



Predictive Value of CHA2DS2 -VASc Score in ST Elevation Myocardial Infarction

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Abstract

Background: ST-segment elevation myocardial infarction (STEMI) is the term cardiologists use to describe a classic heart attack. It is one type of myocardial infarction in which a part of the heart muscle (myocardium) has died due to the prolonged obstruction of blood supply to the area. The aim of the study is to evaluate the possibility of usefulness of CHA2DS2 -VASc Score as a predictor of short term complication in STEMI patients without atrial fibrillation.

Patients and methods: This prospective cohort study was conducted 40 STEMI patients without AF underwent primary PCI or risk coronary angiography and apply CHA2DS2- VASc Score and syntax score, comparison with 40 STEMI patients with AF in Cath Lab unit, CCU, Zagazig University Hospital during the period from December 2021 to June 2022.

Results: SYNTAX scores was statistically significantly positively correlated with CHA2DS2-VASC among STEMI patients without AF (increase of CHA2DS2-VASC was associated with increase of SYNTAX scores ($r=0.58$ & $p\text{-value}=0.001$). CHA2DS2-VASC was statistically significantly negatively correlated with EF (increase of CHA2DS2-VASC was associated with decrease of EF) ($r=-0.43$ & $p\text{-value}=0.005$). while there was no correlation between CHA2DS2-VASC Score and troponin, CKMB and kilip classes. CHA2DS2-VASC score was good predictor of short out comes complications among STEMI with AF group.

Conclusion: Traditional CHA2DS2-VASc model is a useful easily available risk assessment tool to stratify STEMI patients.

Keywords: STEMI, Coronary artery disease, Atrial Fibrillation

DOI Number: 10.14704/nq.2022.20.10.NQ55753

NeuroQuantology 2022;20(10):7649-7660

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morbidity and mortality in elderly adults. Elderly patients are more likely than their younger counterparts to present with comorbidities Tegn et al^[3], contributing to worse outcomes. Patients with AF are relatively older and have higher risk of stroke, which may contribute to increased

Introduction

Coronary artery disease (CAD) is the most common cardiovascular disease, while atrial fibrillation (AF) is the most common cardiac arrhythmia^[1]. The prevalence of both CAD and AF increases monotonically with age. CAD and AF often coexist and interact with each other^[2]. CAD is a leading cause of



Material and methods

This prospective cohort study was conducted in coronary care unit (CCU), Zagazig University Hospital, on 80 ST-segment elevation myocardial infarction (STEMI) patients were divided into two groups 40 STEMI patients without AF underwent primary PCI or risk coronary angiography and apply CHA₂DS₂-VASc Score and syntax score, comparison with 40 STEMI patients with AF during the period from December 2021 to June 2022. Written informed consent was obtained from all patients and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: Patients who had acute STEMI without atrial fibrillation underwent primary percutaneous coronary intervention (*p-PCI*), (as defined by history of chest pain, high cardiac enzyme and ST elevation more than two contiguous leads in ECG). Patients who had acute STEMI with atrial fibrillation underwent primary percutaneous coronary intervention (*p-PCI*).

Exclusion criteria: Significant valvular heart disease. Significant connective tissue disease. Significant (kidney, liver) disease. Significant anemia and hyperthyroidism. Arrhythmias rather than AF. Patient with cardiac muscle diseases.

All patients were subjected to full history taking Including (Name, age, sex, family history of coronary artery disease and risk factors of coronary artery disease), were subjected to complete physical examination including assessment of the general condition and vital signs as blood pressure and heart rate & manifestations of heart failure and Investigations (CBC, Urea, Creatinine, TroponinT, CKMB, INR, LDL, HDL, TG, Cholesterol, fasting blood sugar). Chest pain (duration, character, time before reperfusion, recurrence, radiatio). Symptoms of left ventricular dysfunction (dyspnea, orthopnea,

mortality^[4]. Furthermore, AF is a well-established marker of poor short- and long-term prognosis in patients with acute myocardial infarction (AMI) and is associated with a large increase in overall mortality. Therefore, the coexistence of CAD and AF might lead to a much higher risk of mortality in the elderly population^[5].

The CHA₂DS₂-VASc risk score was developed to predict the risk of stroke in patients with atrial fibrillation (AF). This score includes variables such as heart failure, hypertension, age, diabetes mellitus, gender, vascular disease, and stroke. Since these components are also risk factors for atherosclerosis and ischemic heart disease, it may be reasonable to use this score for the risk stratification of ACS patients irrespective of AF. The ease of calculation at the bedside means that this score is advantageous compared to others that require a computer^[6].

