Anxiety and Depression in Implanted Cardioverter-Defibrillator Recipients and Heart Failure: A Review

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KEYWORDS

- Psychological distress
- Implantable cardioverter-defibrillator
- Gender • Age • Shocks • ICD

Implanted cardioverter-defibrillators (ICDs) are surgically implanted automatic electrical devices designed to terminate ventricular arrhythmias and prevent sudden cardiac death (SCD). They provide antitachycardic pacing and/or deliver a low-energy shock to the heart.[1] In the last decade the use of ICDs has expanded from secondary prevention in patients who have experienced significant ventricular arrhythmias to primary prevention in patients who are at risk for significant ventricular arrhythmias. The clinical use of ICDs for primary prevention in patients with heart failure (HF) escalated rapidly after the Multicenter Automatic Defibrillator Implantation Trial II (MADIT-II)[2] and Sudden Cardiac Death in Heart Failure trial (SCD-HeFT)[3] demonstrated their benefits for reducing mortality in patients with HF or reduced ejection fraction and without significant ventricular arrhythmias. The positive results of these clinical trials, improved ICD technology, and ease of insertion are leading to a rapid expansion in use of these devices. Guidelines specifically recommend ICDs for primary prevention to reduce SCD in patients with ischemic and nonischemic HF who have left ventricular ejection fractions of less than 35% with New York Heart Association (NYHA) functional class II or III, optimal medical management, and a reasonable life expectancy of 1 year or more.[4,5]

Although ICDs clearly reduce mortality, their effects on patients' psychological status are equivocal, with a substantial number of patients becoming depressed or anxious after ICD implantation. Depressive symptoms occur in 24% to 33% of patients who received ICDs for secondary prevention.[6] From 24% to 87% of recipients of ICDs for secondary prevention report increased symptoms of anxiety, and 13% to 35% are clinically anxious.[7]

Although the ICD provides patients with potential protection from SCD, the ICD may increase anxiety and depression in vulnerable patients with HF. Extensive evidence supports depression in patients with HF as an independent predictor of worsening HF, increased hospitalizations, and increased mortality[8–17] Anxiety in outpatients with HF ranges from 18% to 45%.[18,19] Depression occurs in 13%[20] to 48%[21] of outpatients with HF. The combination of anxiety or depression in

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patients with HF who receive ICDs may prove deleterious to the patients' health.

Our prior review in 2006 concluded that anxiety and depression are common in patients who received ICDs for secondary prevention.[22] Younger age, female gender, and shocks were the predictors of worse anxiety and depression in ICD recipients. The current review was undertaken to examine the effects of ICD on anxiety and depression in studies published since that review, and expands to include studies of ICDs in patients with HF. Using the search terms "depression," "anxiety," or "psychological" and "implantable cardioverter-defibrillator" or "implant" and "defibrillator," we searched PubMed and PsychInfo for articles in English on adults (April 2005–February 2010) and any articles in pediatric populations that had been excluded from our previous review. We also scrutinized all references in the articles we obtained for additional articles missed in the electronic database searches.

Twenty-one additional studies were identified that assessed anxiety and/or depression in ICD recipients (**Table 1**). Two studies[23,24] were in pediatric populations and found contrasting results. DeMaso and colleagues[23] found only 12.5% of the patients to be depressed and Eicken and colleagues[24] found 30% anxious and 70% depressed. Nine studies included substantial numbers of patients with HF. Prevalence of anxiety was similar in studies including patients with (19%–48%) and without (13%–46%) HF; prevalence of depression was also similar among studies including patients with (13%–35%) and without (7%–41%) HF.

