Anxiety in Patients With an Automatic Implantable Cardioverter Defibrillator: What Differentiates Them From Panic Patients?

**Paul Pauli, PhD, Georg Wiedemann, MD, Wilhelm Dengler, MD, Gaby Blaumann-Benninghoff, Dipl.-Psych., and Volker Kühlkamp, MD**

**Objective:** Anxiety seems to be a frequent problem in patients with an automatic implantable cardioverter defibrillator (AICD). Distressing experiences before or after AICD implantation such as resuscitation, or AICD shocks are suspected as causes for enhanced anxiety levels. A closer examination of the level and structure of anxiety in AICD patients and a comparison with panic patients might help to examine additionally both conditioning and cognitive models of anxiety. **Methods:** There were 61 AICD patients examined with a specifically designed AICD questionnaire and standardized anxiety and depression questionnaires. Subgroups of AICD patients without, with some, and with definite anxiety related to AICD shocks were compared with panic patients and healthy control subjects. **Results:** Although fear of dying was greatly reduced by AICD implantation, approximately one third of the AICD patients, especially patients with definite anxiety related to AICD shocks, were characterized both by enhanced anxiety levels and avoidance behavior. These patients were comparable with panic patients in most questionnaire scores. Anxiety levels were not associated with objective AICD shock experiences or medical variables. **Conclusions:** Anxiety in AICD patients seems to be unrelated to traumatic experiences, a finding that casts doubt on pure conditioning models of anxiety. Presumably, a life-threatening cardiac disorder increases the likelihood for catastrophic interpretations of bodily signs, especially in anxiety prone AICD patients. In accordance with cognitive models of panic disorder, this cognitive dysfunction could lead to anxiety and depression levels comparable with those of panic patients. **Key words:** automatic implantable cardioverter defibrillator, AICD, anxiety, panic disorder.

AICD = automatic implantable cardioverter defibrillator; US = unconditioned stimulus; UR = unconditioned response; CS = conditioned stimulus; CR = conditioned response; ACQ = Agoraphobia Cognition Questionnaire; BSQ = Body Sensation Questionnaire; FSS = Fear Survey Schedule; TAI = Trait Anxiety Inventory; BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; MI = Mobility Inventory.

**INTRODUCTION**

Sudden cardiac death is one of the leading single causes of mortality. Life-threatening malignant arrhythmias are often ventricular tachycardias or ventricular fibrillations. An increasingly important treatment for patients with malignant arrhythmias is the AICD. This device is highly reliable in the termination of life-threatening malignant arrhythmias and clearly reduces the likelihood of sudden cardiac death (1, 2). Despite its proven medical success and its increased clinical indication, little is known about the psychological and psychiatric consequences of AICD implantation and AICD shock experience.

The most frequently observed psychological problems in AICD patients are anxiety, panic attacks, depression, emotional lability, anger, or adjustment disorder (3–8). These problems may be caused by distressing experiences before or after AICD implantation, such as diagnosis of a life-threatening disease, experience of resuscitation, unpredictable recurrence of malignant arrhythmias, and restricted physical capabilities. Additionally, the AICD treatment includes distressing experiences, such as invasive medical examinations, induction and termination of ventricular tachycardias or fibrillations, and experiences of spontaneous AICD shocks.

Most empirical studies have focused on AICD shocks as distressing experiences that might cause anxiety or affective problems. AICD shocks induce feelings of nervousness, weakness, fear, and palpitations (9). Approximately 50% of AICD patients report pain (10) and 40% to 60% report anxiety related to AICD discharges (10–12). For approximately 30% of AICD patients, anxiety related to AICD discharges is the single most distressing aspect of the AICD treatment (10, 11).

