Uncovering Phantom Shocks in Cardiac Patients with an Implantable Cardioverter Defibrillator

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Background: *Implantable cardioverter defibrillator recipients sometimes report "phantom shocks" (PSs), defined as a reported shock lacking objective evidence. The aim of this study was to describe the subjective experience of PSs and their psychosocial correlates using a mixed methods approach.*

Methods: *PS participants were matched on sex and age with individuals who received objective shocks only (OSO). Participants were interviewed and completed measures of posttraumatic stress disorder (PTSD Checklist—Civilian Version), depression and anxiety (Hospital Anxiety and Depression Scale), disease-specific distress (Cardiac Anxiety Questionnaire—CAQ), and social desirability (Socially Desirable Response Set—SDRS). Interviews were analyzed using interpretative phenomenological analysis (IPA).*

Results: *Seventeen male patients participated (PS: n = 9; OSO: n = 8). Three themes emerged from IPA: (1) PS as a somatic experience, (2) the emotional impact of PSs, and (3) searching for meaning. Quantitative analyses showed that both groups exhibited elevated trauma and anxiety levels. Effect size differences (ESD) suggested a medium ESD on depression ($P = 0.176$, $\eta_p^2 = 0.118$) and PTSD (avoidance: $P = 0.383$, $\eta_p^2 = 0.055$, numbing: $P = 0.311$, $\eta_p^2 = 0.068$), and a large ESD on SDRS ($P = 0.081$, $\eta_p^2 = 0.189$), where PS participants, comparatively, exhibited elevated levels. A medium ESD was detected on CAQ-fear ($P = 0.237$, $\eta_p^2 = 0.092$) where OSO participants exhibited greater heart-focused worry.*

Conclusion: *The qualitative and quantitative findings of this mixed method study show convergence in terms of the emotional factors associated with the experience of PSs. PSs are often reported to be indistinguishable from objective shocks, evoking alarm, frustration, and confusion, forcing the individual to face the uncertainties of what to them is a novel and confusing experience.*

phantom shocks, implantable cardioverter defibrillator, ICD, anxiety, depression, PTSD

An implantable cardioverter defibrillator (ICD) monitors and restores normal heart function upon detecting a malignant arrhythmia. While its advantages over antiarrhythmic drugs have been supported by large-scale clinical trials,[1,2] the impact of defibrillator shocks, often likened to being kicked by a horse in the chest,[3] can be frightening and anxiety-inducing as shocks are typically painful and administered without warning.[4]

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It has come to the attention of health care providers that ICD recipients sometimes report "phantom shocks," (PSs) defined as a patient's report of having received shock therapy without an objective record of a shock upon device interrogation. Reported incidence of PSs is low (7%)[5]; however, this may be an underestimate as patients are not typically screened for PSs during follow-up visits. In a more recent study, 16% of reported shocks were deemed PSs.[6]

To our knowledge, there are only two published case reports, by Prudente[7] and Juan and Pollock,[8] of ICD recipients reporting PSs. However, neither study describes the subjective experience of PSs. Moreover, it has been suggested that psychopathology (anxiety, depression, or other emotional disturbances) contributes to PSs,[7,9] yet mechanisms underlying these assertions have not been addressed. One study found that individuals reporting PSs were more likely to be clinically depressed and display higher levels of anxiety than individuals who had not experienced them.[10] While the cross-sectional design precludes conclusions, this study highlighted psychological factors as potential

contributors to the experience of PSs.[10] A recent retrospective chart review study[11] also observed that individuals experiencing PSs had a higher prevalence of depression and anxiety than individuals without PSs. Few studies have explored PSs, and to date none have captured the ICD recipient's subjective perspective of the PS experience.

Due to the absence of a systematic examination of PSs, the primary goal of this study was to examine the subjective experience of PSs and evaluate psychosocial correlates, thereby gaining further insight into this understudied phenomenon.

Methods

Participants and Procedure

This study received institutional ethics approval. Participants were recruited from the Toronto General Hospital (TGH) ICD clinic between December 2008 and June 2009. Participants presenting with a PS were matched on sex and age (±5 years) with individuals who had received only objectively verified shocks. The main inclusion criterion for the PS group was having reported a PS experience within the preceding 24 months. The main inclusion criteria for the objective shock group were having received objective shock(s) within the preceding 24 months and the absence of PSs. Exclusion criteria were lack of proficiency in spoken/written English, severe cognitive and/or hearing impairment, and unwillingness or inability to participate. Due to the reported low incidence of PSs and the exploratory nature of this study, we used a convenience sample. Since our aim was to examine the lived experience of PSs, sampling was purposive, allowing us to assemble a detailed picture of the PS experience.

All eligible patients were identified by an electrophysiology (EP) research nurse who briefly introduced the study during a follow-up visit at TGH. Eligible patients who chose to participate were mailed two copies of the consent form and a study questionnaire package. Following return of the signed consent form, an in-person or telephone interview was scheduled and conducted by the first author.

Quantitative Procedure

To gain a better understanding of PS participants, we assessed classic domains of psychopathology. Reliable and well-validated measures of symptoms of posttraumatic stress disorder (PTSD) (PTSD Checklist—Civilian Version; PCL-C),[12] anxiety and depression (Hospital Anxiety and Depression Scale; HADS),[13–15] and cardiac anxiety (Cardiac Anxiety Questionnaire-Revised; CAQ)[16] were administered, as well as a short measure of social desirability (Socially Desirable Response Set; SDRS-5).[17] Cardiac variables were extracted from the participants' hospital charts by the EP nurse.

