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Review Article

Post-traumatic stress disorder following implantable cardioverter-defibrillator shocks: a hidden cost of life-saving therapy

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ABSTRACT

Although implantable cardioverter-defibrillators (ICDs) play a critical role in preventing sudden cardiac death, the very shocks that preserve life can paradoxically become a source of long-term psychological harm. PTSD following ICD shocks remains an underrecognized diagnosis, despite mounting evidence linking it to declines in mental health, quality of life, and even cardiovascular prognosis itself. Patients may experience intrusive re-experiencing of trauma, persistent hypervigilance, avoidance behaviors, and anticipatory anxiety: symptoms that not only disrupt daily functioning but can also interfere with treatment adherence and long-term treatment outcomes. A review was conducted of literature published between January 2008 and May 2024 using PubMed, Scopus, and Web of Science databases. Emphasis was placed on patient-reported outcomes, intervention efficacy, and gaps in clinical practice. ICD shocks, particularly when inappropriate or clustered, have been linked to clinically significant PTSD symptoms in as many as 38% of recipients. Proposed mechanisms span heightened sympathetic arousal, maladaptive fear conditioning, and neurobiological changes involving key limbic structures. Risk appears to be elevated among younger patients, women, individuals with preexisting trauma histories, and those with comorbid anxiety or depressive disorders. Validated tools like the PCL-5 and Florida shock anxiety scale (FSAS) offer practical means of detecting distress, and growing evidence supports the benefit of interventions such as trauma-focused cognitive-behavioral therapy, SSRIs, EMDR, and tailored device programming. Routine screening, shock-minimization strategies, and integration of psychological services into device clinics are essential. Future studies should address long-term outcomes, standardized interventions, and guideline development for multidisciplinary management.

Keywords: Post-traumatic stress disorder, Implantable cardioverter-defibrillator, Cardiac shocks, Psychiatry, Cognitive behavioral therapy, Electrophysiology

INTRODUCTION

Implantable cardioverter-defibrillators (ICDs) are remarkable in their capacity to interrupt life-threatening ventricular tachycardia and fibrillation, yet their evolution from a last-resort therapy for arrest survivors to a mainstay of primary prevention, endorsed by leading society guidelines for patients with reduced ejection fraction or inherited arrhythmic syndromes, raises new questions about patient experience.[1,2] As implantation rates have climbed past 200,000 annually, propelled by broader indications, incremental advances (for instance, subcutaneous systems and leadless coils), and an aging, multimorbid population, one might assume that

technological gains alone would dilute the psychological toll of unexpected shocks.[3] Unfortunately, that does not entirely seem to be the case. Although battery life and hardware reliability have noticeably improved, the sudden jolt of a shock remains as startling and, some would argue, as traumatizing as ever.[4]

When shocks recur or arrive without clear need, patients often describe an almost Pavlovian response heart racing at the mere thought of device activation, nightmares that replay the event in excruciating detail, and a gradual retreat from everyday tasks like climbing stairs, jogging, or even social outings, driven by dread of "the next one".[5,6] This pattern of hypervigilance and avoidance mirrors fundamental features of post-traumatic stress disorder, and it may be no surprise that depression and anxiety frequently co-occur, further undermining quality of life and complicating the management of both mood and myocardium.[6]

Despite this emerging evidence, routine ICD follow-up often centres on lead integrity, battery status, and arrhythmic episodes, with formal psychological screening relegated to a footnote, if it appears at all.[7,8] Arguably, this represents a missed opportunity: identifying high-risk individuals (for example, those with prior psychiatric histories or clusters of shocks) and instituting a coordinated cardiology–psychiatry–psychology pathway might not only ease emotional suffering but also bolster device acceptance, improve adherence to life-saving medications, and reduce healthcare utilization. In doing so, we could begin to acknowledge that, for patients with ICDs, treating the heart may sometimes mean caring for the mind as well.

