Posttraumatic Stress and the Implantable Cardioverter-Defibrillator Patient
What the Electrophysiologist Needs to Know
Samuel F. Sears, PhD; Jessica D. Hauf, MA; Kari Kirian, MA; Garrett Hazelton, MA; Jamie B. Conti, MD

The implantable cardioverter-defibrillator (ICD) has revolutionized the care of patients at risk for life-threatening arrhythmias. Large-scale clinical trials established mortality benefits for the ICD over usual care or medications1-2 and led to wider use for both primary and secondary prevention indications. More recent research confirms that the mortality benefits of the ICD extend over 8-year follow-up when compared with usual care.3 These clinical trial successes, in terms of mortality, have allowed for greater focus on patient-centered outcomes, such as quality of life, device acceptance, psychological well-being, and trauma reactions in research and clinical care.4 Shock has been a primary focus in this work because of its potentially traumatic impact on the patient experience. Although there is mixed evidence on the effect of single ICD shocks,5,6 the literature consistently supports the negative impact of >5 shocks on quality of life and emotional distress.7,8

ICD shock has been a focus of research interest because it is a unique experience for the ICD patient and can be perceived as a traumatic event. In addition, the existence of concomitant heart disease, angina, congestive heart failure, or previous sudden death may create sensitivity to traumatic stress that warrants improved understanding by attending electrophysiologists. Although psychological distress in ICD patients has been explored, the possibility that some ICD patients have trauma reactions, up to and including posttraumatic stress disorder (PTSD), has garnered increased attention recently. Therefore, the purposes of this report are to highlight the theory and research addressing psychological distress including PTSD in electrophysiology clinics, to discuss clinical management of these sequelae, and to suggest areas of future research and development.

Psychosocial Distress of ICD Patients in Electrophysiology Clinics
Prevention and identification of distress in ICD patients represents comprehensive, high-quality care, regardless of the cause (eg, depression, anxiety, trauma), consistent with the biopsychosocial model of care.9 This model of care entails the conceptualization and treatment of health problems as an interplay between biological factors, psychological factors, and social factors culminating in the manifestation of symptoms. For an electrophysiologist, these ambitious goals can include prevention of distress through cardiac care and education, recognition of distress warranting referral, optimizing quality-of-life (QoL) outcomes, and promoting patient acceptance of the ICD. Clearly, these are not easily accomplished without sufficient awareness, clinical support, and interdisciplinary expertise. Below are some key considerations for daily clinical practice.

Prevalence and Impact of Psychosocial Distress
General or ICD-specific anxiety as a psychological morbidity has a point prevalence of 13% to 38% of ICD recipients in cross-sectional research.4 Longitudinal assessment of anxiety has indicated that approximately 35% of patients at peri-implant met cutoff criteria for anxiety, whereas approximately 15% of patients remained above cutoff for anxiety at 6- and 12-month follow-up.10 Self-reported anxiety is also predictive of self-reported general health in ICD patients.11 Significant depressive symptoms for ICD patients range from 10% to 41%.4 Baseline depressive symptoms12 and the emotion of anger13 have also been associated with longitudinal increased risk of shock. Finally, personality characteristics associated with negative emotional processes and social inhibition (type D personality) have also been established as prevalent (24%) in ICD patients and linked to increased risk of ventricular arrhythmia (hazard ratio, 1.89) and mortality (hazard ratio, 2.79).5 Taken together, sufficient evidence exists to warrant the inclusion of psychosocial factors in the routine treatment planning of ICD patients.

Prevalence and Clinical Impact of PTSD
The potential for PTSD in cardiac patients is increasingly recognized.14 Rates of PTSD in the general public have been...
estimated at 7.8% and increase further in primary care settings to approximately 11% to 12%. PTSD rates in cardiac clinics range from 0% to 24% prevalence and have recently been established in an ICD clinic to be approximately 20%. Ladwig et al found that experience of sudden cardiac arrest outside of the hospital setting resulted in an even greater prevalence of PTSD (27% to 38%). Interestingly, these results did not differ, based on shock experience, suggesting that in this sample, the trauma associated with the cardiac condition was potentially more salient.