One study of patients with HF who received ICDs as primary prevention examined longitudinal changes in anxiety and depression in 2 years of follow-up.[25] In linear mixed models analysis, anxiety decreased in patients with NYHA class III HF but remained stable in those with NYHA class II HF. Patients with more severe HF were more anxious at the time of ICD implantation and decreased to levels of anxiety similar to those patients with less severe HF by the end of the 2-year follow-up. Overall depression decreased in time, but increased in patients who received shocks. Age and gender did not predict longitudinal changes in anxiety or depression. A longitudinal study of anxiety among ICD recipients, 42% of whom had received ICDs for HF, found that more than half of the ICD recipients who were anxious at insertion remained anxious 1 year later.[26]

AGE

Earlier reviews[22,27,28] found younger age of the ICD recipient to be associated with increased psychological distress. In reviewing the literature since 2005, the authors found 9 studies of adults[11,29–36] and 2 of children[23,24] in which the relationship of age to depression and/or anxiety was examined (**Table 2**). Six studies[29–33,35] found no relationship of anxiety and/or depression to age and 3 studies[11,34,36] found that younger adult patients were more distressed. The 2 studies of the pediatric population[23,24] found conflicting results when examining the relationship of anxiety and depression to age.

In the 3 studies that found a relationship of psychological distress to age, anxiety, depression, or both, anxiety and depression were related to younger age. In a small cross-sectional study of patients with ICDs,[11] age was negatively correlated with state anxiety, trait anxiety, and depression. In a multicenter clinical trial examining predictors of ICD shocks, depression was more common among younger than older patients.[36] Among ICD recipients, initial anxiety was negatively related to age after controlling for gender.[34]

HF status of the ICD recipients was described in 4[31,32,34,36] of the studies that examined the relationship of psychological distress to age. Three of these studies[32,34,36] included more than 100 participants with HF. In 2 of these studies,[34,36] psychological distress was related to younger age. One study[32] found no relationship with age and anxiety and/or depression among 610 ICD recipients with a mean age of 62.4 years, 25% of whom had HF. Smith and colleagues[34] examined both depression and anxiety among 240 ICD recipients, 78% of whom had HF, with a mean age of 58.4 years; anxiety was associated with lower age. Whang and colleagues[36] examined depression but not anxiety among 645 ICD recipients, 49% of whom had HF, with a mean age of 64.1 years. Depression was associated with lower age of ICD recipients. These studies suggest that ICD recipients with HF who are younger may be more depressed or anxious.

GENDER

In the general population, women are 1.9 times as likely to experience significant depression (95% confidence interval [CI] 1.8, 2.0) and 1.7 times as likely to experience anxiety (95% CI 1.6, 1.8) in their lifetimes compared with men.[37] Findings regarding the relationship of gender to depression and/or anxiety in the ICD literature are limited because most ICD recipients in the studies are male. Although women in the general population have increased prevalence of anxiety and depression, this relationship is not consistent in the ICD population. In the review of the literature since

Table 1
Psychological status, depression and anxiety in ICD recipients

Author	Year Published	Sample Size	Tool	% Anxiety	% Depression	% HF, NYHA Class II–IV
Pediatric Population						
DeMaso et al[23]	2004	20	RCMA, RADS	0	12.5	NA
Eicken et al[24]	2005	10	DISYPS-KJ	30	70	NA
No Indication of Patient HF Status						
Pedersen et al[40]	2005	182	HADS	32	28	NS
Bilge et al[29]	2006	91	HADS	46	41	NS
Friedmann et al[11]	2006	48	STAI, BDI	32 state 41 trait	21 mild 6 moderate	NS
Leosdottir et al[33]	2006	44	BAI, BDI	15 mod–severe	10 mod–severe	NS
Luyster et al[38]	2006	100	STAI, BDI	21	22	NS
Crossmann et al[30]	2007	35	STAI, BAI	Not calculated	Not assessed	NS
Lemon and Edelman[62]	2007	49	DASS	33	10	NS
Newall et al[63]	2007	46	HADS	13	7	NS
Pedersen et al[42]	2008	211	HADS	25	25	NS
Spindler et al[35]	2009	535	HADS	37	19	NS
Include Patients with HF						
Whang et al[36]	2005	645	CES-D	Not assessed	18	49
Smith et al[34]	2006	240	STAI, BDI–II	Not calculated	Not calculated	78
Johansen et al[32]	2008	610	HADS	19	13	25
Dougherty and Hunziker[39]	2009	168	STAI, CES-D	33	23	55
Dunbar et al[44]	2009	246	STAI, BDI-II	37	23	32-Class III–IV; 67- Class I–II
Jacq et al[31]	2009	65	MINI, HADS	27	28	77
Luyster et al[57]	2009	88	STAI, BDI	36	24	61
Thomas et al[25]	2009	153	STAI, BDI	25	35	100
ven den Broek et al[41]	2009	391	STAI, BDI	48	35	82

Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; BDI-II, Beck Depression Inventory-II; CES-D, Center for Epidemiologic Studies Depression Scale; DASS, Depression, Anxiety, and Stress Scale; DISYPS-KJ, Diagnostik System für psychische Störungen im Kindes-und Jugendalther nach ICD-10 und DSM-IV; HADS, Hospital Anxiety and Depression Scale; MINI, Mini International Neuropsychiatric Interview; NA, not applicable; NS, not specified; NYHA, New York Heart Association; RADS, Revised Children's Manifest Anxiety Scale; RCMA, Reynold Adolescent/Child Depression Scales.

Table 2
Summary of studies relating age to anxiety and/or depression

Author	Year	N	Age Range	Mean Age (y)	Findings
Pediatric Population					
DeMaso et al[23]	2004	20	9–19	14.8	No increase in anxiety or depression
Eicken et al[24]	2006	16	4–15.9	Median 12.2	7/10 subjects had generalized depression and/or anxiety
No Indication of Patient HF Status					
Bilge et al[29]	2006	91	18–86	53 ± 14	No significant relationship between age and anxiety/depression
Crossmann et al[30]	2007	35	35–65	57 ± 6.3	Age does not predict anxiety (depression not measured)
Friedmann et al[11]	2006	48	34–90	66 ± 12.1	Younger age, increased anxiety and depression
Leosdottir et al[33]	2006	41	23–85	61.8 ± 14.2	Younger patients had better scores but not statistically significant, except on GHQ
Spindler[35]	2009	535		61.5 ± 14.4	Age not related to anxiety/depression
Includes Patients with HF					
Whang et al[36]	2005	645		64.1±	Age inversely related to depression (anxiety not measured)
Smith et al[34]	2006	240		58.4±	Age negatively related to anxiety controlling for gender
Johansen et al[32]	2008	610	8–85	62.4 ± NA	Age not related to anxiety/depression
Jacq et al[31]	2009	65		59.8 ± 14.8	No relationship between age and anxiety/depression

2005, the authors found 8 studies[29–32,34–36,38] addressing gender differences in depression and anxiety among patients (**Table 3**); 3 studies[32,34,36] included a significant number of patients with HF. Women comprised from 5.5% to 25% of the participants in the 8 studies. Two of the studies included fewer than 10 women.[30,31] Of the remaining 6 studies, 1 found greater anxiety and depression among women,[29] 2 of the 5 that assessed anxiety found greater anxiety among women,[32,35] and 2 found greater depression among women.[36,38] Reflecting the population in general, women had more psychological distress than men. Of the 5 studies[29,32,35,36,38] that found increased psychological distress, 2[32,36] included ICD recipients with HF.

Most of the studies used simple chi squares for frequencies or *t*-tests to compare the average scores between men and women. Smith and colleagues[34] used multivariate analysis to compare average anxiety with depression scores between men and women after controlling for age (for anxiety) and HF (for depression) in a group of 240 ICD recipients, 78% of whom had HF. After controlling for these variables, there were no significant differences in anxiety or depression. In this study, HF contributed significantly to depression, but not anxiety. These findings suggest that both female gender and HF are associated with higher depression among ICD recipients independent of age. Female gender also seems to be associated with higher anxiety among ICD recipients independent of HF status and age.

