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Health Psychology

Posttraumatic Stress 18 Months Following Cardioverter Defibrillator Implantation: Shocks, Anxiety, and Personality

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Posttraumatic Stress 18 Months Following Cardioverter Defibrillator Implantation: Shocks, Anxiety, and Personality

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Objective: Posttraumatic stress disorder (PTSD) has been observed in cardiac patients, but little is known about PTSD in implantable cardioverter defibrillator (ICD) patients. We examined the prevalence and predictors (clinical variables, personality, and anxiety) of PTSD in ICD patients. **Method:** Three hundred ninety-five ICD patients (20.1% female; mean age = 62.8 ± 10.3 years) from two Dutch referral hospitals completed the 14-item Type D scale (DS14) and the State-Trait Anxiety Inventory to assess Type D (distressed) personality (high negative affect with social inhibition) and anxiety (on the State Anxiety Inventory) at the time of implantation. Logistic regression analysis was performed to identify independent predictors of PTSD at 18 months postimplantation. **Results:** At 18 months postimplantation, 30 patients (7.6%) qualified for a PTSD diagnosis. Of these patients, 55% ($n = 16$) had a Type D personality, 83% ($n = 25$) experienced anxiety at baseline, and 24% ($n = 7$) had experienced shocks during follow-up. Both Type D personality (odds ratio [OR] = 3.5) and baseline anxiety (OR = 4.3) were significant predictors of posttraumatic stress at 18 months postimplantation, independent of shocks and other clinical and demographic covariates. Shocks were not significantly associated with PTSD. **Conclusion:** A significant group of ICD patients is at risk of posttraumatic stress 18 months postimplantation, especially Type D patients and patients with increased levels of baseline anxiety. Identification of patients with Type D personality and anxiety at the time of implantation may be warranted to prevent PTSD in ICD patients.

Keywords: defibrillators, implantable, posttraumatic, Type D personality, anxiety

The implantable cardioverter defibrillator (ICD) is a standard treatment for patients who have severe left ventricular dysfunction (primary prevention), and for patients who have survived life-threatening cardiac arrhythmias (secondary prevention; Ezekowitz et al., 2007). The ICD is an implantable cardiac device with a defibrillator function that can deliver an electric shock in case of life-threatening arrhythmia (Mirowski et al., 1980). The experience of getting an ICD shock (which can be up to 700 V) is often described by patients as “getting kicked in the chest by a big horse.” Shocks—both appropriate and inappropriate¹—have been associated with patient-centered outcomes including reduced quality of life (Burns, Serber, Keim, & Sears, 2005), anxiety, and depression (Poole et al., 2008). However, to date, these studies

have shown mixed findings (Pedersen, van den Broek, van den Berg, & Theuns, 2009).

ICD treatment is generally well accepted by most patients, but a subgroup of ICD patients experiences anxiety (van den Broek et al., 2009), depression (Whang et al., 2005), and poor quality of life (Sears & Conti, 2002). The ICD may serve as a constant reminder of the cardiac disease, and experiencing a shock can cause great stress to patients (Hamner, Hunt, Gee, Garrell, & Monroe, 1999; Spindler & Pedersen, 2005). This may even result in a posttraumatic stress disorder (PTSD; American Psychiatric Association, 1994), which is characterized by the persistence of intrusive memories, avoidance behavior, and hyperarousal. The prevalence of PTSD in cardiac arrest survivors can range from 27% to 38% (Gamper et al., 2004; Ladwig et al., 1999). In ICD patients, a prevalence of 21% at baseline (within 2 months after ICD implantation) and 13% at the 12-month follow-up has been reported, indicating that PTSD tends to abate over time (Kapa et al., 2010).

PTSD is associated with an increased risk of morbidity and mortality in cardiac patients in general (Boscarino, 2008; Kubzan-

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¹ Besides the appropriate shocks, which are triggered by ventricular arrhythmias and are intended to terminate them, patients can also experience inappropriate shocks. Inappropriate shocks are “unnecessary” shocks that are mostly triggered by atrial fibrillation, ventricular tachycardia, or abnormal sensing by the ICD (Daubert et al., 2008).

sky, Koenen, Spiro, Vokonas, & Sparrow, 2007) and a threefold increased risk for mortality in ICD patients specifically (Ladwig et al., 2008). Posttraumatic stress has direct effects on the heart (Pole, 2007), including atrioventricular conduction defects (Boscarino & Chang, 1999) and increased heart rate (Bedi & Arora, 2007). Other research confirms that negative emotions increase the risk of arrhythmias and shocks in ICD patients (van den Broek et al., 2009; Whang et al., 2005). Finally, cardiac patients with posttraumatic stress are more likely to experience impaired health-related quality of life (Cohen et al., 2009; Wikman, Bhattacharyya, Perkins-Porras, & Steptoe, 2008).