Semistructured Interviews

Semistructured interviews were conducted to investigate the subjective experience of PSs. All interviews, lasting 20–90 minutes, were audio-recorded, transcribed, and analyzed using NVivo 8 (QSR International Pty Ltd., Doncaster, Australia).[18] Informed consent was obtained and all interviews were conducted and analyzed by the first author who was not involved in the participants' health care. To establish a sense of the objective shock experience in relation to the PS experience, participants were first asked whether they had ever experienced an objectively verified shock. If they had, they were asked to describe their first such experience (i.e., the associated quality, intensity, location, emotions, and thoughts), whether they thought anything might have triggered the shock, and whether they had consequently changed any daily activities.

To initiate the discussion of PSs, participants were asked whether they had ever experienced a shock and then later, upon device interrogation, been informed that a shock had not occurred. Questions identical to the ones about objective shocks were asked about the PSs. The term "phantom shock" was used only if the interviewee labeled it as such, so that the descriptive term used always reflected the participant's own labeling of the event. Finally, participants were asked about similarities and differences between recorded and PSs and were invited to add any other information they thought pertinent. Participants in the objective shock group underwent a similar interview with a sole focus on the experience of objective shocks.

Use of mixed methods is becoming increasingly common in behavioral and social science research. Mixed methods research can be helpful in gaining breadth and depth[19] when studying a little explored phenomenon, such as PSs. The qualitative methodology enables a fuller understanding of the patients' experience of PSs since we have an in-depth account of the patients' personal experiences and reactions whereas the quantitative descriptive analysis enables a comparison of the patients' emotional functioning to normative and clinical data from other studies. This is a novel approach to examining PSs as prior studies[10] have employed a quantitative approach alone and thus did not capture the subjective experience of PSs. We believe the results of both

the qualitative and quantitative components of our study inform the literature, provide clinicians with insight, and give more clarity to future research directions.

Data Analysis

Quantitative Analysis Psychological Measures

Quantitative analyses were performed using SPSS version 16.0 (IBM Corp., Armonk, NY, USA).[20] Scores were compared between groups using one-way analysis of variance and were further examined by effect size estimates.

Qualitative Analysis: Interpretative Phenomenological Analysis

Interview transcripts were analyzed using interpretative phenomenological analysis (IPA),[21] the main goals being to conduct a detailed examination and gain an understanding of how individuals perceive a particular lived experience.[22] IPA studies are inductive, grounded in data, and ideographic. As such, IPA involves a thorough analysis of each transcribed interview from which a detailed account of the phenomenon, and the meaning of this phenomenon to the individual, is assembled. Sampling in IPA studies tends to be purposive, allowing the researcher to assemble a rich interpretative picture based on a small number of participants rather than a more broad exploration of the phenomenon from a large sample.

The inductive aspect of IPA involves discovering themes and patterns which emerge out of the data and through the researcher's interaction with the data. Of note, the researcher's reflexivity is an integral part of the interpretative process. Reflexivity requires the researcher to be engaged, aware, and reflective about his/her own position, which might influence the findings of the research.[22] For the present study, the first author maintained awareness that she has had prior experience with ICD literature. In order to address this and in trying to bracket prior knowledge, the first author tried to minimize the amount of reading surrounding the experience of objective and PSs prior to analyzing interviews from this study.

Each transcript was first analyzed individually. Staying close to the text, notes were made on portions, which were informative and pertinent to understanding the PS experience. Emergent themes were noted during the first reading. This list of emerging themes was not referred to until the first reading of every transcript was complete and relevant notes had been made. During the second reading of transcripts, themes most salient to the understanding of the PS experience were identified. At this juncture, the list created during the first reading of the transcripts was examined and themes relevant to all transcripts were noted. All transcripts were reread in this manner. Common links were identified between recorded themes, ordering them in a way, which reflected and encapsulated the emergent meanings. Continually referencing previous transcripts ensured that emerging themes were consistent with the themes, concepts, and reflections captured within previous transcripts. Themes were ordered in a coherent manner and named to reflect their meaning.

Since the primary purpose of this study was to examine the subjective experience of PSs, only transcribed interviews reflecting this experience are included here.

Results

Sample Characteristics

Overall, 16 consecutive patients reporting PSs were approached to participate in the study. Three patients were excluded due to language barriers (two females) and later denying the experience of a PS (one male). Four individuals declined participation due to feeling unwell (one male, one female) and being too busy (two males). No patients withdrew from the study. A total of nine participants (100% male) were enrolled in the PS group and eight age- and sex-matched participants were enrolled in the objective shock group. Demographic variables for both groups are displayed in Table I.

Table I.

Demographic and Medical Characteristics

Variable	Phantom Shock (n = 9)	Objective Shock (n = 8)
Age (years), mean (M) (standard deviation [SD])	65.9 (17.9)	63.9 (18.9)
Age range	28–83	24–80
Education, n		
High school or less	5	5
Trade/technical training after high school	2	1
College or university degree	2	2
Living situation, n		
With partner/ family/roommate	7	7
Alone	1	1
Residential setting	1	0

Table II.

