residential or institutional care, and considering the 22% who stopped prematurely, partly explained by medical problems. Thus, our results might be an underestimation of the severity of acute traumatic stress and PTSD symptoms when considering the total population of patients who have had a cardiac arrest and their partners.

The participants' psychiatric history, including former traumatic events and/or presence of PTSD before the cardiac arrest, was not recorded. Although we specifically examined the association between cardiac arrest–related acute traumatic stress and PTSD symptoms, the presence of premorbid PTSD or other psychiatric conditions would likely inflate patients' and partners' traumatic stress response, which should be taken into account in future

studies. For patients, in- or out-of-hospital cardiac arrest, witnessed arrest, bystander cardiopulmonary resuscitation, shockable initial rhythm, early defibrillations, time to return of spontaneous circulation, cause of the cardiac arrest, and length of stay at the ICU were not included as covariates because earlier findings did not report any important effect on traumatic stress.⁵ However, relevant comorbidities might include fatigue and other mental health issues, and specifically for patients posthypoxic encephalopathy and cognitive dysfunction, which future studies should account for. For the partners, we did not account for those who witnessed the resuscitation, as this information was not available for most partners in our cohort. In the future, studies should account for the level of exposure and involvement in cardiac arrest.

Conclusions

We found that self-reported acute traumatic stress is positively associated with PTSD symptom severity for up to 1 year postresuscitation in both patients who have had a cardiac arrest and their partners. In the early postresuscitation phase, we recommend screening for acute traumatic stress using the IES to identify both patients and partners at increased risk for later development of PTSD symptoms, to refer to organized systematic follow-up programs. Special attention to partners and women is critical because of their marked increased risk of higher PTSD symptom severity.

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