Clinical impressions and single case descriptions suggest that AICD shock experiences cause tonically increased anxiety levels or anxiety problems in AICD patients (4, 5, 13). However, empirical studies including larger samples of AICD patients are equivocal. Morris et al. (6) examined 20 AICD patients and found only a trend (p = .055) for unplanned perioperative shocks to be associated with psychiatric disorder (depression or panic disorder), whereas psychiatric dis
orders were clearly associated with family psychopat-
holology. Scho¨hl et al. (12) and L¨uderitz et al. (10)
found associations between shock experiences and re-
ports of anxiety. However, Scho¨hl et al. assessed anx-
xiety levels with only a single question (“Do you have
feelings of anxiety since AICD implantation?”). Lu¨d-
iert et al. (10) administered psychometric state and
trait anxiety measures (Spielberger Anxiety Inventory)
12 months after AICD implantation and found that
patients who received more than five shocks devel-
oped higher state but not trait anxiety than those with
fewer shock experiences. However, state anxiety was
also modulated by the patients’ age, with younger pa-
tients (age < 50 years) exhibiting more anxiety. There-
fore, it remained unclear whether age or shock expe-
rience was the crucial variable. In contrast to these
studies, both Chevalier et al. (3) and Keren et al. (14),
also using standardized questionnaires (eg, Hamilton
Anxiety Scale, Spielberger Anxiety Inventory, Beck
Depression Inventory), did not find any influence of
shock experience on various psychometric measures
(ie, anxiety, depression, quality of life).

Findings regarding anxiety in AICD patients may be
relevant for conditioning models of anxiety. These
models assume classical conditioning on the basis of
an unconditioned stimulus (US), which triggers anx-
xiety as an unconditioned response (UR). Interoceptive
or external conditioned stimuli (CS), which become
associated with the US, then also elicit anxiety as a
conditioned response (CR). For AICD patients, tra-
umatic experiences, such as an AICD discharge or a
resuscitation, are potentially relevant USs. AICD
shocks can be painful and are often described as sim-
ilar to being punched in the chest. Strong electrical
stimulation is also known to trigger high anxiety and
acts as an US (15, 16). Conditioning models suggest
that AICD patients who experienced traumatic anx-
xiety-eliciting events, such as AICD shocks or resusci-
tations, are especially prone to show increased levels
of anxiety and avoidance behavior. Owen and Harri-
on (13) described an AICD patient who developed over-
whelming fear and agoraphobic avoidance behavior.
The patient complained that he was no longer able to
live independently because he was unable to “open
the refrigerator door” or “touch the water faucet.” The
patient recalled both stimuli as related to his previous
cardiac arrest, which occurred while working in the
kitchen. Although not discussed by Owen and Harri-
on, classical conditioning seems to be the most likely
cause for the patient’s anxiety.

Findings of anxiety in AICD patients may also be
relevant for cognitive models of anxiety, especially
panic disorder. Panic patients are characterized by a
fear of certain bodily sensations (17–21), and cardiac
symptoms are the symptoms that they fear most fre-
quently (22). Panic patients are assumed to interpret
bodily sensations as evidence for a life-threatening
disaster, often a medical emergency situation (ie, per-
ceiving palpitations as evidence of a heart attack). As a
matter of fact, panic patients had more emergency
room visits than cardiac patients (23). Cognitive mod-
els (17, 24) assume that the misinterpretation of certain
bodily sensations, including cardiac symptoms, in a
negative or catastrophic way is a necessary condition
for the production of panic attacks. AICD patients have
a serious, life-threatening cardiac disorder and experi-
enced emergency room visits. These experiences pre-
sumably make them prone for catastrophic interpreta-
tions of bodily signs. AICD shocks or other cardiac
symptoms, as well as bodily sensations, could be in-
terpreted as evidence for a threatening disaster. On the
basis of such a cognitive model, both the interpretation
of and the fear of future shocks should be associated
with the development of enhanced general anxiety
levels. Patients who are characterized by a cata-
strophic interpretation of bodily symptoms and by
anxiety related to AICD shocks should have an in-
creased likelihood to develop an anxiety structure and
avoidance behavior comparable with panic patients.

The purpose of the present study was to addition-
ally elucidate the level and structure of anxiety in
AICD patients. This was done by first examining
whether there is a relation between the experience of
distressing or traumatic events (AICD shocks, resusci-
tations) and fear of dying before or after AICD implan-
tation or anxiety related to future AICD shocks. Sec-
ond, the association between sociodemographic or
medical characteristics of AICD patients, their experi-
ence of distressing events, and more general measures
of anxiety or depression was investigated. Third, AICD
patients, panic patients, and healthy control subjects
were compared regarding level and structure of anx-
ity and depression. Fourth, avoidance behavior of
AICD patients was compared with avoidance behavior
of panic patients and healthy control subjects.