Hence, there are several reasons why it is important to identify patients who are at risk of developing PTSD after ICD treatment, but little is known about the determinants of posttraumatic stress in these patients. A number of potential risk factors of PTSD have been identified in previous trauma research, including family history of psychiatric disorders, childhood trauma, depression, female gender (Breslau, 2002; Brewin, Andrews, & Valentin, 2000; von Känel, Baumert, Kolb, Cho, & Ladwig, 2011), and personality (Kunst, Bogaerts, & Winkel, 2010; Mommersteeg et al., 2011). Type D (distressed) personality (i.e., evidenced by a tendency to experience negative emotions and to inhibit self-expression) has been indicated as an independent predictor of PTSD after a myocardial infarction (Chung, Berger, & Rudd, 2007; Pedersen & Denollet, 2004). In addition, both Type D personality and anxiety are found to be related to PTSD in patients who have experienced a myocardial infarction (Chung, Berger, Jones, & Rudd, 2007; Ginzburg et al., 2003) and to adverse health outcomes in ICD patients (Pedersen et al., 2009; van den Broek et al., 2009).

The aim of this study was to determine the prevalence of PTSD symptoms in ICD patients 18 months postimplantation and to examine the role of shocks, anxiety, and Type D (distressed) personality as independent predictors of PTSD in ICD patients.

Method

Patient Sample and Procedure

This study included patients from two Dutch referral hospitals (Amphia Hospital in Breda and Catharina Hospital in Eindhoven) who were hospitalized between May 2003 and June 2008 for implantation with an ICD. Patients had to be between 18 and 80 years of age. Exclusion criteria were cognitive impairments (e.g., dementia), psychiatric history (other than affective disorders), life-threatening comorbidities (e.g., cancer), a life expectancy <1 year, and insufficient knowledge of the Dutch language.

The study was approved by the Medical Ethics Committee of both hospitals and was conducted in accordance with the Helsinki Declaration. All patients provided written informed consent.

Demographic and Clinical Variables

Demographic variables included age, gender, and marital status (having a partner vs. no partner). Clinical variables were obtained from patients' medical records and included ICD indication (primary vs. secondary prevention), coronary artery disease (CAD), and diabetes. During the 18-month follow-up period, data on shocks were collected from the medical records, with electrophysiologists judging the appropriateness of the ICD therapies on the

basis of electrocardiograms. Because of power issues, shocks were divided into 0 versus ≥ 1 appropriate and/or inappropriate shocks. Besides the appropriate shocks, which are triggered by ventricular arrhythmias and are intended to terminate them, patients could also experience inappropriate shocks. Inappropriate shocks are "unnecessary" shocks that are mostly triggered by atrial fibrillation, ventricular tachycardia, or abnormal sensing by the ICD (Daubert et al., 2008).

Type D Personality and Anxiety

Type D personality and state anxiety were assessed at baseline (0 to 3 weeks postimplantation). Type D personality was assessed with the 14-item Type D scale (DS14) (Denollet, 2005). The DS14 consists of two 7-item subscales measuring negative affectivity (NA; e.g., "I often feel unhappy") and social inhibition (SI; e.g., "I am a 'closed' kind of person"). Items are answered on a 5-point Likert-type scale ranging from 0 (*false*) to 4 (*true*), with total scores on both subscales ranging from 0 to 28. A standardized cutoff ≥ 10 on both subscales indicates a Type D personality (Denollet, 2005; Emons, Meijer, & Denollet, 2007). Both subscales are internally consistent, with a Cronbach's alpha of 0.89 for NA and 0.86 for SI in this study and a test-retest reliability over a 3-month period of $r = .72$ and 0.82 for the two subscales, respectively (Denollet, 2005). Type D personality is not associated with objective indicators of disease severity (de Jonge et al., 2007; Martens, Kupper, Pedersen, Aquarius, & Denollet, 2007) and has shown to be a stable construct over time (Martens et al., 2007). This stability is probably mainly due to a genetic factor (Kupper, Boomsma, de Geus, Denollet, & Willemsen, 2011).

