

The Predictive Role of the CHADS-VASc Score on Reduced Left Ventricular Ejection Fraction in Patients with Acute Coronary Syndrome

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Abstract

Background: Reduced left ventricular systolic function is associated with significant mortality and morbidity in patients with the acute coronary syndrome (ACS). Predicting which patients may go on to develop heart failure (HF) with optimal treatment is thus likely to be effective in reducing mortality and morbidity. This study aims to evaluate the role of the CHA2DS2-VASc score in predicting reduced left ventricular ejection fraction (LVEF) in patients with ACS.

Methods: 202 patients diagnosed with the ACS participated in the study. Coronary angiography (CAG) was performed on all patients. The LVEF values of the patients before and three months after discharge were evaluated by transthoracic echocardiogram (TTE). Group 1 consisted of patients with LVEF values below 50% at the third month, while Group 2 consisted of those with LVEF values of 50% and above.

Results: The mean age of the patients was 62 ± 12 years, and 142 of the patients were male. The LVEF values in the third month were 55.58 ± 0.24 in Group 1 and 42.07 ± 0.86 in Group 2 ($p < 0.001$). While the mean CHA2DS2-VASc score was 0.86 ± 0.78 in Group 1, it was 1.78 ± 0.87 in Group 2 ($p < 0.001$). Multiple regression analysis showed that the CHA2DS2-VASc score had an independent relationship in predicting the LVEF values in patients with ACS (Odds ratio [OR] 3.179, 95% CI 1.972-5.124, $p < 0.001$). CHA2DS2-VASc scores above 1.5 can be used as a predictor for decreased left ventricular systolic function in patients with ACS with 53% sensitivity and 80% specificity.

Conclusion: The CHA2DS2-VASc score is a simple and easy parameter that can be used to predict decreased and preserved left ventricular systolic functions in patients with ACS.

Key words: CHA2DS2-VASc Score, Ejection Fraction, Acute Coronary Syndrome.

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INTRODUCTION

Cardiovascular disease is the leading cause of death in the elderly population worldwide. According to statistics from the American Heart Association (AHA) for 2015, approximately 300,000 recurrent ACS attacks occur annually (1).

The growing prevalences of hypertension (HT), kidney diseases and coronary artery disease (CAD) as age increases are risk factors for ACS and its complications (2). Although the frequency of complications such as free wall rupture, arrhythmias and pericarditis can be reduced with early diagnosis and treatment, congestive heart failure (CHF) is still accepted as an important complication. CHF developing as a result of ACS is associated with high mortality, and clinical pictures with edema, pulmonary congestion, and ventricular arrhythmias in both acute and chronic stages impair the quality of life (3).

Predicting the potential complications after ACS is likely to contribute greatly to the reduction of mortality rates. Although the CHA2DS2-VASc score was developed to predict cerebrovascular events in patients with atrial fibrillation, recent studies have shown that it can also be used in the evaluation of high-risk ACS patients (4). Impaired heart functions are associated with poor prognoses in patients with ACS (5). This study thus aimed to investigate the relationship between the left ventricular systolic function and CHA2DS2-VASc scores in patients with ACS.

MATERIALS AND METHODS

This study was approved by the Çanakkale Onsekiz Mart University ethics committee of the hospital in which it took place in line with the recommendations of the Declaration of Helsinki (Date: 09.12.2020 Decision no: 2020-14).

Study Population and Data Collection

This retrospective study examined data from 202 consecutive patients who were admitted to a single cardiology center with a diagnosis of ACS between January 2017 and December 2019. The diagnosis and treatment of ACS in the patients were made according to current guidelines (6). Coronary angiography (CAG)

was performed in all patients. Before the procedure, transthoracic echocardiogram (TTE) and CHA2DS2-VASc scores were calculated.

Three months after discharge, control TTE was performed and LVEF values were calculated. Patients with LVEF values below 50% were designated as "Group 1", while those with LVEF values of 50% and above were designated as "Group 2".

Patients who were younger than 18 years of age, those with chronic renal failure, HF, previous CAD, active infections, malignant diseases, as well as those who had undergone coronary artery bypass surgery (CABG), who were scheduled for valve surgery, who had contraindications for coronary angiography, and who did not agree to participate in the study, were not included. The hemogram, CRP, whole blood, lipid panel, and kidney function tests of all patients were obtained from the patient files.