In another longitudinal assessment of PTSD symptoms in ICD patients, 21% were found to meet the cutoff for clinically significant PTSD symptoms at initial assessment. These rates dropped significantly in the first 6 months after implantation to 12% and remained stable at 13% at 1 year. Despite an initial reduction in the number of patients with PTSD, a recent study found that 2 years after implant, there is a substantially greater prevalence of PTSD in ICD patients. In fact, at 2 years after implant, 30.8% of patients had PTSD, and this increased to 36.4% at 4 years after implant. Nineteen percent of these patients had PTSD at both assessments, 12.1% remitted between times 1 and 2, and 17.8% had development of new PTSD between times 1 and 2. Altogether, 48.6% of the sample had clinically significant levels of PTSD during one of the time points.

Initially, the clinical significance of PTSD was established in myocardial infarction patients via its apparent link to adherence behaviors and subsequent cardiac hospital readmissions. Moreover, ICD patients with elevated PTSD scores after device implantation were significantly more likely to have shock storm. Furthermore, elevated PTSD scores were associated with a 3.2 times greater likelihood of mortality within 5 years compared with ICD patients with no to moderate symptom levels of PTSD, even after controlling for disease and demographic parameters.

In addition to understanding the prevalence of psychosocial distress, possessing a working knowledge of the presentation of psychosocial distress in ICD patients is the most helpful method of facilitating appropriate intervention. Figure 1 summarizes the key risk factors, prevalence, and presentation of psychosocial distress in implantable cardioverter-defibrillator (ICD) patients. PTSD indicates posttraumatic stress disorder.

The effect of cardiac condition and the experience of shock varies from patient to patient and may not be as straightfor-
ward as previously presumed. Although some have suggested that there is little decrement to QoL after a single shock, debate exists as to whether it is premature to make conclusions regarding the effects of ICD shock. Especially given that the existing data are drawn from large, randomized, controlled trials predominantly using generic QoL measures that might not be as sensitive to detect the specific effects of shock. Targeted assessment of PTSD symptoms may not have been collected sufficiently to fully understand the effect of shock. For example, many ICD patients cope relatively well with shock and are able to adjust and return to living life without marked injury to their psychological well-being or quality of life. However, some ICD patients, especially those who have received multiple shocks or a repeated shock episode (ie, ICD storm), may consider the event traumatic and believe that their life was in danger and emerge with PTSD symptoms.

The available research literature can only provide a limited view of whether ICD shock or the potentially life-threatening arrhythmic condition is the primary driver of a PTSD presentation. Ladwig et al found that prior ICD shocks had no influence on experience of PTSD symptoms. In addition, Kapa et al found that the only difference between ICD patients with shocks and those with no shocks was in the SF36 physical component score. Therefore, despite the fact that the occurrence of ICD shock, the experience of cardiac arrest, or being told of the potential threat seem qualitatively different, there is no current evidence that they result in disparate incidence of PTSD in the first year after implantation. However, there was some evidence that PTSD scores in the Kapa shock group did not improve as quickly as PTSD scores from the group of ICD patients who had electrical storm or no shock. Also, at baseline, history of shock storm increased the likelihood of meeting criteria for PTSD and having greater hyperarousal. More recently, Versteeg et al published a brief report that an ICD shock experience was the strongest determinant of PTSD at 3 months after implant. However, preimplantation anxiety and ICD concerns were the best predictors of PTSD at 6-month follow-up. Moreover, von Kanel et al found that PTSD prevalence increases with time, 2 years after implant. In their sample of patients surveyed 2 and 4 years after implantation, they found significant predictors of PTSD at baseline (24 months after implantation) were peritraumatic dissociation, feelings of helplessness, depression, female sex, history of being resuscitated, and greater number of cardiac symptoms. At 4 years after implantation, low education level, feelings of helplessness, alexithymia, experience of >5 shocks, and previous history of PTSD were found to be significant predictors of PTSD. Collectively, these results suggest that both preexisting psychological functioning and the eventual experience of ICD shocks relate to the presentation of PTSD symptoms in ICD patients. These preliminary results stimulate continual inclusion of both background (eg, personality and trait variables) and experiential (eg, shock and disease severity) variables in psychosocial research with ICD patients.

