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Compound risk: History of traumatic stress predicts posttraumatic stress disorder symptoms and severity in sudden cardiac arrest survivors

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Abstract

Background: Sudden cardiac arrest (SCA) survivors can develop posttraumatic stress disorder (PTSD) which is associated with worse clinical outcomes. The purpose of this study was to evaluate the prevalence and predictors of PTSD in a large sample of SCA survivors. Prior history of psychological trauma and the effects of repeated trauma exposure on subsequent PTSD and symptom severity after SCA were also explored.

Methods: A retrospective, cross-sectional study of 188 SCA survivors from the Sudden Cardiac Arrest Association patient registry completed an online questionnaire that included measures of PTSD, trauma history, sociodemographics, general health, and cardiac history.

Results: Sixty-three (36.2%) SCA survivors in this sample scored above the clinical cutoff for PTSD. Female gender, worse general health, and younger age predicted PTSD symptoms after SCA. Additionally, 50.2% of SCA survivors (n = 95) reported a history of trauma exposure and 25.4% (n = 48) of the total sample endorsed a traumatic stress response to a historic trauma. Results indicated that a traumatic stress response to a historic trauma was a stronger predictor of PTSD after SCA (odds ratio = 4.77) than all other variables in the model.

Conclusions: PTSD symptoms are present in over one-third of SCA survivors. While demographic or health history variables predicted PTSD after SCA, a history of traumatic stress response to a previous trauma emerged as the strongest predictor of these symptoms. Routine assessment and interdisciplinary management are discussed as potential ways to expedite survivors' recovery and return to daily living.

Keywords

Sudden cardiac arrest, SCA, posttraumatic stress disorder, PTSD

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Introduction

Sudden cardiac arrest (SCA) is a leading cause of morbidity and mortality in the United States and claims the lives of more than 350,000 people each year.[1] With recent advances in resuscitation and medical therapies, a growing number of individuals survive SCA and increased attention to psychological adjustment is needed. SCA forces survivors to immediately adjust to their new cardiac condition and medical regimen, as well as cope with physical, psychological and interpersonal disruptions. Among survivors, the prevalence

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of depression ranges from 14% to 45%, and the prevalence of anxiety ranges from 13% to 61%,[2] rates that are significantly greater than in the general population. Many survivors face additional challenges related to fatigue, hypoxic-injury, cognitive deficits, disability, financial debt, and difficulty returning to activities of daily living.[3,4]

A proportion of survivors consider SCA to be a traumatic event, and SCA may lead to post-traumatic reactions ranging from acute distress to a traumatic stress response (intense feelings of helplessness or horror).[5] For 19% to 27% of SCA survivors, those symptoms persist and worsen over time and are indicative of posttraumatic stress disorder (PTSD).[2] PTSD is a psychological condition characterized by cognitive and affective processes of re-experiencing, avoidance behaviors, and increased physiological arousal following exposure to a traumatic event.[5] PTSD is clinically relevant to cardiac patients, as it has been associated with worse medical outcomes (e.g. increased rates of cardiac death, rehospitalization, reduced adherence to medication and medical regimen), increased medical care utilization, more severe functional impairments, and poor quality of life.[6-8] Alterations in cardiac function have also been associated with PTSD (e.g. increased heart rate, systolic blood pressure, coagulation abnormalities, endothelial dysfunction, platelet abnormalities) and may contribute to increased morbidity and mortality in cardiac patients.[6,9,10] Additionally, clinically significant PTSD symptoms and increased rates of depression and anxiety, demoralization, negative health beliefs, social impairment, and preoccupation with somatic symptoms have been reported in the literature.[4,11]

