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BRIEF REPORT

The relationship between mindfulness and enduring somatic threat severity in long-term cardiac arrest survivors

Alexander M. Presciutti[1,2] · Sarah M. Bannon[1,2] · Jolin B. Yamin[3] · Mary M. Newman[4] · Robert A. Parker[5,6] · Jonathan Elmer[7] · Ona Wu[8,9] · Michael W. Donnino[3] · Sarah M. Perman[10] · Ana-Maria Vranceanu[1,2]

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Abstract

Background Cardiac arrest (CA) survivors experience continuous exposures to potential traumas though chronic cognitive, physical and emotional sequelae and enduring somatic threats (ESTs) (i.e., recurring somatic traumatic reminders of the event). Sources of ESTs can include the daily sensation of an implantable cardioverter defibrillator (ICD), ICD-delivered shocks, pain from rescue compressions, fatigue, weakness, and changes in physical function. Mindfulness, defined as non-judgmental present-moment awareness, is a teachable skill that might help CA survivors cope with ESTs. Here we describe the severity of ESTs in a sample of long-term CA survivors and explore the cross-sectional relationship between mindfulness and severity of ESTs.

Methods We analyzed survey data of long-term CA survivors who were members of the Sudden Cardiac Arrest Foundation (collected 10–11/2020). We assessed ESTs using 4 cardiac threat items from the Anxiety Sensitivity Index-revised (items range from 0 "very little" to 4 "very much") which we summed to create a score reflecting total EST burden (range 0–16). We assessed mindfulness using the Cognitive and Affective Mindfulness Scale-Revised. First, we summarized the distribution of EST scores. Second, we used linear regression to describe the relationship between mindfulness and EST severity adjusting for age, gender, time since arrest, COVID-19-related stress, and loss of income due to COVID.

Results We included 145 CA survivors (mean age: 51 years, 52% male, 93.8% white, mean time since arrest: 6 years, 24.1% scored in the upper quarter of EST severity). Greater mindfulness (β: -30, $p = 0.002$), older age (β: -0.30, $p = 0.01$) and longer time since CA (β: -0.23, $p = 0.005$) were associated with lower EST severity. Male sex was also associated with greater EST severity (β: 0.21, $p = 0.009$).

Conclusion ESTs are common among CA survivors. Mindfulness may be a protective skill that CA survivors use to cope with ESTs. Future psychosocial interventions for the CA population should consider using mindfulness as a core skill to reduce ESTs.

Keywords Cardiac arrest · Mindfulness · Enduring somatic threat · Trauma

✉ Alexander M. Presciutti
apresciutti@mgh.harvard.edu

[1] Massachusetts General Hospital, Department of Psychiatry, Center for Health Outcomes and Interdisciplinary Research, Boston, United States

[2] Harvard Medical School, Department of Psychiatry, Boston, United States

[3] Beth Israel Deaconess Medical Center/Harvard Medical School, Department of Emergency Medicine, Center for Resuscitation Science, Boston, United States

[4] Sudden Cardiac Arrest Foundation, Wexford, United States

[5] Harvard Medical School, Department of Medicine, Boston, United States

[6] Massachusetts General Hospital, Department of Medicine, Biostatistics Center, Boston, United States

[7] Departments of Emergency Medicine, Critical Care Medicine, and Neurology, University of Pittsburgh School of Medicine, Pittsburgh, United States

[8] Massachusetts General Hospital, Athinoula A. Martinos Center for Biomedical Imaging, Boston, United States

[9] Harvard Medical School, Department of Radiology, Boston, United States

[10] Department of Emergency Medicine, University of Colorado School of Medicine, Aurora, United States

Introduction

Cardiac arrest (CA) is the abrupt cessation of the heart's mechanical activity and effective circulation (Tsao et al., 2022). CA abolishes blood flow to the brain, causing hypoxic-ischemic brain injury (Sekhon et al., 2017).