The CHA₂DS₂-VASc score [congestive heart failure, hypertension, age ≥75 years (doubled), diabetes, stroke/transient ischemic attack/thromboembolism (doubled), vascular disease (prior myocardial infarction, peripheral artery disease, or aortic plaque), age 65–74 years, sex category (female)] has been used for the assessment of thromboembolic (TE) risk and the guidance of antithrombotic treatment in patients with AF^[7]. In addition, this simple and well-established scoring system has been shown to predict the risk for other conditions beyond its original designations^[8].

CHADS and CHA₂DS₂-VASc scores were first designed to help patients with atrial fibrillation by estimating their systemic embolism or stroke risk. Recently, in a large number of patient cohorts, it was proven that they might also estimate short- and long-term cardiovascular outcomes^[9]. However, their prognostic value in ACS patients after PCI was not thoroughly explored^[10]. The aim of this study was to evaluate the possibility of usefulness of CHA₂DS₂-VASc Score as a predictor of short term complication in STEMI patients without atrial fibrillation.

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Syntax trial, patients were divided into 3 tertiles depending on their score; low score (0-22), intermediate score (23-32) and high score (≥ 33). Final 5-year results showed that no significant difference in outcomes between PCI and CABG in low score patients. Significant difference was noted in MACE (Major Adverse Cardiac Events) in intermediate and high risk groups with no significant mortality difference in intermediate group^[13].

Follow up :

All Patients who had acute STEMI underwent primary percutaneous coronary intervention (p-PCI) followed up within (3- 5) days of hospital stay in coronary care unit (CCU) for detection short out comes complication.

Statistical analysis

Data were checked, entered and analyzed using SPSS version 23 for data processing. Data were expressed as mean + standard deviation (SD) for quantitative one and expressed as frequencies and percentage for qualitative data. The standard deviation (SD) was used to as a measure of dispersion of the results around the mean. The student "t" test was used to for comparison of means of two independent groups. Mann Whitney test was used to calculate difference between quantitative variables in not normally distributed data in two groups. Chi- square test (χ^2) was used to find the association between row and column variables. Receiver operating characteristic (ROC) curve analysis was used to identify optimal cut-off values. The threshold of significance was fixed at a 5% level (P-value).

Results :

Correlation between CHA2DS2-VASC and SYNTAX scores among STEMI without AF patients

SYNTAX scores was statistically significantly positively correlated with CHA2DS2-VASC among STEMI patients without AF (increase of CHA2DS2-VASC was associated with increase of SYNTAX scores ($r=0.58$ & $p\text{-value}=0.001$) as shown in **Figure (1)**. There was significant

paroxysmal nocturnal dyspnea, fatigue). History of prior myocardial infarction, heart failure and cerebrovascular diseases (defined as ischemic or hemorrhagic stroke or transient ischemic attack).

Standard 12-leads ECG was done for all patients 10 minutes' maximum from first medical contact to detect ST segment elevation and T wave abnormalities for diagnosis of acute STEMI. Standard 12-lead electrocardiograms were recorded at presentation, every 8 hours for 24 hours then daily till discharge, Presence of ST segment elevation and its distribution and Brady arrhythmias or tachy arrhythmias.

Left Ventricular End Systolic and End Diastolic Dimensions: End diastole was defined as the frame with the largest cavity area that correlated with ECG at the beginning of QRS complex and end-systole as the subsequent frame with the smallest cavity area that correlated with ECG at the end of the T wave.

CHA2DS2-VASc Score is the most frequently used method for predicting thromboembolic risk. CHA2DS2 is an acronym for (Congestive heart failure, hypertension, advanced age ($> 65 = 1$ point, $> 75 = 2$ points), diabetes, and stroke/transient ischemic attack history (2 points). VASc refers to vascular disease (peripheral arterial disease, aortic atheroma, and prior myocardial infarction), and this scoring system also includes a gender component (female sex). Each risk factor is worth one point, with the exception of age > 75 and stroke/TIA, which are worth two points^[11].

CHA2DS2 and CHA2DS2-VASc score models are widely applied to predict the risk of subsequent thromboembolic events in patients with atrial fibrillation. Furthermore, such instruments have represented ample power in estimating major adverse cardiovascular outcomes in the setting of acute coronary syndrome^[12].

