The Relationship Between HbA1c Level and Beck Depression Scale in Patients with Heart Failure with Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: Multiple studies have shown the relationship between heart failure (HF) and development of depression. Several studies have demonstrated worse perception of quality of life among patients with type 2 diabetes mellitus (T2DM). We aimed to assess the association between glycated hemoglobin (HbA1c) levels and depression severity in patients with diabetic HF.

Patients and Methods: Between July 2015 and June 2016, 179 patients with HF (left ventricular ejection fraction < 35%) and T2DM were included in the study. Blood samples for HbA1c were obtained from patients with T2DM. The severity of depression was assessed using the Beck Depression Inventory (BDI). Patients with depression were classified as follows: minimal with score 0-13 (group I), mild with score 14-19 (group II), moderate with score 20-28 (group III), and severe with score 29-63 (group IV).

Results: The median age of the study population was 64 (57-75) years (98 females and 81 males). There was no significant difference between the groups regarding the frequency of hypertension and gender. There was a significant positive correlation between BDI and HbA1c levels in patients with HF ($r= 0.488$, $p< 0.001$). According to the analysis performed between the groups, HbA1c values were found to be significantly higher in group IV than in groups I, II, and III (6.0 ± 1.47, 6.4 ± 0.6, 7.03 ± 0.7, and 7.6 ± 1.23, respectively; $p< 0.001$), which indicate the association between severity of depression and HbA1c level.

Conclusion: We detected a significant association between BDI and HbA1c level in patients with chronic HF with T2DM. Therefore, more strict control of blood glucose level may improve quality of life and decrease depressive symptoms in patients with diabetic HF.

Key Words: Beck depression scale; diabetes mellitus; HbA1c; heart failure

Tip 2 Diabetes Mellitusu Olan Kalp Yetmezlikli Hastalarda HbA1c Seviyesi ile Beck Depresyon Skalası Arasındaki İlişki

ÖZET

Giriş: Birçok çalışma kalp yetmezliği ile depresyon gelişimi arasındaki ilişkiyi göstermiştir. Bazı çalışmalar tip 2 diabetes mellitus (DM) olanlarda yaşam kalitesinin bozulduğunu göstermiştir. Diyabetik kalp yetmezlikli hastalarda HbA1c düzeyleri ile depresyon arasındaki ilişkiyi değerlendirmeyi amaçladık.

Hastalar ve Yöntem: Temmuz 2015 ve Haziran 2016 tarihleri arasında, 179 Tip 2 DM'li kalp yetmezliği olan (LV-EF < %35) hastalar çalışmaya dahil edildi. Tip 2 DM'li hastalardan HbA1c için kan örnekleri alındı. Depresyonun şiddeti Beck Depresyon Envanteri (BDE) kullanılarak değerlendirildi. Depresyonu olan hastalar aşağıdaki gibi sınıflandırıldı: minimal skor 0-13 (grup I), hafif skor 14-19 (grup II), orta skor 20-28 (grup III) ve şiddetli skor 29-63 (grup IV).

Bulgular: Çalışma popülasyonunun medyan yaşı 64 (57-75) idi (kadın: 98, erkek: 81). Hipertansiyon ve cinsiyet sıklığı açısından gruplar arasında anlamlı fark yoktu. BDE skorlama sistemine göre sınıflandırılan hastaların sayısı, I ila IV. gruplarda sırasıyla 42, 45, 46 ve 46 idi. Kalp yetmezliği olan hastalarda BDE ve HbA1c düzeyleri arasında anlamlı pozitif korelasyon vardı ($r= 0.488$, $p< 0.001$). Gruplar arasında yapılan analizlere göre HbA1c değerleri grup 4 te grup I, II ve III'e göre anlamlı olarak yüksek bulundu (6.0 ± 1.47, 6.4 ± 0.6, 7.03 ± 0.7, 7.6 ± 1.23, sırasıyla, $p< 0.001$).

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Sonuç: Tip 2 DM'li kronik kalp yetmezlikli hastalarda BDE ve HbA1c düzeyleri arasında anlamlı ilişki saptadık. Bu nedenle, kan glukoz seviyesinin daha sıkı kontrolü, diyabetik kalp yetmezlikli hastalarda yaşam kalitesini artırabilir ve depresif belirtileri azaltabilir.