METHODS

Subjects

All of the 124 AICD patients aged below 65 years at the Medical
Clinic of the University of T¨ubingen were contacted through a letter
from their cardiologist (V.K.).1 This letter informed the patients about
an ongoing research project about coping and anxiety in patients
with a distressing disease, including patients with an AICD. It was

1 Patients older than 65 years were excluded because we expected
them to have memory and concentration problems and, therefore,
will have difficulties with the rather complex questionnaires.
emphasized that this research would, in the long run, improve the psychosocial treatment of patients with an AICD, and patients were encouraged to participate. Patients were asked to sign a consent form, thereby allowing the research team to contact them and to send them a set of questionnaires.

There were 70 AICD patients who gave written consent. These patients were mailed a set of questionnaires with a cover letter emphasizing that all questionnaire data would be treated confidentially and analyzed anonymously. A prepaid return envelope was also included. Questionnaires were returned by 61 patients, which corresponds to 87% of the patients who gave written consent. See the Results section for a detailed description of the AICD patients.

There were 36 panic patients recruited from the anxiety outpatient clinic of the University Hospital of Psychiatry and Psychotherapy. These patients were diagnosed by experienced psychiatrists (G.W. or W.D.) according to DSM-IV. A set of questionnaires was handed to the patients for completion at home. Patients returned the questionnaires at the next session or by mail. The 29 control subjects were recruited through advertisements, mainly as control subjects for the panic patients. They were screened for somatic or psychiatric diseases and then asked to complete the questionnaires at home. They returned the questionnaires mainly through mail. Control subjects received financial reward for participation. See the Results section for the age and sex ratio of panic patients and control subjects.

**Questionnaires**

An AICD questionnaire was developed for the present study to assess anxiety related to AICD implantation. All other questionnaires are widely used, standardized, and well-validated instruments.

The AICD-questionnaire contains the following items. Fear of dying, both before and after AICD implantation, and anxiety related to future AICD shocks were assessed with three-point scales (no anxiety, some anxiety, definite anxiety). The number of AICD shocks experienced since AICD implantation was assessed through the patients’ report. The relative number of AICD shocks per year was then calculated. Medical records of the patients indicated the underlying cardiac diagnosis and the occurrence of resuscitations.

The ACQ (German version) (25) consists of 14 items and assesses catastrophizing cognitions. Each item is rated on a 5-point scale, ranging from 1 = “thought never occurs” to 5 = “thought always occurs.” Mean scores can be calculated for two subscales. The “loss of control” subscale (ACQ-loss of control) consists of 7 items (eg, “I am going to go crazy”) and the “physiological consequences” subscale (ACQ-physiological) consists of 5 items (eg, “I will have a heart attack”). Two items are discarded for the subscale analysis.

The BSQ (German version) (25) consists of 17 items and assesses anxiety of bodily symptoms (eg, “heart palpitations”). Each item is rated on a 5-point scale, ranging from 1 = “not frightened or worried by this sensation” to 5 = “extremely frightened by this sensation.” A mean score is calculated.

The FSS is an adapted version of the FSS-III (26)(German version (27)) and consists of 55 items. Each item describes a specific stimulus (eg, “snakes”) or a specific situation (eg, “driving a car”) and is rated on a 4-point scale, ranging from 0 = “no anxiety” to 3 = “extreme anxiety.” A sum score is calculated.

The TAI (Spielberger Trait Anxiety Inventory, German version (28)) consists of 20 items (eg, “I am happy”) that are rated on 4-point scales, ranging from 1 = “about never” to 4 = “about always.” A sum score is calculated.

The BAI (29) consists of 21 items describing sensations related to anxiety (eg, “weakness”) that are rated on 4-point scales, ranging from 0 = “never” to 3 = “extreme.” A sum score is calculated.

The BDI (30) assesses depression with a sum score potentially ranging from 0 to 63. A score between 4 and 7 indicates slight depression, between 8 and 15 moderate depression, and more than 15 severe depression.

The MI (German version (25)) consists of 26 items describing the most important agoraphobic situations (eg, “elevator”). Each item is rated on a 5-point scale, ranging from 1 = “avoid situation never” to 5 = “avoid situation always.” Items are rated twice: when alone (MI-alone) and when accompanied (MI-accompanied). Participants frequently did not answer items, presumably because these items were not relevant for them. To have a reliable measure of agoraphobic avoidance behavior, mean scores were calculated for both subscales only for participants who answered at least 20 of the 26 items.