SYNTAX score:

The main utility of the Syntax score is to predict outcomes in patients with complex coronary artery disease undergoing revascularization either by PCI or CABG. In the

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Score and syntax score. positive correlation between CHA2DS2-VASC

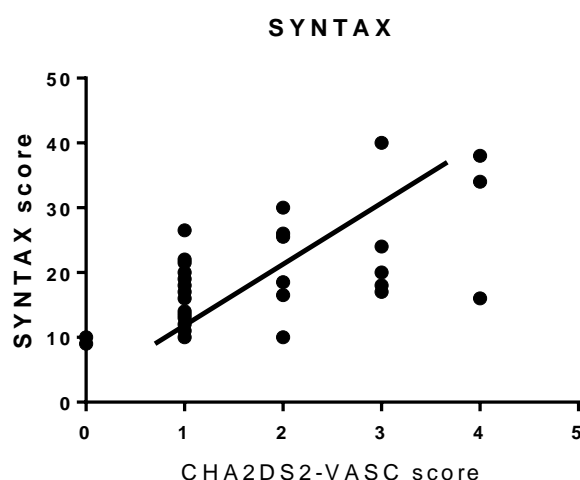
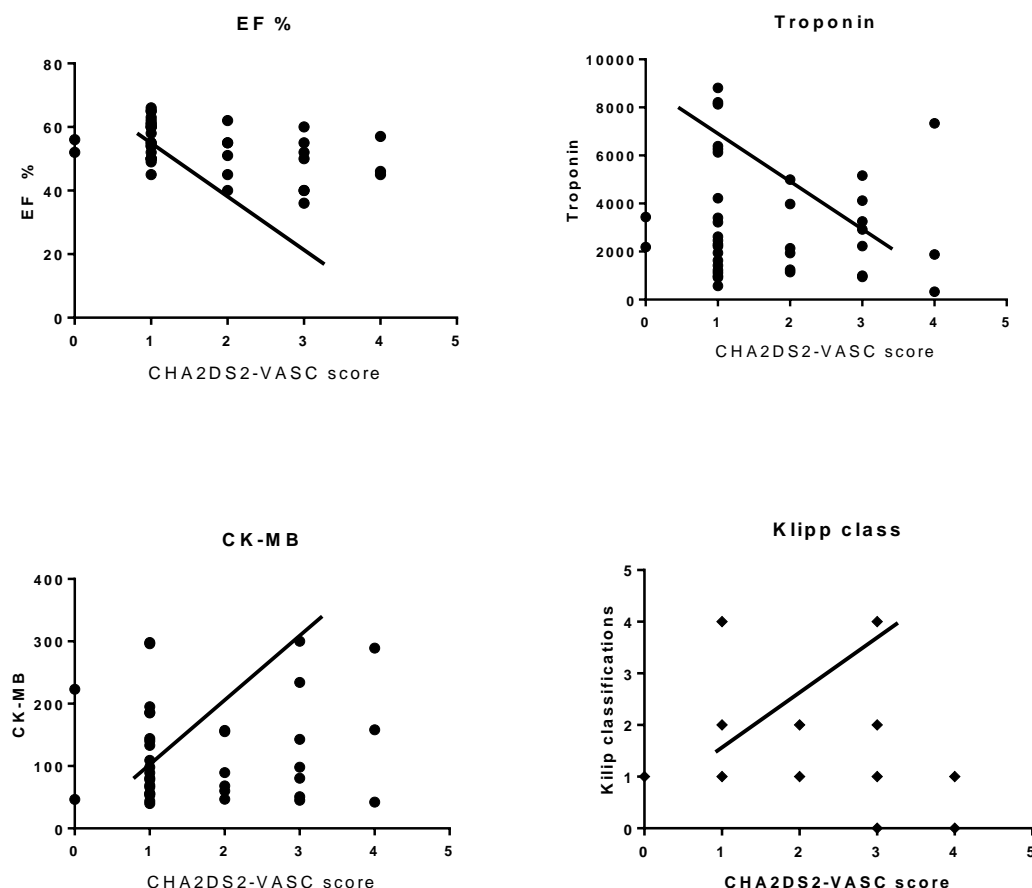


Figure (1): Correlation between CHA2DS2-VASC and SYNTAX scores among STEMI without AF patients

negatively correlated CHA2DS2-VASC among STEMI without AF patients ($r=-0.03$, 0.12 & 0.03 and $p\text{-value}=0.8$, 0.4 & 0.8) respectively as shown in **Figure (2)**. There was significant negative correlation between CHA2DS2-VASC Score and EF while there was no correlation between CHA2DS2-VASC Score and troponin, CKMB and kilip classes.

