ORIGINAL ARTICLE

Depression and all-cause mortality in patients with congestive heart failure and an implanted cardiac device

Kardiyak cihaz implante edilmiş konjestif kalp yetersizliği olan hastalarda depresyon ve tüm nedenlere bağlı mortalite

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ABSTRACT

Objective: The purpose of this study was to assess the association between depression and all-cause mortality in patients with congestive heart failure (CHF) and an implanted cardiac device.

Methods: The study enrolled 260 patients (mean age 56.8±10.0 years; 83.1% male) with CHF and an implanted cardiac device (156 patients with a resynchronization therapy cardiac device, 104 patients with an implantable cardioverter defibrillator). The mean duration of follow-up was 48.6±32.2 months. The Beck Depression Inventory was used to measure depressive symptoms. Depression was considered absent for a score between 0 and 9, mild to moderate for a score between 10 and 18, and severe if the score was 19 or greater. The Cox proportional hazards regression model was used to estimate hazard ratios (HR) with a 95% confidence interval (CI) for the impact of depression on all-cause mortality. The HR was calculated after adjustment for the following confounders: age, gender, smoking status, hypertension, diabetes mellitus, body mass index, hypercholesterolemia, left ventricular ejection fraction, number of hemodynamically significant lesions of the coronary arteries, and the type of implanted cardiac device.

Results: During the follow-up period, 37 patients died (14.2%). The adjusted HR of depression for all-cause mortality was 1.05, with a 95% CI of 1.01–1.09. Patients without depression were accepted as a reference group with HR=1.0 for analysis of the categorical indicator. The HR was 1.32, with a 95% CI of 0.57–3.03, in patients with mild depressive symptoms, and the HR was 3.18 with a 95% CI of 1.31–7.73 in patients with severe depressive symptoms.

Conclusion: Increased depressive symptoms were independently associated with all-cause mortality in patients with CHF and an implanted cardiac device.

ÖZET

Amaç: Çalışmanın amacı kardiyak cihaz implante edilmiş konjestif kalp yetersizliği (KKY) hastalarında depresyon ile tüm nedenlere bağlı mortalite arasındaki ilişkiyi değerlendirmekti.

Yöntemler: Çalışmaya kardiyak cihaz implante edilmiş 360 hasta (yaş ortalaması, 56.8±10.0 yıl, %83.1'i erkek hasta) (156 hastaya resenkronizasyon tedavisi için kardiyak cihaz, 104 hastaya ise kardiyoversiyon için defibrilatör takılmış) alındı. Ortalama izlem süresi 48.6±32.2 aydı. Depresif semptomları değerlendirmek için Beck Depresyon Envanteri (BDI) kullanıldı. BDI skoru 0–9 olanlarda depresyonun olmadığı, 10–18 arası hafif-orta derecede depresyon ve 19'dan yüksekse hastaların ağır depresyonda olduğu kabul edildi. Depresyonun tüm nedenlere bağlı mortaliteye etkisini değerlendirmede %95 güven aralığında risk oranlarını (HR) tahmin etme amacıyla Cox orantısal riskler modeli kullanıldı. Karışıklığa neden olan faktörler (yaş, cinsiyet, sigara içme durumu, hipertansiyon, diabetes mellitus, beden kütle indeksi, hiperkolesterolemi, sol ventrikül ejeksiyon fraksiyonu, koroner arterlerin hemodinamik açıdan önemli olan lezyonlarının sayısı ve implante edilmiş kardiyak cihazların tipi) için düzenlemeler yapıldıktan sonra HR hesaplandı.

Bulgular: İzlem dönemi sırasında 37 (%14.2) hasta hayatını kaybetti. Depresyon skoruna tüm nedenlere bağlı mortalitenin etkisi için düzeltilmiş HR 1.05 (%95 GA 1.01–1.09) idi. Depresyonu olmayan hastalar (HR=1.0) kategorik göstergelerin analizi için referans grubu olarak kabul edildi. HR, hafif depresif semptomları olanlarda 1.32 (%95 GA 0.57–3.03), ağır depresif semptomları olanlarda 3.18 (%95 GA 1.31–7.73) idi.