Definitions

Patients who were using antihypertensive drugs, and who had a systolic blood pressure equal to 140 mmHg or above and a diastolic blood pressure equal to 90 mmHg or above, were defined as high-blood-pressure patients. Patients who had fasting blood glucose levels equal to 126 mg/dL or above or who were using a drug for glucose regulation were defined as diabetes mellitus.

Coronary Angiography and Calculation of CHA2DS2-VASc Score

CAG was performed using the Judkins technique through the femoral or radial arteries. Coronary arteries were evaluated by analyzing images obtained from at least two different angles. Percutaneous coronary intervention (PCI) was performed using the standard technique. All of the PCIs were performed successfully. Points were allocated for each item specified for calculating the CHA2DS2-VASc score as follows: CHF (ejection fraction <40%) (1 point), HT (1 point), age \geq 75 years (2 points), diabetes mellitus (1 point), stroke (2 points), vascular disease (peripheral artery disease or myocardial infarction) (1 point), age 65-74 (1 point) and gender (female) (1 point).

Echocardiographic examination

Echocardiography of the patients was performed by an independent cardiologist who did not have any information about the clinical characteristics of the patients. All the echocardiographic examinations were performed using a Philips EPIQ 7 Ultrasound Machine (Philips EPIQ 7 Cardiac Ultrasound, Bothell, WA, USA) and a 2.5 MHz probe. The LVEF values were calculated using the modified Simpson method as pre-discharge and third-month controls. TTE examinations were performed in accordance with the imaging guidelines recommended by the American and European Societies (8).

Statistical Analysis

The SPSS 21.0 (SPSS Inc, Chicago, IL, USA) program was used for statistical analysis. Whether the variables fitted normal or non-normal distribution was evaluated using the Kolmogorov–Smirnov test. Continuous variables were expressed as mean \pm standard deviation, while categorical variables were expressed as percentages and numbers. The one-way ANOVA test was used for analysis of the normal distribution of parametric values between groups. The chi-square test was used to compare the odds ratios of categorical variables. Logistic regression analysis was performed to determine the effect of variables. 95% confidence intervals were calculated with standardized beta coefficients. The ROC curve was used to predict the CHA2DS2-VASc score for the left ventricular systolic function in patients with ACS. $p < 0.05$ was considered statistically significant.

RESULTS

The basic clinical, echocardiographic, and laboratory values of the 202 patients are shown in Table 1. A total of 130 patients were diagnosed with ST-segment elevation myocardial infarction (STEMI), and 72 patients were diagnosed with non-ST segment elevation myocardial infarction (NSTEMI). According to the CAG results, 165 patients had single vessel disease, 30 patients had double vessel disease, and 7 patients had triple vessel disease. In addition, the culprit lesions were identified in the left anterior descending artery (LAD) in 69 patients, in the circumflex artery (Cx) in 78 patients, and in the right coronary artery (RCA) in 65 patients (Table 1).