Given the considerable prevalence and impact of PTSD on clinical outcomes, understanding potential mechanisms that contribute to and maintain PTSD in cardiac patients is crucial. Known predictors of PTSD in cardiac patients include personality traits (type D personality, repressive coping style, and negative affect), medical and psychiatric history (past psychiatric illness or history of myocardial infarction), sociodemographic characteristics (younger age, female gender, and ethnic origin), inadequate social support, and dissociative symptoms.[12] In addition, prior exposure to traumatic events (e.g. severe medical injury, natural disaster, physical assault) may be another potentially important factor in understanding survivors' risk for PTSD after SCA. Supporting this hypothesis, prior research has found that exposure to multiple traumatic events is associated with increased risk for PTSD.[13-15] Studies have also found that a traumatic stress response to an initial trauma may lead to persistent functional changes in multiple physiological systems (e.g. serotonergic dysfunction, sympathetic nervous system and hypothalamic–pituitary–adrenal axis), which consequently may increase risk for PTSD following subsequent trauma.[16-19] Taken together, history trauma may be another important risk factor for development of PTSD after experiencing SCA.

While these data are suggestive, no prior studies have explored the cumulative effects of exposure to multiple traumatic events on SCA survivors' psychological adjustment. Thus, the aims of this study were (1) to describe the prevalence of clinically-significant PTSD symptoms associated with SCA in a large cross-section of SCA survivors; and (2) to identify predictors of clinically significant symptoms of PTSD due to SCA, including history of prior trauma.

Methods

Study population

Self-identified survivors of SCA who voluntarily registered with the Sudden Cardiac Arrest Association (SCAA, Washington, DC) patient registry were contacted to participate in this retrospective cross-sectional study. The SCAA registry is an online platform that provides patient education, support and information about ongoing research studies to SCA survivors. For inclusion in the study, participants were required to be aged 18 or older and able to read and complete study questionnaires.

Data collection procedures

Data for the current study were collected as part of a larger study designed to assess the educational needs of SCA survivors and long-term effects of SCA on psychological adjustment and quality of life. For the overall study, an online survey was distributed to 591 SCA survivors who were registered with the SCAA between October 2012 and January 2013. Participants completed questionnaires regarding sociodemographic information, general health, cardiac history, prodromal symptoms experienced prior to SCA, and quality of life (QoL) concerns after SCA. Sociodemographic information, general and emotional health, and cardiac history were collected by self-report. Relevant to the current study, measures of exposure to a prior traumatic event and current symptoms of PTSD associated with SCA were included. The study protocol was approved by the Internal Review Board at East Carolina University.

Measurement instruments

Prodromal symptoms prior to SCA. A seven-item measure of prodromal symptoms of SCA was developed for use in the current study to assess whether participants had experienced syncope, angina, dyspnea, heart palpitations, arrhythmias, dizziness or heart murmur one month prior to SCA. Symptoms were dichotomized as present or absent and summed to give a total score.

Trauma history. For the purposes of this study, an a priori classification system was derived to delineate the presence of, and reaction to, history of traumatic experience. See