Sonuç: Artmış depresif semptomlar kardiyak cihaz implante edilmiş KKY olan hastalarda tüm nedenlere bağlı mortaliteyle bağımsız olarak korelasyon göstermektedir.

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There are multiple risk factors for cardiovascular diseases (CVD). The most well-studied factors include traditional factors, such as high blood pressure, smoking, dyslipidemia, obesity, etc.[1] Psychosocial risk factors are equally important. According to experts from the European Society of Cardiology, the most important psychosocial factors affecting the health status of patients with a cardiac pathology include depression, anxiety, panic disorder, post-traumatic stress disorder, social isolation, and type D personality.[2] Depression as a prognostic marker of CVD is studied primarily in patients with coronary artery disease (CAD).[3] There is also a relationship to adverse clinical outcomes after percutaneous coronary intervention (PCI).[4] On the cardiovascular continuum, one outcome of CVD, such as hypertension or CAD, is congestive heart failure (CHF).[5] The effect of depression on the prognosis of CHF patients was described in a meta-analysis performed by Rutledge et al.:[6] depression increased the risk of death in CHF patients by 2.1 times during a monitoring period of 6 months to 4 years.

Cardiac resynchronization therapy (CRT) is one of promising new methods of heart failure treatment. CRT is indicated for patients with a left ventricular (LV) ejection fraction (LVEF) ≤35%, wide QRS complex ≥150 milliseconds, or left bundle branch block. In addition, the implantation of a cardioverter defibrillator (ICD) is often indicated for such patients to prevent sudden cardiac death.[7]

However, the impact of depression on mortality in patients with implanted cardiac devices has not been fully evaluated.[8] Thus, study of the effect of depression on the risk of death in CHF patients who have undergone the implantation of a cardiac electronic device appears to be very relevant. The aim of the present study was to assess the association between depression and all-cause mortality in patients with CHF and an implanted cardiac device.

METHODS

The study included patients who underwent implantation of an electronic cardiac device at the Tyumen Cardiology Research Center. In total, 260 patients (216 males and 44 females) aged 23 to 84 years (average age: 56.8±10.0 years) were examined. Of the group, 156 patients underwent implantation of a resynchronization therapy device, and 104 patients underwent ICD placement. In 70.0% of the patients, CHF was caused by CAD. The average length of the follow-up period was 48.6±32.2 months.

Abbreviations:

CAD	*Coronary artery disease*
CHF	*Congestive heart failure*
CI	*Confidence interval*
CRP	*C-reactive protein*
CRT	*Cardiac resynchronization therapy*
CVD	*Cardiovascular disease*
HR	*Hazard ratio*
ICD	*Implantable cardioverter-defibrillator*
IL	*Interleukin*
LV	*Left ventricular*
LVEF	*Left ventricular ejection fraction*
PCI	*Percutaneous coronary intervention*

All of the patients underwent a transthoracic echocardiographic examination using a Philips iE 33 (Phillips Healthcare, Inc., Andover, MA, USA) or a General Electric Vivid E9 (GE Healthcare, Inc. Chicago, IL, USA) ultrasonography device. The diameter of the aortic root, diameter of the left atrium, diameter of the right ventricle, LV end-diastolic and end-systolic volumes, thickness of the interventricular septum, LV posterior wall thickness, LVEF, LV myocardial mass, and LV myocardial mass index were evaluated.

The Beck Depression Inventory was used to determine and assess symptoms of depression.[9] The inventory contains 21 items with statements that correspond to specific manifestations/symptoms of depression. Based on the severity of a symptom, each statement is assigned a value from 0 (no symptom or minimal manifestation) to 3 (maximum severity). The final score is calculated by summing the results for all of the items. A total score of 19 points or more indicates severe symptoms of depression, and a total score of 10 to 18 points is considered to reflect mild symptoms of depression. A score of 9 points or less suggests the patient has no symptoms of depression. The Beck Depression Inventory has a high level of reliability, with an overall Cronbach's alpha coefficient of 0.86 (cognitive-affective subscale: 0.79, somatic subscale: 0.79).[9] All of the patients included in the study completed the entire depression questionnaire. This study was approved by the local ethics committee, and patients were included in the study only after providing written informed consent.