Psychological Measures

Measure Variable	Phantom Shock (n = 9) (Mean [SD])	Objective Shock (n = 8) (Mean [SD])	F Value[§]	P Value	η_p^{2*}
PCL-C					
Reexperiencing	10.38 (4.63)	9.63 (4.10)	0.118[†]	0.737	0.008[a]
Avoidance	4.00 (2.00)	3.13 (1.89)	0.811[†]	0.383	0.055[b]
Numbing	11.31 (5.01)	9.00 (3.89)	1.10	0.311	0.068[b]
Hyperarousal	11.22 (5.31)	11.38 (4.50)	0.004	0.950	0.000
Total	36.89 (14.92)	33.13 (10.75)	0.348	0.564	0.023[a]
HADS					
Anxiety	7.89 (4.91)	8.13 (3.87)	0.012	0.915	0.001
Depression	8.02 (3.87)	5.50 (3.38)	2.105	0.176	0.118[b]
CAQ					
Fear	1.76 (0.65)	2.22 (0.87)	1.516	0.237	0.092[b]
Avoidance	2.64 (1.21)	2.18 (1.17)	0.641	0.436	0.041[a]
Attention	1.20 (0.87)	1.28 (0.83)	0.033	0.859	0.002
Total	1.86 (0.66)	1.95 (0.75)	0.063	0.806	0.004
SDRS-5 (%)	91.11 (75.57)	27.50 (63.19)	3.491	0.081	0.189[c]

All F statistics are based on (1, 15) degrees of freedom (df) unless otherwise indicated.
[†]Reflects (1, 14) df.
[§]One-way ANOVA statistic.
[*]η_p^2 = Partial Eta-squared: [a]small, [b]medium, [c]large associations.
PCL-C = PTSD Checklist – Civilian Version; HADS = Hospital Anxiety and Depression Scale; CAQ = Cardiac Anxiety Questionnaire; SDRS-5 = Socially Desirable Response Set.

There were no significant differences between patients in the phantom and objective shock groups with respect to months since ICD implantation (M = 49.5, standard deviation [SD] = 44.0 vs M = 43.2, SD = 36.9, respectively, F [1, 15] = 0.101, P = 0.755, $\eta^2 = 0.007$), the number of objective shocks (M = 6.1, SD = 6.7 vs M = 3.6, SD = 3.2, respectively, F [1, 15] = 0.912, P = 0.355, $\eta^2 = 0.057$), or the use of mood (χ^2 [1, 17] = 0.008, P = 0.929) or sleep (χ^2 [1, 17] = 0.701, P = 0.402) medications. PS participants, however, were more likely to have primary indication for ICD implantation as compared to their objective shock group counterparts (66.7% vs 12.5%, χ^2 [1, 17] = 5.13, P = 0.024). Notably, all but one of the PS participants had received prior objective shock therapy.

Table II summarizes the psychological questionnaire data. The following guidelines were used for the effect size measure, partial eta-squared (η_p^2): small association 0.01–0.05, medium association 0.06–0.14, and large association ≥0.15.

Qualitative Results: Themes

Qualitative results reflect interviews with eight PS participants, as one individual chose not to complete the interview. Three superordinate themes emerged: (1) PS as a somatic experience, (2) the emotional impact of PSs, and (3) searching for meaning.

PS as a Somatic Experience

Participant accounts reflected the perceived reality and vividness of PSs. The physical location, sensation, and impact of PSs were described vividly as being strikingly similar to previous objective shocks. All participants reported believing PSs to be objective shock therapy.

One participant recounted:

> I don't feel that it was quite different. It was very similar to . . . what it does . . . it, it is like a shock, like somebody pulls you, punches you, and you back up, you sort of, you know, automatically uh, are not prepared to go forward . . . But, but there's, there's nothing . . . I don't feel that there's hell of a lot of difference between those two physically. [02]

Another participant recalled:

> Well, the first time, I thought it was another appropriate- appropriate shock. Not, not *appropriate*, but it was a real shock . . . But the *first* time it happened, I thought it was real, it was happening, because I couldn't

> tell the difference . . . they can be identical, in terms of how it affects your body. How, or how you think it affects your body. They're like a kick in the back . . . Like they, they, uh, the top of the column in terms of the phantom shock could be *exactly* the same as, as a real shock- the *assault* if you wanna call it. [04]

Only after participants had their ICD interrogated and were told the shock was not recorded did they begin to consider the plausibility that what they experienced was a PS. One individual, even after being told his shock was not recorded, maintained that his PS was indeed an objective shock:

> It definitely was [a shock]. When you get it, you feel it . . . it's like a punch, like somebody would punch you right, with a closed, with a fist . . . I feel, it definitely happened, but uh, the device did not record and I am not sure what else one can do, you know. [02]

Seven participants reported feeling PSs in their chest; one described feeling it through the left arm and chest. Despite the variation in the location, each participant described the PS as having occurred at the same location as previous objective shock therapy. The accompanying vivid physical sensation further accentuated their physical reality. The majority of participants stated that PSs felt as vivid as objective shocks. Some described PSs as having a lesser physical impact: "a punch in middle of the breast," "like a punch, but a little heavier than a punch," "you get this sharp feeling and you get a little bit of pain, but then it goes away." Others offered more distressing accounts:

> I was actually sleeping and I woke up because . . . my body started uh . . . *jumping* in bed . . . and I woke up . . . uh I think that I had a . . . heart attack in bed, 'cause it felt-weird. I woke up afraid. But when I went to the hospital, it was, it was not recorded! . . . I was sleeping and just like a bang and I woke up shaking . . . So I'm like 'something happened.' (chuckles) . . . The feeling inside the pacemaker was the same. Very . . . *tingly*, and uh red, not red but hot . . . A good example is when those two pads that they use (motions to show external defibrillator paddles) . . . those ones, that's how it feels. Your body jumps . . . That's exactly how it was. [05]

Furthermore, the majority of participants (6/8) experienced a PS while asleep. One individual reported experiencing a PS during the transition phase between wakefulness and sleep. Others reported being wakened from a deep sleep by what they believed was an objective shock. Three individuals reported experiencing PSs while awake.