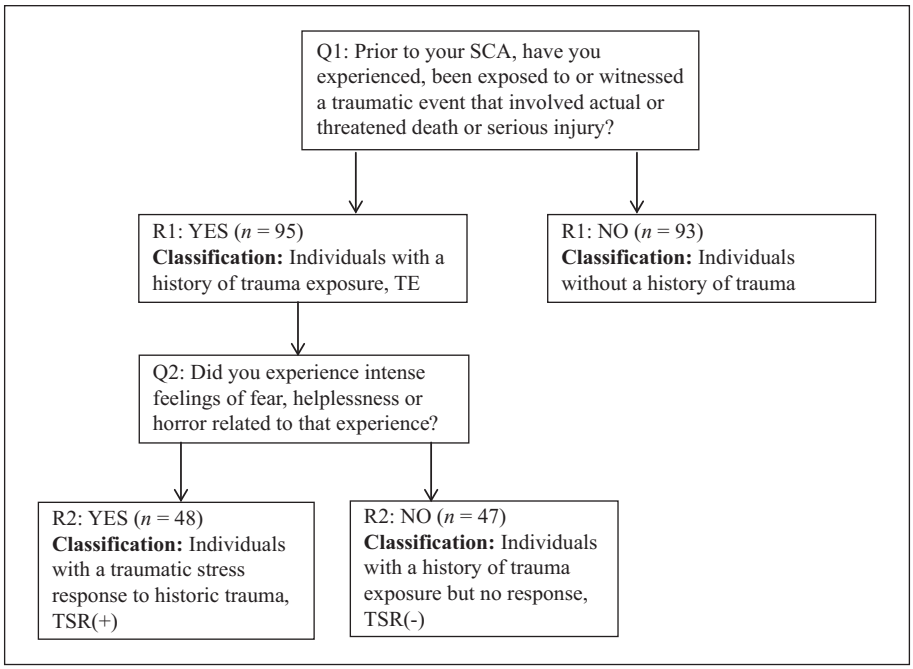

Figure 1. Illustration of trauma history classification.

Figure 1 for an illustration of trauma history classification. Two dichotomous items were used to assess participants' history of exposure to a prior traumatic event and their subjective response to that event. First, participants were asked whether they had previously experienced, been exposed to or witnessed a traumatic event that involved actual or threatened death, or serious injury. Once again, traumatic events may include a range of medical and non-medical events, such as assault, natural disaster, motor vehicle accident, or combat, among many others. These broad categories are frequently used to capture and quantify a range of stressful life events associated with the development of PTSD. Participants who responded "no" to the first question were considered individuals without a history of trauma. Participants who reported "yes" to the initial trauma exposure item were categorized as having a history of exposure to some form of trauma (TE (trauma exposure)). This subset of individuals was subsequently asked if they had experienced intense feelings of fear, helplessness or horror related to that experience. Individuals who responded "yes" were identified as participants with a traumatic stress response to historic trauma (TSR(+)). Participants who responded "yes" to question 1 but did not experience an intense psychological reaction ("no" to question 2) were classified as individuals with a history of trauma exposure without traumatic stress response (TSR(-)). In addition, participants with a history of TE were asked to identify which traumatic event(s) they experienced from a list of potentially traumatic events. The list included physical/sexual assault, unexpected familial death, motor vehicle accident, severe medical illness/injury, fire or explosion, combat or war, and other.

PTSD symptoms due to SCA. The PTSD Checklist (PCL) is one of the most frequently used self-report measures to assess symptoms of PTSD experienced in the past month. The PCL has 17 items and is based on DSM-IV PTSD criteria.[20] The PCL-S, or Specific Trauma version of the instrument, was used to assess PTSD symptoms specifically associated with SCA. For each item, participants rated the extent to which they had been bothered by 17 symptoms on a five-point Likert scale bounded by 1 (not at all) and 5 (extremely). Individual items on the PCL-S were summed and averaged to obtain a PTSD symptom severity score. Total scores on the PCL-S range from 17 to 85. A clinical cutoff score of 30 or higher was used to identify individuals with clinically significant symptoms of PTSD and is consistent with current recommendations from the VA National Center for PTSD (2010) and supported by the literature examining cut scores in non-military primary care facilities.[21,22] Data were dichotomized accordingly, resulting in a group that was positive for post-SCA PTSD and a group that was negative for post-SCA PTSD. Cronbach's alpha for the measure ranges from 0.94 to 0.97, with a test–retest reliability of 0.88.[23] Cronbach's alpha in the current study was 0.94.

Physical health. A single-item continuous measure was used to assess current physical health (i.e., "Today, how would you describe your overall physical health?"). Physical health was rated on a five-point Likert scale bounded by 1 (poor) and 5 (excellent) with a higher score indicating better self-reported health.

Table 1. Sociodemographic, cardiac characteristics and psychological adjustment in SCA survivors.