Anahtar Kelimeler: Beck depresyon skalası; diyabet hastalığı; HbA1c; kalp yetmezliği

INTRODUCTION

Heart failure (HF) is associated with poor quality of life, limited social functioning, and lost work capacity[1]. These conditions have a strong adverse effect on functional status, and poor functional status has implications for exercise capacity, illness severity, and quality of life in patients with HF[2,3]. Depression is one of the most common psychiatric disorders[4]. Initial presenting symptoms tend to include an increasingly reduced sense of self-efficacy, reduced self-care behaviors, mood swings, and, in some cases, increased suicidal ideation. More than 20% of patients with HF suffer from depression[5]. Diabetes mellitus (DM) is a chronic disease that can lead to many complications. It affects the patients' quality of life and is often associated with depression[6,7]. Abundant evidence demonstrates a strong relationship between depression and HF[5-8]. Comorbid DM and HF confer a significant risk of cardiovascular morbidity and mortality. Recently, Dogdu et al. reported the relationship between psychosocial status, DM, and left ventricular systolic function in patients with stable multivessel coronary artery disease[9].

The aim of the present study was to determine the impact of glycated hemoglobin (HbA1c) on depression in patients with HF with type 2 DM (T2DM).

PATIENTS and METHODS

Study Population

Between July 2015 and June 2016, 179 patients with HF (left ventricular ejection fraction (LVEF) < 35%) and T2DM were included in the study. Demographic data including age, hypertension, gender, and marital status; etiology of HF (ischemic vs. non-ischemic); HbA1c level; and New York Heart Association (NYHA) class (I-IV) were collected. T2DM was diagnosed according to the American Diabetes Association criteria[10]. Blood samples were obtained at the time of admission for HbA1c. Eligible patients were those whose NYHA class of HF were I or greater and those who had an EF ≤ 35% by echocardiography. Patients who were mentally subnormal or who had other neurological problems, presence of type 1 DM, and gestational DM were excluded from the study. Informed consent was obtained from each patient. The study protocol was reviewed and approved by the local ethics committee of the university in accordance with the Declaration of Helsinki.

Echocardiography

The left lateral decubitus position was used to obtain images during echocardiography. Transthoracic echocardiographic (Vivid 3, GE) study included measurements of the left ventricular end-systolic diameter (LVESD), left ventricular end-diastolic diameter (LVEDD), pulmonary artery pressure (PAP), LVEF as determined using the Simpson method, and left atrial diameter (LAD). The apical four-chamber and two-chamber images of the heart were acquired by a single sonographer. LVEF < 35% was defined as HF.

Psychological Tests

The severity of depression was assessed using the Beck Depression Inventory (BDI), which consists of 21 items related to cognitive and somatic symptoms of depression[11]. The items refer to sadness, pessimism, sense of failure, lack of satisfaction, guilt, feeling of punishment, self-deprecation, self-accusation, suicidal ideation, crying spells, irritability, social withdrawal, indecisiveness, distortion of body image, inhibition to work, sleep disorder, fatigue, loss of appetite, weight loss, somatic concern, and decreased libido. BDI is composed of closed questions with four options of answers for each question; each answer has a score between 0 and 3, indicating severity of symptoms. Patients with depression were classified as follows: minimal with score 0-13 (group I), mild with score 14-19 (group II), moderate with score 20-28 (group III), and severe with score 29-63 (group IV).

Statistical Analysis

All statistical analyses were performed using SPSS for Windows, version 16.0 (SPSS Inc., IBM, Armonk, NY, USA). Variables were investigated using analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk test) to determine whether or not they are normally distributed. Continuous variables were presented as medians and interquartile ranges or as mean ± SD, as appropriate. Categorical variables were presented as observed frequencies and percentages. Group means for continuous variables were compared using the Student's t-test or the Mann-Whitney U test as appropriate. Between-group comparisons were conducted using one-way analysis of variance for continuous variables and two-test for categorical variables. Categorical variables were compared using the chi-square or Fisher's exact tests. Correlation of parametric test measures was evaluated by using parametric Pearson r or non-parametric Spearman rank R, as appropriate. A p-value < 0.05 was accepted as statistically significant.