**Statistical Analysis**

Differences between subgroups of AICD patients on continuous variables were tested with t tests or analysis of variance (ANOVA). Associations between continuous variables or nominal variables were analyzed with Pearson’s correlations and χ² tests, respectively.

A multivariate approach was taken to analyze associations or differences between the standardized anxiety and depression questionnaires. Dependent variables were the questionnaire data (ACQ-body, ACQ-loss, BSQ, FSS, TAI, BAI, BDI) taken as a whole. Only significant effects revealed by the multivariate test were analyzed additionally. This multivariate approach was taken to reduce the number of necessary tests and to avoid multiple testing.

Associations between continuous variables characterizing AICD patients (eg, age, time since AICD implantation) and their anxiety and depression levels were analyzed with multiple regressions, using the questionnaire data taken as a whole as dependent variable. Significant effects were additionally evaluated with Pearson’s correlations. Associations between nominal variables characterizing AICD patients (eg, sex, diagnosis, resuscitation) and their anxiety and depression questionnaires were analyzed with multivariate analyses of variance (MANOVAs), using the questionnaire data taken as a whole as dependent variable. Significant effects were additionally evaluated with univariate tests (ANOVA) and post hoc comparisons.

Differences between AICD patients, panic patients, and healthy control participants in anxiety and depression levels were also analyzed with a MANOVA with the questionnaire data taken as a whole as dependent variables. Significant effects were additionally evaluated with univariate tests (ANOVA) and post hoc comparisons. This MANOVA also included the variables age and sex, in order to control for age, F(2,123) = 55.3, p < .001, and sex ratio, χ²(2) = 35.0, p < .001, differences between AICD patients, panic patients, and control participants. The AICD patients were significantly older and included more males than the panic patients or the healthy controls, whereas panic patients and healthy controls did not differ on these variables.

The two scales of the MI were not included as dependent variables in the overall MANOVAs because of missing data. The subsample of patients with complete MI questionnaires (see above) was analyzed with two univariate tests (ANOVA).

**RESULTS**

**Patients Characteristics**

Table 1 describes the sample of AICD patients. The patients’ ages varied from 25 to 65 years with a mean of 56, and most patients were male (80%). The time since AICD implantation was, on average, 23 months with a

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minimum of 2 months and a maximum of 89 months. The most frequent underlying heart diseases were coronary heart disease (CHD, 51%) and cardiomyopathy (CM, 36%).

Approximately half of the patients (53%) had experienced a resuscitation because of cardiac failure before AICD implantation, and about half of the AICD patients (46%) had experienced AICD shocks after implantation. The whole sample of patients experienced about 2.5 shocks since AICD implantation, which represents an average of 1.8 shocks per year. The sub-sample of patients who received at least one AICD shock experienced 5.5 shocks or an average of 4.0 shocks per year. Time since AICD implantation tended to be longer in patients with shock experience (2.2 years ± 1.6) than in patients without shock experience (1.5 years ± 1.2), t(56) = 1.9, p = .06. However, the time since AICD implantation did not correlate with the absolute or relative numbers of shocks, r = .19, not significant (NS), and r = -.10, NS, respectively.

**Fear of Dying**

Table 1 (last three rows) also displays the ratings of AICD patients regarding their fear of dying before and after AICD implantation and regarding their anxiety related to AICD shocks. Before AICD implantation, 23% of the patients experienced some fear and 18% experienced definite fear of dying, whereas 59% did not experience fear of dying. There was no association between fear of dying before AICD implantation, the underlying diagnosis $\chi^2(4) = 4.5$, NS, and the experience of resuscitation, $\chi^2(2) = 1.3$, NS.

After AICD implantation, only 8% of the patients reported definite fear of dying, 18% some fear of dying, and 74% reported no fear of dying. Thus, AICD implantation significantly reduced fear of dying, $\chi^2(4) = 14.4$, p < .01. Fear of dying after AICD implantation was unrelated either to the underlying diagnosis, $\chi^2(4) = 3.8$, NS, or to time since AICD implantation, $F(2,57) = 2.1$, NS. However, it was positively associated with shock experience, $\chi^2(2) = 8.2$, p = .02, with the absolute number of shocks, $F(2,56) = 15.4$, p < .001, and with the relative number of shocks per year, $F(2,55) = 7.6$, p = .001.