Although the defibrillation (especially ICD storm) may be considered traumatic, it is also unique to other traumas in that the persistent threat of future shocks exists. Fear of future shock is realistic. Thus, the trauma response resulting from ICD defibrillation is dissimilar to other trauma experiences in which subsequent trauma experience is unlikely. An ICD patient is continually exposed to the threat of future defibrillation and must live with a visible and tactile reminder of this threat (eg, ICD pocket and scar). In military trauma, when persons are continually exposed to war, a short-term and natural response to this stress is called “combat and operational stress reaction.” These persons may go on to have development of PTSD; however, because they are still exposed to the realistic threat of future trauma, their experiences may not warrant diagnosis with a potentially severe mental illness such as PTSD. When considering the diagnosis of PTSD for ICD recipients, clinicians will recall that PTSD is merely a label for a clinical phenomenon. Diagnosis with PTSD does not infer causality but is rather a method of categorizing a distinct presentation. The experience of the ICD patient may be better related to “combat and operational stress reaction” rather than the more stigmatizing label of PTSD because of the nature of the traumatic stressor. A term for the stress reaction that ICD patients experience, such as “post-ICD shock stress reaction,” which is similar to “combat and operational stress reaction” for patients with ICDs having distress related to shock trauma may be a more realistic and less stigmatizing descriptor of the ICD patient’s experience. Further evidence for the unique aspects of adjustment necessary to the ICD is the existence of ICD phantom shocks. Phantom shock, or a patient-perceived shock that is not validated by device interrogation, may be a manifestation of hyperarousal or reexperiencing the ICD shock event. Additional research examining the experience of phantom shocks demonstrated it to be more common in patients with increased depression and anxiety symptoms and prompted further linkage to the PTSD syndrome. To meet criteria outlined in the DSM IV-TR for PTSD, a patient must have experienced intense fear and perceived that his or her life was in jeopardy at the time of the trauma, reexperience the event, avoid reminders of the event, and experience increased physiological and/or psychological arousal that was not present before the traumatic event (ie, shock). Additionally, these symptoms must last longer than 1 month. If symptoms have not lasted a full month, a more appropriate diagnosis may be acute stress disorder. Figure 2 presents examples of how PTSD symptoms may be expressed in ICD patients. Formal diagnosis requires that the symptoms last >1 month and cause clinically significant impairment in occupational, social, or other important areas of functioning.

The following case is illustrative of the presentation of a trauma reaction in a patient with an ICD. The case represents a marked presentation of trauma. Some patients may present their distress in a more guarded fashion.

**Case Example**

The patient was a 70-year-old, married, retired farmer, with a significant cardiac history of previous myocardial infarction, atrial fibrillation, congestive heart failure, and an ICD implant 10 years prior with a subsequent generator replacement 6 years prior. Most notably, he had an extensive history of ICD shocks and was referred for psychological evaluation.
His shock history began after his first shock episode 3 months before the evaluation in which he was shocked 3 times and appeared to have coped well with the event. The shocks were appropriate and medication changes were noted. He coped less well a few months later when he was shocked 6 consecutive times and began having problems sleeping related to increased anxiety. Then, 1 month before psychological referral, he received an estimated 10 “inappropriate” shocks and asked for device inactivation.

At the time of evaluation, his chief complaint was significant distress because of the 10-shock episode and an impending need to decide whether he would receive a second-generator replacement before his battery was entirely depleted. He reported being extremely fearful of shock, and his agitation and hyperkinetic behavior were obvious during the course of the interview as evidenced by crying, shallow breathing, and verbalizations of being “terrified” of receiving additional shocks. Further, he reported possible “phantom shocks” after suddenly awakening on a recent night. Of note, although the patient was ambulatory, he presented in a clinic-provided wheelchair as the result of his physiological instability and agitation; he was visibly shaking.

