Psychological Indices as Predictors for Phantom Shocks in Implantable Cardioverter Defibrillator Recipients

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Background: *A phantom shock—the sensation of an implantable cardioverter defibrillator (ICD) discharge in the absence of an actual discharge—is a phenomenon that can occur in ICD patients. Little is known about the influence of psychological factors on the incidence of phantom shocks. We evaluated psychological correlates of phantom shocks 2 years post-ICD implant in a cohort of Dutch ICD recipients.*

Methods: *Consecutive patients (N = 300; 87.5% men; mean age = 62.3) willing to participate in a prospective study (Twente ICD Cohort Study) on psychological factors in ICD recipients received an ICD between September 2007 and February 2010. At baseline, patients complete the 36-item Short Form Health Survey, Hospital Anxiety and Depression Scale, and the Type D Scale. Lifetime presence of anxiety and depression was assessed with the MINI structural interview.*

Results: *During a follow-up of 24 months, 16 patients (5.4%) experienced a phantom shock. Median time to (first) phantom shock was 13 weeks (range 0–48 weeks). In univariable analysis, no significant relationships were found between clinical or psychological indices and the occurrence of phantom shocks, nor was there an association between phantom shocks and type D personality, symptoms of anxiety, or a history of anxiety and depression.*

Conclusions: *Neither symptoms of anxiety and depression nor psychiatric history were associated with the occurrence of phantom shocks. Further studies using more explorative, qualitative research techniques are warranted to examine the correlates of phantom shocks. (PACE 2014; 37:768–773)*

phantom shocks, implantable cardioverter defibrillators, anxiety, depression

Introduction

The implantable cardioverter defibrillator (ICD) is the first-line treatment for the prevention of sudden cardiac death (SCD) both as primary and secondary prevention.[1–3] Following current guidelines, both patients with a history of aborted SCD and patients who are at high risk for potentially life-threatening ventricular tachyarrhythmia are candidates for ICD implantation.[4] ICDs are designed to prevent SCD by converting ventricular arrhythmia into a normal heart rhythm by the use of antitachycardia pacing or shock therapy.

Despite improvements in ICD technology, complications still occur. Complications can be implantation-related, device-related, or related to the clinical condition.[5] Furthermore, a minority of patients suffer from psychological distress postimplant,[4,5] although there is evidence to suggest that the postimplantantion level remains similar to the preimplantation level in around 80% of patients.[6] Anxiety symptoms are experienced in 13–46% of ICD patients and 24–46% report depressive symptoms.[6] ICD shocks,[7,8] heart failure,[9] and a type D personality (the tendency to experience increased levels of anxiety, irritation, and depressed mood across situations and time, while not sharing these emotions with others because of fear of disapproval),[10,11] have been identified as important correlates of psychological distress and poor health-related quality of life (HQOL).

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One of the more unfamiliar, but established, complications of living with an ICD is the occurrence of a phantom shock.[12] In the case of a phantom shock, ICD patients subjectively feel that they have received a shock while there has been no actual ICD discharge.[13] The incidence of phantom shocks in ICD recipients is relatively unknown, as are the risk factors. Prevalence of phantom shocks has been investigated in three studies, and ranges from 5.1% in a population of general ICD recipients to 21.4% in young adults (<30 years) with an ICD.[14–16] The occurrence of phantom shocks was not associated with age, gender, left ventricular ejection fraction, number of shocks, or appropriate shocks versus inappropriate shocks,[16] although one study found that in primary prevention patients, a history of atrial fibrillation and New York Heart Association (NYHA) functional class < III were associated with the occurrence of phantom shocks.[14]

A paucity of studies has focused on the psychological indices of the occurrence of phantom shocks. No literature was found on the effect of phantom shocks on HQOL, but Prudente et al., and more recently Jacob et al., found that the experience of a phantom shock was associated with higher levels of anxiety and depression.[17,18] However, given the retrospective nature of their studies, it is still unclear whether phantom shock is a manifestation of anxiety or depression and whether phantom shock is contributing to maladjustment to the ICD. A clear cause and effect relationship between phantom shocks and clinical or psychological factors has not yet been established.

The aim of this study was to investigate clinical and psychological indices as predictors of phantom shocks. We hypothesized that patients with a history of anxiety or depression, a distressed (type D) personality, lower HQOL, or symptoms of anxiety or depression at the time of implantation have an increased risk of experiencing phantom shocks in the first 2 years following ICD implantation.