Statistical analyses were performed using. IBM SPSS Statistics for Windows, Version 21.0. (IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was used to test for normal distribution of the data. If the distribution was considered normal, the mean±SD

was calculated. If the distribution differed from the normal, the median and interquartile range (25%; 75%) was calculated. For normally distributed parameters, analysis of variance was performed. For non-normally distributed parameters, the Kruskal-Wallis test was applied. For normally distributed parameters, a post-hoc test was performed using the least-square difference procedure. Post-hoc tests for non-normally distributed parameters were carried out using the Mann-Whitney U test. For categorical variables, the statistical significance of differences between groups was calculated using the maximum likelihood chi-square test. A pairwise group comparison using Pearson's chi-square was also conducted. Survival rate was estimated using the Kaplan-Meier method. The Cox proportional hazards regression model was used to assess the hazard ratio (HR) with a 95% confidence interval (CI) for all-cause mortality. Univariate analysis was performed at the first stage of the research. In the second stage, HR with 95% CI was calculated after adjustment for the following confounders: age, sex, smoking, body mass index, LVEF, hemodynamically significant coronary arteries stenosis, hypercholesterolemia, previous myocardial infarction, arterial hypertension, diabetes, atrial fibrillation, and heart failure functional class (New York Heart Association classification), as well as the type of implantable device. The analysis of the effect of depression on all-cause mortality included both quantitative and categorical indicators. For the categorical variables, HR was calculated relative to the selected reference group, for which the risk was assumed to be 1.0. The group with no symptoms of depression was used as the reference group. A value of $p<0.05$ was considered to be statistically significant.[10]

RESULTS

Comparative characteristics of clinical-functional and laboratory indicators of the patients according to the severity of depression are presented in Table 1. The groups did not differ significantly in terms of age, smoking prevalence, arterial hypertension, diabetes, hypercholesterolemia, atrial fibrillation, or CAD. No statistically significant differences were observed between the groups in body mass index, functional class of CHF, or history of PCI, and the groups had an equal frequency of previous myocardial infarction.

The groups differed significantly in gender distribution. Among individuals without symptoms of depression, males predominated (89.4% in the non-depressed group vs 74.6% in the group with severe depression; $p<0.013$).

No statistically significant differences were observed between the groups in the echocardiographic parameters of diameter of the aortic root, diameter of the left atrium, diameter of the right ventricle, thickness of the interventricular septum, LV posterior wall, LV end-diastolic and end-systolic volumes, LVEF, as well as in LV myocardium mass and LV mass index (Table 2).

The average total Beck Depression Inventory score was 12.8±8.1 points. In 104 patients (40.0%) there were no symptoms of depression, 97 patients (37.3%) had mild depression, and 59 patients (22.7%) had severe symptoms of depression.

In total, 37 patients (14.2%) died from all causes during the follow-up period. Figure 1 illustrates the Kaplan-Meier curves of the survival rate in the patient groups. At the end of follow-up period, the cumulative fraction of surviving patients in the group without depression symptoms or with mild symptoms of depression was statistically greater than that of the group of patients with severe depression symptoms ($p=0.020$). The mean life expectancy of patients without depression symptoms or with mild symptoms was 102.2 months, with a 95% CI of 96.5–107.8, while for patients with severe depression it was 84.8 months with a 95% CI of 73.0–96.6.