Characteristic	Entire sample (N = 188)	Below PCL cut (n = 111)	Above PCL cut (n = 63)	p
PTSD (PCL-S score)[a,b]	25.34 ± 12.65	21.56 ± 3.77	43.0 ± 11.0	<0.01*
Age in years	55.43 ± 12.07	57.73 ± 12.09	50.94 ± 11.49	<0.01*
Men	104 (55.0%)	68 (61.3%)	29 (46.0%)	0.09
White/Caucasian	177 (93.7%)	103 (92.8%)	59 (93.7%)	0.64
Education				
High school	4 (2.1%)	1 (0.9%)	3 (4.8%)	0.11
Some college/Technical School	63 (33.3%)	30 (27.0%)	30 (47.6%)	<0.01*
College graduate	64 (33.9%)	41 (36.9%)	18 (28.6%)	0.28
Graduate school	58 (30.7%)	39 (35.1%)	12 (19.0%)	0.01*
Income				
Low: $0–$49,999	29 (15.3%)	15 (13.5%)	13 (20.6%)	0.21
Medium: $50,000–$149,999	94 (49.7%)	59 (53.1)	35 (55.6%)	0.30
High: $150,000+	51 (27.0%)	30 (27.0%)	14 (22.2%)	0.68
Time since SCA (years)	4.7 ± 3.9			
Cardiac characteristics				
Heart disease prior to SCA	45 (23.8%)	26 (23.4%)	15 (23.8%)	0.90
ICD	148 (78.3%)	84 (75.7%)	52 (82.5%)	0.29
History of ICD shock	68 (36.0%)	34 (30.6%)	27 (42.9%)	0.21

Chi-square and t-test were performed. Values are n (%) or mean ± standard deviation.
[a]Clinical cutoff for PTSD on the PCL-S are scores ⩾ 30.
[b]Data (n = 14) excluded due to incomplete or missing PCL scores.
*$p < 0.05$.
SCA: sudden cardiac arrest; PCL: PTSD Checklist; PCL-S: PTSD Checklist, Specific Trauma version; PTSD: posttraumatic stress disorder; ICD: implantable cardioverter-defibrillator.

Statistical analysis

Descriptive statistics were used to characterize sociodemographic information and cardiac health history. Dichotomous medical variables were coded as present or absent and multiple response medical variables were coded according to participant response. Chi-square (χ^2) tests and t-tests were used to compare categorical and continuous measures, respectively, between individuals who scored above and below the clinical cutoff for PTSD on the PCL-S. Binary logistic regression modeling was performed to identify predictors of clinically significant symptoms of PTSD due to SCA. In this model, PTSD was entered as the dependent variable and independent predictor variables included gender, age, history of heart disease, prodromal symptoms of SCA, history of TE, and TSR to historic trauma. Follow-up exploratory analyses were also conducted to evaluate history of a traumatic stress response, TE(+), as a predictor of post-SCA PTSD symptom severity and determine whether type of previous trauma predicted PTSD after SCA. Differences with a p-value of < 0.05 were considered significant. All analyses were performed with SPSS version 20.0 (SPSS Inc., Chicago, Illinois).

Results

Of the 591 SCA survivors in the SCAA registry contacted about this research, 188 (31%) provided electronic consent to participate and completed the survey. A substantial number of survivors (n = 76, 13%) contacted for this study were unable to be reached due to invalid or expired email addresses associated with their SCAA registry account. Sociodemographic and clinical characteristics of the sample are presented in Table 1. In addition, 50.2% of SCA survivors (n = 95) reported a history of TE and 25.4% (n = 48) of the total sample endorsed a traumatic stress response to a historic trauma. Medical traumas were reported most frequently, and physical/sexual assault was the least frequently endorsed in the current sample. The frequencies of each type of trauma are summarized in Figure 2. No participants endorsed exposure to multiple non-SCA traumas.

Prevalence of PTSD secondary to SCA

Results from this study revealed that 36.2% (n = 63) of survivors from the overall sample had current symptoms of PTSD due to SCA.