PATHOPHYSIOLOGY OF POST-TRAUMATIC STRESS DISORDER AFTER IMPLANTABLE CARDIOVERTER-DEFIBRILLATORS SHOCKS

ICD shocks occur suddenly, often compared to a "kick in the chest", and, when unexpected, may feel like a life-threatening situation.[9] When these discharges happen again or occur inappropriately, the emotional impact can buildup, effectively rehearsing fear memories and maintaining neural stress circuits in constant readiness. From a neurobiological perspective, PTSD seems to rely on an excessively active amygdala that is poorly managed by the medial prefrontal and anterior cingulate cortices, meaning that even a harmless stimulus, like a missed heartbeat or a regular notification, might provoke a sudden rush of anxiety and adrenaline.[10,11]

Experiencing a shock appears to stimulate both the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis, flooding the body with norepinephrine and cortisol.[12] Over weeks to months, this prolonged "fight or flight" environment may lead to insomnia, irritability, hypervigilance, and an amplified startle reaction- symptoms that frequent shocks are believed to reinforce through maladaptive neuroplastic alterations.[10] Arguably the most troubling aspect is the two-way relationship between psychological trauma and heart function. In individuals with PTSD, research indicates decreased heart rate variability, increased sympathetic tone, and reduced baroreflex sensitivity-all elements that may contribute to arrhythmias and sudden death in ICD populations.[12] On top of these changes, a proinflammatory state-marked by increased cytokines, endothelial impairment, and activated platelets-can further increase the risk of unfavourable cardiovascular occurrences, forming a self-sustaining cycle where shocks lead to trauma and trauma leads to additional shocks .[13,14]

DIAGNOSTIC CHALLENGES AND ASSESSMENT TOOLS

Recognizing PTSD in ICD recipients can be deceptively difficult, since hallmark symptoms palpitations, chest tightness, breathlessness, even dizziness-so often mirror arrhythmia or heart failure that clinicians may chalk them up to cardiac status rather than trauma, inadvertently delaying mental-health referrals.[15] It's perhaps unsurprising, then, that many patients develop anticipatory anxiety: once a particularly painful or unexpected shock occurs, everyday activities-from climbing a few stairs to entering a clinic room-may become conditioned triggers, prompting avoidance behaviors aimed at escaping "the next one".[16] Add to this the quiet stigma surrounding what's deemed "normal" post-implant distress, and it's easy to see why some sufferers simply mask their anguish rather than seek help.[17]

Fortunately, validated screening tools can help disentangle cardiac from psychological distress. The PTSD checklist for DSM-5 (PCL-5), a 20-item self-report instrument covering intrusion, avoidance, negative mood, and hyperarousal clusters, may be especially useful if its wording is fine-tuned for cardiac cohorts—distinguishing, say, panic-driven palpitations from arrhythmic events—to preserve sensitivity without sacrificing specificity.[18] Administering it routinely at three- and six-month checks could catch emerging cases before they spiral. For a definitive diagnosis, the clinician-administered PTSD scale (CAPS-5) remains the gold standard, charting symptom onset, severity, and functional impact although it demands more resources, a brief training session for device-clinic staff might smooth the path for timely referrals.[19,20]

To concentrate on device-specific anxieties even sooner, the Florida shock anxiety scale (FSAS) directly addresses shock-related fears and device-related anxiety. It exhibits strong psychometric characteristics in ICD groups, and higher scores consistently predicts the risk of PTSD.[21] Certainly, precise diagnosis relies on collaborative efforts among various disciplines: cardiologists are equipped for initial evaluations but may not possess extensive mental health knowledge, whereas psychiatrists and psychologists are skilled in detailed assessments but may not fully understand the complexities of device operation.

Integrated models-whether a specialized cardio-psychology clinics or as behavioral-health specialists included in device follow-up teams provide a hopeful approach to close this gap.[22,23] Ultimately, timely and accurate recognition of PTSD in ICD patients is not just a theoretical endeavour ignored trauma can diminish quality of life and, in a very real sense, threaten cardiac results.