**Anxiety Related to AICD Shocks**

Definite anxiety related to AICD shocks was reported by approximately one third of the patients (34%). Approximately another third reported some anxiety related to future shocks (31%), and one third reported no anxiety related to future shocks (34%). There were no significant associations between anxiety related to AICD shocks and either resuscitation, $\chi^2(2) = 1.3$, NS, time since AICD implantation, $F(2,57) = 1.4$, NS, shock experience, $\chi^2(2) = 1.0$, NS, absolute number of experienced shocks, $F(2,56) = 2.3$, NS, or relative number of shocks experienced per year, $F(2,55) = .8$, NS.

Anxiety related to AICD shocks was significantly associated with fear of dying before AICD implantation, $\chi^2(4) = 10.5$, p = .03, and with fear of dying after AICD implantation, $\chi^2(4) = 21.5$, p < .01.

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**TABLE 1. Description of AICD Patients**

<table>
<thead>
<tr>
<th></th>
<th>N (%)</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
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<tbody>
<tr>
<td>Age (yr)</td>
<td>55.7 ± 9.0</td>
<td>25–65</td>
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<tr>
<td>Sex ratio</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Male</td>
<td>49 (80)</td>
<td></td>
<td></td>
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<tr>
<td>Female</td>
<td>12 (20)</td>
<td></td>
<td></td>
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<tr>
<td>Time since AICD implantation (mo)</td>
<td>22.8 ± 19.2</td>
<td>2–89</td>
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<tr>
<td>Cardiac Diagnosis</td>
<td></td>
<td></td>
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<tr>
<td>CHD*</td>
<td>31 (51)</td>
<td></td>
<td></td>
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<tr>
<td>CM</td>
<td>22 (36)</td>
<td></td>
<td></td>
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<tr>
<td>Idiopathic</td>
<td>5 (8)</td>
<td></td>
<td></td>
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<tr>
<td>Other</td>
<td>3 (5)</td>
<td></td>
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<tr>
<td>Resuscitation</td>
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<tr>
<td>No</td>
<td>28 (47.5)</td>
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</tr>
<tr>
<td>Yes</td>
<td>31 (52.5)</td>
<td></td>
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<tr>
<td>AICD shock experience</td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>32 (54)</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>27 (46)</td>
<td></td>
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<tr>
<td>Frequency of AICD shocks</td>
<td></td>
<td></td>
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<tr>
<td>All patients</td>
<td>2.5 ± 5.7</td>
<td>0–30</td>
<td></td>
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<tr>
<td>Patients with shock</td>
<td>5.5 ± 7.5</td>
<td>1–30</td>
<td></td>
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<tr>
<td>experience only</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Relative frequency of AICD shocks (N/yr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>1.8 ± 4.8</td>
<td>0–26</td>
<td></td>
</tr>
<tr>
<td>Patients with shock</td>
<td>4.0 ± 6.6</td>
<td>0.4–26</td>
<td></td>
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<tr>
<td>experience only</td>
<td></td>
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<tr>
<td>Fear of dying before AICD implantation</td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>36 (59)</td>
<td></td>
<td></td>
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<tr>
<td>Some</td>
<td>14 (23)</td>
<td></td>
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<tr>
<td>Definite</td>
<td>11 (18)</td>
<td></td>
<td></td>
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<tr>
<td>Fear of dying after AICD implantation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>45 (74)</td>
<td></td>
<td></td>
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<tr>
<td>Some</td>
<td>11 (18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definite</td>
<td>5 (8)</td>
<td></td>
<td></td>
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<tr>
<td>Anxiety related to AICD shocks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>21 (34.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some</td>
<td>19 (31)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definite</td>
<td>21 (34.5)</td>
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</table>

* CHD = coronary heart disease; CM = cardiomyopathy.
Associations Between Anxiety and Depression Measures and AICD-Patient Characteristics

The anxiety and depression levels of AICD patients as assessed with standardized questionnaires did not correlate with either age of patients, $F(7,49) < 1.0$, NS, time since AICD implantation, $F(7,49) = 1.6$, NS, or absolute, $F(7,48) < 1.0$, NS, or relative number of AICD shocks per year, $F(7,48) < 1.0$, NS. In addition, the anxiety and depression levels of AICD patients were independent of sex of the patients, Wilks $\lambda = .81$, $F(7,48) = 1.7$, NS, underlying diagnosis, Wilks $\lambda = .72$, $F(14,88) = 1.2$, NS, resuscitation, Wilks $\lambda = .80$, $F(7,46) = 1.7$, NS, or experience of at least one AICD shock, Wilks $\lambda = .76$, $F(7,46) = 2.1$, NS.