Taken together, for the majority of participants the physical experience of a PS was reported to be similar in intensity as that of an objective shock. Accounts indicated that the emotional and psychological impact of PSs can be pronounced. The inability on part of the participants to distinguish between objective and PSs was striking.

The Emotional Impact of PSs

The unexpected and unpredictable nature of PSs and the individual's inability to distinguish them from objective shock therapy, left the majority of participants with a sense of concern, fear, anticipation, and anxiety, confused about the appropriate action to take in response to future shocks, objective or phantom. One individual recalled:

> I wasn't ready for it, so it was, it was like a sudden happening, you know, and I wake up many times, and . . . at the time of waking up, nothing like that happens. So this was definitely a different experience. [08]

The suddenness and unpredictability of PSs, coupled with a conviction that an objective shock was delivered rendered many individuals alarmed and confused by the experience. One emotional consequence of this experience was anxiety. Participants expressed a fear of not knowing what to do next, and the majority contacted the hospital immediately following the PS: "It was bad enough to wake me up, and uh, I sat up in bed waiting for what's gonna happen next . . . it was *scary*" [08]. As a precaution, two individuals requested that a monitor be placed in their home to monitor ICD activity so that they would know if the shock was real or not.

Anxiety also arose over the absence of a recording of an event which was experienced so vividly. For some individuals, this triggered a mistrust of device integrity. One participant expressed a sense of frustration, confusion, and helplessness reflecting his feelings of loneliness in his unique experience:

> That made me feel very depressed because I'm like 'why is this happening to me and not recording?' (shrugs). [He thought] "I want to hide" (smirk). [From] myself. Because I felt different from everybody else . . . Just, not normal life of living (stopped talking, looked at interviewer) . . . just um, nothing recorded. Nothing happened . . . I just went

> home and cried . . . a release of tension . . . the thoughts were just . . . sad thoughts. Depressing thoughts . . . To this day I still get them, but there's no, there's no records of it, no . . . no meanings of why I get it . . . I always go to the hospital – because I'm scared of . . . if I'm alone it just . . . hits me. [05]

Another individual voiced helplessness and profound disappointment and demanded device replacement when he learned that no shock was recorded:

> The doctor . . . .told me that these shocks are *phantom* shocks. But I told him, 'you don't got idea what I have. I, I know, know what I feel' . . . why, why is not recording shocks? . . . I said, I thought this is, this is ridiculous. How come this device is isn't recording the way it should be? [07]

Three individuals, however, reported a lesser emotional impact surrounding PSs, indicating that they were not significantly worried. Nevertheless, all three informed their medical teams of the shock. One individual emphasized that specific tragic life circumstances had dampened his concern regarding shocks in general, also conveying his confusion about the most appropriate actions to be taken following the experience of a shock. Together, these three accounts suggest that even less alarmed reactions to PSs appear to be accompanied by anxiety and concern, at least at the time of occurrence.

Searching for Meaning

Faced with the task of reconciling a vivid sensation for which objective data were not evident, individuals searched for meaning. Some patients attempted to rationalize the situation while others expressed persistent confusion. Several participants normalized the experience in their attempts to explain the cause of PSs. Three individuals suggested that PSs could have been associated with what they had dreamed or their state before sleep:

> Uh, I have . . . lately I dream more, and the dreams are not always positive, or pleasant. Uh, so conceivably, there was something that I was thinking before and that it affected, but I have no idea. Yeah. But what happens is..(sigh).. I, I have, I am dreaming more often than I used to . . . well, either that or whatever I was thinking before I went to bed . . . but I don't know . . . [02]

Some participants attempted to distinguish between a phantom and objective shock:

> If I had a shock and it was when I was awakening, or dozing, or about to go to sleep, then it was in my opinion, a phantom shock. Because they all occurred in the transition between sleep and awake . . . I mean I can tell when it's a phantom shock. Yeah, just, just by the timing. [04]

One individual suggested that the origin of his PSs was a PTSD flashback to a shock storm consisting of eight consecutive verified shocks:

> Well, I, I read a lot of stuff about PTSD and flashbacks. And what it had seemed to me that if it wasn't recorded that it was a flashback. Because I know from people who were in Vietnam or places like that, that flashback, you could be right there in the jungle being shot. So it's very real for the person who is *affected* by it. So I, I didn't originally describe it to myself as a phantom shock. I called it a flashback . . . Then I read up on it, more about it . . . It's just a form of a flashback, peculiar to this device going off and traumatizing or something. [04]

Despite attempts at explanations, all patients maintained that they would immediately report any similar event to the hospital.

Discussion

This study contributes to the increasing awareness of the occurrence of PSs associated with an ICD by illuminating patients' subjective experiences. The experience of PSs appears to be as vivid and real as that of objective shocks.

PS as a Somatic Experience

PSs possess a physical reality and are perceived as distressing and virtually indistinguishable from recorded shocks. Accounts of objective shocks from our participants were comparable to previous reports of ICD shocks[3,23] described as a punch in the chest or the belly, causing the entire body to jump.[3] Importantly, descriptions reflecting the physical power of recorded shocks were also used to describe the PS experience, reaffirming their perceived reality. An earlier case study of a man who had five objective shocks asserted that his PSs all felt like previously recorded shock therapies, suggesting a similar pattern of PS descriptions.[7] Furthermore, it was reported that in response to objective shocks, most patients immediately contacted a physician.[3] In the present study, participants responded with the same urgency following a PS, further attesting to its physical reality and the easy misidentification of a PS as an objective shock.