SHOCKS

The shocks generated by ICDs are both life saving and frightening and have the potential to cause

Table 3
Summary of studies relating gender to anxiety and/or depression

Author	Year	N	Women (%)	Women (N)	Anxiety	Depression
No Indication of Patients' HF Status						
Bilge et al[29]	2006	91	15	12	W>M	W>M
Luyster et al[38]	2006	100	19	19	NS	W>M
Crossmann et al[30]	2007	35	14.3	5	NS	NS
Spindler et al[35]	2009	535	5.5	97	W>M	NS
Includes Patients with HF						
Whang et al[36]	2005	645	18.3	118	NA	W>M
Smith et al[34]	2006	240	25	60	NS	NS
Johansen et al[32]	2008	610	17.7	108	W>M	NS
Jacq et al[31]	2009	65	13.8	9	NS	NS

Abbreviations: M, men; NA, not assessed; NS, $P>.05$; S, $P<.05$; W, women.

anxiety and depression in patients. In previous reviews,[22,27,28] the number and frequency of shocks were related to negative psychosocial status and increased anger, depression, and anxiety. The authors found 13 studies not included in our previous review that address the effect of shocks on ICD recipient's psychological status (**Table 4**).[23,24,29,31,32,36,38–41] Four of these studies included significant numbers of ICD recipients with HF,[32,36,39,41] and 2[23,24] were pediatric studies.

Table 4
Summary of studies relating shocks to anxiety and/or depression

Author	Year Published	Sample Size	Anxiety	Depression	% Shocked
Pediatric Population					
DeMaso et al[23]	2004	20	NS	NS	40
Eicken et al[24]	2005	10	Anxiety > shocks	NS	30
No Indication of Patients' HF Status					
Pedersen et al[40]	2005	182	Anxiety > shocks	NS	30
Bilge et al[29]	2006	91	Anxiety > shocks	NS	62
Leosdottir et al[33]	2006	44	NS	NS	15
Luyster et al[38]	2006	100	NS	Depr > shocks	26
Crossmann et al[30]	2007	35	NS	NA	64
Pedersen et al[42]	2008	211	Anxiety > shocks	Depr > shocks	13
Includes Patients with HF					
Whang et al[36]	2005	645	NA	Depr > shocks	9
Johansen et al[32]	2008	610	Anxiety > shocks	Depr > shocks	43
Dougherty and Hunziker[39]	2009	168	Anxiety tends > shocks	NS	33
Jacq et al[31]	2009	65	Anxiety > shocks (MINI)	Depr > shock (HADS)	62
ven den Broek et al[41]	2009	391	Anxiety + type D > shocks	NS	19

Abbreviations: Depr, depression; HADS, Hospital Anxiety and Depression Scale; MINI, Mini International Neuropsychiatric Interview; NA, not assessed; NS, $P>.05$.

Nine of the studies of adult ICD recipients found higher anxiety and depression related to ICD shocks[29,31,32,36,38–42]; 2 did not.[30,33] In 7 of 10 adult studies that included assessment of anxiety, anxiety was higher among those who received shocks than among those who did not.[29,31,32,39–42] In all studies that included patients with HF, anxiety was higher among those who were shocked.[31,32,36,39,41] In 5 of the 10 adult studies that examined the relationship of depression to ICD shock, depression was higher among those who were shocked.[31,32,36,38,42] In 3 of the 5 studies that included patients with HF, depression was higher among those who were shocked than among those who were not.[31,32,36]