Only anxiety related to AICD shocks was significantly related to the anxiety and depression scores of AICD patients, Wilks $\lambda = .54$, $F(14,94) = 2.4$, $p < .01$, and univariate follow-up tests revealed that the anxiety related to future shocks significantly affected all questionnaire measures, all $F(2,53) < 5.0$, all $p$ values $< .01$. Table 2 (left three columns) displays mean anxiety and depression scores of AICD patients differentiated according to their level of anxiety related to AICD shocks. An increase in anxiety related to AICD shocks was positively associated with an increase in all anxiety and depression questionnaire scores.

Differences Between AICD-Patients, Panic Patients, and Control Participants

Table 2 also displays anxiety and depression scores of panic patients and healthy control participants. A comparison between groups revealed that AICD patients with definite anxiety related to future shocks exhibited questionnaire scores comparable with panic patients. On the other hand, AICD patients without anxiety related to AICD shocks had scores comparable with healthy control participants. To confirm this observation statistically, a MANOVA was conducted which compared AICD patients without, with some, and with definite anxiety related to future shocks with panic patients and healthy control participants on anxiety and depression measures. This MANOVA revealed that the five groups differed significantly in the questionnaire scores, Wilks $\lambda = .42$, $F$ approx. $(28,366) = 3.6$, $p < .001$. Univariate follow-up tests for the seven questionnaires indicated significant group differences for all questionnaires, all $F$ values $(4,116) > 12$, all $p$ values $< .001$. Additional post hoc tests indicated three major findings: First, AICD patients with definite anxiety related to future shocks showed scores comparable with those of the panic patients for all but one questionnaire (see below), all $p$ values $< .05$. Second, AICD patients without anxiety related to future shocks did not differ from control subjects in their questionnaire scores, all $p$ values $> .05$. Finally, AICD patients with some anxiety related to future shocks revealed scores for all but one questionnaire (see below) which fell between the scores of healthy controls and panic patients. The only exception to this pattern was found for the ACQ-loss of control subscale. ACQ-loss of control scores of all AICD patients were comparable with those of healthy control sub-

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**TABLE 2. Measures of Anxiety, Depression, and Agoraphobic Avoidance in AICD Patients, Panic Patients, and Control Participants**

<table>
<thead>
<tr>
<th></th>
<th>AICD Patients Differentiated by Anxiety Related to AICD Shocks</th>
<th>Control Subjects</th>
<th>Panic Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No anxiety</td>
<td>Some anxiety</td>
<td>Definite anxiety</td>
</tr>
<tr>
<td><strong>Sex ratio (M/F)</strong></td>
<td>18/3</td>
<td>16/3</td>
<td>15/6</td>
</tr>
<tr>
<td><strong>Age (yr)</strong></td>
<td>55.8 ± 9.8</td>
<td>58.8 ± 7.4</td>
<td>52.9 ± 10.9</td>
</tr>
<tr>
<td><strong>ACQ-physiological consequences</strong></td>
<td>1.19 ± .24</td>
<td>1.45 ± .38</td>
<td>1.78 ± .62</td>
</tr>
<tr>
<td><strong>ACQ-loss of control</strong></td>
<td>1.14 ± .19</td>
<td>1.15 ± .20</td>
<td>1.46 ± .49</td>
</tr>
<tr>
<td><strong>BSQ</strong></td>
<td>1.51 ± .42</td>
<td>1.87 ± .55</td>
<td>2.17 ± .85</td>
</tr>
<tr>
<td><strong>FSS</strong></td>
<td>14 ± 13</td>
<td>22 ± 15</td>
<td>42 ± 27</td>
</tr>
<tr>
<td><strong>STAI</strong></td>
<td>34 ± 9</td>
<td>37 ± 9</td>
<td>48 ± 12</td>
</tr>
<tr>
<td><strong>BAI</strong></td>
<td>8 ± 6</td>
<td>10 ± 8</td>
<td>19 ± 13</td>
</tr>
<tr>
<td><strong>BDI</strong></td>
<td>7 ± 4</td>
<td>7 ± 5</td>
<td>14 ± 8</td>
</tr>
<tr>
<td><strong>M-a-alone</strong></td>
<td>1.46 ± .72</td>
<td>1.54 ± .58</td>
<td>2.30 ± .93</td>
</tr>
<tr>
<td><strong>M-a-accompanied</strong></td>
<td>1.20 ± .36</td>
<td>1.28 ± .31</td>
<td>1.90 ± .69</td>
</tr>
</tbody>
</table>