EPIDEMIOLOGY AND RISK FACTORS

PTSD following ICD therapy impacts a significant group of patients, with prevalence rates reported between 12% and 38%, varying by study design and diagnostic standards.[24,25] Rates differ by location and method-elevated in single-center groups utilizing structured clinical interviews as opposed to registry-based self-report studies.[24,25] Women regularly report a greater severity of PTSD symptoms compared to men, possibly indicating variations in emotional processing or bodily sensitivity.[26] A good social support and educational programs correlate with reduced symptom intensity.[27] Socioeconomic obstacles, such as inadequate health literacy and limited access to mental health services, hinder timely identification and care.[28] Cultural standards that shame psychological issues exacerbate the difficulty of seeking help.[29] Harmonizing assessment timing and diagnostic criteria across research would improve comparability and aid in developing targeted prevention strategies.[24,25]

Table 1: Prevalence and risk factors for PTSD in ICD recipients.

Variable	Details
Prevalence of PTSD	12%–38% depending on diagnostic method and study setting.[24,25]
Gender	Women report more severe PTSD symptoms than men.[26]
Social support and education	Good social support and educational interventions reduce severity.[27]
Socioeconomic and cultural factors	Limited access, low health literacy, and stigma exacerbate underdiagnosis.[28,29]

Table 2: Evidence-based approaches for managing PTSD after ICD shocks.

Modality	Intervention/example	Benefits
Pharmacotherapy	SSRIs (sertraline, fluoxetine); prazosin for nightmares	Reduces PTSD symptoms; safe in cardiac patients.[37,39,40]
Psychotherapy	CBT, EMDR, mindfulness interventions	Effective in reducing PTSD severity and improving QOL.[41,42,54]
Device programming	ATP, extended detection intervals, refined discrimination algorithms	Reduces inappropriate shocks, mitigates anticipatory fear.[55,56]
Screening tools	PCL-5, FSAS, CAPS-5	Facilitates early diagnosis and targeted referrals.[18,19,21]
Specialist integration	Cardio-psychology clinics, behavioral health in ICD follow-up	Enhances multidisciplinary care.[22,23]
Tailored interventions	Gender-specific counseling, geriatric CBT, trauma-informed care	Addresses population-specific needs.[26,44,57]
Future directions	Biomarker/genetic-guided risk stratification (e.g., FKBP5, cytokines)	Promising for individualized care.[48,49]

CLINICAL SPECTRUM AND OUTCOMES

PTSD in the aftermath of ICD shocks may present along a spectrum, from fleeting waves of anxiety to a profoundly disabling disorder. In its milder form, patients might report the occasional intrusive thought, restless nights, or a nagging unease around the device; at the severe end, one sees relentless re-experiencing, steadfast avoidance of anything reminiscent of the shock, an exaggerated startle reflex, and a pervasive sense of danger.[30] Often, the earliest-and perhaps most telling-sign is avoidance: an understandable, fear-driven pullback from exercise, driving, travel, or even routine medical visits and medication schedules. Over time, this self-protective behavior may precipitate deconditioning, diminished exercise tolerance, muscular weakness, and social withdrawal.[31,32] Such changes hardly remain confined to the body; missed workdays, dips in productivity, and, in some cases, job loss can amplify financial hardship and psychological distress, creating a feedback loop that many patients find difficult to break.[33] Acceptance of devices often reflects this discomfort. Instances arise where patients, overwhelmed by anxiety, doubt the usefulness of their ICD, frequently check the device's status, or-despite clearly explained arrhythmic risks ask for deactivation.[34] This resistance is not simply defiance; instead, it may represent a deep conflict between the device's life-saving potential and the trauma it can cause.