While possibly still describing a PS, it is also plausible that the two individuals who used milder descriptive terms in relation to the intensity of PSs might have been reporting sensations other than what we had conceived of as PSs. Instead, these sensations may have been cardiac arrhythmic events that were below the ICD detection threshold but perceived as shocks. This nuance in reporting was noted in a case report suggesting that a patient may have responded to undetected subthreshold cardiac events.[7] Alternatively, these two individuals might have been reporting manifestations of anxiety related to the anticipation of an impending shock which were misinterpreted as cardiac events. Individuals who are hypervigilant and anxious about physical symptoms may be more likely to misinterpret their meaning, focusing attention on their heart during times of arousal or stress.[24] Moreover, a focus on potential health-related problems could lead to an increased risk of making interpretative errors, mislabeling innocuous cardiac events as potentially catastrophic ones.[25] The fleeting and variable nature of arrhythmia events, the associated lightheadedness and nausea, make it very difficult for patients and physicians alike to distinguish arrhythmia symptoms from anxiety symptoms or even phantom device sensations.

Consistent with previous findings,[11,26] most of our participants experienced PSs while asleep. However, PSs were not unequivocally a nocturnal experience. Findings from our study and that of Kowey and colleagues[26] contrast with a report which noted that PSs usually occur at night, when a person is in the process of falling asleep, and are associated with hypnagogic muscle contractions which patients misinterpreted as shock therapy.[27] Hypnagogic muscle contractions are characterized by complaints of sudden brief jerks during sleep onset and are often described as a feeling of falling or a sensory flash.[28] However, our participants suggested that PSs generally occurred during later stages of sleep (when hypnagogic muscle contractions are unlikely to occur) and sometimes occurred when awake. In accord with previous reports, our participants tended to characterize PSs as resulting in distinct chest soreness[26] and physical movement (e.g., off the bed)[7] that have also been described in objective shocks. These studies, along with the present results, suggest that PSs are not misinterpreted hypnagogic muscle contractions. Rather, most participants described PSs as indistinguishable from objective shocks in body location, quality of sensation, and, at most times, intensity.

It is appropriate to consider phantom sensations documented in other health populations, such as individuals who have undergone amputation of a limb or mastectomy[29–32] and post-surgical patients experiencing pain flashbacks.[33] The prevalence of phantom sensations ranges from 76% in upper limb amputees to 100% in lower limb amputees.[30,31] Moreover, it was noted, "phantom sensations and pains are experienced as if the actual organs were still present. They are as real to the patient as were the original sensations which accompanied the normal functioning of the organ prior to their removal" (p. 320).[29] This draws attention to the similarity in quality and location between phantom sensations and sensations previously experienced in the amputated body part. In light of this, one possibility is that PSs are similar to the somatosensory pain memories that amputees experience in the phantom limb[29] or the pain flashbacks that some patients with PTSD report[33] after episodes of awareness under surgical anesthesia. In both instances, patients report the reexperiencing of a past pain either in the absence of a peripheral input[29] or triggered by a stimulus that was conditioned at the time of the initial pain experience.[33] Not unlike the above examples, the qualitative reports described by the participants in the present study suggest that PSs resemble in all respects the sensations and emotions experienced following an objective shock. It is possible that the objective shock experience is reactivated in vulnerable individuals or at times when the tonic inhibitory control over the central neural structures housing the memories is diminished (e.g., during sleep). Additional research is required to elucidate the mechanisms underlying PSs.

Quantitative results indicate that both groups exhibited elevated levels of anxiety and trauma. Effect size analyses suggest greater psychological distress on symptoms of depression and PTSD in the PS group as compared to the objective shock group suggesting that for some individuals, symptoms of PTSD and depression may contribute to the experience of PSs. However, it should be noted that the absence of significant intergroup differences may also reflect the fact that the present study is underpowered.

The Emotional Impact of PSs

Anxiety

The unexpected and unpredictable nature of PSs generally provoked anxiety, fear, and concern. The inability to distinguish a phantom from an objective shock served to exacerbate these emotional responses, resulting in similar reports of anxiety following shock experiences. Other researchers have also found that shocked individuals become aware of their unpredictable nature, which can heighten shock-related concerns and fears.[34–37] From the patient perspective, the vivid experience

of PSs appears to contribute to ICD-related anxiety and mistrust and confusion over the suspected malfunctioning of the device. Coupled with the vividness of PSs, the unexpectedness and uncontrollability of the experience prompted the individuals to call an ambulance or go to the hospital. PS recipients reflected on the fear of future shocks and the uncertainty surrounding such therapies. This suggests that irrespective of the recording of an ICD therapy, the mere perception that a shock was received rendered a person vulnerable. Given the perceived reality of PSs and their ambiguous nature, they do not present as benign events, but serve as yet another reminder of the possibility of impending shocks, exacerbating fears regarding future shocks.

Confusion and Helplessness

Frustration with the lack of objective verification of a perceived event and the uncontrollability of such occurrences can lead to a sense of confusion, helplessness, and vulnerability, also observed in another case study.[7] Two of our study participants expressed helplessness with regard to their inability to reconcile the reality of PSs with a lack of their objective recordings. The youngest participant expressed sadness and confusion related to PSs, and the perceived lack of normalcy of his situation, as his siblings did not have to manage such events. Another participant expressed bewilderment caused by the lack of a shock recording and a loss of confidence in the medical system. Taken together, the occurrence of PSs added a further component of vulnerability for patients with ICDs, leading them to question the functioning of the ICD, their own ability to evaluate the veracity of bodily sensations, or both.