The state version of the State-Trait Anxiety Inventory (STAI) was used to assess general symptoms of anxiety, such as worries, concerns, and tension (Van der Ploeg, Defares, & Spielberger, 1980). The STAI is a self-report measure, with 10 items measuring the presence of anxiety and 10 items measuring the absence of anxiety. Items are answered on a 4-point Likert-type scale ranging from 1 (*not at all*) to 4 (*very much so*), with total scores (after recoding the anxiety absent items) ranging from 20 (*low level of state anxiety*) to 80 (*high level of state anxiety*). A state anxiety score >40 has previously been used to assess increased anxiety in the ICD population (van den Broek, Nyklicek, Van der Voort, Alings, & Denollet, 2008). The STAI has shown to be a valid and reliable measure, with Cronbach's alpha ranging from 0.87 to 0.92 (Van der Ploeg et al., 1980).

Posttraumatic Stress

At 18 months follow-up, symptoms of PTSD were assessed with the Posttraumatic Stress Diagnostic Scale (PDS; Foa, 1995), a self-report instrument that can be used to generate a diagnosis of PTSD that is consistent with the criteria of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV;* American Psychiatric Association, 1994). Because receiving an ICD was defined a priori as the traumatic experience in this study, we focused on the 17 PDS items measuring reexperiencing, avoidance, and hyperarousal symptoms related to the ICD. To qualify for a diagnosis of PTSD, the respondent has to endorse at least 1 of 5 reexperiencing symptoms (e.g., "having bad dreams or nightmares about the traumatic event"), at least 3 of 7 avoidance symptoms (e.g., "trying

not to think about, talk about, or have feelings about the traumatic event”), and at least 2 of 5 hyperarousal symptoms (e.g., “having trouble falling or staying asleep”). The frequency of each symptom’s occurrence in the past month is rated on a 4-point scale ranging from 0 (*not at all or only one time*) to 3 (*five or more times a week or almost always*). Patients were classified as having a PTSD diagnosis if they had a positive score on all the three criteria. In previous research in noncardiac populations, the PDS has shown to be a reliable and valid measure, with a Cronbach’s alpha of 0.92 and a high correlation with the STAI ($r = .73-.79$; Foa, Cashman, Jaycox, & Perry, 1997). Cronbach’s alpha for the 17 PDS items in the present study was 0.83.

Statistical Analyses

Groups were compared on discrete variables with the chi-square test, and data are presented as numbers and percentages. Groups were compared on continuous variables with Student’s t test for independent samples, and these data are presented as means plus or minus standard deviations. Univariate and multivariate linear and logistic regression analyses were used to determine the predictors of posttraumatic symptom levels and PTSD diagnosis at 18 months postimplantation. For the logistic regression (predictors of PTSD

diagnosis), dummy variables were created for the Type D personality (high NA/high SI), high NA/low SI, and low NA/high SI. Low NA/low SI served as the reference category. Odds ratios (ORs) with 95% confidence intervals (CIs) are reported for logistic regression, and betas are reported for linear regression analyses. We adjusted a priori for age, gender, secondary indication, CAD, smoking, and (appropriate and inappropriate) shocks received between implantation and at 18 months postimplantation. We analyzed all data with SPSS 17.0. All tests were two-tailed, with a $p < .05$ indicating statistical significance.

Results

Patient Characteristics

Of the 542 patients who were screened, 395 patients were included in the analyses (Figure 1); 8% of these patients, ($n = 30/395$) were classified as having PTSD. No significant differences were observed between patients who were included versus excluded in the analyses. The mean score on the 17 PDS items on reexperiencing, avoidance, and arousal was 3.81 ($SD = 5.04$). Patients with PTSD were significantly more likely to have a Type

Number of patients at baseline

Died between hospitalization and 18 months follow-up

Refused to participate at 18 months follow-up

Lost to follow-up

Missing data on self-report measures

Missing data on clinical measures

Number included patients

Figure 1. Flowchart of patient selection.

D personality, $\chi^2(1) = 20.89, p < .001$; and increased anxiety at baseline, $\chi^2(1) = 18.67, p < .001$; compared with patients without PTSD (Table 1). The prevalence of PTSD was higher among patients who were on psychotropic medication and patients who have experienced shocks during follow-up, but this difference was not statistically significant ($p = .05$). However, this could mean that at least a number of the patients who were diagnosed with PTSD were previously known to medical health providers. No other significant differences were found in demographic or clinical variables in patients with versus without PTSD diagnosis.