RESULTS

The median age of the study population (n= 179) was 64 (57-75) years. There were 98 female and 81 male patients. Table 1 summarizes the demographic, clinical, laboratory, and echocardiographic characteristics of the patients. There was no significant difference between the groups regarding gender,

Table 1. Demographic, clinical, laboratory, and echocardiographic characteristics of the patients according to the beck depression inventory

	BDI 0-13	BDI 14-19	BDI 20-28	BDI 29-63	p
BDI	7 (4-12)	17 (15-18)	25 (23-27)	47.5 (36.7-56.2)	
Age (year)	0.70 ± 0.11	60.5 (57-65)	62 (56-64)	67 (56-69.7)	0.007
Gender					0.232
Female	27	21	22	28	
Male	15	24	24	18	
Marital status					0.352
Married (n)	33	36	37	43	
Not married (n)	9	9	9	4	
Systolic PAP	37.6 ± 6.3	39.2 ± 7.6	41.9 ± 9.7	51.6 ± 10.1	< 0.001
HF etiology					
Ischemic	32	32	17	33	
Non-ischemic	10	13	29	13	
Electrocardiogram					0.439
Sinus rhythm (n)	28	32	26	27	
Atrial fibrillation (n)	14	13	20	19	
Treatment of DM					0.131
None	6	0	2	3	
OAD	25	32	35	34	
Insulin	11	13	9	9	
Hypertension					0.164
Yes	28	27	34	37	
No	14	18	12	9	
NYHA score					< 0.001
1	19	12	8	2	
2	17	25	15	12	
3	6	7	23	23	
4	0	1	0	9	
HbA1c	6.0 ± 1.4	6.4 ± 0	7.03 ± 0.7	7.6 ± 1.2	< 0.001
Medication use					
Beta blocker	28	25	34	40	0.009
ACE-I/ARB	31	27	35	43	0.003
Digoxin	10	10	12	7	0.621
Diuretics	26	24	30	37	0.052
Acetylsalicylic acid	34	35	38	43	0.197
Statin	14	23	30	17	0.001
Antidepressant use					0.230
Yes	3	6	10	9	
No	39	39	36	37	
Echocardiography					
LVEDD	5.1 (4.8-5.5)	5.2 (4.8-5.9)	5.5 (5.1-6.0)	6.4 (5.9-6.8)	< 0.001
LVESD	3.8 (3.1-4.5)	3.7 (3.1-4.8)	4.3 (3.5-4.9)	4.9 (4.6-5.5)	< 0.001
LAD	4.1 (3.6-4.3)	3.8 (3.2-4.1)	4.0 (3.6-4.3)	4.4 (4.2-4.7)	< 0.001

BDI: Beck depression inventory, HF: Heart failure, NYHA: New York Heart Association, DM: Diabetes mellitus, OAD: Oral antidiabetic, ACE-I: Angiotensin-converting enzyme inhibitor, ARB: Angiotensin receptor blocker, PAP: Pulmonary artery pressure, LVEDD: Left ventricular end-diastolic diameter, LVESD: Left ventricular end-systolic diameter, LAD: Left atrial diameter. Continuous variables with normal distribution were expressed as mean ± standard deviation. Continuous variables without normal distribution were expressed as median (25^{th}-75^{th} percentiles).

marital status, and hypertension. Ischemic etiology was the most common cause of HF (63.7%). The median age of group IV was significantly higher than that of the other groups (p= 0.007). The numbers of patients classified according to the BDI scoring system (group I to IV) were 42, 45, 46, and 46, respectively. The median Beck depression scores (group I to IV) were 7 (4-10.25), 17 (15-18), 25 (23-27), and 47.5 (36.75-56.25), respectively. The Beck depression score was moderately correlated with HbA1c (r= 0.488, p< 0.001) (Figure 1). The majority of the patients (71.5%) were NYHA II to III. The median NYHA class of group IV was significantly higher than that of the other groups. Systolic PAP was compared between the four groups (37.6 ± 6.3 mmHg, 39.2 ± 7.6 mmHg, 43 ± 8.9 mmHg, and 51.6 ± 10.1 mmHg, respectively; p< 0.001) (group 1 vs. group 3, p= 0.01; group 1 vs. group 4, p= 0.000; group 2 vs. group 4, p= 0.000; group 3 vs. group 4, p= 0.000). The echocardiographic parameters LVEDD, LVESD, and LAD were also compared between the groups (p< 0.001, p< 0.001, and p< 0.001, respectively). The results of the post hoc analysis for LVEDD were as follows: group 1 vs. group 3, p= 0.026; group 1 vs. group 4, p= 0.000; group 2 vs. group 4, p= 0.000; and group 3 vs. group 4, p= 0.000. Post hoc analysis was also performed for LVESD (group 1 vs. group 4, p= 0.000; group 2 vs. group 4, p= 0.000; group 3 vs. group 4, p= 0.000) and LAD (group 1 vs. group 4, p= 0.002; group 2 vs. group 4, p= 0.000; group 3 vs. group 4, p= 0.000). The cut-off values of HbA1c for prediction of group IV were detected by using receiver operating characteristic cure analysis. An HbA1c value of > 6.75 yielded an area under the curve value of 0.756 (95% CI 0.678-0.835; p< 0.001). Furthermore, the HbA1c value > 6.75 demonstrated a sensitivity of 76% and a specificity of 60% for the prediction of group IV (Figure 2). Further, the patients were divided into two groups according to HbA1c levels (group I HbA1c < 6.75 and group II HbA1c ≥ 6.75). Table 2 shows the clinical and laboratory characteristics of the patients according to