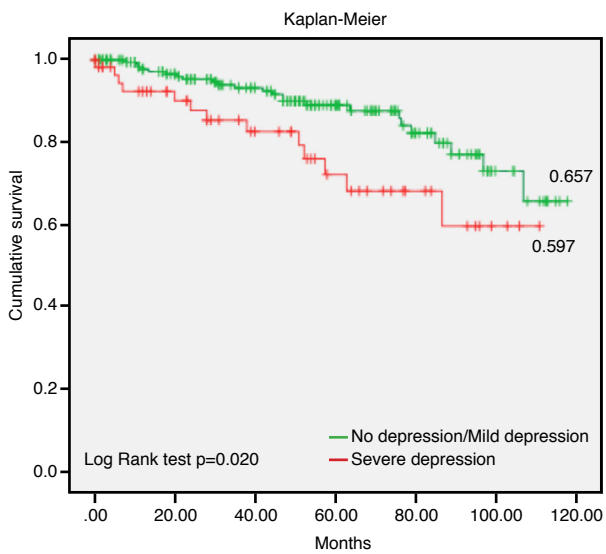

Figure 1. Cumulative patient survival rate according to depression symptoms.

Table 1. Comparative characteristics of clinical, functional, and laboratory parameters in patients according to the level of depression

Parameters	No depression (n=104)	Mild depression (n=97)	Severe depression (n=59)	*p*
Age, years	56.0±10.0	57.6±9.1	56.9±11.6	0.539
Sex, n (%)				
Male	93 (89.4)*	79 (81.4)	44 (74.6)*	0.045
Female	11 (10.6)*	18 (18.6)	15 (25.4)*	
Coronary artery disease, n (%)	73 (70.2)	65 (67.0)	43 (72.9)	0.367
Previous myocardial infarction, n (%)	47 (45.2)	43 (44.3)	29 (49.2)	0.832
Smoking, n (%)	27 (26.0)	26 (26.8)	9 (15.3)	0.210
Arterial hypertension, n (%)	75 (72.1)	77 (79.4)	49 (83.1)	0.229
Diabetes, n (%)	15 (14.4)	15 (15.5)	13 (22.0)	0.425
Body mass index (kg/m²)	30.0±6.3	30.3±5.7	29.9±6.7	0.897
Hypercholesterolemia, n (%)	49 (47.6)	61 (63.5)	33 (55.9)	0.077
Atrial fibrillation, n (%)	41 (39.4)	44 (45.4)	23 (39.0)	0.627
History of PCI, n (%)	27 (26.0)	19 (19.6)	15 (25.4)	0.522
NYHA classification of heart failure, n (%)				
I-II	44 (42.3)	40 (41.2)	22 (37.3)	0.816
III-IV	60 (57.7)	57 (58.8)	37 (62.7)	
Type of an implantable cardiac device, n (%)				
CRT/CRT+ICD	66 (63.5)	57 (58.8)	33 (55.9)	0.610
ICD	38 (36.5)	40 (41.2)	26 (44.1)	

NYHA: New York Heart Association; PCI: Percutaneous coronary intervention; CRT: Cardiac resynchronization therapy; ICD: Implantable cardioverter defibrillator; *– P= 0.01.

Table 2. Comparative characteristics of echocardiographic indicators according to the level of depression

Parameters	No depression (n=104)	Mild depression (n=97)	Severe depression (n=59)	*p*
Aortic root diameter (mm)	34 (32;36)	34 (32;36)	34 (32;36)	0.746
Left atrium dimensions (mm)	49.3±6.2	50.1±7.1	49.7±5.8	0.671
End-diastolic volume left ventricular (mL)	209 (180;239)	216 (177;255)	209 (167;245)	0.851
End-systolic volume left ventricular (mL)	146.7±47.3	148.5±54.5	145.9±58.3	0.950
Right ventricle dimensions (mm)	30 (26;33)	28 (26;33)	29 (26;32)	0.924
Interventricular septum thickness (mm)	11 (10;12)	11 (10;12)	11 (9;12)	0.505
Left ventricular posterior wall thickness (mm)	11(10;12)	10 (9;11)	10 (9;11)	0.060
Left ventricular ejection fraction (%)	32 (28;36)	33 (29;38)	33 (29;38)	0.644
Left ventricular myocardial mass (g)	322.8±82.1	330.7±78.0	303.2±85.5	0.127
Left ventricular myocardial mass index (g/m²)	166.3±43.3	167.2±38.4	156.1±40.8	0.225