Patients who are resuscitated from CA and recover consciousness ("CA survivors") experience continuous exposures to potential traumas throughout their recovery and survivorship (Gamper et al., 2004; Presciutti et al., 2021, 2022a; Sawyer et al., 2020; Wilder Schaaf et al., 2013). First, they must contend with sudden losses in cognitive and physical abilities from brain injury, which often become chronic problems (Harrod et al., 2021; Moulaert et al., 2009; Sawyer et al., 2020; Presciutti et al., 2022a). Second, they often do not expect to experience these sequelae and are unprepared to manage them when they occur (Sawyer et al., 2016, 2020; Presciutti et al., 2022a). Third, they experience recurring traumatic, somatic reminders of their CA, i.e., enduring somatic threats (ESTs; see Edmondson, 2014). ESTs serve as reminders of the vulnerability of one's body and mortality (Meli et al., 2019), which are two issues that are particularly present in the CA population (Bremer et al., 2019; Sawyer et al., 2020). Sources of post-CA ESTs can include the daily sensation of an implantable cardioverter defibrillator (ICD) in those who received ICDs, ICD-delivered shocks, pain from rescue compressions, fatigue, weakness, changes in physical function, sensitivity to changes in heart rate, cognitive changes, and any other threatening somatic reminder of the CA event (Pedersen et al. 2005; Presciutti et al. 2022a; Qintar et al. 2015; Rosman et al., 2015; Sawyer et al., 2016; Sawyer et al., 2020). While CA survivors have discussed experiences that are consistent with the EST model (see Presciutti et al. 2022a), no studies have quantified the severity of ESTs post-CA.

Mindfulness can be defined as non-judgmental present-moment awareness (Kabat-Zinn, 2003). Mindfulness is a teachable skill that could be taught to CA survivors to cope with ESTs. ESTs invasively distract survivors from the present moment by way of threatening bodily reminders of the CA (Edmondson et al., 2018). Practicing mindfulness, instead, may serve to reorient survivors to the present moment. Indeed, in a previous analysis of the present sample, greater mindfulness was associated with lower emotional distress (Presciutti et al., 2022b). The relationship between mindfulness and ESTs post-CA, however, has not yet been explored.

The objective of this study was two-fold: first, to describe the severity of ESTs in a sample of long-term CA survivors (i.e., > 1-year post-CA), and second, to test the hypothesis that greater mindfulness is cross-sectionally associated with lower EST severity in long-term CA survivors.

Methods

We analyzed follow-up survey data from long-term CA survivors who were members of the Sudden Cardiac Arrest Foundation (SCAF). The SCAF is a non-profit organization that offers an online support group for CA survivors and their families. Because the onset of the COVID-19 pandemic occurred after baseline administration but before follow-up, we included COVID-19-related stress questions in our follow-up survey. We also included measures capturing ESTs and mindfulness during follow-up data collection to identify future intervention targets. The primary variables in this analysis were thus only collected at follow-up and not available at baseline assessment.

We sent follow-up survey invitations via email to participants with full baseline data (collected 10–11/2019; $N = 169$); 145 survivors provided sufficient data for the present analysis (collected 10–11/2020). We developed and deployed surveys using REDCap, a secure data capture software. Further details on the original and follow-up survey can be found at Presciutti et al. (2020, 2022b). Our study was approved by the Colorado Multiple Institutional Review Board.

Measures

Survivor characteristics

In general, we opted to utilize brief measures to minimize survey fatigue. At baseline, participants reported the following characteristics: age at CA, sex, income (later categorized as low: < $50,000, medium: $50,000–99,999, and high: > $100,000), race, months since initial CA, comorbidities at the time of the CA (which were then used to calculate the Charlson Comorbidity Index [Charlson et al., 1987]), provision of targeted temperature management, and CA location (out-of-hospital vs. in-hospital).

We assessed functional independence at both timepoints via the Lawton Instrumental Activities of Daily Living scale (Lawton & Brody, 1969), which we used to dichotomize participants as functionally independent (8) or dependent (< 8). Additionally, survivors reported on presence of ongoing daily memory problems at both timepoints.