Table 1. Demographic, clinical and laboratory features of the patients

| Variables | Group 1 (n=157) | Group 2 (n=45) | P |
|---|-------------------|--------------------|--------|
| Age (years) | 60.2 \pm 1 | 69 \pm 1.8 | <0.001 |
| Female n (%) | 38(24.2) | 22(48.9) | 0.003 |
| HT n (%) | 78(49.7) | 24(53.3) | 0.666 |
| DM n (%) | 18(11.5) | 12(26.7) | 0.022 |
| LVEF at admission % | 55.58 \pm 0.24 | 42.07 \pm 0.86 | <0.001 |
| LVEF at third month % | 45.95 \pm 0.39 | 35.16 \pm 0.74 | <0.001 |
| Current smoker n (%) | 104(66.2) | 25(56.2) | 0.254 |
| Serum glucose mg/dL | 136.66 \pm 1.70 | 176.07 \pm 14.42 | 0.001 |
| Creatinine (mg/dL) | 0.88 \pm 0.01 | 0.95 \pm 0.02 | 0.010 |
| Sodium (mmol/L) | 138.87 \pm 0.22 | 139.93 \pm 0.57 | 0.045 |
| Potassium (mmol/L) | 4.28 \pm 0.03 | 4.78 \pm 0.07 | <0.001 |
| GFR, mL/min, median (IQR) | 68(40) | 94(34) | <0.001 |
| STEMI, n (%) | 102(65) | 28(62) | <0.001 |
| NSTEMI, n (%) | 55(35) | 17(38) | <0.001 |
| Number of coronary arteries narrowed, n (%) | | | |
| 1 | 124(79) | 41(91) | <0.001 |
| 2 | 26(17) | 4(9) | <0.001 |
| 3 | 7(5) | 0(0) | <0.001 |
| Culprit lesion, n (%) | | | |
| LAD | 58(84) | 11(16) | <0.001 |
| Cx | 59(76) | 19(24) | <0.001 |
| RCA | 40(73) | 15(42) | 0.001 |
| CHA2DS2-VASc score, median (IQR) | 0.86 \pm 0.78 | 1.78 \pm 0.87 | <0.001 |

DM: Diabetes mellitus; HT: Hypertension; LVEF: Left ventricular ejection fraction; GFR: Glomerular filtration rate; STEMI: ST elevation myocardial infarction; NSTEMI: non-ST elevation myocardial infarction; LAD: Left anterior descending; CX: Circumflex; RCA: Right coronary artery; CHA2DS2-VASc: Congestive heart failure, hypertension, age \geq 75 years (doubled), diabetes mellitus, prior stroke or transient ischemic attack (doubled), and vascular disease, age 65-74 years, and sex category (female).

There was no statistically significant difference between the groups in terms of HT. In the group with LVEF values below 50%, more patients were diabetic or smokers. The CHA2DS2-VASc score values showed a statistically significant difference between the groups ($p < 0.001$). While the mean LVEF value at the third month was 55.58 ± 0.24 in Group 1, it was 42.07 ± 0.86 in Group 2 (Table 1). In the univariate logistic regression analysis, a significant correlation was found between the CHA2DS2-VASc score and glucose values for the LVEF values below 50%. The results of the multivariate logistic regression analysis showed that there was a significant independent correlation between the CHA2DS2-VASc score and LVEF scores below 50% in the patients with ACS, unlike other parameters. (odds ratio: 3.179, 95% CI: 1.972-5.124, $p < 0.001$; Table 2). The receiver operating characteristic (ROC) curve analysis revealed that when the CHA2DS2-VASc scores are higher than 1.5, LVEF values below 50% can be predicted in patients with ACS [$p < 0.001$] (with 53% sensitivity and 80% specificity, 0.764 are under the curve 95% CI: 0.689-0.839)] (Fig.1).

Figure 1. CHA2DS2-VASc score greater than 1.5 could predict heart failure with 53% sensitivity and 80% specificity in receiver operating characteristic (ROC)-curve.

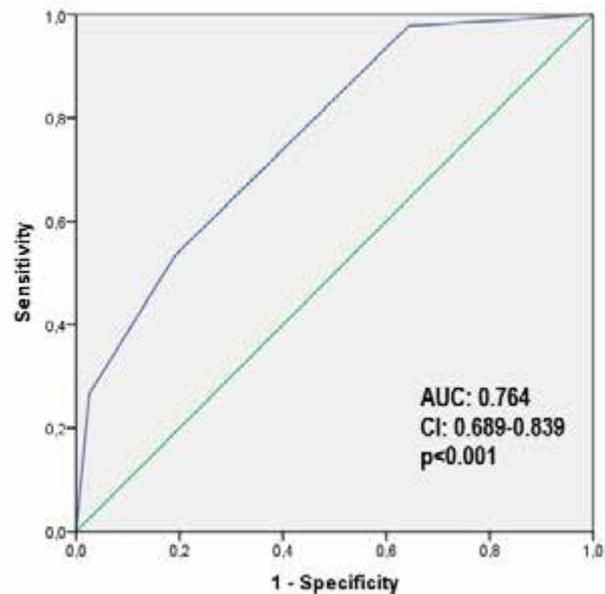


Table 2. Univariate and multivariate regression analysis of predictors of reduced left ventricular ejection fraction