He reported feeling like a “completely different person” since his shock episode last month and described transient suicidal ideation (ie, wishing he would have “gone ahead and died”) but denied suicidal intent or a plan. Symptoms of posttraumatic stress included symptoms of (1) reexperiencing, (2) avoidance, and (3) hyperarousal. He described reexperiencing the shock episode whereby he has intrusive and distressing thoughts and episodes of feeling as if he were being shocked again. Symptoms of avoidance were significant and include avoidance of talking about shock, thinking about shock, and places and things that remind him of shock (e.g., doctors and doctor offices). He avoided most people and no longer left his house. Symptoms of increased arousal included difficulty sleeping and hypervigilance. These psychological and behavioral symptoms were consistent with a diagnosis of PTSD. Interestingly, the patient compared the experience with his time spent as a soldier in Vietnam, in which he laid helpless in a foxhole while mortars and improvised explosive devices were exploding all around him and there was no method of securing his own safety. He reported that he would “rather die than get shocked again.”

The patient returned for 6 sessions of individual psychotherapy focusing on stress and anxiety management: increasing his distress tolerance via exposure, relaxation techniques, thought-stopping techniques, cognitive reframing for cata-

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**Figure 2.** Posttraumatic stress disorder symptom clusters and presentation in patients with implantable cardioverter-defibrillators (ICD).
strophic thinking, and psychosocial education regarding shock and his device. He also benefited from psychiatric evaluation, in which he began pharmacotherapy with clonazepam and alprazolam. Through concomitant pharmacotherapy and cognitive-behavioral therapy, his symptoms of anxiety abated significantly and allowed him to actively reengage in life. He also opted to undergo device replacement.

Clinical Management of Psychosocial Distress

Identification of General and Trauma-Specific Distress

Established risk markers for psychosocial distress in ICD patients include being young (<50 years old), being female, having a premorbid psychiatric diagnosis, having inadequate social support, or having a history of receiving ≥5 defibrillations.26,32 These risk markers provide the clinician with an initial method of identifying patients who may warrant further assessment of psychosocial distress.

Clinical Assessment to “Screen and Refer” Patients Possibly Having PTSD

The initiation of psychosocial care for the ICD patient who is probably having PTSD can occur in the electrophysiological setting. The existing evidence on the prevalence and importance of psychosocial distress in ICD patients has been mounting. Unfortunately, the typical electrophysiology clinic is faced with the inability to easily address and attend to these factors because of the lack of available mental health specialists. Specialty referral was obviously needed in the case of our study patient, but most clinicians would not have a cardiac psychologist available in their clinic. Figure 3 addresses the tasks of developing a “screen and refer” process for ICD patients having psychosocial distress, including those with PTSD symptomatology. The Table provides sample questions and examples of brief screeners that may assist with identification of distressed patients.

Standard Cardiac Management Plus Cardiac Rehabilitation

Within the electrophysiology clinic, cardiac management is often successful at decreasing inappropriate shocks and shock storms through optimal programming of the ICD, particularly via use of antitachycardia pacing and reducing shocks for nonsustained tachycardias.45 Adjustments to antiarrhythmic medication can also help reduce ventricular tachycardia/ventricular fibrillation episodes, thereby reducing shocks in the first year ranging from as high as 38.5% (when β-blockers alone were given) to as low as 10.3%, (when β-blockers and amiodarone were administered) in the OPTIC study.46 By use of these strategies, shock prevention can be tailored to the patient’s unique cardiac profile.47 The importance and distinguishing experience of inappropriate shocks was recently demonstrated as
ICD patients reported significantly more pain caused by inappropriate shocks versus appropriate shocks. Furthermore, inappropriate shocks were established as the only predictor of patients desiring ICD deactivation.48 These results highlight the role of psychological factors and patient understanding about shock and its manifestation in the patient experience. Emphasizing physician efforts to prevent shock can provide reassurance to patients that shock will occur primarily to “save life.”

Cardiac rehabilitation efforts not only improve function of the heart, but QoL benefits have been observed.49 Exercise may be viewed as a safe exposure to fear that leads to successive advances at returning to a full range of lifestyle and activities. Fitchet et al50 compared the effects of a cardiac rehabilitation program with ICD patients including exercise, education, and psychotherapy (12 weeks) with usual care. Exercise time improved 16%, with no ventricular tachycardia or shocks. In addition, anxiety and depression scores improved 25% to 30%. These results provide support for the extension of the established benefits of cardiac rehabilitation approaches to ICD patients.