Predictors of Posttraumatic Symptoms

Univariate linear regression analyses showed that baseline anxiety ($\beta = 0.32; p < .001$), Type D personality ($\beta = 0.23; p < .001$), and not having a partner ($\beta = 0.12; p = .022$) were significant predictors of posttraumatic symptom levels. In contrast, these symptoms were not predicted by ICD shocks ($\beta = 0.03; p = .56$), secondary indication ($\beta = 0.03; p = .58$), CAD ($\beta = 0.08; p = .14$), diabetes ($\beta = 0.02; p = .77$), age ($\beta = -0.02; p = .72$), or gender ($\beta = 0.03; p = .63$).

Multivariate linear regression showed that baseline anxiety ($\beta = 0.27, p < .001$) and Type D personality ($\beta = 0.13, p = .015$) were the only independent predictors of posttraumatic symptom levels. Not having a partner was no longer a significant predictor ($\beta = 0.09, p = .06$). Once again, shocks ($p = .58$), secondary indication ($p = .59$), CAD ($p = .08$), diabetes ($p = .66$), age ($p = .54$) and gender ($p = .96$) did not predict these symptom levels. In secondary analyses, we tested whether the interaction between baseline anxiety and Type D significantly predicted posttraumatic symptom levels. This model included the main effects of anxiety ($\beta = 1.9$,

$p = .005$) and Type D ($\beta = 2.2, p = .02$), as well as their interaction; however, this interaction was not significant ($\beta = -0.57, p = .71$).

Predictors of PTSD Diagnosis

The diagnosis of PTSD was more prevalent among ICD patients with high baseline anxiety (14%) and patients with a Type D personality (19%), than in patients who received a shock between implantation and 18-month follow-up (12%). Similar to results of posttraumatic symptom levels, univariate logistic regression analyses showed that baseline anxiety (OR = 6.79, 95% CI = 2.54–18.14, $p < .001$) and Type D personality (OR = 5.28; 95% CI = 2.43–11.49, $p < .001$) were significant predictors of PTSD diagnosis, whereas high NA/low SI ($p = .15$), low NA/high SI ($p = .12$), shocks ($p = .16$), secondary indication ($p = .16$), CAD ($p = .32$), diabetes ($p = .15$), age ($p = .18$), gender ($p = .74$) and partner status ($p = .89$) were not associated with the diagnosis of PTSD.

Multivariate analyses confirmed that patients with increased levels of anxiety had a 4.3-fold increased risk and patients with a Type D personality a 3.5-fold increase risk for PTSD diagnosis (Table 2). The other variables, including shocks and secondary indication, were not significant predictors of PTSD diagnosis. High NA/low SI and low NA/high SI were both not significant independent predictors of PTSD diagnosis. In secondary analyses, we tested whether the interaction between baseline anxiety and Type D significantly predicted posttraumatic symptom levels. This model included the main effects of anxiety (OR = 9.1) and Type D (OR = 7.3), as well as their interaction; however, this interac-

Table 1
Baseline Characteristics of the Total Sample as Well as Stratified by PTSD Status

Characteristic	Total (n = 395)	PTSD (n = 30)	Non-PTSD (n = 365)	p
Demographic				
Mean age $\pm$ SD	62.8 $\pm$ 10.3	60.2 $\pm$ 11.8	62.8 $\pm$ 9.9	.18
Gender (female)	75 (19.0)	5 (16.7)	70 (19.2)	.75
Partner (yes)	338 (85.6)	26 (86.7)	312 (85.5)	.86
Clinical				
Indication (secondary)	161 (41.2)	16 (53.3)	145 (40.2)	.16
CAD	285 (72.2)	24 (80.0)	261 (71.5)	.32
Diabetes	64 (16.4)	2 (6.7)	62 (17.2)	.14
Any shocks ^a	58 (15.1)	7 (24.1)	51 (14.4)	.16
Appropriate shocks	40 (10.5)	5 (17.2)	35 (10.0)	.22
Inappropriate shocks	18 (4.7)	2 (6.9)	16 (4.6)	.57
LVEF < 35% ^b	300 (80.0)	26 (78.8)	274 (80.1)	.83
Medication				
Psychotropics	67 (17.9)	10 (30.3)	57 (16.7)	.05
ACE inhibitors	252 (67.0)	21 (63.6)	231 (67.3)	.67
Beta blockers	313 (83.2)	28 (84.8)	285 (83.1)	.80
Statins	259 (68.9)	23 (69.7)	236 (68.8)	.92
Diuretics	239 (63.6)	21 (63.6)	218 (63.6)	.99
Amiodarone	74 (19.7)	4 (12.1)	70 (20.4)	.25
Psychological				
High baseline anxiety	176 (45.6)	25 (83.3)	151 (42.4)	<.001
Type D personality	85 (21.6)	16 (55.2)	69 (18.9)	<.001

Note. Data are presented as numbers (and percentages) unless otherwise indicated. PTSD = posttraumatic stress disorder; CAD = coronary artery disease; LVEF = left ventricular ejection fraction; ACE = angiotensin-converting enzyme.

