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Depressive disorders in a group of patients after implantation of a cardioverter-defibrillator

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A. Study design/planning • B. Data collection/entry • C. Data analysis/statistics • D. Data interpretation • E. Preparation of manuscript • F. Literature analysis/search • G. Funds collection

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ABSTRACT

Introduction: Implantation of a cardioverter-defibrillator, used for primary and secondary prevention of sudden cardiac arrest, can lead to depressive disorders among some patients, which often results in a worse course of the underlying disease and poorer patient cooperation in the therapeutic process.
Aim of the study was assessment of the prevalence and severity of depressive disorders among patients after implantation of a cardioverter-defibrillator and the relationship between the study variables and sociodemographic situation, factors related to the subjects' health, and the support received by the respondents.
Material and methods: The study involved a total of 63 patients aged 23-82 years with an implantable cardioverter-defibrillator. The author's survey questionnaire (which included questions on sociodemographic data, related to the implanted cardioverter-defibrillator, relating to mental health and support received), the BDI-II Beck Depression Inventory, and information from medical records were used to obtain data. Material was statistically analysed using the Statistica 13.1 package from StatSoft, using the Mann-Whitney *U*-test, Pearson's χ^2 test, and Spearman's rank correlation test. The level of statistical significance was adopted as $p < 0.05$.
Results: The mean score on the BDI-II Beck Depression Inventory for the study group was 23.19 ±12.20 points. Subjects with no or minimal depressive symptoms accounted for 31.7%, individuals with mild symptoms accounted for 14.3%, moderate symptoms accounted for 15.9%, and severe symptoms accounted for 38.1%. The greater the severity of depressive symptoms, the more concerns related to the occurrence of device discharge were reported by respondents ($R = 0.33$, $p = 0.008$).
Conclusions: Evaluation of the mental state of patients with an implantable cardioverter-defibrillator may help to diagnose depressive disorders in this group of patients and allow identification of the factors that determine them.
Key words: implantable cardioverter defibrillator, Beck Depression Inventory, depressive disorders.

INTRODUCTION

Depressive disorders are a group of mental disorders in which reduced mood is an important, but not the only, feature [1]. According to the International Statistical Classification of Diseases and Related Health Problems (ICD-10), depression is a condition in which "the patient suffers from depressed mood, loss of interest and ability to enjoy, decreased energy leading to increased fatigue and decreased activity" [2, p. 340]. To make a diagnosis, 2 of the 3 main symptoms must persist for at least 2 weeks, with the exception of symptoms that are very severe and increase over a short period of time [2]. Often patients also experience impaired attention span, lowered self-esteem and lack of self-confidence, a pessimistic view of the future, sleep disturbances, decreased appetite, and suicidal thoughts and acts [3]. The Classification ICD-10 includes 4 degrees of severity of a depressive episode: mild, moderate, severe, and severe with psychotic symptoms, in which delusions, hallucinations, and depressive stupor are included in the clinical picture [4].

According to the World Health Organization (WHO), depressive disorders are among the leading causes of disability and incapacity. Untreated depression increases the risk of suicide and death, and accelerates the development of somatic diseases. At the same time, an inverse relationship can be found in this context – chronic somatic diseases promote the development of depressive disorders [5].

Depressive episodes quite often accompany cardiovascular diseases; for example, among post-myocardial infarction patients who are at high risk of sudden cardiac arrest, the danger of depression increases

significantly, especially in the first days of hospitalization [5, 6]. Patients with cardiac conditions with concomitant depression show a worse course of the underlying disease and poorer levels of cooperation, and the sleep problems they experience contribute to dysfunction at the cognitive level, causing difficulties with attention, memory and chronic fatigue [7].

In the group of patients with cardiac conditions, the implantable cardioverter-defibrillator (ICD) is fundamental in the prevention of sudden cardiac arrest, the primary function of which is to recognize and terminate ventricular tachycardia (VT) and ventricular fibrillation (VF) as well as to stimulate the heart in bradycardia [8]. The device differentiates between arrhythmia and baseline cardiac rhythm, has Holter memory, and can restore ECG recordings from the time of arrhythmia incident [9]. The cardioverter-defibrillator also has applications in the primary and secondary prevention of sudden cardiac arrest. Primary prevention applies to patients who have not experienced sudden cardiac arrest or haemodynamically unstable VT but are at high risk of arrhythmic death [8]. Secondary prevention, on the other hand, applies to survivors of an episode of sudden cardiac arrest [10].