Predictors of PTSD after SCA

Binary logistic regression analysis was performed to identify predictors of clinical levels of PTSD due to SCA. Model-predicted probabilities of PTSD after SCA are summarized in Table 2. The full model containing all predictors was statistically significant, χ^2 (7, N = 183) = 36.09, $p < 0.001$, with 66.1% of cases correctly classified. Younger age (odds ratio (OR), 0.94; 95% confidence interval (CI), 0.91–0.97) and worse general health (OR,

0.56; 95% CI, 0.39–0.81) made a statistically significant contribution to the model. The variable carrying the largest percentage of variance in the model was a history of TSR(+) to a historic trauma (OR, 4.77 95% CI, 1.69–13.42). In other words, controlling for all other factors in the model, SCA survivors with a history of TSR(+) were over four times more likely to report PTSD symptoms secondary to their experience of SCA than survivors without a history of TSR(–).

Trauma history and PTSD severity following SCA

A Mann–Whitney *U* test revealed a significant difference in SCA-related PCL-S scores among TSR(+) individuals (*Md* = 1.82, *n* = 48) compared with TSR(-) individuals (*Md* = 1.29, *n* = 47), *U* = 738.50, *z* = –2.20, *p* = 0.03, *r* = 0.23. History of TSR(+) was associated with more severe symptoms of PTSD after SCA.

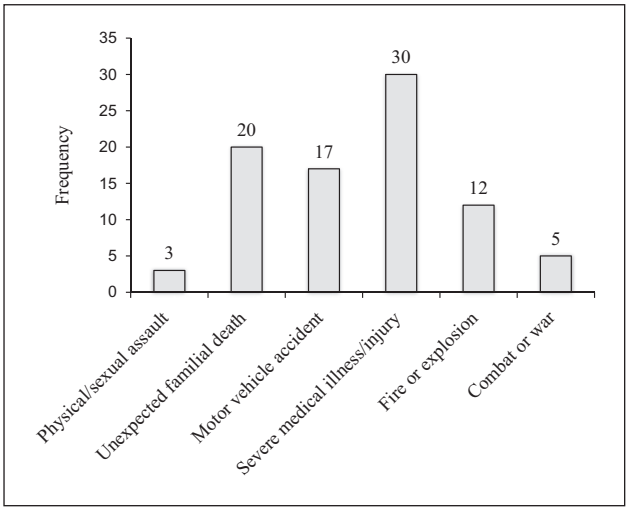

Figure 2. Frequency of trauma history by type of trauma experienced (*n* = 87). Missing data *n* = 8.

Trauma type and PTSD following SCA

A Kruskal–Wallis test indicated that PCL-S scores did not differ significantly across five different types of historic trauma, χ^2 (4, *n* = 87) = 2.50, *p* = 0.65. Physical/sexual assault was excluded from this analysis due to an insufficient number of cases in this category (*n* = 3).

Discussion

In this study, nearly one-third of participants reported symptoms of PTSD following SCA, which is higher than previously published data on the rate of PTSD in SCA survivors.[7] Collectively, these data suggest that the prevalence of PTSD after SCA is similar to the rates found in combat veterans (12–30%)[24] and is 4.5 times higher than in the general population (7–8%).[25]

Although the specific effects of PTSD on objective clinical outcomes in SCA survivors has yet to be determined, SCA has been shown to be related to cognitive deficits in sustained attention, working memory, affect regulation and information integration due to fatigue and/or hypoxic injury during and/or after SCA.[3] Further, in the PTSD literature, it is widely recognized that deficits in executive functioning are associated with PTSD.[26] Collectively, SCA survivors with consequent PTSD symptoms may have particular difficulty with long-term adjustment and completing tasks that are influenced by cognitive capabilities. These could include acceptance or understanding of the cardiac event, adherence to new behavioral or medical prescriptions given by providers

Table 2. Binary logistic regression model predicting PTSD after SCA.