| Variables | Univariate | | | Multivariate | | |
|---------------------|------------|-------|-------------|--------------|-------|-------------|
| | p | OR | 95% CI | p | OR | 95% CI |
| CHA2DS2-VASc score | <0,001 | 3.469 | 2.225-5.410 | <0,001 | 3.179 | 1.972-5.124 |
| Age ≥ 65 years | 0.240 | 1.038 | 0.975-1105 | | | |
| Glucose | 0.002 | 1.007 | 1.002-1.011 | | | |
| STEMI | 0.735 | 0.888 | 0.447-1.764 | | | |
| NSTEMI | 0.735 | 1.126 | 0.567-2.236 | | | |
| 1 vessel | 0.062 | 2.833 | 0.948-8.466 | | | |
| 2 \geq vesssels | 0.099 | 0.397 | 0.132-1.190 | | | |

DISCUSSION

The most important result of the current study was that the CHA2DS2-VASc score was found to be associated with the LVEF values in patients with ACS, and was a strong indicator for LVEF. CHA2DS2-VASc scores above 1.5 were found to be an independent predictor for decreased LVEF values.

ACS is still the most important cause of mortality and morbidity globally, and there is a strong increase in

mortality rates due to HF that develops as a result of a decrease in LVEF values after ACS (9). It is thus important to predetermine the high-risk patients.

Although the CHA2DS2-VASc score is used to detect a stroke in patients with nonvalvular atrial fibrillation who require treatment at an early stage (10), Mony et al. showed that it is also associated with the follow-up results of patients with HF (11). Fernando et al. showed that the severity of CAD in patients with ACS was correlated with

the CHA2DS2-VASc score (12). The current study found a correlation between the CHA2DS2-VASc score and left ventricular systolic function in the follow-up of patients who had undergone PCI due to the diagnosis of ACS.

The LVEF value is an important prognosis criterion in patients with CAD (13). While advances in treatments and its effective administration improve survival, individuals with reduced ejection fraction still have higher mortality than individuals with preserved ejection fraction (14).

Hyperglycemia, an increased CRP value and the neutrophil-to-lymphocyte ratio are associated with many adverse clinical scenarios (15). Sílvia et al. showed that hyperglycemia is a strong predictor of short and long-term mortality in diabetic and non-diabetic patients with ACS (16). In the current study, higher glucose levels were observed in the group with low LVEF values, which is an effective and useful predictor for the prognosis of ACS in patients. Zhang et al. conducted a meta-analysis with 10,245 patients with acute myocardial infarction with ST segment elevation and found a significant relationship between NLR and clinical conditions such as HF and major adverse cardiovascular events (17). Similarly, higher NLR values were observed in the group with LVEF values below 50% in the current study.

The CHA2DS2-VASc score has been shown to be a strong predictor of mortality in patients with low ejection fraction (18). The relationship between the CHA2DS2-VASc score and left ventricular systolic function has not been investigated in the follow-up of ACS patients (19). According to the results of this study, the CHA2DS2-VASc score can be used to predict preserved and decreased left ventricular systolic functions in the follow-up of patients with ACS.

The main limitation of this study is its retrospective design and monocentricity. Data on adverse cardiovascular events could not be obtained in the follow-up of the patients. Since the study was carried out over a relatively short period of time, no data could be obtained about the usability of the CHA2DS2-VASc score to predict decreased LVEF values when the maximal treatment that patients can tolerate in the long term is reached. Also, since patients with a history of CABG with preserved LVEF values were not included in the study,

data regarding the usability of the CHA2DS2-VASc score after CAG in these patients could not be obtained. The results of the current study need to be further confirmed by prospective and multi-center studies.

The CHA2DS2-VASc score is an easy-to-calculate measurement that can be used to predict preserved and reduced left ventricular systolic functions in patients with ACS.

Declarations

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

This study was approved by the Çanakkale Onsekiz Mart University ethics committee of the hospital in which it took place in line with the recommendations of the Declaration of Helsinki (Date: 09.12.2020 Decision no: 2020-14).

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