Univariate Cox proportional hazards model evaluation of the effect of depression and clinical and instrumental indicators on all-cause mortality are presented in Table 3. The significant predictors of all-cause patient mortality were depression parameters, LVEF, hemodynamically significant coronary artery stenosis, heart failure functional class, and the type of implantable cardiac device. Analysis of patients who

Table 3. The hazard ratio and 95% confidence interval for death from all causes in patients with an implanted cardiac device according to depression and other clinical and instrumental parameters*

Patients	Parameters	HR	95% CI	*p*
CRT or CRT+ICD or ICD	Depression (points)	1.04	1.01–1.08	0.023
	No depression	1.00		
	Mild depression	1.32	0.54–2.68	0.659
	Severe depression	2.41	1.08–5.38	0.032
	Age	0.98	0.95–1.01	0.201
	Sex	0.31	0.07–1.27	0.102
	Smoking	1.63	0.83–3.20	0.157
	Body mass index	1.02	0.97–1.07	0.528
	Left ventricular ejection fraction	0.92	0.88–0.96	0.000
	Hemodynamically significant lesions of the coronary arteries	1.44	1.08–1.91	0.013
	Hypercholesterolemia	1.20	0.62–2.34	0.584
	Previous myocardial infarction	1.48	0.77–2.82	0.240
	Arterial hypertension	0.73	0.35–1.51	0.393
	Diabetes	1.03	0.40–2.65	0.952
	Atrial fibrillation	1.21	0.64–2.31	0.563
	Heart failure functional class (NYHA)	2.04	1.26–3.28	0.004
	Type of implantable device	0.22	0.08–0.63	0.005

*Univariate model. CI: Confidence interval; HR: Hazard ratio; CRT: Cardiac resynchronization therapy; ICD: Implantable cardioverter defibrillators.

Table 4. The hazard ratio and 95% confidence interval for death from all causes in cardiac resynchronization therapy patients according to depression and other clinical and instrumental parameters*

Patients	Parameters	HR	95% CI	*p*
CRT or CRT+ICD	Depression (points)	1.04	1.00–1.07	0.058
	No depression	1.00		
	Mild depression	1.08	0.47–2.50	0.853
	Severe depression	2.08	0.90–4.81	0.086
	Age	0.97	0.96–1.02	0.415
	Sex	0.30	0.07–1.27	0.102
	Smoking	1.49	0.73–3.04	0.271
	Body mass index	0.99	0.93–1.05	0.788
	Left ventricular ejection fraction	0.94	0.89–0.99	0.014
	Hemodynamically significant lesions of the coronary arteries	1.61	1.20–2.17	0.001
	Hypercholesterolemia	1.24	0.62–2.50	0.545
	Previous myocardial infarction	1.99	1.00–3.95	0.051
	Arterial hypertension	0.66	0.31–1.39	0.272
	Diabetes	0.73	0.22–2.40	0.601
	Atrial fibrillation	1.19	0.60–2.36	0.615
	Heart failure functional class (NYHA)	1.37	0.80–2.36	0.248

*Univariate model. CI: Confidence interval; HR: Hazard ratio; CRT: Cardiac resynchronization therapy; ICD: Implantable cardioverter defibrillators.