At follow-up we included a 5-point Likert scale rating of COVID-19-related stress: "On a scale from 1 to 5, how much stress have you experienced as a result of the COVID-19 pandemic; 1 = No stress, 5 = An extreme amount of stress." We also queried participants if they had experienced a loss of income due to COVID-19 (both items created by the first author).

Enduring somatic threats

We assessed ongoing ESTs through the 4 cardiac threat items from the Anxiety Sensitivity Index-revised (Peterson & Reiss, 1993): "It scares me when my heart beats rapidly," "When my chest feels tight, I get scared that I won't be able to breathe properly," "When I notice my heart skipping a beat, I worry that there is something seriously wrong with me," and "When I feel pain in my chest, I worry that I'm going to have a heart attack or arrest." We added "or arrest" to the fourth item. Item ratings ranged from 0 "very little" to 4 "very much." We summed the four items to create a total EST score (range 0–16). Our approach to measuring ESTs is consistent with a previous study that examined ESTs in acute coronary syndrome patients (Meli et al., 2019).

Mindfulness

We assessed mindfulness using the Cognitive and Affective Mindfulness Scale-Revised (CAMS-R) (Feldman et al., 2007). The CAMS-R is a 12-item scale (range 12–48); items were summed for a total mindfulness score. Higher scores reflect a greater tendency to live and act mindfully. The CAMS-R has been used as a correlate of adjustment (Feldman et al., 2007), in this case, adjustment to CA survivorship. The CAMS-R has been used in various clinical populations, including neurocritical care (Choi et al., 2018; Meyers et al., 2020; Shaffer et al., 2016; Vranceanu et al., 2020), chronic pain (Greenberg et al., 2020), and neurofibromatosis (Mace et al., 2021) and has been validated in people living with HIV in Myanmar (Huang et al., 2021).

Statistical analysis

We summarized participant characteristics and outcomes using descriptive statistics. In the absence of established clinical cut-offs of the EST score, we presented participant characteristics based on each quartile of the EST score (range 0–16): first (bottom) quarter (0–3), second quarter (4–7), third quartile (8–11) and fourth (upper) quartile (12–16).

We used linear regression to describe the relationship between the CAMS-R and the EST score (continuous variable) after adjusting for covariates. We took a data driven approach to covariate selection by including those with unadjusted associations with the EST score significant at a level of $p < 0.10$. We explored these unadjusted associations between all participant characteristics reported and EST score for possible inclusion as covariates. We recognize that the final model selected will need to be validated in future studies.

Results

We included 145 CA survivors (mean age: 51 years, 52% male, 93.8% self-identified as white, mean time since arrest: 6 years). Full details on survivor characteristics are presented in Table 1. The distribution of EST scores was as follows: first (lower) quarter (0–3): 27.6%, second quarter (4–7): 27.6%, third quarter (8–11): 20.6%, fourth (upper) quarter (12–16): 24.1%.

Results of our adjusted regression are presented in Table 2. Greater mindfulness was associated with lower EST severity (β: -0.30, $p = 0.002$). Older age (β: -0.30, $p = 0.01$) and greater time since the CA (-0.23, $p = 0.005$) were also associated with lower EST severity. Male sex was associated with greater EST severity (β: 0.21, $p = 0.009$). Our model explained 39% of the variance in EST score.

Discussion

Our findings suggest that (1) ESTs are common post-CA and (2) are inversely related to CA survivors' levels of mindfulness. Medical providers, including critical care providers and cardiologists, should be aware of the potential to develop ESTs post-CA so that they can prepare survivors and families accordingly during discharge planning and at post-discharge follow-up.