Several studies that included patients with HF used multivariate analyses to examine the relationship of shocks and psychological status. In multivariate time-to-event analysis, greater depression severity was associated with ICD shocks after controlling for age and gender.[36] In multivariate logistic regression, both female gender and ICD shocks were significant predictors of anxiety, but not depression.[36] In a similar multivariate logistic regression analysis, female gender (odds ratio [OR] 2.38), symptomatic HF (OR 5.15), and ICD shocks (OR 2.21) independently predicted anxiety after controlling for psychotropic medication, and multiple covariates. Symptomatic HF (OR 6.82), ICD shocks (OR 2.0), and psychotropic medication (OR 2.75) independently predicted depression after controlling for age and numerous covariates.[32] In a study with a different perspective, the odds of receiving ICD shocks within the first 12 months after implantation were higher in patients with chronic obstructive pulmonary disease (OR 3.1), HF (OR 3.1), and implantation for unmonitored syncope or ventricular tachycardia lasting longer than 10 seconds (OR 4.45). High anxiety at the time of ICD implantation approached statistical significance (OR 2.82, $P = .09$).[39]

Two studies examined the effects of shocks on mood in pediatric populations.[23,24] Among pediatric ICD recipients (N = 10), the 3 who were shocked in the past 6 months exhibited severe signs of anxiety.[24] Among 20 pediatric ICD recipients, including 40% who experienced shocks, neither anxiety nor depression differed according to shock experience.[23] The ability to generalize from the findings of these studies is severely hampered by the small number of participants.

Two studies[29,31] examined the relationship of number of ICD shocks to psychological distress. The greater number of ICD shocks was associated with both anxiety and depression in 1 study[29] and depression in another.[31]

Most studies examining the relationship of shocks to depression and/or anxiety used psychological scales to rate the severity of psychological distress. The 2 studies, 1 of pediatric patients[24] and 1 of adults,[31] that included interviews found that anxiety was more common among patients who received ICD shocks than among those who did not, but found no differences in frequency of depression. The later study[31] also included the Hospital Anxiety and Depression Scale (HADS). Depression scores were significantly higher among patients who received ICD shocks than among those who did not, but anxiety scores did not differ. Both HF and shocks predict psychosocial distress. Interventions to reduce distress may be particularly important for ICD recipients with HF and those who receive ICD shocks.

CLINICAL IMPLICATIONS

Prevention of the development of anxiety and depression is essential for the effective use of ICDs in patients with HF. Medical management of patients with HF with ICDs must be optimized to slow the progression of HF and decrease the number of ICD shocks. Screening for anxiety and depression before ICD implantation for all patients with HF can identify those with pre-ICD depression and anxiety. Younger patients and women are particularly vulnerable. Repeated assessment of anxiety and depression every 6 months is warranted in these groups and patients who receive ICD shocks.

TREATMENT OF DEPRESSION AND ANXIETY IN ICD RECIPIENTS WITH HF

No large clinical trials have examined pharmacologic treatment of anxiety or depression in ICD recipients with HF. Pharmacologic treatment of anxiety and depression in patients with HF is addressed in the article by Echols and Jiang elsewhere in this issue.

Five recent randomized controlled trials of nonpharmacologic interventions were identified for ICD patients (**Table 5**). Nonpharmacologic intervention in ICD recipients positively affects depression, anxiety, psychosocial distress, and overall adaptation.[43–46] Cognitive behavioral therapy (CBT) shows promise at improving anxiety and psychological symptoms related to living with an ICD.[45,46] A home-based CBT program for patients with ICDs was associated with decreased anxiety and depression compared with a usual hospital-based program.[45] A 6-week CBT intervention was more effective than a 4-hour psychoeducational workshop at controlling psychological distress including anxiety and depression over

Table 5
Summary of recent randomized clinical trials (evidence level A) of nonpharmacologic interventions in ICD recipients

Author	Year Published	N	Intervention	Reduction in Psychological Distress	% HF
Dougherty et al[43]	2005	168	Telephone intervention information and support	S	Not assessed
Edelman et al[47]	2007	22	Informational session	NS	Not assessed
Sears et al[46]	2007	30	Cognitive behavioral	S	Not assessed
Dunbar et al[44]	2009	246	Psychoeducational telephone or in-hospital group counseling	S	32% NYHA class III–IV; 67% NYHA class I–II
Lewin et al[45]	2009	192	Cognitive behavioral	S	77