Despite the undeniable advantages of device implantation, the presence of an implant carries a risk of affective disorders. Risk factors for the development of depressive disorders among patients after implantation of a cardioverter-defibrillator include not only the nature of the underlying disease, but also the need for long-term, regular follow-ups at a specialty clinic, awareness of the presence of a foreign body in the body, a history of high-energy therapy (cardioversion; defibrillation), fear of another discharge, the risk of inadequate high-energy intervention, fear of stigma and physical contact, restrictions on sports and occupational activities [11, 12]. Symptoms indicative of depressive disorders are reported more often by those who have been implanted with the device as a secondary prevention compared to patients who have not experienced such an episode [6]. Also, the number of high-energy interventions may be related to decreased quality of life and increased severity of depressive disorders [13].

Another factor that predisposes to the development of depressive disorders among patients after implantation of a cardioverter-defibrillator is the occurrence of electrical storm. This phenomenon affects 10-20% of ICD patients. Experiencing an electrical storm episode can result in catastrophic thinking, a tendency to withdraw from social activities, negative depressive thinking, feelings of helplessness, loss of control, guilt and shame, and increased crying [14].

The aim of this study is to assess the prevalence and severity of depressive disorders among patients after implantation of a cardioverter-defibrillator and also the relationship between the study variables and socio-demographic situation, factors related to the subjects' health, and the support received by the respondents.

MATERIAL AND METHODS

The study included patients with an implantable cardioverter-defibrillator hospitalized in one of the cardiology departments in the Lesser Poland Voivodeship. Adult patients who gave informed consent to participate in the study were selected. All subjects underwent implantation of a cardioverter-defibrillator before hospitalization, during which the study was conducted. It was conducted between July 2020 and February 2021.

A diagnostic survey method was employed in the study, along with a questionnaire technique. A questionnaire of our own authorship was used, which included questions on sociodemographic data and questions related to the implanted cardioverter-defibrillator. In addition, the questionnaire contained questions relating to mental health (including a history of diagnosed mental disorders and use of psychiatric or psychological care) and support received. The study also used the BDI-II (Beck Depression Inventory – Second Edition) by Aaron T. Beck, Robert A. Steer, and Gregory K. Brown. The use of the BDI-II allowed measurement of the severity of depressive disorder symptoms (the inventory is not a tool designed for clinical diagnosis of depression). The BDI-II is a self-report tool consisting of 21 items: sadness, pessimism, past failures, loss of feeling pleasure, guilt, punishing feelings, self-loathing, self-criticism, suicidal thoughts and desires, crying, anxiety, loss of interest, indecisiveness, low self-worth, loss of energy, sleep, irritability, appetite, concentration problems, fatigue, and loss of interest in sex. The respondent chooses one statement from each item that best reflects how he or she has been feeling over the past 2 weeks. The individual items are scored on a scale of 0 to 3 points, depending on the intensity of symptoms experienced. Interpretation of the results is based on score evaluation. The adopted cut-off points were as follows: 0-13 points – minimal depression, 14-19 points – mild depression, 20-28 points – moderate depression, 29-63 points – severe depression. The inventory is characterized by high internal consistency. The reliability of the test was determined by Cronbach's αcoefficient. For the entire normalization sample, it was 0.91, and for subjects with depression it was 0.93, which indicates the suitability of this test for individual studies conducted for preliminary evaluation of the severity of depressive symptoms. To estimate the stability of the BDI II results, individuals from the normalization sample were tested twice with an interval of 4 weeks between measurements.

Differences between the test and re-test results were statistically insignificant, and their correlation, estimated by the Pearson correlation method was 0.85. This shows the high stability of results obtained in the study [15].

The collected study material was supplemented with information from medical records according to the criteria adopted for the study (including indications for device implantation, comorbidities, and medications taken).

The obtained material was subjected to statistical analysis in the Statistica 13.1 package from StatSoft. Analysis of variables was conducted using non-parametric tests. The Mann-Whitney *U*-test was used to evaluate differences in the average level of a numerical trait in 2 populations. Analysis of variables having qualitative variables was carried out using Pearson's χ^2 test. Correlations between variables of at least ordinal type were conducted using Spearman's rank correlation test. The level of statistical significance was adopted as $p < 0.05$.

RESULTS

Baseline characteristics of study participants

Sixty-three patients participated in the study. The group was dominated by men (69.8%, *n* = 44). The age range of the patients was from 23 to 82 years (60.40 ±15.03). 54.0% of the respondents were married (*n* = 34). Rural residents were the least numerous group (11.1%, *n* = 7) and similarly with vocational education 19.0% (n = 12). Professionally active respondents comprised 31.7% (*n* = 20). Detailed data are included in Table 1.