Table 5. The hazard and 95% confidence interval for death from all causes according to level of depression*

Patients	Parameters	HR	95% CI	*p*
CRT or CRT+ICD or ICD	Depression (points)	1.05	1.01–1.09	0.019
	No depression	1.00		
	Mild depression	1.32	0.57–3.03	0.514
	Severe depression	3.18	1.31–7.73	0.011
	Age	1.00	0.96–1.04	0.865
	Sex	0.42	0.09–2.10	0.293
	Smoking	1.57	0.75–3.28	0.233
	Body mass index	1.02	0.96–1.09	0.532
	LVEF	0.92	0.87–0.98	0.006
	Hemodynamically significant stenotic lesions of the coronary arteries	1.33	0.92–1.94	0.131
	Hypercholesterolemia	1.66	0.79–3.49	0.179
	Previous myocardial infarction	1.23	0.54–2.81	0.618
	Arterial hypertension	0.59	0.25–1.38	0.226
	Diabetes	0.84	0.30–2.37	0.747
	Atrial fibrillation	1.38	0.65–2.92	0.402
	Heart failure functional class (NYHA)	1.47	0.84–2.58	0.180
	Type of implantable device	0.28	0.09–0.83	0.022

*Multivariate model adjusted for age, sex, smoking, body mass index, LVEF, hemodynamically significant stenotic lesions of the coronary arteries, hypercholesterolemia, previous myocardial infarction, arterial hypertension, diabetes, atrial fibrillation, heart failure functional class (New York Heart Association), and the type of implantable device. CI: Confidence interval; HR: Hazard ratio; CRT: Cardiac resynchronization therapy; ICD: Implantable cardioverter defibrillators; LVEF: Left ventricular ejection fraction.

underwent CRT with or without an ICD was also performed. In all, 33 patients (21.2%) died in this group. The significant predictors of all-cause mortality in this subgroup of patients were LVEF and hemodynamically significant coronary artery stenosis (Table 4). Depression and previous myocardial infarction revealed only a statistical trend. Next, multivariate statistical analysis was performed. The adjusted HR for all-cause mortality for the depression score was 1.05, with a 95% CI of 1.01–1.09 (Table 5). Thus, a 1-point increase in the Beck Depression Inventory score raised the risk of death from all causes by 5%. When analyzing the categorical indicators of depression, the HR of death from all causes (Table 5) was found to be significantly higher in the group of patients with severe symptoms of depression compared with the group of patients with no signs of depression. In patients with only mild symptoms of depression, no statistically significant difference in HR was observed.

Further, the effect of depression on the risk of all-cause mortality was assessed in the subgroup of patients who underwent CRT alone or CRT in combination with ICD. The HR for all-cause mortality for the depression score was 1.05, with a 95% CI of 1.01–1.10 (Table 6). The analysis of the categorical indicators of depression indicated that the HR for death from all causes (Table 6) was significantly greater in the group of patients with severe symptoms of depression compared with the group with no signs of depression (HR: 3.44; 95% CI: 1.31–9.01). In patients with mild symptoms of depression, no statistically significant difference in HR for death was found.

DISCUSSION

Our study results indicated that the level of depressive symptoms was related to gender. In the group with severe depression, the percentage of female patients was significantly greater than that in the group without symptoms of depression. It is well known that women suffer from depression 2 times more often than men. [11] Several reasons have been proposed in the literature, including social, psychological, and family

Table 6. The hazard ratio and 95% confidence interval for death from all causes according to level of depression*

Patients	Parameters	HR	95% CI	*p*
CRT or CRT+ICD	Depression (points)	1.05	1.01–1.10	0.016
	No depression	1.00		
	Mild depression	1.20	0.50–2.89	0.683
	Severe depression	3.44	1.31–9.01	0.012
	Age	0.99	0.95–1.03	0.612
	Sex	0.70	0.13–3.69	0.673
	Smoking	1.61	0.73–3.55	0.238
	Body mass index	0.98	0.91–1.06	0.606
	LVEF	0.93	0.87–0.99	0.017
	Hemodynamically significant lesions of the coronary arteries	1.54	1.00–2.37	0.050
	Hypercholesterolemia	1.75	0.78–3.88	0.173
	Previous myocardial infarction	1.38	0.54–3.54	0.502
	Arterial hypertension	0.52	0.22–1.24	0.140
	Diabetes	0.62	0.17–2.23	0.463
	Atrial fibrillation	1.92	0.84–4.36	0.126
	Heart failure functional class (NYHA)	1.15	0.63–2.09	0.646