From a physiological standpoint, PTSD seems to create a unique strain on the heart studies show heightened sympathetic activity, decreased heart-rate variability, and

compromised baroreflex responsiveness, all of which elevate the risk of arrhythmias and ischemic events in ICD groups.[12] Longitudinal data indicate a 1.5- to 2-fold increase in emergency visits, readmissions, and cardiac fatalities over one to three years for those experiencing post-shock PTSD symptoms .35,36 The financial impacts are comparable-extra diagnostics, psychiatric evaluations, and in some instances, removal or deactivation of devices can raise costs and deplete resources.[37]

People who obtain prompt psychological or medication-related treatment often report improved quality of life, better acceptance of devices, and reduced utilization of healthcare services. Integrating systematic screening and rapid referral methods into regular ICD clinic protocols could offer a practical way to safeguard both mental wellness and cardiovascular health.[36,37]

PSYCHOSOCIAL AND NEUROCOGNITIVE SEQUELAE

Psychosocial and neurocognitive sequelae of ICD-related PTSD may be strikingly diverse. Many cases exhibit profound social withdrawal and emotional numbing, as patients abandon once-cherished activities and gradually retreat into isolation, a trajectory that often paves the way to depressive symptoms.[38] Pharmacologic interventions, while potentially beneficial, require careful balancing of psychiatric efficacy against cardiac safety selective serotonin reuptake inhibitors may alleviate mood dysregulation but could interact with arrhythmic risk factors , whereas prazosin has shown promise in mitigating shock-related nightmares, albeit in small cohorts.[39,40]

Psychotherapeutic modalities have similarly been explored with cautious optimism. Eye movement desensitization and reprocessing (EMDR), though piloted in only a handful of studies, appears feasible for attenuating device-triggered reactivity, and mindfulness-based interventions seem to bolster resilience against hyperarousal.[41,42] Emerging approaches-such as MDMA-assisted therapy have yielded impressive reductions in trauma symptoms in broader PTSD populations but remain untested in ICD recipients.[43]

Individual differences in device understanding are significant: older adults or those with cognitive impairment may find it difficult to adapt to advanced programming modifications, highlighting the need for regular cognitive assessments (such as the montreal cognitive assessment) and therapy models based on phases customized for individuals with reduced executive function.[44,45]

Clinicians should remain mindful that long-term outcomes of distress are poorly characterized beyond the first year post-implant, and that randomized controlled trials specific to ICD-related PTSD are scarce.[34,46,47] Precision-medicine frameworks which might integrate biomarkers such as cytokine profiles or heart-rate variability (and genetic predictors like FKBP5 variants) offer a hugely promising path toward individualized risk stratification, though such approaches await central validation.[48,49] Finally, implementation-science strategies to embed behavioral-health consultants within cardiology services, and to ensure culturally sensitive, equitable care models, may be critical for closing current gaps in diagnosis and treatment, especially among older adults prone to underrecognized neurocognitive symptoms.[50–53]

MANAGEMENT STRATEGIES

Successful management of PTSD in ICD recipients frequently relies on a multimodal, collaborative approach.

Pharmacotherapy typically begins with selective serotonin reuptake inhibitors—medications like sertraline, paroxetine, or fluoxetine—that are attributed to reducing intrusive thoughts and hyperarousal while ensuring a good cardiac safety profile; treatment lengths usually range from six to twelve months, involving regular ECG and blood-pressure monitoring to watch for any unexpected or adverse effects.[37] For patients exhibiting pronounced somatic symptoms in conjunction with PTSD, serotonin-norepinephrine reuptake inhibitors such as venlafaxine or duloxetine might be options, though caution is warranted due to their possible impact on prolonging QTc intervals or increasing blood pressure.[39]

Prazosin has emerged as a noteworthy off-label choice for nightmares related to trauma. While evidence is still restricted to small groups, initial results indicate it may reduce nighttime symptoms without causing considerable cardiovascular risk.[40]

In recent phase 3 trials, MDMA-assisted therapy has shown significant decreases in the severity of PTSD. However, despite its potential, its safety and effectiveness in the unique physiological and psychological environment of ICD recipients are still under studied, necessitating careful interpretation and focused research.[43]