Sears and Conti[38] suggest that security is an important benefit of ICDs and that faith in the device is of fundamental importance for ICD patients. If such faith is lacking, psychological acceptance of the device may be affected. The occurrence of PSs can challenge this notion of security, provoking emotional anxiety. Research evaluating ICD recalls suggests that anxiety levels might increase following the announcement of possible device malfunction.[39] The notion that one's device is potentially faulty carries many implications, indicating a heightened risk of death, or cardiac events which ICD shock therapy could fail to correct. If PSs are construed in such a manner, it is not surprising that anxious responses ensue.

Searching for Meaning

PSs can be conceptualized as events which disrupt the global meaning of what it means to be an ICD recipient and how the device is meant to function. The occurrence of PSs serves as a reminder that the ICD treatment trajectory might not be predictable. The vivid, convincing, and emotionally and physically challenging nature of PSs prompted many individuals in our study to engage in a search for meaning of their experiences. This process seemed to entail becoming acquainted with the ICD and shock experience, thereby increasing comfort in the device and one's own health.

A search for meaning has been examined in the context of several health populations, including ICD recipients,[40] cancer patients,[41] and individuals who had undergone the traumatic experiences of witnessing the World Trade Center attacks.[42] Faced with change or a negative life event, searching for meaning can be a way to attempt to regain control of a situation.[40,43] Unexpected or negative events, such as PSs, have the potential to disrupt one's global meaning that life is predictable,[44] leading to emotional distress. A person might be able to successfully confront and reevaluate a stressful event, thereby allowing for its assimilation into preexisting conceptual models or for the adaptation of the conceptual models to accommodate it. Psychological distress, however, can occur when a person is unable to reach a satisfactory resolution with construction of meaning.[41,42] While most participants in this study engaged in a search for meaning, it is unclear whether all constructed meaning.

It is not surprising that many PSs were explained within a framework of a prior, more familiar experience of objective shocks, because attaching known explanations and labels to novel symptoms is a way of dealing with novel situations.[45] Some participants sought causes for arrhythmic events (e.g., exercise), and others suggested that PSs were dreams or flashbacks to previous traumatic experiences. Framing or normalizing PSs in these ways seemed to help alleviate distress and allowed for control over an ambiguous event whose very occurrence emphasized the uncontrollable and unpredictable characteristic of shocks. A similar pattern of normalizing was described in a study of heart failure patients, in which one individual explained the consequences of his heart failure (e.g., decreased energy, slowing down) within the context of his retirement.[45]

While we could not anticipate what themes would emerge from the qualitative analysis it is interesting to note that many findings from the two types of analyses converge, as illustrated in Table III. While some themes align well with the psychological measures that were used, others would benefit from quantitative exploration in future research.

Table III.

Overview of Qualitative Themes and Quantitative Analyses

Qualitative Themes	Quantitative Analysis Instruments
I. *Phantom shocks as a somatic experience* Phantom shocks were reported to be strikingly similar to previous ICD shock therapy with respect to the physical location, sensation, and impact. The intensity of phantom shocks was often perceived as distressing, being likened to a heart attack in bed. The qualitative theme captured the physical reality of phantom shocks and their similarity to objective shocks.	Although not recorded by the ICD, the vivid experience of phantom shocks can be perceived as distressing by the patient. This was reflected by the PCL-C, which measures symptoms of PTSD. Effect size comparisons suggested that phantom shock participants showed higher levels of distress and were closer to clinically significant levels of PTSD. It is worth noting that this similarity resembles flashbacks seen in PTSD and is an area in need of further exploration.
II. *The emotional impact of phantom shocks* Patient interviews revealed the anxiety, fear, and concern which arose from the unexpected and unpredictable nature of phantom shocks. a) *Anxiety* – Fear of not knowing what would happen following a phantom shock further emphasized the unpredictability of ICD shocks. Adding to the anxiety was the inability to distinguish between a phantom and objective shocks.	Phantom shock participants showed elevated levels of anxiety. The objective shock group also displayed elevated anxiety scores, in this instance, even higher than the phantom shock group. However, it is noteworthy, that anxiety scores in both groups approached clinically significant levels. This is an area in need of further exploration.
– Some individuals requested a monitor for their ICD to be placed in their home.	The qualitative theme reflected cardioprotective behaviors, such as requesting a monitor. However, the CAQ scores were not elevated significantly as compared to normative data.
b) *Confusion and helplessness* – Some individuals expressed a feeling of helplessness following the phantom shock. The lack of objective verification of the perceived event can further add to the feeling of helplessness, sadness, and vulnerability.	The HADS depression subscale may have reflected the notion of learned helplessness following unpredictable and unexpected phantom shocks. Effect size analyses suggested that phantom shock participants displayed higher depressive symptoms, reaching the clinical cutoff score of 8, as compared to their objective shock counterparts.
III. *Searching for meaning* While most individuals engaged in a search for meaning, many were not able to construct meaning. – Psychological distress may arise if meaning is not found. One individual explained his phantom shocks as flashbacks.	Interestingly, while the qualitative findings suggest that phantom shocks may be akin to a PSTD flashback, the PCL-C suggested a small effect size on the reexperiencing subscale, albeit phantom shock participants showing elevated levels as compared to their objective shock counterparts. This is an area in need of further exploration. There was a large effect on SDSR-5, with the phantom shock group exhibiting elevated levels of social desirability compared to the objective shock group. While the qualitative theme does not map directly onto this construct, it may be hypothesized that the elevated sense of self-presentation evolved as a defense against being told one did not have an objective shock, but rather a phantom shock.