	B	Wald	*p*	Odds ratio	95% CI odds ratio	
					Lower	Upper
Sociodemographics						
Gender	–0.01	0.01	0.98	0.99	0.47	2.09
Age	–0.06	13.16	<0.01*	0.94	0.91	0.97
Cardiac history						
History of heart disease	0.45	1.18	0.28	1.58	0.69	3.57
Prodromal symptoms	–0.05	0.34	0.56	0.95	0.81	1.12
Physical health						
General health	–0.58	9.55	<0.01*	0.56	0.39	0.81
Trauma history						
History of trauma exposure (TE)	–0.28	0.35	0.55	0.76	0.30	1.92
TSR(+) to historic trauma[a]	4.19	8.73	<0.01*	4.77	1.69	13.42

[a]TSR(+) are participants with a traumatic stress response to historic (non-SCA) trauma.
*$p < 0.05$.
PTSD: posttraumatic stress disorder; SCA: sudden cardiac arrest; CI: confidence interval.

(e.g. appointment follow-up, resuming physical activity), medical-decision making, and mobilizing support networks, among many other critical processes that can directly or indirectly affect clinical outcomes. However, the causal pathways among these variables could not be explicitly addressed with the current data due to its cross-sectional nature.

Predictors of PTSD after SCA

Consistent with prior research, age emerged as an independent predictor of clinically significant symptoms of PTSD. Younger SCA survivors were significantly more likely to experience PTSD symptoms after SCA than older survivors. In combination with previous studies,[7,27,28] these findings may reflect differences in age-related adjustment due to biological, behavioral, and interpersonal factors, as well as possessing fewer emotional, social, and financial resources. However, the cause of this link has not been directly investigated to date. Worse physical health also predicted clinical levels of PTSD associated with SCA, whereas gender, history of heart disease, and prodromal symptoms did not.

Compound risk: history of trauma as a predictor of PTSD after SCA

Roughly half of the SCA survivors in this sample reported a history of some form of traumatic experience, which reflects the 50–60% risk of TE in the general population.[25] In addition, 25.4% (n = 48) of the total sample endorsed a traumatic stress response to a historic trauma. In support of Yehuda and colleagues' vulnerability model,[16] TE alone did not predict PTSD after SCA. Rather, it was an individual's *report of a traumatic stress response* that was related to clinically significant PTSD and more severe symptoms after SCA. In fact, survivors with a history of TSR(+) were over four times more likely to report PTSD symptoms after SCA than survivors without a history of traumatic stress or without a history of trauma. Having a prior history of TSR(+) was the strongest predictor among all variables found to be significantly related to clinical levels of PTSD post-SCA, including current physical health, cardiac history, and patient characteristics. Although it cannot be concluded with any certainty due to the cross-sectional nature our data, it does not appear likely that experiencing a traumatic event conveys risk for clinically significant PTSD symptoms unless the trauma is accompanied by intense feelings of fear, helplessness or horror. This pattern is consistent with prior studies that have found a history of TSR(+) to consistently predict PTSD and more severe symptoms after a subsequent trauma, lending support to the vulnerability pathway proposed by Yehuda and colleagues.[16] Thus, it seems possible that previous, non-SCA traumatic experience facilitates a psycho-physiological pathway that serves as a foundation for PTSD after SCA due to re-activation or exacerbation of those pathways.

Limitations

As with all studies, several limitations should be noted. First, results from this study were based on cross-sectional retrospective self-report data and thus, temporal relationships could not be explored between variables. The limitations of retrospective recall for past events are well documented in the literature as they have the potential to be influenced by current mood states and recall bias.[29] With regard to PTSD symptoms, there is known potential for reports of the nature and severity of previous trauma(s) to be influenced by more recent trauma (e.g. SCA), so it is possible that those with higher reported PTSD symptoms after recent SCA had inflated rates of recalling traumatic stress responses to past trauma.[30] An additional limitation is that internet accessibility, or lack thereof, may have introduced selection bias of an unknown nature or consequence. The implications and limitations associated with selection bias are well-documented in the SCA literature.[7] To that end, investigators in the current study sought to minimize participation bias while also addressing two other commonly reported limitations in SCA survivor research, small sample sizes and sample homogeneity. An email survey distribution strategy was employed to increase recruitment and sample size but led to a low response rate, which is consistent with other studies that rely on email-based recruitment and may reduce the generalizability of study findings.[31] Collectively, we felt that the strengths of using an online patient registry for recruitment outweighed the potential limitations, as it allowed us to recruit a larger sample of SCA survivors from diverse age groups, educational and socioeconomic backgrounds. However, racial and ethnic differences were underrepresented in our sample and may limit the generalizability of study findings to the broader SCA survivor population.