Correlation between CHA2DS2-VASC and EF, Troponin, CKMB and kilip classes among STEMI without AF patients

CHA2DS2-VASC was statistically significantly negatively correlated with EF (increase of CHA2DS2-VASC was associated with decrease of EF) ($r=-0.43$ & $p\text{-value}=0.005$). Troponin, CKMB and kilip classes weren't statistically significantly



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Figure (2): Correlation between CHA2DS2-VASc scores with other parameters among STEMI without AF patients

AF patients, there was no correlation between CHA2DS2-VASc and SYNTAX scores ($r=0.09$ & $p\text{-value}=0.5$) as shown in **Figure (3)**.

Correlation between CHA2DS2-VASc and SYNTAX scores among STEMI with AF patients

Regarding to correlation between CHA2DS2-VASc and SYNTAX scores among STEMI with



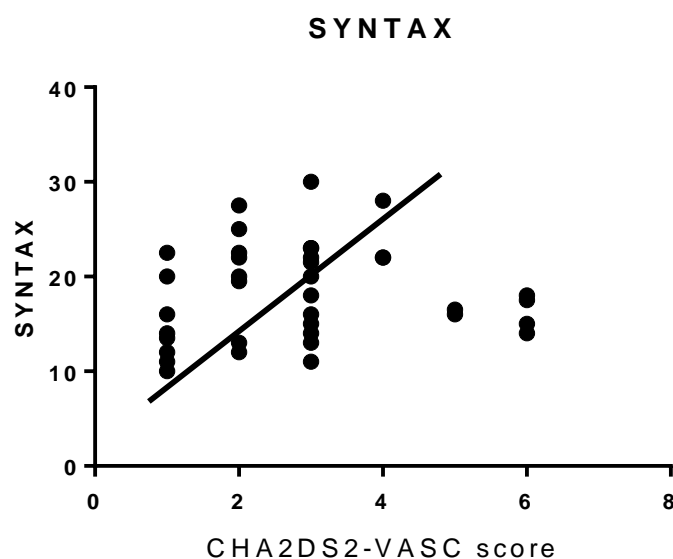


Figure (3): Correlation between CHA2DS2-VASc and SYNTAX scores among STEMI with AF patients

Correlation between CHA2DS2-VASc and EF, Troponin, CKMB and kilip classes among STEMI with AF patients

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CHA2DS2-VASc was statistically significantly positively correlated with CKMB (increase of CHA2DS2-VASc was associated with increase of CKMB) ($r=-0.42$ & $p\text{-value}=0.007$). EF, Troponin and kilip classes weren't statistically significantly negatively correlated CHA2DS2-VASc among STEMI without AF patients ($r=-0.25, 0.07$ & 0.18 and $p\text{-value}=0.1, 0.6$ & 0.24) respectively as shown in **Figure (4)**. There was significant positive correlation between CHA2DS2-VASc Score and CKMB, while there was no correlation between CHA2DS2-VASc Score and EF, troponin and kilip classes.