Our study contributes to previous reports of CA survivors that described experiences consistent with ESTs (Presciutti et al., 2020a; Rosman et al., 2015; Sawyer et al., 2016). Here, we provide quantitative support that a significant proportion of CA survivors experience ongoing ESTs years after their arrest. As these trauma cues are internal and recurring, they may perpetuate emotional distress long after the initial CA. Given this ongoing feedback loop, the experience of ESTs may in part contribute to the high prevalence of emotional distress post-CA (Gamper et al., 2004; Naber & Bullinger, 2018; Wilder Schaaf et al., 2013), though this would need to be examined in a longitudinal design. Nevertheless, psychosocial interventions for CA survivors should consider targeting both emotional distress and ESTs early post-CA.

Given the inverse relationship between ESTs and mindfulness, future longitudinal study should examine if mindfulness is indeed protective of EST severity. Indeed, it is possible that both constructs impact each other (e.g., greater mindfulness may reduce the severity of ESTs AND experiencing less ESTs may make it easier to be more mindful). Notably, however, previous interventions in ICD recipients that focused on mindfulness-based exercises were efficacious in reducing anxiety and distress (Irvine et al., 2011; Qintar et al., 2015). Still, identifying coping skills to manage distress and enduring threats post-CA, such as

Table 1 Demographic and survivor characteristics

Demographics	Total Sample ($N=145$)	1st Qrtr EST ($N=40$)	2nd Qrtr EST ($N=40$)	3rd Qrtr EST ($N=30$)	4th Qrtr EST ($N=35$)	Scale Range
Age at arrest, mean ± SD[a]	51.3 ± 11.5	54 ± 10.9	51.7 ± 10.4	52.8 ± 10.5	45.9 ± 13.2	
Gender—Male, % (n)	52.4 (76)	35 (14)	50 (20)	53.3 (16)	74.3 (26)	
Race, % (n)						
-White	93.8 (136)	95 (38)	95 (38)	90 (27)	94.2 (33)	
-Non-white	6.2 (9)	5 (2)	5 (2)	10 (3)	5.8 (2)	
Income, % (n)						
-Low (<$50,000)	13.8 (20)	7.5 (3)	15 (6)	13.3 (4)	20 (7)	
-Medium ($50,000 - $99,999)	26.9 (39)	27.5 (11)	30 (12)	20 (6)	28.6 (10)	
-High (>$99,999)	56.5 (82)	62.5 (25)	50 (20)	66.7 (20)	48.6 (17)	
-Did not disclose	2.8(4)	2.5 (1)	5 (2)	0 (0)	2.8 (1)	
Survivor Characteristics						
Pre-arrest Charlson Comorbidity Index[b], median (IQR[c])	1 (0–2)	1 (0-2.5)	1 (0–2)	1 (0–2)	0 (0-1.25)	0–37
Out-of-hospital arrest, % (n)	85.5 (124)	90 (36)	87.5 (35)	80 (24)	82.9 (29)	
Targeted temperature management, % (n)	35.9 (52)	32.5 (13)	37.5 (15)	30 (9)	42.9 (15)	
Implantable cardioverter-defibrillator placed, % (n)	63.4 (92)	62.5 (25)	57.5 (23)	60 (18)	74.3 (26)	
Discharge Disposition, % (n)						
- Acute rehab/long-term acute care facility (> 3 h of therapy per day)	3.4 (5)	2.5 (1)	2.5 (1)	6.7 (2)	2.9 (1)	
- Subacute rehab (1 h of therapy per day)	2.1 (3)	5 (2)	2.5 (1)	0 (0)	0 (0)	
- Home with in-home therapy	5.5 (8)	0 (0)	7.5 (3)	10 (3)	5.7 (2)	
- Home with out-patient therapy	14.5 (21)	10 (4)	15 (6)	33.3 (10)	2.9 (1)	
- Home without in-home or outpatient therapy	64.8 (94)	72.5 (29)	55 (22)	46.7 (14)	82.9 (29)	
- Unsure	9.6 (14)	10 (4)	17.5 (7)	6.6 (2)	2.8 (1)	
Months since arrest, mean ± SD, (IQR)	72.5 ± 48.4 (37.5-101.5)	87.5 ± 65.2 (37.5-129.75)	79.7 ± 42 (43.75-118.75)	49.1 ± 43.5 (30.75–64.25)	67.1 ± 40.6 (40–93)	
COVID-19-related stress[d], mean ± SD	2.8 ± 1	2.4 ± 0.9	2.8 ± 0.9	3 ± 1.2	3 ± 0.9	1–5
Loss of income due to COVID-19, % (n)	15.2 (22)	5 (2)	20 (8)	13.3 (4)	22.9 (8)	
Self-reported presence of daily memory problems, % (n)	46.9 (68)	22.5 (9)	50 (20)	56.7 (17)	62.9 (22)	
Functional dependence[e], % (n)	15.9 (23)	12.5 (5)	22.5 (9)	20 (6)	8.6 (3)	
Enduring somatic threat score[f], mean ± SD	7 ± 4.9	1.1 ± 0.9	5.3 ± 1.1	9.2 ± 1.1	13.7 ± 1.6	0–16
-First quarter (0–3), %, (n)	27.6 (40)					
-Second quarter (4–7), % (n)	27.6 (40)					
-Third quarter (8–11), % (n)	20.6 (30)					
-Fourth quarter (12–16), % (n)	24.1 (35)					
Enduring somatic threat score items, mean ± SD						0–4
- "It scares me when my heart beats rapidly"	2 ± 1.4	0.4 ± 0.6	1.8 ± 0.9	2.7 ± 0.8	3.7 ± 0.5	
- "When my chest feels tight, I get scared that I won't be able to breath properly"	1.5 ± 1.3	0.1 ± 0.3	0.9 ± 0.7	1.9 ± 0.8	3.1 ± 0.9	
- "When I notice my heart skipping a beat, I worry that there is something seriously wrong with me"	1.8 ± 1.4	0.4 ± 0.5	1.4 ± 1.1	2.5 ± 1	3.3 ± 1	
- "When I feel pain in my chest, I worry that I'm going to have a heart attack or arrest."	1.7 ± 1.4	0.3 ± 0.6	1.1 ± 0.7	2.2 ± 0.9	3.6 ± 0.6	
Mindfulness score[g] mean, ± SD	34.8 ± 7.2	40.1 ± 5.7	34.7 ± 7.7	32.1 ± 5.6	31.3 ± 6.4	12–48