Methods

Patients and Design

The study population consisted of a consecutive cohort of patients implanted with an ICD at Medisch Spectrum Twente, Enschede, the Netherlands, between September 2007 and April 2010, as part of the Twente ICD Cohort Study (TICS, trial register number NL13939.044.06). The TICS study was designed to examine the value of biomedical and psychological risk markers for predicting life-threatening ventricular arrhythmias requiring ICD therapy. Patients were eligible for study participation if they met the following inclusion criteria: (1) indication for a first ICD implantation according to the guidelines of the Netherlands Society of Cardiology and the European Society of Cardiology[4,19,20]; (2) age ≥ 18 years; and (3) providing written informed consent. Exclusion criteria were inability to read or write Dutch, congenital heart disease, major psychiatric disorders other than affective spectrum disorders (e.g., psychosis, dementia), and participation in other studies. After implantation, regular visits to the ICD outpatient clinic were scheduled every 3–6 months and after every experienced ICD discharge. Phantom shocks were defined as the experience of an ICD discharge reported by the patient, without an actual ICD discharge seen by device interrogation.

The study was conducted according to the Helsinki Declaration and the research protocol was approved by the local ethics committee. All patients provided written informed consent.

Demographic and Clinical Characteristics

Information on demographic and clinical data was captured from the patients' medical records. Demographic variables included gender and age. Clinical variables included indication for ICD implantation (i.e., primary versus secondary), etiology (i.e., ischemic vs nonischemic), comorbidity (i.e., chronic obstructive pulmonary disease, hypertension, diabetes mellitus), NYHA class, and the occurrence of shocks. Information on current smoking status and alcohol use was collected through a questionnaire.

Psychological Measurements

All patients completed a set of validated questionnaires (see below) at baseline, prior to ICD implantation.

Personality

Type D personality was measured with the 14-item Type D Scale (DS14),[21] which is a self-report questionnaire assessing the personality traits negative affectivity (seven items; e.g., "I often feel unhappy") and social inhibition (seven items; e.g., "I am a closed kind of person"). Items are answered on a 5-point Likert scale from 0 (not true) to 4 (true), with scores ranging from 0 to 28 for both subscales. Type D case is defined by a score of ≥10 on both subscales,[21] with this cutoff being the most optimal according to item response theory.[22] The DS14 has good psychometric properties with Cronbach's α = 0.88/0.86 and 3-month test-retest reliability = 0.72/0.82 for the negative affect and the social inhibition subscales, respectively.[21] Type D personality is not confounded by indicators of disease

severity, such as left ventricular dysfunction, in postmyocardial infarction patients,[23,24] nor by NYHA functional class in patients with heart failure.[25]

General Anxiety and Depression

Symptoms of anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS).[26] The HADS is a validated self-report measure consisting of 14 questions about symptoms of anxiety and depression. Items are answered on a 4-point Likert scale (0–3), with a score range of 0–21 for both anxiety and depression. A higher score indicates higher levels of anxiety or depression. The HADS has been sufficient for good psychometric properties, as indicated by Cronbach's $\alpha = 0.71$ and 0.90 for the anxiety and depression subscales, respectively, and test-retest reliability of 0.86 and 0.91, respectively.[27]

Psychiatric History

History of depressive disorder or anxiety disorder was measured with the Dutch version of the Mini International Neuropsychiatric Interview (MINI).[28,29] This is a structured diagnostic interview that systematically determines psychiatric diagnoses. It was developed to meet the need for a short but accurate structured psychiatric interview for multicenter clinical trials and epidemiological studies, addressing the feasibility shortcomings of two other frequently used structured psychiatric interviews, the Structured Clinical Interview for DSM-IV-TR Axis I (SCID-I) and the Composite International Diagnostic Interview (CIDI). In this study, only the parts relating to depressive disorder and anxiety disorder were administered. Test-retest reliability Kappa scores are 0.89 and 0.79, and interrater Kappa scores are 1.00 and 0.97, respectively.[28]

Health-Related Quality of Life

HQOL was assessed with the 36-item Short Form Health Survey (SF-36).[30] The SF-36 is a self-report measure composed of eight multi-item scales: physical functioning, social functioning, vitality, role limitations regarding physical problems, role limitations regarding emotional problems, general mental health, bodily pain, and general health perception. The raw scale scores are transformed into a scale ranging from 0 to 100, with a higher score indicative of a better HQOL (and absence of pain for the Bodily pain scale). The SF-36 has good psychometric properties, with Cronbach's α ranging from 0.78 to 0.93 for the separate subscales in a sample of 4,172 Dutch adults.[30]

Statistical Analysis

Differences in demographic and clinical characteristics between groups were analyzed using Student's *t*-tests, Wilcoxon Signed-Ranks test, χ^2 tests, or Fisher's exact test, as appropriate. To examine risk factors for the occurrence of phantom shocks, each variable was first entered into a univariable analysis with the occurrence of phantom shocks as the dependent variables.