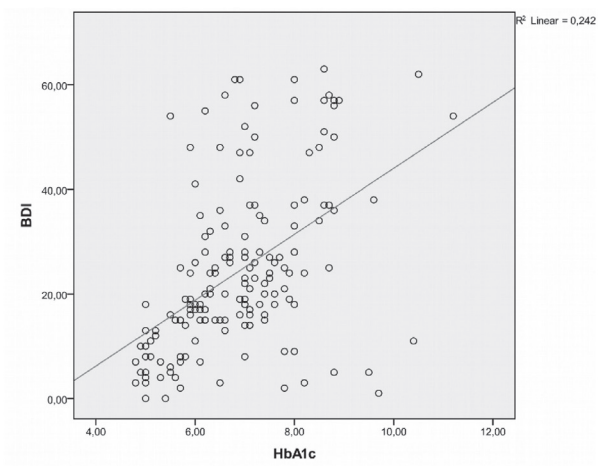

Figure 1. Scatter graphs demonstrating moderate positive correlations between HbA1c levels and Beck Depression Inventory (BDI).

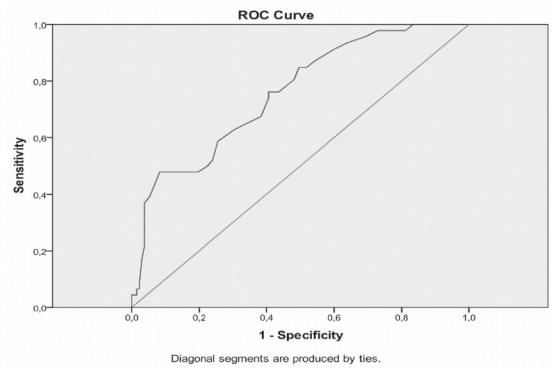

Figure 2. Receiver operating characteristic curve graphics to detect the best cut-off value of HbA1c in the prediction of group IV.

Table 2. Demographic, clinical, laboratory, and echocardiographic characteristics of the patients according to HbA1c levels

	HbA1c < 6.75	HbA1c > 6.75	p
BDI	16 (10-25)	26.5 (18-39)	< 0.001
Age (year)	62 (56-67)	63 (57-68)	0.158
Gender			
Female	47	51	0.604
Male	42	39	
Marital status			
Married (n)	74	74	0.87
Not married (n)	15	16	
NYHA			
1	28	13	
2	34	35	0.033
3	23	36	
4	4	6	
Hypertension			
Yes	61	65	0.589
No	28	25	
Electrocardiogram			
SR	56	57	0.954
AF	33	33	
Pulmonary artery pressure	40 (35-45)	45 (35-55.5)	0.002
Echocardiography			
LVEDD	5.4 (4.9-5.9)	5.7 (5.1-6.5)	0.018
LVESD	4.1 (3.2-4.8)	4.6 (3.7-5.1)	0.024
LAD	4.1 (3.5-4.3)	4.2 (3.7-4.5)	0.04

BDI: Beck depression inventory, NYHA: New York heart association, SR: Sinus rhythm, AF: Atrial fibrillation, PAP: Pulmonary artery pressure, LVEDD: Left ventricular end-diastolic diameter, LVESD: Left ventricular end-systolic diameter, LAD: Left atrial diameter.
Continuous variables with normal distribution were expressed as mean ± standard deviation. Continuous variables without normal distribution were expressed as median (25^{th}-75^{th} percentiles).