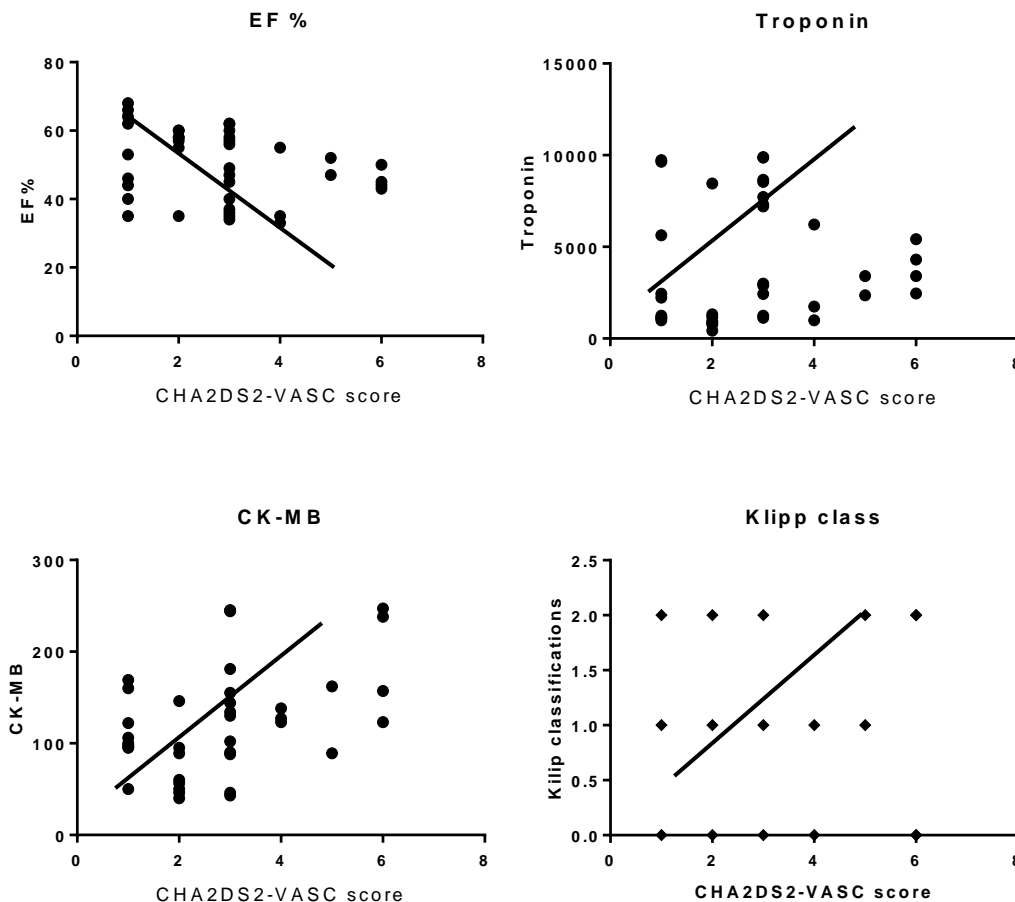


Figure (4): Correlation between CHA2DS2-VASc scores with other parameters among STEMI with AF patients

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Prediction of short outcomes complication among the STEMI patients without atrial fibrillation

The Univariate regression analysis for prediction of short term outcomes among STEMI patients without atrial fibrillation showed that CHA2DS2-VASc score, Syntax score and Killip class>1 were statistically significantly predictors of the outcome, unadjusted OR of CHA2DS2-VASc score was 3.8 with lower bound 1.4 & upper bound 10.3 (P-value=0.008), unadjusted OR of Killip class>1 was 7.1 with lower bound 1.2 & upper bound 39.9 (P-value=0.02). Unadjusted OR of Syntax score was 1.08 with upper bound 1.5 & lower bound 1.04 and significant P-value (P-value=0.04). Regarding Age ≥ 65 years, it wasn't statistically significantly predictor of the outcome with unadjusted OR was 0.29 with upper bound 1.6 & lower bound 0.05 and non-significant P-value (P-value=0.16).

Concerning the multivariate regression analysis for prediction of short term outcomes among STEMI patients without atrial fibrillation, it showed that CHA2DS2-VASc score and Killip class>1 were the only statistically significantly predictors of the outcome, unadjusted OR of CHA2DS2-VASc score was 4.04 with lower bound 1.2 & upper bound 13.4 (P-value=0.02), unadjusted OR of Killip class>1 was 7.3 with lower bound 1.2 & upper bound 44.3 (P-value=0.03). Both Syntax score and Age ≥ 65 years weren't statistically significantly predictors (P-value for Syntax score =0.56) as shown in table (1)

Table (1): Univariable and multivariable logistic predictors of short-term outcomes in STEMI patients without atrial fibrillation.



	Univariate			Multivariate		
	% CI	OR	P value	95% CI	OR	P value
Age ≥65 years	0.05-1.6	0.29	0.16			
Killip class>1	1.2-39.9	7.1	0.02*	1.2-44.3	7.3	0.03*
CHA2DS2-VASc score	1.4-10.3	3.8	0.008*	1.2-13.4	4.04	0.02*
Syntax score	1.04-1.5	1.08	0.04*	0.88-1.2	1.05	0.56

value=0.43) and unadjusted OR of Syntax score was 0.93 with upper bound 1.08 & lower bound 0.8 and non-significant P-value (P-value=0.37) .