*Values are mean ± SD.*
Avoidance Behavior

Table 2 (last two rows) shows the MI-alone and MI-accompanied scores for the subsamples of patients with complete MI questionnaires (see Methods). ANOVAs revealed significant group effects for the MI alone, $F(4,98) = 13.5, p < .001$, and the MI-accompanied scores, $F(4,93) = 12.5, p < .001$. Post hoc tests indicated that AICD patients with definite anxiety related to AICD shocks were characterized by MI scores that were higher than those for healthy control participants, both $p$ values < .05, and comparable with panic patients, both $p$ values > .05. However, AICD patients without anxiety related to future shocks revealed MI scores comparable to control subjects, both $p$ values > .05, but significantly lower than panic patients, both $p$ values < .05. AICD patients with some anxiety revealed scores falling between scores for panic patients and control subjects.

DISCUSSION

The present sample of 61 AICD patients was comparable to those of most other studies regarding age and sex ratio (eg, Refs. 3, 31). In addition, coronary heart disease followed by cardiomyopathy were the most frequent underlying cardiac diagnoses both in our sample and in most other studies (3, 10, 12). Approximately half of the patients of our sample had been resuscitated (53%), which is somewhat lower than in other studies (Stankoweit et al. 31, 69%; Schöhl et al. 12, 86%).

Anxiety seems to be one of the major psychological problems of AICD patients (8). In our sample, approximately 40% of the patients experienced at least some fear of dying before AICD implantation. AICD implantation significantly reduced fear of dying. This reduction in anxiety is in line with previous studies (8, 12) and reflects an important therapeutic effect of the device. However, 26% of our patients still experienced at least some fear of dying, and Schöhl et al. (12) reported that 11% of their patients had anxiety related to malignant arrhythmias after AICD implantation. Therefore, we conclude that AICD implantation reduces anxiety; however, a considerable number of patients still experiences substantial anxiety after AICD implantation. Inasmuch as no indication was found that anxiety decreases with time after AICD implantation (see also Ref. 11), the need for psychological or psychiatric support for at least a subgroup of patients is evident. Tools to identify these patients would be very helpful.

AICD discharge may be one of the important reasons for anxiety in AICD patients (5). A convergent finding, both in the present and most other studies (3, 31), is that approximately 50% of the AICD patients experienced one or more discharges since implantation. However, 65% of our patients reported anxiety related to future shocks; 34% reported definite anxiety and 31% some anxiety. These numbers seem to be reliable because Schöhl et al. (12) found that 58% of their AICD patients reported anxiety related to shocks, and Lüderitz et al. (11) discovered that 35% of their patients considered anxiety related to AICD discharge as their most distressing problem.

In line with the hypothesis that anxiety in AICD patients may be caused by the experience of AICD shocks (4, 6, 32), we found that fear of dying after AICD implantation was positively associated with shock experience. Schöhl et al. (12) also reported an association between anxiety since AICD implantation and shock experience. Interestingly, in both studies these associations were found for anxiety assessed with a single question and with a clear reference to the time since AICD implantation. Despite the open issue of the lack of reliability and validity of a single-item assessment, it could be postulated that the reference to the time since AICD implantation makes patients answer the questions on the basis of frequency of experienced shocks.

However, we and two previous studies (3, 14) found no association between shock experiences and psychometrically assessed levels of anxiety or depression. Only Lüderitz et al. (10) found that a state, but not a trait anxiety measure was enhanced in patients who experienced more than five AICD shocks. This finding does not conflict with our results inasmuch as both studies found no effect of AICD shock experience on trait anxiety. However, Keren et al. (14) found no association between trait or state anxiety and shock experience. It is conceivable that Lüderitz et al. (10) examined an atypical sample of AICD patients with frequent shock experiences (13 shocks within 20 months vs. less than 5 shocks within 2 years in the present and in the Keren et al. studies). In addition, Lüderitz et al. (10) also found that the patients’ age affected state anxiety, with younger patients (age < 50) exhibiting more anxiety. Therefore, it remains unclear whether age or frequency of shocks were the crucial variable. On the basis of most of the data, we would conclude that AICD shock occurrence is not associated with psychometrically assessed levels of anxiety and depression.