*Multivariate model adjusted for age, sex, smoking, body mass index, LVEF, hemodynamically significant stenotic lesions of the coronary arteries, hypercholesterolemia, previous myocardial infarction, arterial hypertension, diabetes, atrial fibrillation, and heart failure functional class (New York Heart Association). CI: Confidence interval; HR: Hazard ratio; CRT: Cardiac resynchronization therapy; ICD: Implantable cardioverter defibrillators; LVEF: Left ventricular ejection fraction.

problems, such as loneliness, infertility, divorce, and strong emotional experience.[12] The average age of the women in our study was 54.3±10.5 years. Age-related features can affect the level of depression in women. During the perimenopause period, the natural process of neuroendocrine restructuring causes stress in the adaptation mechanisms, and the influence of additional factors can lead to disruption of adaptation and the appearance of both somato-vegetative and psychiatric disorders.[12] During the climacterium period, depressive symptoms may be at least in part a result of decreased levels of monoamines, monoamine oxidase, and endorphins, which may be a consequence of the age-related decrease in estrogen.[13]

According to the results of our study, depression was independently associated with the risk of death from all causes and the HR was significantly greater in CHF patients with severe depression. In their meta-analysis, Rutledge et al.,[6] also found that depression increased the risk of death for CHF patients. Similar data were obtained in by Sokoreli et al.:[14] in patients with CHF decompensation, depression was associated with an unfavorable outcome within a year after discharge from the hospital.

Numerous studies have demonstrated that depressive symptoms contribute to the high risk of death in CAD patients, which is reflected in the Recommendations for Screening, Referral, and Treatment of Depression and Coronary Heart Disease of the American Heart Association.[3] Watkins et al.,[15] studied 934 patients with CAD and found a high level of depression and anxiety. The authors observed that a high level of depression and anxiety increased the HR of death by 2.18 times. Konrad et al.[16] found that the risk of depression was significantly greater in patients with CAD compared with patients without CAD. Thus, in our patients, CAD could make a significant contribution to aggravating the symptoms of depression, which could worsen CHF.

Some studies have demonstrated an increase in the levels of the proinflammatory cytokines C-reactive protein (CRP), interleukin (IL) 6, and tumor necrosis factor-α (TNF-α) in CHF patients prior to CRT;[17] it has also been reported that each increase in the functional class of CHF in patients results in increased levels of CRP, IL-1, IL-6.[18] Moreover, depression and CHF have common pathologies: hyperreactivity of the sympathoadrenal and hypothalamic-pituitary-

adrenal axis ultimately leads to hyperproduction of pro-inflammatory cytokines, which in turn influence the regulation of neurotransmitters, especially serotonergic transmission, and serotonin plays a major role in mood regulation.[19] A study by Howren et al.[20] showed cause-effect relationships: depression leads to elevated blood levels of CRP, IL-1, and IL-6, and these cytokines increase the level of depression in patients with CVD. It has been established that CHF pathogenesis includes an inflammatory syndrome that is the result of activation of the cytokine system.[21] The negative effect of cytokines on CHF progression has been demonstrated in a major meta-analysis.[22] In our study, subclinical inflammation may have been maintained by either depression or CHF and had a negative impact on the heart function. This fact does not exclude the reason for increased rates of unfavorable outcomes in patients with severe depression.

Data about the influence of implanted cardiac devices on depressive symptoms are contradictory: Duncker et al.[23] have demonstrated that depressive symptoms significantly decreased 6 months after CRT; however; other research indicated that CRT did not change the severity of depressive symptoms.[24]

Thus, early diagnosis and treatment of depression in CHF patients recommended to undergo the implantation of a cardiac electronic device will help to increase the effectiveness of this method of CHF treatment and will reduce the risk of death in these patients.

Conclusion

Increased depressive symptoms are independently associated with all-cause mortality in patients with CHF and implanted cardiac devices.

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