### Effective Psychosocial Care for ICD Patients

Preparing patients for shock has been effective in mollifying levels of distress in ICD patients. Lewin et al.51 in 2009, (n = 192; treatment=71, control=121) designed the “ICD Plan” which consisted of cognitive behavioral therapy (CBT) versus usual care. Three professional contacts were made throughout the treatment period in person or by phone. Results at 6-month follow-up showed that the ICD Plan group had fewer physical limitations and better physical QoL. Anxiety and depression scores were improved, but these findings were not statistically significant. Similarly, Chevalier et al52 (n=70) compared 6 sessions of CBT with usual care, with shock occurrence as the dependent variable. The CBT group had fewer shocks and lower anxiety at 3-month follow-up. Whereas at 12 months, no differences were noted on shocks, anxiety was still improved in the CBT group. A recent meta-analysis of treatment studies by Pederson et al53 reviewed psychosocial treatment studies with ICD patients and found studies with mostly small sample sizes. In those studies in which the reduction of shock was the dependent variable, only small effects were noted. When anxiety was a dependent variable, wide-ranging effects were seen, including effect sizes ranging from small 0.14 to large 0.89. Collectively, these results are interpreted as evidence that psychosocial treatment, specifically CBT, in ICD patients is promising. Unfortunately, PTSD treatments for ICD patients have not been specifically studied, and no treatment outcome data are available.

Helping patients cope after shock has seen notable improvements as well. Sears et al54 demonstrated the effectiveness of psychosocial treatment for ICD patients when they examined the effects of a 6-week treatment plan versus a 1-day workshop in shocked ICD patients (n = 30). The program was multifaceted, giving attention to patient outlook, social support, action planning, device and shock specific knowledge, stress management, shock management, cognitive techniques, and exercise education. Both groups had reduction in anxiety as measured by salivary cortisol. Reported levels of anxiety decreased in the weekly treatment group, but no differences were found at a 4-month follow-up. In addition, both groups showed increased patient acceptance of the device, as measured by the Florida Patient Acceptance Survey, and had a better QoL; however, the weekly group showed greater increases.

### Standard PTSD Treatments

ICD patients such as our study patient are at risk for repeated exposure to the fearful situation (arrhythmia-shock). This probably warrants an ICD-specific PTSD treatment approach. For those patients who are having marked distress caused by shock, there are a number of methods for addressing patient needs including pharmacological treatments, cardiac rehabilitation approaches, preshock treatments, postshock treatments, and standard PTSD treatment. In the future,
Effective treatment probably will require an extension of proven anxiety-reducing techniques used in both ICD patients and PTSD patients.53,54

Standard efficacious PTSD treatments are a reasonable starting point for an ICD specific treatment for a postshock stress reaction.55,56 A promising pilot study revealed success of CBT in a group of patients with myocardial infarction and PTSD symptomatology, which signals support of its applicability with the shocked ICD patient population.24 Additionally, relaxation techniques are often used in those with PTSD, including diaphragmatic breathing, meditation, progressive muscle relaxation, and hypnosis.57 Distraction techniques such as focal point, counting, and imagery are used as well. As PTSD disrupts sleep, sleep hygiene and behavioral sleep techniques are often viewed as a necessary component of treatment. PTSD and anxiety-specific education help normalize symptoms and bring them into a manageable structure. Exposure therapy has been found to be the most effective treatment of PTSD. Exposure therapy involves exposing patients to memories of the trauma or cues associated with the trauma. In an ICD patient, this may mean exposing them to stimuli that were paired with and are now associated with shock. For example, patients who were shocked while performing physical activity may be slowly exposed to safe elevations of heart rate in cardiac rehabilitation programs or cardiac stress tests. Clinical health psychologists have the training to conduct therapy with patients that use the aforementioned techniques, which have been shown effective in decreasing PTSD symptomatology. In a review of PTSD treatments, it was suggested that the majority of patients treated with psychotherapy improve or recover with effect sizes ranging from large to very large: $d=0.83 \text{ to } 1.43$.55 These effect sizes indicate that psychotherapy greatly reduced trauma symptoms. Effect sizes differed depending on type of trauma. Clinical trials are needed to study the effect of PTSD treatments applied to ICD patients.