^a Shocks received between implantation and 18 months. ^b n = 375.

Table 2

Independent Predictors of PTSD Diagnosis at 18 Months After ICD Implantation (Multivariable Logistic Regression)

Predictor variable	OR	95% CI	<i>p</i>
Age	0.97	0.93–1.01	.14
Gender (female)	0.82	0.26–2.57	.73
Partner (yes)	0.66	0.17–2.49	.54
Secondary indication	1.38	0.60–3.21	.45
CAD	1.78	0.58–5.48	.31
Diabetes	0.33	0.07–1.52	.16
Shocks ^a	2.08	0.71–6.06	.18
High baseline anxiety	4.29	1.46–12.57	.008
Type D personality	3.48	1.44–8.41	.006

Note. PTSD = posttraumatic stress disorder; ICD = implantable cardioverter defibrillator; OR = odds ratio; CI = confidence interval; CAD = coronary artery disease; $p \leq 0.05$ are presented in bold face.

^a Both appropriate and inappropriate shocks received between implantation and 18 months follow-up.

tion was not significant (OR = .24). The ORs for PTSD diagnosis are displayed in Figure 2.

Discussion

ICD treatment is generally well accepted by most patients, but some patients suffer from impairments in mental and physical health status (Irvine et al., 2002; Pedersen, Theuns, Erdman, & Jordaens, 2008; Sears & Conti, 2002; van den Broek et al., 2009; Whang et al., 2005). Some patients may even experience posttraumatic stress after implantation of the device (Hamner et al., 1999; Kapa et al., 2010; Ladwig et al., 2008). In the present study, the prevalence of a PTSD diagnosis was 8% at 18 months postimplantation, which is in line with other studies. PTSD has been reported with a prevalence of 21% at baseline and 13% at 12-month follow-up in another ICD study (Kapa et al., 2010). Research within the general cardiac population showed that patients are at risk of developing PTSD after a cardiac event, with a prevalence

rate of 27% in cardiac arrest survivors (Ladwig et al., 1999) and 9.5% in myocardial infarction survivors (Spindler & Pedersen, 2005). Because little is known about the determinants of PTSD in ICD patients, we examined the role of shocks, anxiety, and personality over time. High baseline anxiety was associated with a 4.3-fold increased risk of PTSD diagnosis at 18-month follow-up, and Type D personality was associated with a 3.5-fold increased risk, adjusting for shocks and clinical variables.

Others also found that shocks were not related to PTSD (Kapa et al., 2010; Ladwig et al., 2008; van den Broek et al., 2008), and some have suggested that only patients experiencing ≥ 5 shocks are at risk for emotional distress (Irvine et al., 2002). Research in other cardiac populations seems to confirm that PTSD may be more strongly related to psychosocial patient characteristics than to objective measures of cardiac function (Cohen et al., 2009; Spindler & Pedersen, 2005; Wikman et al., 2008). After controlling for disease severity, Type D and other personality traits

Figure 2. Odds ratios (ORs) of posttraumatic stress disorder (PTSD) diagnosis among patients with an implantable cardioverter defibrillator (ICD) and with low negative affectivity (NA)/high social inhibition (SI), high NA/low SI, and high NA/high SI (Type D personality).

remained independent predictors of posttraumatic stress after myocardial infarction (Chung et al., 2007; Pedersen & Denollet, 2004). Also, Type D personality predicted PTSD in a young, healthy population (Mommersteeg et al., 2010), supporting the notion that the relation between personality and PTSD risk is not caused by somatic confounding.