Note:

[a]Standard Deviation

[b]Based on Charlson Comorbidity Index (range 0–37). Higher scores = great comorbidity severity.

[c]Interquartile Range

[d]Based on 5-point Likert scale (range 1–5). Higher scores = greater COVID-19-related stress

[e]Functional dependence based on a Lawton Instrumental Activities of Daily Living score of < 8.

[f]Based on enduring somatic threat severity score (scale range 0–16). Higher scores = more severe enduring somatic threat.

[g]Based on Cognitive and Affective Mindfulness Scale-Revised (scale range 12–48). Higher scores = greater mindfulness.

Table 2 Associations with Enduring Somatic Threat Severity

Variable	Enduring Somatic Threat[a]
	β [95% CI] (p-value)
Mindfulness[b]	**-0.30 [-0.50, -0.12] (0.002)**
Age at arrest	**-0.30 [-0.55, -0.08] (0.01)**
Male sex	**0.21 [0.05, 0.37] (0.009)**
Months since arrest	**-0.23 [-0.38, -0.07] (0.005)**
Ongoing experience of daily memory problems	0.09 [-0.08, 0.26] (0.30)
Pre-arrest comorbidity severity[c]	0.06 [-0.16, 0.28] (0.60)
COVID-19 stress[d]	0.02 [-0.15, 0.19] (0.81)
Loss of income due to COVID-19	0.07 [-0.09, 0.22] (0.41)
Total R^2	**0.39**

Note: All included variables had a significant unadjusted association with the enduring somatic threat severity score at $p < 0.10$.

[a] = Based on enduring somatic threat severity score (scale range 0–16). Higher scores = more severe enduring somatic threat.