Multivariable logistic regression analysis was performed to investigate the relationship between phantom shocks and type D personality, psychiatric history, anxiety or depressive symptoms prior to ICD implantation, and HQOL domains. *A priori* based on the literature, we chose to include sex, age, ICD indication, etiology, and NYHA functional class in adjusted analysis. Variables were removed from the models, based on their statistical significance, to obtain parsimonious models. For this, a P value of <0.05 was considered statistically significant. All analyses were performed with SPSS 15.01 (IBM Corp., Armonk, NY, USA).

Results

Baseline Characteristics of the Total Sample and Stratified by Phantom Shock

From September 2007 until March 2010, 503 patients received an ICD at Medical Spectrum Twente, Enschede, the Netherlands. Of 347 eligible patients, 47 patients refused to participate. No data are available on differences between participants and nonparticipants in baseline characteristics. The remaining 300 patients (83.4% men, mean age = 62.3 ± 11 years) were included in the TICS and informed consent was obtained. Patients were followed for 24 months after ICD implantation. During follow-up, 43 patients died and 26 patients withdrew their informed consent, due to various personal reasons. Baseline characteristics for the total sample and stratified by phantom shock are shown in Table I.

Demographic and Clinical Variables and the Occurrence of Phantom Shocks

Phantom shocks were experienced by 16 patients (5.4%; see Table I). The mean time to phantom shock was 13 weeks (range 0–48 weeks). In univariable analysis, no demographic or clinical variables, including appropriate or inappropriate shocks, were significantly associated with the occurrence of phantom shocks. A weak trend was found for phantom shocks and NYHA functional class < III (P = 0.131).

Table I.

Patient Characteristics Stratified by Phantom Shock† (N = 300)

N (%)	Phantom Shock N = 16 (5.4)	No Phantom Shock N = 284 (94.6)	P Value
Age Mean (SD)	58.4 (15.0)	62.5 (11.0)	0.300
Gender			
Male	14 (87.5)	233 (82.0)	0.746
Female	2 (12.5)	51 (18.0)	
Clinical variables, N (%)			
Primary ICD indication	12 (75.0)	200 (70.4)	1.000
Ischemic heart disease	12 (75.0)	173 (60.9)	0.303
Smoking	3 (18.8)	62 (21.8)	1.000
Comorbidity‡	7 (43.8)	137 (48.2)	0.727
NYHA class < III	15 (93.8)	208 (73.2)	0.131
Prior shock therapy			
Appropriate shock, N (%)	2 (12.5)	38 (13.4)	0.651
Inappropriate shock, N (%)	1 (6.3)	18 (6.3)	0.651
Psychological variables			
Psychological symptoms, HADS§ (N = 267)			
Anxiety symptoms, Mean (SD)	5.8 (4.4)	5.4 (3.7)	0.685
Depressive symptoms, Mean (SD)	3.5 (4.8)	4.4 (3.4)	0.368
Personality, DS14¶ (N = 279)			
Type D personality	1 (7.1)	58 (21.9)	0.314
Negative affectivity, mean (SD)	6.6 (6.1)	7.6 (6.3)	0.586
Social inhibition, mean (SD)	5.9 (4.7)	8.3 (6.0)	0.143
Psychiatric history, MINI†† (N = 290)			
History of anxiety disorder	3 (20.0)	21 (7.6)	0.117
History of depressive disorder	2 (13.6)	53 (19.3)	0.744
Quality of life, SF36‡‡ Mean (SD) (N = 263)			
Physical functioning	61.4 (31.3)	59.5 (27.9)	0.803
Social functioning	69.6 (34.7)	17.2 (28.2)	0.844
Role limitations (physical)	57.1 (46.4)	43.3 (44.4)	0.260
Role limitations (emotional)	78.6 (33.6)	66.1 (41.8)	0.203
Mental health	75.1 (19.0)	73.9 (19.3)	0.808
Vitality	56.1 (22.5)	56.6 (22.3)	0.932
Bodily pain	78.7 (23.0)	74.5 (27.5)	0.577
General health	47.9 (16.4)	51.8 (20.5)	0.481

†Presented as n (%) unless otherwise indicated.
‡Chronic obstructive pulmonary disease (COPD), hypertension, and/or diabetes.
§Hospital Anxiety and Depression Scale (HADS), administered prior to ICD implantation.
¶Type D caseness, as assessed with the Type D Scale (DS14), administered prior to ICD implantation.
††Mini International Neuropsychiatric Interview, administered prior to ICD implantation.
‡‡Short Form Health Survey-36 (SF-36), administered prior to ICD implantation.
ICD = implantable cardioverter defibrillator; NYHA = New York Heart Association; SD = standard deviation.