Our findings indicate that anxiety and Type D personality should not be overlooked in the identification of ICD patients at risk for PTSD. This is important for several reasons. First, cardiac patients with posttraumatic stress are more likely to experience impaired health-related quality of life (Cohen et al., 2009; Wikman et al., 2008). After surviving a myocardial infarction, patients with PTSD have more severe comorbidity than other patients (Chung et al., 2007; Wikman et al., 2008). Type D personality and device-related concerns also have a greater effect on distress after ICD implantation as compared with shocks (Pedersen et al., 2008). Second, posttraumatic stress has been associated with an increased risk of cardiac morbidity and mortality among veterans (Boscarino, 2008) and community-dwelling individuals (Kubzansky et al., 2007) and with a threefold increased risk for mortality in ICD patients (Ladwig et al., 2008). Third, posttraumatic stress is associated with physiological stress responses that may have direct effects on the cardiovascular system (Bedi & Arora, 2007; Kubzansky et al., 2007; Pole, 2007). Heart rate is a robust psychophysiological correlate of PTSD (Pole, 2007), including increased resting heart rate and heart rate responses to stress (Bedi & Arora, 2007) and atrioventricular conduction defects (Boscarino & Chang, 1999). Of note, anxiety and depression are also related to an increased risk of arrhythmias in ICD patients (van den Broek et al., 2009; Whang et al., 2005).

However, several limitations must be acknowledged. First, a relatively small number of patients were classified as having a PTSD diagnosis. Hence, the power for finding more subtle effects of our predictors may have been too small. For example, the prevalence of PTSD was higher in patients who experienced shocks than in nonshocked patients, but this difference was not statistically significant. Limited power also made it impossible to distinguish between appropriate and inappropriate shocks. The distribution of the number of received shocks was also rather small; therefore, we were not able to include the continuous shock scores in the analyses. Second, PTSD diagnosis was set using self-reported symptoms, where diagnostic interviews may perform better in classifying patients as having PTSD. Third, we included no comparison group, which makes it unclear whether the rates of PTSD are significantly higher than in a demographically similar population without an ICD. Fourth, by asking patients to complete the PDS with ICD implantation as a traumatic experience, we excluded the possibility that patients may have experienced another traumatic event. Fifth, we did not have information on preimplantation illness of the patients. It is possible that their medical status could influence the development of adverse psychological outcomes. However, we have compared baseline medical data of patients who did and did not develop PTSD, and there were no significant differences. The strengths of this study include the prospective study design, relatively longer follow-up period, and the use of standardized and validated questionnaires to assess outcome. In the analyses, we have controlled for specific clinical variables, which makes our findings even more reliable.

PTSD is a burden on its own but is also associated with impaired health status (Wikman et al., 2008) and an increased mortality risk in ICD patients (Ladwig et al., 2008). Hence, the identification of ICD patients who have an increased risk to develop posttraumatic stress is of importance. The findings of the present study suggest that patients with a Type D personality and high baseline anxiety may be particularly vulnerable to develop PTSD symptoms. Although systematic screening for posttraumatic symptoms has been advocated by others (Wikman et al., 2008), to date there is not enough evidence to actually recommend screening for PTSD in the ICD population. In our opinion, a number of relevant considerations should be taken into account before implementing screening. First, a reliable screening tool is needed, with good sensitivity and specificity, that will be able to accurately identify the patients that are in need for help. Second, the screening tool should be tested in a RCT before it is implemented in health care. Third, there should be clear guidelines on how to use the screening tool (with an a priori threshold) and what to do in case one detects patients who need further monitoring. Fourth, the assessment tool (if questionnaire) has to be short and easy to use for both patients and practitioners. Fifth, the use of the screening tool (and the treatment that follows) should be cost effective. Sixth, it has to be possible to implement a screening tool in current health care models. Developing a good instrument to screen is a time- and money-consuming effort with possibly low benefits. However, it is important to raise the awareness of the physicians to psychological sequelae and the potential negative outcomes on patients' health. More attention should be paid to patients with psychological problems who need closer monitoring.

It is important to be aware of the fact that medical treatment can influence patient-centered outcomes and that these outcomes and their predictors should not be overlooked. Although to date no ICD intervention research has been conducted with PTSD as outcome measure, a recent study by Shemesh et al. (2011) has shown that cognitive-behavioral therapy can reduce PTSD symptoms in patients with acute cardiovascular events and high baseline PTSD. In addition, patients and clinical trials have shown that cognitive-behavioral therapy as well as exercise training may be indicated for anxious ICD patients (Fitchet et al., 2003; Pedersen, van den Broek, & Sears, 2007).

Our findings indicate that particular attention should be paid to (risk of) posttraumatic stress in ICD patients with high baseline anxiety and/or a Type D personality. Further clarification of the risk factors would provide us with a better understanding of the PTSD construct and may help health care providers provide better care for their patients and perhaps prevent additional health problems.

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