Psychotherapeutic approaches are essential for managing PTSD related to ICD, especially in promoting long term psychological adjustment. Trauma-oriented cognitive behavioral therapy (CBT), usually provided in 8 to 12 weekly sessions, empowers patients with strategies to shift negative thinking, minimize avoidance actions, and restore interrupted daily life routines. An increasing amount of evidence, including meta-analyses, endorse its effectiveness in groups suffering from cardiac-related PTSD, indicating it can significantly enhance both mental health and functional results.[54] Another promising approach eye movement desensitization and reprocessing (EMDR), employs bilateral stimulation to aid in the processing of traumatic memories, and has demonstrated feasibility in initial studies with ICD recipients and appears to reduce autonomic arousal, yet further definitive research is warranted.[41] For individuals looking for alternative methods, techniques such as mindfulness-based

stress reduction and acceptance and commitment therapy can improve emotional resilience and alleviate underlying anxiety, providing a softer approach to trauma treatment.[42]

At the same time, device-based strategies play a crucial role in reducing psychological burden at its source. Programming modifications such as utilizing anti-tachycardia pacing to terminate arrhythmias painlessly, extending detection intervals to allow self-terminating episodes to resolve, increasing rate thresholds, and refining discrimination algorithms-can significantly decrease both inappropriate and unnecessary shocks.[55,56] Importantly, these technical adjustments not only reduce the objective shock burden but also mitigate anticipatory anxiety. By lowering the perceived threat of the device, they may reduce requests for deactivation and contribute to fewer hospital readmissions, reinforcing the value of aligning electrophysiologic precision with psychological care.[36]

Ultimately, appropriate attention for ICD patients dealing with PTSD necessitates the collaboration of a diverse team-including cardiologists, electrophysiologists, psychiatrists, psychologists, nurses, and device-clinic personnel, along with primary care physicians working together to provide genuinely patient-focused care. Regular device follow-up appointments provide an ideal opportunity to incorporate standardized mental health assessments, utilizing instruments like the PCL-5 and the FSAS, in conjunction with well-established referral channels to behavioral health professionals. This unified model not only aids in early detection but also guarantees that psychological issues are handled with the same promptness and accuracy as arrhythmic occurrences.[22,23]

In rare but deeply challenging cases where PTSD symptoms remain refractory to intervention and severely diminish quality of life, ethically grounded conversations about device deactivation may become necessary. Such discussions should be approached with care, involving consensus among the treating team, the patient, and their support system, and always anchored in a shared understanding of medical risks, psychological burden, and the patient's values.

SPECIAL POPULATIONS

Certain patient groups are prone to experience a high amount of psychological burden after ICD implantation, highlighting the need for specially targeted interventions.

Women regularly report greater incidences of PTSD, anxiety, and device-related fear compared to men; this disparity may arise from increased somatic sensitivity, fear about body image and intimacy, and shift in social and societal role dynamics after ICD implantation.[26] Gender-specific counselling during device insertion and female-oriented support groups have demonstrated promise in alleviating fears and improving coping strategies.[32] Older patients, on the other hand, face a distinct range of difficulties. Cognitive deterioration, diminished musculo-skeletal capacity, and reduced social support can increase the likelihood of PTSD and depression, while also making participation in typical educational and therapeutic programs more challenging. In such situations, essential elements of management should include straightforward device training, discussions that involve caregivers, and the participation of specialists trained in geriatric psychiatry. Modified psychotherapies, such as problem-solving therapy, reminiscence-focused interventions, or CBT tailored for cognitive challenges, combined with regular follow-up calls, can identify early indicators of psychological distress and subsequently improve management outcomes.[44,45]

People with a background of traumatic events like violence, serious health problems, or other adverse experiences may be especially prone to increased emotional reactions when unexpected disruptions occur. Trauma assessment prior to implants and informed consent procedures that take trauma into account create a foundation for safety and trust. When necessary, prompt referrals for phase-oriented or narrative exposure therapies can diminish the risk of retraumatization and promote a more robust psychological recovery.[57]