[b] = Based on Cognitive and Affective Mindfulness Scale-Revised (scale range 12–48). Higher scores = greater mindfulness.

[c] = Based on Charlson Comorbidity Index (range 0–37). Higher scores = great comorbidity severity.

[d] = Based on 5-point Likert scale (range 1–5). Higher scores = greater COVID-19-related stress

mindfulness, is necessary to inform psychosocial interventions for the CA population. Other coping skills, including cognitive restructuring, problem solving, relaxation induction, and effectively utilizing social support have already shown promise in ICD recipients, and should be considered in future CA-specific interventions (Berg et al., 2020; Irvine et al., 2011; Qintar et al., 2015). As more people are surviving CA now than ever before, it is critical to turn toward addressing emotional distress in this population (Sawyer et al., 2020).

The relationships between age, time since arrest, sex, and EST severity also merit attention. Experiencing a CA may be more surprising and traumatic for younger survivors, given their lower likelihood of experiencing major medical events. Consistent with this finding, a previous study of CA survivors also showed that younger survivors were more likely to experience cardiac-related anxiety (Rosman et al., 2015). As survivors get older, and more time passes, their sensitivity to ESTs may wane, though this needs to be confirmed by continued study. Curiously, there was a significant association between male sex and greater EST severity, when compared to females. This contrasts with other conditions with similar recovery trajectories including stroke (Morrison et al., 2005) and ICD recipients (Spindler et al., 2009). This finding may be related to the recruitment source such that SCAF membership is opt-in and may attract survivors who are more likely to endorse and/or experience emotional distress than those consecutively enrolled in a medical setting.

Limitations

Our study has limitations. First, our convenience sample predominantly self-identified as white, experienced good neurologic recovery, and were all SCAF members, which limits the representativeness of our findings. Indeed, SCAF members are likely more exposed to survivorship topics, such as mindfulness and ESTs, than the average CA survivor, and may have had an availability bias in their response pattern to our study's measures. Second, we did not collect pharmacological or CA clinical characteristics typically extracted from medical records, which both may have been relevant for better understanding ESTs post-CA. To that end, our model explained only 39% of the variance in ESTs, suggesting a need to identify additional contributors to post-CA ESTs. Third, in the absence of an established EST measure, we instead utilized the four cardiac threat items from Anxiety Sensitivity Index, following the method of a previous study of EST in acute coronary syndrome patients (Meli et al., 2019). Lastly, given that this study was cross-sectional, we cannot discern the direction of the relationship between mindfulness and EST severity. Future study should examine the longitudinal relationship of mindfulness and ESTs post-CA.

Conclusion

ESTs are common in a sample of long-term CA survivors. Mindfulness may be a potential protective skill that CA survivors can use to cope with ESTs, though this must be confirmed in longitudinal study. Identifying effective coping skills, like mindfulness, is necessary to inform interventions for trauma and distress post-CA.

Author Contribution AP: conception and design; data acquisition, analysis, and interpretation; drafted the work; approved final version; agreed to be accountable for all aspects of the work.
SMB: data interpretation; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.
JY: data interpretation; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.
MMN: data acquisition; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.
RAP: data interpretation; revised draft for critically important intel-

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JE: data interpretation; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.
OW: data interpretation; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.
MWD: data interpretation; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.
SMP: conception and design; data acquisition, analysis, and interpretation; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.
AMV: design; data interpretation; revised draft for critically important intellectual content; approved final version; agreed to be accountable for all aspects of the work.

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Data Availability Data is available upon request.

Code Availability Not applicable.

Declarations

Conflicts of interest/Competing interests All authors report no conflicts of interest.

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent for publication Not applicable.

References

Berg, S. K., Rasmussen, T. B., Herning, M., et al. (2020). Cognitive behavioural therapy significantly reduces anxiety in patients with implanted cardioverter defibrillator compared with usual care: Findings from the Screen-ICD randomised controlled trial. *European Journal of Preventive Cardiology*, *27*(3), 258–268.