Prevalence and severity of depressive disorders among patients after implantation of a cardioverter-defibrillator

The prevalence and severity of depressive disorders among patients after implantation of a cardioverter-defibrillator were analysed. The mean score

Table 1. Structure of the study group by sociodemographic variables

Sociodemographic variables							
Age (years)							
N	**M**	**SD**	**Me**	**Min.**	**Max.**	**Q1**	**Q3**
63	60.40	15.03	62.00	23.0	82.0	51.0	72.0
Gender, % (*n*)							
Women					30.2 (19)		
Men					69.8 (44)		
Place of residence, % (*n*)							
Large city					31.7 (20)		
Medium/small city					57.1 (36)		
Rural area					11.1 (7)		
Marital status, % (*n*)							
Single					14.3 (9)		
Married					54.0 (34)		
Divorced					9.5 (6)		
Widowed					15.9 (10)		
Free relationship					6.3 (4)		
Education, % (*n*)							
Vocational					19.0 (12)		
Secondary					39.7 (25)		
Higher					41.3 (26)		
Primary source of livelihood, % (*n*)							
Professional work					31.7 (20)		
Retirement					42.9 (27)		
Pension					22.2 (14)		
Other					3.2 (2)		

n – number of observations, $\bar{x}$ – arithmetic mean, SD – standard deviation, Me – median, Min – minimum, Max – maximum, Q1 – lower quartile, Q3 – upper quartile

Table 2. Scores on the BDI-II obtained in the group of patients under study

Scores BDI-II (points)							
N	$\bar{x}$	SD	Me	Min.	Max.	Q1	Q3
63	23.19	12.20	24.00	4.00	50.00	13.00	32.00

n – number of observations, $\bar{x}$ – arithmetic mean, SD – standard deviation, Me – median, Min – minimum, Max – maximum, Q1 – lower quartile, Q3 – upper quartile

Table 3. Severity of depressive disorders in the BDI-II in the group of patients under study

Severity of depressive disorders in the BDI-II			% (*n*)
Group I	No depression/minimal depression		31.7 (20)
Group II	Mild depression	14.3 (9)	68.3 (43)
	Moderate depression	15.9 (10)	
	Severe depression	38.1 (24)	

% – percentage, n – number of observations

obtained from the BDI-II was 23.19 ±12.20 points. Detailed data are included in Table 2.

In the interpretation of results, the patients under study were classified into 2 distinct groups that were depending on the severity of their depressive disorders. Group I included individuals with no or minimal depressive symptoms – 31.7% of the subjects (n = 20). Group II was represented by subjects with mild, moderate, or severe depressive symptoms. A total of 68.3% of the subjects (n = 43) were in group II. Detailed data are included in Table 3.

Relationships between the occurrence of depressive disorders and the sociodemographic situation of the subjects

There was no relationship between the severity of depressive symptoms and the following variables: subjects' age, gender, marital status, education, place of residence, and occupational activity or lack thereof (p > 0.05).

Relationships between the occurrence of depressive disorders and factors related to the subjects' health

In the study group, 31.7% (n = 20) of the respondents had a history of diagnosed depression. A physician's diagnosis of depression was significantly more common among subjects who were classified in group II during the study (p = 0.011). Psychiatric or psychological care was received at some time by 34.9% of the subjects (n = 22), including 10.0% of individuals in group I (n = 2) and 46.5% in group II (n = 20). This difference was statistically significant (p = 0.005). It was also found that patients in group II – 39.5% (n = 17) – were significantly more likely (p = 0.001) to use sedative/sleep medications, in contrast to patients in group I, in which no one used medications with such effects.

Relationships between the severity of depressive symptoms and the support received by the respondents

Analysis of the study material showed a negative correlation between the severity of depressive disorders and subjective evaluation of the level of support received (at a sufficient level) in relation to the cardiac disease. The less severe the depressive symptoms, the greater the support declared by the respondents (R = –0.28, p = 0.026).

Relationships between the incidence of depressive disorders in the study group and factors related to implantation and functioning with a cardioverter defibrillator

Implantation of a cardioverter-defibrillator under primary prevention of sudden cardiac arrest was performed in 58.7% of the subjects (n = 37), and under secondary prevention – in 41.3% (n = 26). There were no significant differences between the severity of depressive disorders and the type of prevention under which a cardioverter-defibrillator was implanted (p > 0.05). However, it was found that patients classified in group II were significantly more prone (p = 0.024) to have chronic heart failure as an indication for implantation of a cardioverter-defibrillator (60.5%, n = 26) compared to patients in group I (30%, n = 6).

Subjects representing group II – who had a higher severity of depressive symptoms – experienced cardioverter-defibrillator discharge significantly more often than individuals in group I (p = 0.008). The mean number of discharges was 7.68 in group II and 2.9 in group I.

During the discharge of the cardioverter-defibrillator, the subjects experienced various discomforts. Loss of consciousness was experienced by 42.9% (n = 15) of the subjects. This occurred only among pa-

tients classified in group II (60.0% of the subjects in this group) (p = 0.001).