It should also be recognized that logistic analyses can overestimate ORs and produce wider CIs in small samples,[32] which in turn may limit the precision and interpretation of reported estimates. However, such a statistical bias is unlikely as our sample did meet the minimum requirements for size to conduct these analyses.[33] A larger sample nonetheless would have had greater power to detect statistical differences between outcome variables and improved performance of the estimate. Another potential limitation was the use of a single-item self-report measure to assess current physical health. While prior research has demonstrated the reliability and validity of single-item measures of physical health,[34] future studies should include a more robust evaluation of PTSD symptoms in relationship to other bio-behavioral variables in order to provide comprehensive measures of self-reported health. Finally, other unexamined behavioral and biologic factors not included in this study may be important risk factors for PTSD after SCA and should be considered in future investigations.

Summary and conclusions

With recent advancements in technology and medical therapies, a growing number of men and women will experience and survive traumatic events (i.e. military trauma, cancer, natural disaster), and the cumulative effects of traumatic stress from repeated exposure may have a profound effect on survivors' emotional resiliency and physical recovery after a cardiac event. In an effort to more comprehensively understand the psychological experience of survivors, the current study sought to document the prevalence of post-arrest PTSD symptoms as well as identify factors related to the development of PTSD secondary to cardiac arrest. Findings from the current study suggest that roughly one third of SCA survivors reported clinically significant symptoms of PTSD due to SCA. Younger age, worse general health, and history of a significant stress response to a prior traumatic event emerged as predictors of PTSD after SCA.

A novel contribution of this study was the examination of history of a traumatic stress response as a predictor of subsequent PTSD after cardiac arrest. Of all predictors, history of a traumatic stress response exhibited the highest predictive value in the statistical model. Consistent with the broader mental health literature, it was the traumatic stress response, and not simply experiencing a previous trauma of some kind, that predicted clinical levels of PTSD and more severe PTSD symptoms after SCA. Taken together, findings from this study and extant research provide initial evidence that justifies psychological screening and referrals for further assessment or treatment, when indicated. Early detection and psychological intervention may be critical to reducing PTSD-related morbidity and mortality in SCA survivors. Furthermore, multidisciplinary management of this condition will enhance cardiovascular disease management as well as expedite survivors' recovery and return to daily living.

Implications for practice

- Roughly one-third of sudden cardiac arrest survivors report clinically significant symptoms of posttraumatic stress disorder due to sudden cardiac arrest.
- Patients with a prior history of traumatic stress were over four times more likely to report posttraumatic stress disorder symptoms after sudden cardiac arrest than survivors without a history of trauma.
- Findings from this study provide initial evidence that justifies psychological screening and referrals for further assessment or treatment, when indicated.
- Early detection and psychological intervention is critical to reducing posttraumatic stress disorder related morbidity and mortality in sudden cardiac arrest survivors.

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Conflict of interest

Rachel Lampert received significant research funding from St Jude, Boston Scientific, Medtronic, and GE Healthcare. Samuel F Sears has research grants from Medtronic. These funds from Medtronic are directed to East Carolina University. Dr. Sears also serves as a consultant to Medtronic and St Jude Medical. He has received speaker honorarium from Medtronic, Boston Scientific, and St Jude Medical in the last two years. Dr. Sears is the founder of QOL Apps, Inc and inventor of ICD Coach. Christine Lawless: Advisory board of Privit.

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