4 months.[46] There was no difference in device acceptance, which improved with time, between the groups. One of these studies, in which a nonpharmacologic intervention was effective, included a significant proportion of ICD recipients with HF.[45] Psychoeducational interventions have also proved effective. A structured 8-week post-hospital telephone intervention led to 6- and 12-month improvements in anxiety and distress compared with usual care.[43] A combined in-hospital/out-of-hospital psychoeducational intervention was more effective than usual care for reducing anxiety and depression at 12 months. A telephone intervention in the same timeframe was equally effective.[44] One of these studies included a significant number of patients with HF with ICDs.[44] One trial found that a single session lasting 60 to 90 minutes that provided information and reassurance was not effective at reducing ICD-related distress[47]; the small sample size precludes sufficient power to conclude that this intervention is ineffective.

Nonpharmacologic interventions positively affect depression, anxiety, psychosocial distress, and overall adaptation in patients with HF who have not received ICDs.[48,49] CBT may be superior to pharmacotherapy in preventing relapsing depression in patients with HF.[48] In the Support, Education, and Research in Chronic Heart Failure (SEARCH) study, a nonrandomized clinical trial of depression, anxiety, and HF symptoms, depressed patients with HF (n = 208) improved more at 1 year following an 8-week mindfulness-based psychoeducational intervention compared with usual care.[49]

Computer-based CBT intervention may be a viable application in the population of patients with ICDs, based on its successful use in other clinical populations.[50] As cited in our previous review, patients with ICDs benefit from group support and forums to discuss their shared experiences, whether in person or via online chat rooms.[46,50,51] Nurses have successfully implemented patient programs such as telephone intervention, verbal and written patient education materials, coping skill training, and patient support groups.[43,44,51–53]

Overall, there remains a paucity of randomized controlled trials examining interventions to improve anxiety, depression, and psychological distress in the population of patients with ICDs, especially among those with HF. In addition, the authors found no studies addressing interventions among pediatric patients, whereas the number of ICD implants in this truly young population is increasing as ICDs become small enough to implant in younger children. The use of cognitive behavior therapy and other nonpharmacologic interventions is appropriate for the treatment of psychological distress in ICD recipients with HF. This area of research is ripe for investigation.

DISCUSSION

Anxiety and depression are common in patients with HF with ICDs and occur at rates similar to those of other patients with HF. In view of the high prevalence of anxiety and depression among ICD recipients with HF, psychosocial issues must be addressed at implantation and for at least the first 2 years.

ICD recipients with HF who are younger may be more depressed or anxious. Both female gender and HF are associated with higher anxiety and

depression among ICD recipients. The strongest predictor of psychological distress is receiving ICD shocks. Screening and interventions to reduce psychological distress among ICD recipients are particularly important for those who are younger than 60 years old, female, and those who receive ICD shocks.

Additional examination of factors associated with increased anxiety and depression in patients with HF with ICDs is warranted. Two longitudinal studies[25,26] suggest that patients with more severe HF and those who are psychologically distressed require close monitoring of psychological status and may benefit from intervention at time of implantation.

Shared pathophysiologic pathways and behavioral risk factors emphasize the importance of a holistic approach to screening, diagnosis, and treatment of anxiety and depression in ICD recipients with HF. Depression, anxiety, and HF share elements of common neuroendocrine pathways. These pathways include increased activation of the hypothalamic-pituitary-adrenal axis, autonomic dysregulation, immune system alterations, and increased platelet activation.[54] Health behaviors common in patients who are anxious and depressed may contribute to poorer health outcomes. Poor medication and diet adherence and decreased exercise are frequently associated with anxiety and depression.[55–60] Limited evidence on the effects of pharmacologic and nonpharmacologic therapy for depression and anxiety in patients with HF precludes the development of treatment guidelines for this population at this time.[61] CBT[45,46] and psychoeducational programs[43,44] show promise for reducing psychological distress in ICD recipients with HF.[45]

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