Concerning the multivariate regression analysis for prediction of short term outcomes among STEMI patients with atrial fibrillation, it showed that CHA2DS2-VASc score was the only statistically significantly predictors of the outcome, unadjusted OR of CHA2DS2-VASc score was 2.2 with lower bound 1.21 & upper bound 14.7 (P-value=0.01), unadjusted OR of Killip class>1 was 6.1 with lower bound 2.1 & upper bound 14.7 (P-value=0.03). Each of Killip class>1, Syntax score and Age ≥65 years weren't statistically significantly predictors as shown in table (2)

Prediction of short outcomes complication among the STEMI patients with atrial fibrillation

The Univariate regression analysis for prediction of short term outcomes among STEMI patients with atrial fibrillation showed that CHA2DS2-VASc score and Killip class>1 were statistically significantly predictors of the outcome, unadjusted OR of CHA2DS2-VASc score was 2.02 with lower bound 1.16 & upper bound 3.5 (P-value=0.01), unadjusted OR of Killip class>1 was 3.1 with lower bound 2.1 & upper bound 14.7 (P-value=0.03). Regarding Syntax score and age ≥65 years, they weren't statistically significantly predictor of the outcome with unadjusted OR of age ≥65 years was 0.5 with upper bound 2.5 & lower bound 0.11 and non-significant P-value (P-

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Table (2): Univariable and multivariable logistic predictors of short-term outcomes in STEMI patients with atrial fibrillation

	Univariate			Multivariate		
	% CI	OR	P value	95% CI	OR	P value
Age ≥65 years	0.11-2.5	0.5	0.43			
Killip class>1	2.1-14.7	3.1	0.03*	0.59-60.8	6.1	0.12
CHA2DS2-VASc score	1.16-3.5	2.02	0.01*	1.21-4.2	2.2	0.01*
Syntax score	0.8-1.08	0.93	0.37			

Cut off values of CHA2DS2-VASc score for prediction of short outcomes complications among STEMI with AF patients

Receiver operating characteristics (ROC) curve was used to define the best cut off value of CHA2DS2-VASc score for prediction of complications among STEMI with AF patients which was ≥ 2 with sensitivity 92 %, specificity

eISSN1303-5150

By applying univariate logistic regression analysis, Killip class >1 and CHA2DS2-VASc score were independent predictors of short-term adverse outcomes in patients with STEMI with atrial fibrillation. Whilst by applying multivariate logistic regression, only CHA2DS2-VASc score was independent predictor of short term outcomes in STEMI patients with atrial fibrillation.

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was good predictor of short out comes complications among STEMI with AF group.

62 %, accuracy 81 %, AUROC was 0.76 (0.61 – 0.92) & P-Value=0.007 as shown in Figure(5).showed that CHA2DS2-VASc score

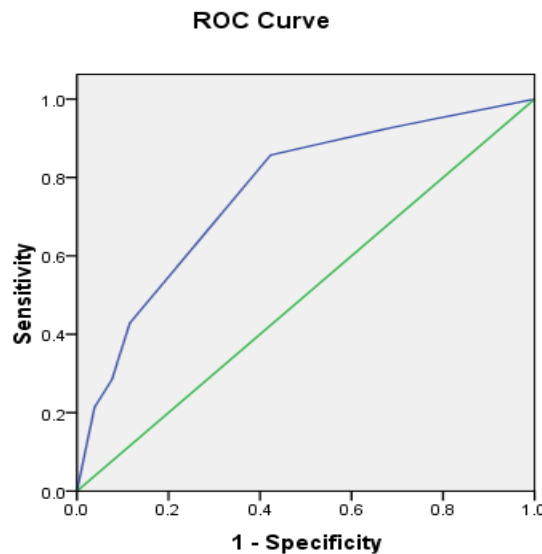


Figure (5): ROC curve of CHA2DS2-VASc score for prediction of short out comes complications among STEMI with AF group.

The current study showed that there was significant negative correlation between CHA2DS2-VASc Score and EF% while there was no correlation between CHA2DS2-VASc Score and troponin, CKMB and kilip classes among STEMI with out AF.

Aksoy et al^[16] reported that univariate analysis showed that high CHA2DS2-VASc score, enlarged left atrium, high peak creatine kinase-myocardial binding (CK-MB) level, low left ventricle ejection fraction, advanced age, female gender and history of hypertension were significantly associated with higher risk of incident AF.