HbA1c levels. BDI scores and Pain Attitudes and Beliefs Scale were significantly different between these two groups, whereas there was no significant difference between the groups in terms of age, LVEDD, LVESD, and LAD. There was also significant difference between these two groups regarding NYHA class (p= 0.033). In the analysis performed between the groups (according to the BDI scoring system), HbA1c values were found to be significantly higher in group IV than in groups I, II, and III (6.0 ± 1.47, 6.4 ± 0.6, 7.03 ± 0.7, and 7.6 ± 1.23, respectively; p< 0.001). The results of the post hoc analysis (group 1 vs. group 3, p= 0.001; group 1 vs. group 4, p= 0.000; group 2 vs. group 4, p= 0.000; group 3 vs. group 4, p= 0.017) show the association between severity of depression and HbA1c levels.

DISCUSSION

In the present study, we found a significant association between BDI and HbA1c level in patients with T2DM with HF with reduced ejection fraction. There are several methods for the evaluation of depression, in addition to the criteria in the Diagnostic and Statistical Manual of Mental Disorders, such as the Geriatric Depression Scale, the Center for Epidemiologic Studies Depression Scale, the BDI, the Hamilton Depression Rating Scale, and the Patient Health Questionnaire-2[12,13]. In the current study, BDI was used for the assessment of the severity of depression. Depression is common in people with HF, with the prevalence ranging from 12% to 40%[14]. HF duration is associated with physical impairment, resulting in significant limitations in these patients' daily life and activities. Relevant research has shown a high prevalence of depression in patients with severe HF or a poor level of physical function[15,16]. Owing to the associations of depression with decreased functional performance and adverse outcomes, assessment and treatment of depression in HF is advocated. Gottlieb et al. demonstrated that patients classified as NYHA classes III and IV are more likely to be depressed than class II patients[17]. In the current study, higher HbA1c levels, PAP, NYHA class, and presence of underlying ischemic etiology were found to be associated with higher BDI scores in patients with HF. Depression is associated with hyperglycemia in patients with DM, but the underlying mechanisms are unclear[18]. Several studies observed higher rates of depression in patients with DM and tried to demonstrate the association between the presence of depressive symptoms and an increased prevalence of clinical complications of DM. Several studies showed a higher prevalence of depression in patients with diabetes than in non-diabetic sex- and age-matched control group[18,19]. Papelbaum et al. found that patients with DM who displayed depression have higher HbA1c levels than those without depression[20]. A recent study suggested that micro- and macrovascular diabetic complications are associated with depression[21]. In contrast, another study showed that HbA1c levels are not associated with the presence of depression[22]. However, the existing literature data are still inconsistent with respect to the relationship between depressive symptoms and poor glycemic control.

In the current study, BDI was higher in patients with poor glycemic control and increased HbA1c levels. As increased PAP and NYHA class were found to be associated with high HbA1c levels in patients with T2DM, the severity of depression can decrease with strict regulation of blood glucose levels.

Increased HbA1c levels were associated with increased PAP and NYHA class in patients with T2DM with HF. This may result in increased hospitalization rates and may probably explain the increased frequency of depression and BDI score in this group of patients.

Limitation

Our study has several limitations. The sample size was relatively small, which can partially be attributed to the larger number of patients with chronic HF screened. BDI score and HbA1c levels were measured once in the study patients and were not re-evaluated during follow-up. In the present study, we did not aim to assess the potential relationship between diabetic complications and depression.

CONCLUSION

The present study revealed that there was an association between DM and depression; the correlation between BDI and HbA1c was significant. Patients with DM should be screened for depression, and strict glucose control should be maintained. The results of the present study should be further confirmed in future studies.

CONFLICT of INTEREST

The authors reported no conflict of interest related to this article.

AUTHORSHIP CONTRIBUTIONS

Concept/Design: MY, MÇ, SK
Analysis/Interpretation: IR, YK, MK
Data Acquisition: OG, YK
Writting: MY, MK
Critical Revision: MÇ, SK, İR, OG, YK
Final Approval: All of authors

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