The AICD patients’ anxiety and depression levels
were closely associated with their anxiety related to future AICD shocks. These expectations regarding the consequences of future AICD discharges seem to depend mainly on psychological variables (eg, trait anxiety), and are unrelated to medical variables (eg, AICD shocks). An increase in anxiety related to future AICD shocks was associated with an increase in most anxiety and depression scores. It is important to note that the questionnaires used not only assess anxiety related to bodily sensations (such as the BSQ or the ACQ-physiological consequences subscale), but also trait anxiety (TAI), anxiety related to a wide variety of stimuli (FSS), depression (BDI), and agoraphobic behavior (MI). The only exception found was the ACQ subscale “loss of control,” in which all AICD patients exhibited scores similar to healthy subjects and lower than panic patients. Loss of control may represent a cognition that presumably is a specific characteristic of panic patients.

Conditioning models assume that traumatic events such as AICD shocks or resuscitations may serve as unconditioned stimuli (US) which elicit anxiety and, therefore, play an important role for the development of anxiety in AICD patients. However, we found no associations between resuscitation or shock experiences and psychometrically assessed levels of anxiety. As a matter of fact, there are AICD patients who never experienced a resuscitation or an AICD shock, but who report anxiety related to future shocks and who exhibit high general anxiety levels and avoidance behavior. There also were no associations between anxiety and depression measures and other medical factors (underlying diagnosis, time since AICD implantation). Therefore, our data cast doubt on simple conditioning models of anxiety in AICD patients, although it is still possible that unconditioned stimuli, which we did not assess, might be responsible for conditioning processes in AICD patients. In our opinion, the most straightforward explanation of our findings is on the basis of a cognitive model of anxiety and panic disorder (17, 19). A cognitive model predicts that anxiety of AICD patients is unrelated to objectively distressing experiences or medical complications; rather, it depends on catastrophic cognitions. AICD patients have a serious life-threatening cardiac disorder that might induce panic-like cognitions and anxiety (with the exception of loss of control) in a subgroup of AICD patients. This is reflected in their anxiety related to future AICD shocks and their increased BSQ and ACQ-physiological consequences scores. The catastrophic, negative interpretation of bodily symptoms and anxiety related to possible AICD shocks presumably triggers anxiety and, in the long run, leads to high general levels of anxiety and depression as well as avoidance behavior.

However, not all AICD patients show a catastrophic interpretation of bodily signs and enhanced anxiety and depression levels. Similarly, not all individuals who experience a panic attack will develop a panic disorder. Factors that are known to play an important role in the development of panic disorder may also be important for the development of anxiety in AICD patients (33–36). Most importantly, AICD patients with a premorbidly enhanced anxiety level may be prone to interpret bodily signs in a catastrophic manner and to develop additionally increased levels of anxiety and depression. Prospective studies are warranted to additionally elucidate this model and to identify variables that predispose AICD patients for the development of enhanced anxiety and depression levels.

Finally, we would like to address two critical issues. First, multiple comparisons were made without correcting the α error. Second, the present study used self-report measures only, and the AICD questionnaire consists of single-item questions with unknown reliability and validity. However, correction of α error would simultaneously reduce the power of tests leading to a different type of error (37), and the unusual nature of the population warranted consideration of any possible difference. In addition, our main findings were highly significant \( p < .01 \) and were reflected consistently in several different measures of anxiety. Finally, most of the questionnaires in this study are widely used, standardized, reliable, and well-validated. Therefore, our findings seem to be highly reliable and it is unlikely that the present findings arose only as an artifact of the statistical tests. Nevertheless, future studies should be conducted to provide additional confirmatory observational and clinical data.

In summary, the present study demonstrated that an AICD implantation leads to a significant reduction of anxiety. However, enhanced anxiety and depression scores are still evident in AICD patients. One third of the patients exhibited anxiety and depression levels comparable with DSM-IV diagnosed panic patients. Anxiety in AICD patients seems to be unrelated to traumatic experiences (eg, resuscitation, AICD discharge), a finding which casts doubt on pure conditioning models. A more likely explanation would be that the life-threatening cardiac disorder causes enhanced anxiety and depression levels in AICD patients who are prone for catastrophic interpretations of bodily signs.

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