Pharmacological management is primarily through the use of selective serotonin reuptake inhibitors.58 However, response rates are generally low, and only 20% to 30% of patients given selective serotonin reuptake inhibitors for PTSD achieve full remission. Sometimes benzodiazepines are used as needed,59 but there are often mixed results in effectiveness. Additionally, there is a substantial amount of evidence suggesting that CBT for anxiety disorders tends to result in greater decrement of symptoms than either medication or combined medication and CBT.60 On the other hand, in several smaller-scale studies, a more sophisticated CBT and pharmacotherapy combination has been shown to have greater success. Reviews specifically examining these studies in the context of the anxiety disorder treatment literature suggest that the use of medication during initial stages of CBT, followed by tapering of medication and continuation of CBT, may be optimal.60 Polypharmacy and multiple comorbidity issues may play a part in the use of medication. Again, no randomized, controlled trials exist to address the safety or efficacy of psychopharmacological approaches in ICD patients.

Toward a Better Understanding and Treatment of ICD Patients With Trauma Reactions

Clearly, improved understanding, research, and clinical strategies are needed to address PTSD in ICD patients. Future areas of investigation include better description of the experience of trauma in ICD patients, empirical validation of methods of prevention of trauma reactions, and investigation of the use of ICD-specific alterations of current empirically validated PTSD treatments. Current research in prevention of psychosocial distress in ICD patients supports the use of education, support, and cognitive-behavioral interventions.51 However, PTSD symptoms have not been an outcome measure for any ICD intervention research, and there is currently debate in the PTSD literature regarding the efficacy of providing psychoeducation about trauma reactions before trauma as means of prevention.51,62 Some believe psychoeducation promotes resiliency, hope, and normalization of trauma symptoms,64 whereas others believe it may promote disturbance by suggesting symptoms that would not manifest otherwise.62 Currently, the evidence is mixed and requires greater study in ICD-related trauma and other trauma populations.

Pharmacological intervention has also explored the use of $\beta$-blockers that cross the blood-brain barrier to prevent trauma reactions via the reduction of elevated adrenergic activity after trauma exposure.63 Although there is currently no research evidence supporting the use of these medications as prophylaxis of trauma symptomatology in ICD patients and only a few small trials supporting its use in other trauma groups,64–66 there is indication for further research and exploration. An additional area of promise is the application of d-cycloserine, a partial agonist at the glutamatergic N-methyl-D-aspartate receptor, during CBT to enhance extinction of fear conditioning present in PTSD.67

Promoting resiliency from posttraumatic stress represents another important next step for the care of ICD patients. Given that approximately one-fifth of patients with ICDs are having trauma reactions, the converse that four-fifths are not having trauma prompts examinations into posttraumatic growth as well. Posttraumatic growth (PTG), also known as “benefit finding,” and “stress-related growth” refer to positive change or growth resulting from having a traumatic event and initiating cognitive processes of coping.68 Chevelier et al69 found increases in QoL after ICD implantation, which may imply PTG in ICD patients. PTG in cardiac patients has been found to be a protective factor. Specifically, Affleck et al70 found that after accounting for age, socioeconomic status, and physician rating of prognostic severity, patients with lower levels of PTG were more likely to have a subsequent myocardial infarction and a greater chance of having a comorbidity 8 years after their initial myocardial infarction. In fact, development of PTG over the course of a cognitive behavioral intervention was found to be a sensitive metric of successful cognitive processing of a traumatic event in patients with PTSD.71

Conclusions

Current available research suggests that approximately 20% of patients with ICDs have PTSD. Increased attention to...
PTSD is a relatively new development to the broader findings of psychosocial research with ICD patients, suggesting a point prevalence of 13% to 38% for anxiety across studies and 10% to 41% for depressive symptoms. Current treatment research for ICD patients focuses on the prophylaxis of distress (through education and medication management) and the treatment of anxiety and depression. Our review indicates that electrophysiologists “need to know” how to develop a screen and refer plan for patients with PTSD symptoms. Mounting evidence suggests that PTSD symptomatology is highly prevalent in electrophysiology clinics and detrimental to psychosocial and physical health end points.

Disclosures

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