Bremer, A., Dahne, T., Stureson, L., et al. (2019). Lived experiences of surviving in-hospital cardiac arrest. *Scandinavian Journal of Caring Sciences*, *33*, 156–164.

Charlson, M. E., Pompei, P., Ales, K. L., et al. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases*, *40*(5), 373–383.

Choi, K. W., Shaffer, K. M., Zale, E. L., et al. (2018). Early risk and resiliency factors predict chronic posttraumatic stress disorder in caregivers of patients admitted to a neuroscience ICU. *Critical Care Medicine*, *46*, 713–719.

Edmondson, D. (2014). An enduring somatic threat model of posttraumatic stress disorder due to acute life-threatening medical events. Soc Personal Psychol Compas, 8,118 – 34.

Edmondson, D., Birk, J. L., Ho, V. T., et al. (2018). A challenge for psychocardiology: Addressing the causes and consequences of patients' perceptions of enduring somatic threat. *The American Psychologist*, *73*(9), 1160–1171.

Feldman, G., Hayes, A., Kumar, S., et al. (2007). Mindfulness and emotion regulation: The development and initial validation of the cognitive and affective mindfulness scale-revised (CAMS-R). *Journal of Psychopathological and Behavioral Assessment*, *29*, 177.

Gamper, G., Willeit, M., Sterz, F., et al. (2004). Life after death: Posttraumatic stress disorder in survivors of cardiac arrest–prevalence, associated factors, and the influence of sedation and analgesia. *Critical Care Medicine*, *32*(2), 378–383.

Greenberg, J., Popok, P. J., Lin, A., et al. (2020). A mind-body physical activity program for chronic pain with or without a digital monitoring device: Proof-of-concept feasibility randomized controlled trial. *JMIR Form Res*, *4*, e18703.

Harrod, M., Kamphuis, L. A., Hauschildt, K., et al. (2021). Getting better or getting by?: A qualitative study of in-hospital cardiac arrest survivors long-term recovery experiences. *SSM Qualitative research in health*, *1*, 100002.

Huang, F., Wei-Ti, C., Cheng-Shi, S., et al. (2021). Adaptation and validation of the cognitive and affective mindfulness scale-revised (CAMS-R) in people living with HIV in Myanmar. *Mindfulness*, *13*, 188–197.

Irvine, J., Firestone, J., Ong, L., et al. (2011). A randomized controlled trial of cognitive behavior therapy tailored to psychological adaptation to an implantable cardioverter defibrillator. *Psychosomatic Medicine*, *73*(3), 226–233.

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, *10*, 144–156.

Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *The Gerontologist*, *9*, 179–186.

Mace, R. A., Doorley, J., Bakhshaie, J., et al. (2021). Psychological resiliency explains the relationship between emotional distress and quality of life in neurofibromatosis. *Journal of Neuro-Oncology*, *155*, 125–132.

Meli, L., Alcántara, C., Sumner, J. A., et al. (2019). Enduring somatic threat perceptions and post-traumatic stress disorder symptoms in survivors of cardiac events. *Journal of Health Psychology*, *24*, 1817–1827.

Meyers, E. E., Presciutti, A., Shaffer, K. A., et al. (2020). The impact of resilience factors and anxiety during hospital admission on longitudinal anxiety among dyads of neurocritical care patients without major cognitive impairment and their family caregivers. *Neurocritical Care*, *33*, 468–478.

Morrison, V., Pollard, B., Johnston, M., & MacWalter, R. (2005). Anxiety and depression 3 years following stroke: Demographic, clinical, and psychological predictors. *Journal of psychosomatic research*, *59*(4), 209–213.

Moulaert, V., Verbunt, J. A., van Heugten, C. A., & Wade, D. T. (2009). Cognitive impairments in survivors of out-of-hospital cardiac arrest: A systematic review. *Resuscitation*, *80*, 297–305.

Naber, D., & Bullinger, M. (2018). Psychiatric sequelae of cardiac arrest. *Dialogues in Clinical Neuroscience*, *20*(1), 73–77.