Psychological Variables and the Occurrence of Phantom Shocks

No significant associations were found between phantom shocks and depressive or anxiety symptoms or the presence of type D personality (Table I). However, a weak trend was found for patients with a lower score on the DS14 subscale Social inhibition and phantom shocks (P = 0.143). Another weak trend was found for the association between history of an anxiety disorder and the occurrence of phantom shocks (P = 0.117).

HQOL and the Occurrence of Phantom Shocks

No associations were found between HQOL subscales and phantom shocks.

Predictors of the Occurrence of Phantom Shocks (Multivariable Analysis)

All variables with a P value lower than 0.15 were entered in a logistic regression analysis. However, none of the variables, history of anxiety disorder (Odds Ratio [OR] 2.47; 95% confidence interval [95% CI] 0.50–12.36; P = 0.270), social inhibition (OR 1.08; 95% CI 0.97–1.20; P = 0.159), or NYHA functional class > III (OR 4.3; 95% CI 0.56–33.9; P = 0.163), were significant correlates of the occurrence of phantom shocks.

Discussion

In this study, we examined psychological predictors for the occurrence of phantom shocks in a cohort of first-time ICD recipients. During a follow-up period of 24 months, 5.4% of patients reported the sensation of a phantom shock. Although some studies have previously addressed the psychological consequences associated with phantom shocks,[17,18] this is the first study to examine psychological predictors for the occurrence of phantom shocks. The results of our study show that there are trends between some of the psychological factors and phantom shocks, but these were not significant and were weak trends: we found that psychiatric history and some type D personality traits were weakly associated with the occurrence of phantom shocks. However, anxiety or depression symptoms and HQOL at baseline were not significantly associated with the occurrence of phantom shocks. Nor did we find any other significant associations between demographic or clinical variables and the occurrence of phantom shocks. Our initial hypothesis was not supported, but the results may serve as hypothesis-generating, and that it would be worthwhile to pursue whether there is an association between these factors and the occurrence of phantom shocks in larger studies.

The weak trend that was found for history of an anxiety disorder and lower scores on the DS14 subscale social inhibition raises the question whether the focus of research on phantom shocks should be on psychological traits (i.e., personality traits or anxiety sensitivity) instead of psychological states (i.e., symptoms of anxiety and depression). The construct *somatosensory amplification* (the tendency to perceive benign somatic sensations or minor physical problems and to label them as symptoms requiring medical intervention)[31] could be of interest when studying the influence of psychological factors on the occurrence of phantom shocks. In that case, phantom shocks could be considered and regarded as a consequence of somatosensory sensitivity. Further research is needed to examine this hypothesis, as in clinical practice, knowledge of the patient's psychological traits may help healthcare professionals in managing and caring for ICD patients more optimally.

This study adds to the findings of previous studies in ICD patients focusing on psychological characteristics and the occurrence of phantom shocks by using a prospective study design, enabling hypotheses about cause and effect. Although most studies used a cross-sectional study design,[17,18] we followed our cohort from the moment of ICD implantation until the end of the follow-up period 2 years later.

This study has some limitations that should be taken into consideration when interpreting the results. First, in the assessment of anxiety and depressive symptoms, type D personality and HQOL patients used self-rating questionnaires instead of a clinical diagnostic interview. We emphasized confidentiality to counter any effect of patient's tendency to response in a social desirable manner. Furthermore, in a recent review it was found that due to the presence of a strong general factor, the HADS might not distinguish well enough between symptoms of anxiety and depression, although the bifactor structure of the HADS was confirmed.[32] Second, gender and age are the only sociodemographic variables included in this study. Other variables, such as social status, educational level, marital status, etc., may also have had a role in the occurrence of phantom shocks, and should be included in future research. Third, a possible explanation for not finding a significant association between psychological indices and the occurrence of phantom shocks might be due to the relatively small incidence of phantom shocks in our population. This could have led to a reduced chance to identify relevant predictors for the occurrence of phantom shocks. The absolute differences in DS14 subscale social inhibition, history of an anxiety disorder, and NYHA functional class < III between those with and without phantom shocks, however, might potentially be of clinical relevance.

In conclusion, this study showed that ICD patients reporting a phantom shock do not seem to have a significantly different demographic, psychological, or clinical profile compared to patients who did not report a phantom shock: no significant associations were found between medical status, anxiety and depressive symptoms, HQOL, psychiatric history, type D personality, and phantom shocks. In order to better understand the underlying factors that play a role in the occurrence of phantom shocks, future studies could be focusing on the role of somatosensory amplification, or include more qualitative

research techniques. An explorative, in-depth structured interview could be used, focusing on how the patient experienced the occurrence of the phantom shock, what his or her perspective is on the phantom shock, and how the patient describes precipitating events. Through rating the answer patterns using content analyses, it would be possible to generate new hypotheses for future studies examining the occurrence of phantom shocks and its correlates.

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