Children and teens who receive ICDs often have underlying genetic arrhythmia syndromes, and they may struggle with identity formation, peer acceptance, and articulating their anxieties. Care frameworks that merge pediatric cardiology, child psychology, school liaison services, and family-centered therapy can assist in emotional adjustment during significant developmental shifts such as returning to school, facing puberty, or moving to adult care.[58,59]

GAPS IN LITERATURE AND FUTURE DIRECTIONS

Even with growing recognition of PTSD linked to ICD treatment, several significant gaps still hinder the advancement of genuinely evidence-based care. A significant restriction is found in our comprehension of long-term symptom patterns. Most current research finishes within a year after implantation, resulting in the chronic nature and variability of distress remaining largely unexplored. Future cohort studies combining sequential mental health questionnaires with time-coded device event records may clarify how symptoms progress concerning shocks, alerts, or perceived threats possibly uncovering optimal opportunities for focused intervention.[46]

Another significant deficiency is the lack of randomized controlled trials specific to ICD. So far, limited research has integrated trauma-focused CBT, EMDR, or pharmacotherapy into practical device clinics however, these real-world trials are essential to assess both psychological effectiveness and tolerability, as well as cardiac safety within this demographic.[34,47] In addition to this, precision risk stratification signifies an intriguing but

still emerging avenue. Models utilizing machine learning that integrate inflammatory markers (like cytokines), autonomic indicators (such as heart rate variability), and genetic variations such as FKBP5 might ultimately produce personalized PTSD risk assessments, though these methods need thorough validation in larger, varied groups.[48,49]

The absence of official protocols for PTSD evaluation and treatment in ICD follow-up constitutes another significant obstacle. Without uniform guidelines, practices continue to be inconsistent. Support from prominent cardiology and psychiatric organizations may facilitate agreement on screening intervals, referral criteria, and the framework of multidisciplinary care approaches, promoting wider and more uniform implementation.[50]

From an implementation viewpoint, converting evidence into standard practice will probably rely on the careful application of quality improvement frameworks. Testing plan-do-study-act (PDSA) cycles, incorporating telepsychology, and integrating behavioral-health consultants into device clinics are effective approaches that may improve adoption and adherence.[51] Ultimately, the uniformity of many ICD-PTSD research groups brings up issues regarding fairness. Future research should deliberately oversample marginalized groups and employ qualitative methods to guarantee that interventions are culturally relevant and accessible essential measures to achieve equitable, person-centered care for all ICD recipients.

CONCLUSION

PTSD emerging after implantable cardioverter-defibrillator (ICD) therapy is no longer a clinical footnote but a measurable determinant of morbidity, mortality, and health-care cost. By weaving together evidence on epidemiology, screening tools, device programming, and patient-centred interventions, this review clarifies three advances. First, it underscores that routine surveillance with brief, validated instruments such as the PCL-5 and Florida shock anxiety scale can feasibly be embedded in device clinics, potentially reducing the current diagnostic lag that leaves many patients untreated. Second, it shows that technically simple programming strategies, longer detection intervals, proactive anti-tachycardia pacing, and shock-reduction algorithms, may alleviate anticipatory anxiety and interrupt the feed-forward loop between psychological distress and arrhythmia burden.

Third, by mapping data across vulnerable subgroups (women, older adults with cognitive change, paediatric recipients), the review moves the conversation from one-size-fits-all care to tailored, equity-minded pathways that integrate trauma-focused psychotherapy, pharmacotherapy, and social support. Taken together, these insights point toward an integrated model in which electrophysiology teams and mental-health professionals collaborate from the first post-implant visit onward, using precision-risk tools, including emerging genomic and inflammatory markers, to identify those at highest risk and aligning implementation strategies to ensure access across socioeconomic strata. In doing so, the review advances the field from descriptive recognition of ICD-related PTSD to a pragmatic, multidisciplinary framework aimed at helping patients not merely survive sudden-death risk but genuinely thrive with their devices in place.

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