Pedersen, S. S., van Domburg, R. T., Theuns, D. A., et al. (2005). Concerns about the implantable cardioverter defibrillator: A determinant of anxiety and depressive symptoms independent of experienced shocks. *American Heart Journal*, *149*(4), 664–669.

Peterson, R. A., & Reiss, S. (1993). *Anxiety sensitivity index revised test manual*. IDS Publ.

Presciutti, A., Shaffer, J. A., Newman, M. M., et al. (2020). Modifiable provider-patient relationship factors and illness perceptions are associated with quality of life in survivors of cardiac arrest with good neurologic recovery. *Resuscitation Plus*, *3*, 100008.

Presciutti, A., Newman, M. M., Grigsby, J., et al. (2021). Associations between posttraumatic stress symptoms and quality of life in cardiac arrest survivors and informal caregivers: A pilot survey study. *Resuscitation Plus*, *5*, 100085.

Presciutti, A., Siry-Bove, B., Newman, M. M. (2022a). Qualitative study of long-term cardiac arrest survivors' challenges and recommendations for improving survivorship. JAHA, 11(14), e025713.

Presciutti, A., Greenberg, J., Lester, E., et al. (2022b). Mindfulness is inversely associated with psychological symptoms in long-term cardiac arrest survivors. *Journal of Behavioral Medicine*, *45*(4), 643–648.

Qintar, M., George, J. J., Panko, et al. (2015). A prospective study of anxiety in ICD patients with a pilot randomized controlled trial of cognitive behavioral therapy for patients with moderate to severe anxiety. *Journal of interventional cardiac electrophysiology: an international journal of arrhythmias and pacing*, *43*(1), 65–75.

Rosman, L., Whited, A., Lampert, R., Mosesso, V. N., Lawless, C., & Sears, S. F. (2015). Cardiac anxiety after sudden cardiac arrest: Severity, predictors and clinical implications. *Int J of Card*, *181*, 73–76.

Sawyer, K. N., Brown, F., Christensen, R., et al. (2016). Surviving sudden cardiac arrest: A pilot qualitative survey study of survivors. *Therapeutic Hypothermia Temperature Management*, *6*, 76–84.

Sawyer, K. N., Camp-Rogers, T. R., Kotini-Shah, P., et al. (2020). Sudden cardiac arrest survivorship: A scientific statement from the American Heart Association. *Circulation*, *141*(12), e654–e685.

Sekhon, M. S., Ainslie, P. N., & Griesdale, D. E. (2017). Clinical pathophysiology of hypoxic ischemic brain injury after cardiac arrest: A "two-hit" model. *Critical care*, *21*(1), 90.

Shaffer, K. M., Riklin, E., Jacobs, J. M., et al. (2016). Mindfulness and coping are inversely related to psychiatric symptoms in patients and informal caregivers in the neuroscience ICU: Implications for clinical care. *Critical Care Medicine*, *44*, 2028–2036.

Spindler, H., Johansen, J. B., Andersen, K., et al. (2009). Gender differences in anxiety and concerns about the cardioverter defibrillator. *Pacing and clinical electrophysiology:PACE*, *32*(5), 614–621.

Tsao, C. W., Aday, A. W., Almarzooq, Z. I., et al. (2022). Heart disease and stroke statistics-2022 update: A report from the American Heart Association. *Circulation*, *145*(8), e153–e639.

Vranceanu, A. M., Bannon, S., Mace, R. (2020). Feasibility and efficacy of a resiliency intervention for the prevention of chronic emotional distress among survivor-caregiver dyads admitted to the neuroscience intensive care unit: A randomized clinical trial. JAMA Network Open, 3(10), e2020807.

Wilder Schaaf, K. P., Artman, L. K., Peberdy, M. A., et al. (2013). Anxiety, depression, and PTSD following cardiac arrest: A systematic review of the literature. *Resuscitation*, *84*(7), 873–877.