ICD = implantable cardioverter defibrillator; PCL-C = PTSD Checklist – Civilian Version; HADS = Hospital Anxiety and Depression Scale; CAQ = Cardiac Anxiety Questionnaire; SDRS-5 = Socially Desirable Response Set.

Study Limitations

Despite our plan to recruit both men and women, our sample consisted only of males; our findings thus lack generalizability to female ICD recipients. Also, qualitative analyses focused on the PS experience, and the experiential similarity of phantom and objective shocks was based only on the accounts from our PS participants. The future use of interviewers blind to participant condition (i.e., presence/absence of PSs) is also recommended in order to examine potential qualitative differences between phantom and objective shocks.

While the purposive sampling for this study allowed an in-depth examination of the subjective experience of PSs, it meant that the sample size was underpowered for quantitative analyses. This suggests that we may have failed to detect significant effects on the psychosocial variables. In light of this, we included effect size analyses, which show that the majority of comparisons revealed medium to large effect size differences between the PS patients and the objective shock patients. These effect size estimates can be utilized in estimating sample size requirements in follow-up studies.

Clinical Implications

Detailed descriptions of PSs have been absent from the ICD literature, and mechanisms underlying this phenomenon remain largely unexplored. This study investigated the complexity of this phenomenon and captured the subjective experience of PSs, offering novel insights into this distressing occurrence. Our findings suggest that PSs provoke complex emotional, behavioral, and cognitive reactions. PSs can provoke alarmed reactions and demand emotional and cognitive resources to manage them. While the subjective experience of the PSs varied at times, for some individuals they engendered anxiety, confusion, a sense of helplessness, and a loss of confidence in the ICD. At this time, however, mechanisms underlying the PS experience are not fully understood.[11] Further prospective research is needed to investigate the mechanisms underlying their occurrence.

In order to enhance patient care, it is essential for health care providers to recognize that the experience of PSs is not transient and may have a profound effect on patients with ICDs. Patient education might even include the potential for PSs and the reassurance that other ICD recipients have also experienced similar events. Such education might proactively alleviate the potentially embarrassing situation of reporting shocks that are not present upon device interrogation. In fact, patients have been shown to benefit from ICD educational interventions, which can help to reduce psychological distress.[46] The offer of reassurance to patients reporting PSs would provide a comforting environment in which a person could openly discuss their concerns and experiences. Having a safe environment and an opportunity in which to discuss PSs would likely help individuals accommodate and validate their experience.

References

1. The Antiarrhythmics versus Implantable Defibrillators (AVID) Investigators. A comparison of antiarrhythmic-drug therapy with implantable defibrillators in patients resuscitated from near-fatal ventricular arrhythmias. The Antiarrhythmics versus Implantable Defibrillators (AVID) Investigators. N Engl J Med 1997; 337:1576–1583.
2. Connolly SJ, Gent M, Roberts RS, Dorian P, Roy D, Sheldon RS, Mitchell LB, et al. Canadian Implantable Defibrillator Study (CIDS): A randomized trial of the implantable cardioverter defibrillator against amiodarone. Circulation 2000; 101:1297–1302.
3. Ahmad M, Bloomstein L, Roelke M, Bernstein AD, Parsonnet V. Patient's attitudes toward implanted defibrillator shocks. Pacing Clin Electrophysiol 2000; 23:934–938.
4. Porterfield JG, Porterfield LM, Bray L, Sugalski J Jr. A prospective study utilizing a transtelephonic electrocardiographic transmission program to manage patients in the first several months of post-ICD implant. Pacing Clin Electrophysiol 1991; 14:308–311.
5. Swygman CA, Link MS, Cliff DL, Foote CB, Homoud MK, Wang PJ, Estes III NAM (Abstract) Incidence of phantom shocks in patients with implantable cardioverter defibrillators. Presented at: North American Society of Pacing and Electrophysiology, San Diego, CA, 1998.
6. Burg MM, Lampert R, Joska T, Batsford W, Jain D. Psychological traits and emotion-triggering of ICD shock-terminated arrhythmias. Psychosom Med 2004; 66:898–902.
7. Prudente LA. Phantom shock in a patient with an implantable cardioverter defibrillator: Case report. Am J Crit Care 2003; 12:144–146.
8. Juan EA, Pollock M. Phantom shocks in patients with an implantable cardioverter defibrillator. J Emerg Med 2010; 38:22–24.
9. Prudente LA. Psychological disturbance, adjustment, and the development of phantom shocks in patients with an implantable cardioverter defibrillator. J Cardiovasc Nurs 2005; 20:288–293.
10. Prudente LA, Reigle J, Bourguignon C, Haines DE, DiMarco JP. Psychological indices and phantom shocks in patients with ICD. J Interv Card Electrophysiol 2006; 15:185–190.
11. Jacob S, Panaich SS, Zalawadiya SK, McKelvey G, Abraham G, Aravindhakshan R, Sears SF, et al. Phantom shocks unmasked: Clinical data and proposed mechanism of memory reactivation of past traumatic shocks in patients with implantable cardioverter defibrillators. J Interv Card Electrophysiol 2012; 34:205–213.
12. Weathers FW, Litz BT, Herman DS, Huska JA, Keane TM. The PTSD checklist: Reliability, validity, and diagnostic utility. Paper presented at the Annual Meeting of the International Society for Traumatic Stress Studies, San Antonio, TX, 1993.
13. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983; 67:361–370.
14. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. J Psychosom Res 2002; 52:69–77.
15. Herrmann C. International experiences with the Hospital Anxiety and Depression Scale—A review of validation data and clinical results. J Psychosom Res 1997; 42:17–41.
16. Eifert GH, Thompson RN, Zvolensky MJ, Edwards K, Frazer NL, Haddad JW, Davig J. The Cardiac Anxiety Questionnaire:

Development and preliminary validity. Behav Res Ther 2000; 38:1039–1053.
17. Hays RD, Hayashi T, Stewart AL. A five-item measure of socially desirable response set. Educ Psychol Meas 1989; 49:629–636.
18. NVivo qualitative data analysis software; QSR International Pty Ltd. Version 8, 2008.
19. Johnson RB, Onwuegbuzie AJ, Turner LA. (2007). Toward a definition of mixed methods research. J Mix Methods Res 1: 112–133.
20. SPSS for Windows, Rel. 16.0.1.2007. Chicago, SPSS Inc.
21. Smith JA. Semi-structured interviewing and qualitative analysis. In Smith JA, Harre R, Van Langenhove L (eds.): Rethinking Methods in Psychology. London, Sage, 1995, pp. 9–26.
22. Langdridge D. Phenomenological Psychology: Theory, Research and Method. Harlow, England, Pearson Education, 2007.
23. Burke LJ. Securing life through technology acceptance: The first six months after transvenous internal cardioverter defibrillator implantation. Heart Lung 1996; 25:352–366.
24. Eifert GH. Cardiophobia: A paradigmatic behavioural model of heart-focused anxiety and non-anginal chest pain. Behav Res Ther 1992; 30:329–345.
25. Marker CD, Carmin CN, Ownby RL. Cardiac anxiety in people with and without coronary atherosclerosis. Depress Anxiety 2008; 25:824–831.
26. Kowey PR, Marnichak R, Rials S. Things that go bang in the night [letter]. N Engl J Med 1992; 327:1884.
27. Groh WJ, Foreman LD, Zipes DP. Advances in the treatment of arrhythmias: Implantable cardioverter-defibrillators. Am Fam Physician 1998; 57:297–309.
28. Walters AS. Clinical identification of the simple sleep-related movement disorders. Chest 2007; 131:1260–1266.
29. Katz J, Melzack R. Pain 'memories' in phantom limbs: Review and clinical observations. Pain 1990; 43:319–336.
30. Kooijman CM, Dijkstra PU, Geertzen JHB, Elzinga A, van der Schans CP. Phantom pain and phantom sensations in upper limb amputees: An epidemiological study. Pain 2000; 87:33–41.
31. Richardson C, Glenn S, Nurmikko T, Horgan M. Incidence of phantom phenomena including phantom limb pain 6 months after major lower limb amputation in patients with peripheral vascular disease. Clin J Pain 2006; 22:353–358.
32. Rothemund Y, Grusser SM, Liebeskind U, Schlag PM, Glor H. Phantom phenomena in mastectomized patients and their relation to chronic and acute pre-mastectomy pain. Pain 2004; 107:140–146.
33. Salomons TV, Osterman JE, Gagliese L, Katz J. Pain flashbacks in posttraumatic stress disorder. J Clin Pain 2004; 20:83–87.
34. Carroll DL, Hamilton GA. Quality of life in implanted cardioverter defibrillator recipients: The impact of a device shock. Heart Lung 2005; 34:169–178.
35. Sears SF, Vazquez LD, Matchett M, Pitzalis M. State-of-the-art: Anxiety management in patients with implantable cardioverter defibrillators. Stress Health 2008; 24:239–248.
36. Herrmann C, von zur Mühen F, Schaumann A, Buss U, Kemper S, Wantzen C, Gonska BD. Standardized assessment of psychological well-being and quality-of-life in patients with implanted defibrillators. Pacing Clin Electrophysiol 1997; 20:95–103.
37. Pauli P, Wiedemann G, Dengler W, Blaumann-Benninghoff G, Kuhlkamp V. Anxiety in patients with an automatic implantable cardioverter defibrillator: What differentiates them from panic patients? Psychosom Med 1999; 61:69–71.
38. Sears SF, Conti JB. Psychological aspects of cardiac devices and recalls in patients with implantable cardioverter defibrillators. Am J Cardiol 2006; 98:565–567.
39. Van den Broek KC, Denollet J, Nyklíček I, van der Voort PH. Psychological reaction to potential malfunctioning of implantable defibrillators. Pacing Clin Electrophysiol 2006; 29:953–956.
40. Dunbar SB, Warner CD, Purcell JA. Internal cardioverter defibrillator device discharge: Experiences of patients and family members. Heart Lung 1993; 22:494–501.
41. Kernan WD, Lepore SJ. Searching for and making meaning after breast cancer: Prevalence, patterns, and negative affect. Soc Sci Med 2009; 68:1176–1182.
42. Updegraff JA, Silver RC, Holman EA. Searching for and finding meaning in collective trauma: Results from a national longitudinal study of the 9/11 terrorist attacks. J Pers Soc Psychol 2008; 95:709–722.
43. Taylor EJ. Whys and wherefores: Adult patient perspectives of the meaning of cancer. Semin Oncol Nurs 1995; 11:32–40.
44. Skaggs BG, Barron CR. Searching for meaning in negative events: Concept analysis. J Adv Nurs 2006; 53:559–570.
45. Stull DE, Starling R, Haas G, Young JB. Becoming a patient with heart failure. Heart Lung 1999; 28:284–292.
46. Sears SF, Sowell LD, Kuhl EA, Kovacs AH, Serber ER, Handberg E, Kneipp SM, et al. The ICD shock and stress management program: A randomized trial of psychosocial treatment to optimize quality of life in ICD patients. Pacing Clin Electrophysiol 2007; 30:858–864.