There was a positive correlation between the BDI-II scale score and the presence of device discharge concerns. The greater the severity of depressive symptoms, the more concerns related to the occurrence of device discharge were reported by respondents (R = 0.33, p = 0.008).

DISCUSSION

The subject literature highlights the prevalence of depressive disorders among patients with cardiac conditions, including those following implantation of a cardioverter defibrillator [12]. This study evaluates the prevalence of depressive disorders in a group of patients after implantation of a cardioverter-defibrillator. Our study using the BDI-II scale showed a mean severity of depressive disorders of 23.19 ±12.20 points. This score indicates moderate depressive disorder. It is significantly higher than in the study of Farahani *et al.* (12.96 ±8.98 points) [16] and in the analysis of Pushkarev *et al.* (12.8 ±8.1) [17]. These differences may be due to the small sample size of our study, cultural differences, or the location of conducting the study. In the group analysed, the study was conducted while patients were hospitalized, and staying in a ward is a stressful situation for many patients and is associated with deterioration of health. These factors may affect well-being and result in responses indicating a worse mental state than during surveys conducted in an outpatient setting. It is also interesting to note that none of the sociodemographic variables analysed in our study was significantly associated with the severity of depressive disorders. In studies reported in the literature, there are also discrepancies regarding the influence of sociodemographic variables on the appearance of depressive disorders in the group of implantable cardioverter-defibrillator patients. For example, a study conducted by Rahmawati *et al.* showed that women were more likely than men to report depressive symptoms and present higher levels of anxiety in relation to having the device [18]. Whereas, in a study by Spindler *et al.*, the subjects' gender was not found to differentiate the incidence of depressive disorders, although women did report higher levels of anxiety and worry about the implanted device, regardless of whether they experienced a discharge [19]. Similar results were obtained by Tsuyoski *et al.* [20]. In their study, the female gender showed poorer acceptance of the device and higher levels of anxiety.

The results of our study showed correlation between higher severity of depressive disorders and chronic heart failure as an indication for implantation of a cardioverter-defibrillator, treatment for depression in the past, and current use of sedative and sleep medications. Pedersen *et al.* also showed that heart failure, psychotropic medication use, and high levels of anxiety were significant unidimensional correlates of persistent depression 3 months after implantation of a cardioverter-defibrillator. In this study, the relationship between depressive disorders and New York Heart Association (NYHA) class III and IV heart failure was found to be significant [21]. In a study by van der Lingen *et al.*, depression correlated positively with higher heart failure class and reduced left ventricular ejection fraction [22].

The literature also suggests that high-energy therapy applied by a cardioverter-defibrillator becomes important for patients. In a study conducted by Mańkowska-Załuska *et al.*, subjects experiencing high-energy therapy rated their quality of life lower, were more likely to experience fear and anxiety, and showed symptoms of depression [23]. Kazimierska *et al.* emphasized that incidents of electrical storm significantly increased anxiety and fear of the next device detection in the group of patients surveyed and influenced the development of mild depressive disorder, as assessed by the Beck Depression Scale [24]. In a study by Jacq *et al.*, individuals experiencing a high number of discharges were more likely to develop depressive symptoms [25]. Similar results were also obtained by Herrman *et al.* [26]. In our study, analogous observations were made. The mean number of device discharges in the group of subjects with mild, moderate, or severe depressive symptoms was significantly higher compared to the group of subjects with minimal or no depressive disorder symptoms, and higher severity of depressive symptoms was associated with more frequent reporting by the subjects of fear of device discharge.

Both the literature analysis and the results of our own study suggest that, already at the stage of preparation for implantation/reimplantation of a cardioverter-defibrillator, it is necessary to evaluate the patient's mental state as well as to pay attention to potential symptoms that may indicate a depressive disorder. It is also extremely important to simultaneously undertake appropriate interventions aimed at improving the patient's emotional state.

CONCLUSIONS

The largest group of subjects reported severely aggravated depressive disorder symptoms.

Greater severity of depressive symptoms was significantly more frequent in subjects with diagnosed depression in the past, receiving psychiatric/psychological care, taking sedative and sleep medications, having chronic heart failure as an indication for implantation of a cardioverter-defibrillator, experiencing more frequent discharges of the implanted device, reporting more anxiety related to the occurrence of

device discharge, and who experienced unconsciousness during device discharge.

Lower severity of depressive disorders was related to higher subjective evaluation of the support received by the subjects in relation to their cardiac disease.

Evaluation of the mental state of patients with an implantable cardioverter-defibrillator may help to diagnose depressive disorders in this group of patients and allow identification of the factors that determine them.

The BDI-II Inventory may be a useful tool for studying the severity of depressive symptoms among patients after implantation of a cardioverter-defibrillator.

Disclosure

The authors declare no conflict of interest.

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