The current study showed that regarding to correlation between CHA2DS2-VASc and SYNTAX scores among STEMI with AF patients, there was no correlation between CHA2DS2-VASc and SYNTAX scores, which in contrast with the study of **Al-Shorbagy et al^[14]** who found that there was a correlation between CHA2DS2-VASc and SYNTAX scores with AF patients (($r = 0.4811$, $P < 0.0$)

Akboğa et al^[17] found that there was a positive correlation between the SYNTAX score and the CHA2DS2-VASc score. This

Discussion:

The current study showed that regarding to correlation between CHA2DS2-VASc and SYNTAX scores among STEMI without AF patients, there was significant positive correlation between CHA2DS2-VASc Score and syntax score.

Al-Shorbagy et al^[14] found that there is a highly statistical significant positive correlation between CHA2DS2-VASc score and Syntax score I of the patients ($r = 0.3326$, $P < 0.01$) and Syntax score II for PCI ($r = 0.3869$, $P < 0.01$).

Hioki et al^[15], demonstrated that the CHA2DS2-VASc score had predictive value for adverse outcomes in patients with CHD undergoing PCI, even in patients without AF. They reported that the clinical benefit of the CHA2DS2-VASc score in risk stratification for patients undergoing PCI is its simplicity. Only simple addition is needed to calculate CHA2DS2-VASc score without complex equations. We could stratify each patient undergoing PCI based on the CHA2DS2-VASc score, especially patients with a CHA2DS2-VASc score ≥ 5 , which is considered high-risk



CHA2DS2-VASc score was independent predictor of short term outcomes in STEMI patients with atrial fibrillation.

While Aksoy et al^[16] found that Univariate analysis showed that high CHA2DS2-VASc score, enlarged left atrium, high peak creatine kinase-myocardial binding (CK-MB) level, low left ventricle ejection fraction, long duration of hospitalization in the CICU, advanced age, female gender and history of hypertension were significantly associated with higher risk of incident AF.

The current study showed that CHA2DS2-VASc score was good predictor for complications among STEMI with AF group.

Chou et al^[19] found that the ROC analysis revealed that the CHA2DS2-VASc score had good predictive ability for future ACS risk (85.9%, 95% CI: 78.5%–93.2%; sensitivity: 78.6%; and specificity: 76.7%) in patients with AF. Fisher linear discriminant analysis revealed that a baseline CHA2DS2-VASc score ≥ 4 was a suitable cut-off value for predicting future ACS events (positive predictive rate: 14.3%) with an overall accuracy of 97.6%. The presence of AF was an independent risk factor for ACS in both univariate and multivariate analysis.

Conclusion:

The clinical benefit of the CHA2DS2-VASc score in risk stratification for patients underwent PCI is its simplicity. We could stratify each patient undergoing PCI based on the CHA2DS2-VASc score, especially patients with a CHA2DS2-VASc score ≥ 2 , which is considered high-risk. traditional CHA2DS2-VASc model is a useful easily available risk assessment tool to stratify STEMI patients. Although CHA2DS2-VASc score is widely used in atrial fibrillation patients to predict embolic stroke, several studies have demonstrated that its scope extend beyond atrial fibrillation. CHA2DS2-VASc score is a simple easy to use tool which can be used in assessing and risk stratifying various cardiovascular and cerebral vascular conditions in the absence of atrial fibrillation. CHA2DS2-VASc is Good reliable predictor easy to calculate and very useful in

shows that the CHA2DS2-VASc score is higher in patients with more complex and severe atherosclerosis.

The current study showed that there was significant positive correlation between CHA2DS2-VASc Score and CKMB, while there was no correlation between CHA2DS2-VASc Score and EF%, troponin and kilip classes among STEMI with AF patients.

Akboğa et al^[17] observed that a higher CHA2DS2-VASc score was independently associated with in-hospital mortality. Moreover, this score and lower ejection fraction (EF) were independent predictors of a high SYNTAX score.

Bozbay et al^[10] showed that CHA2DS2-VASc score >2 was associated with cardiogenic shock, high Killip class, low LVEF, fatal reinfarction, and in-hospital and long-term mortality in patients with ST-segment elevation MI.

The current study showed that by applying univariate and multivariate logistic regression analysis, Kilip class >1 and CHA2DS2-VASc score were independent predictors of short-term adverse outcomes in patients with STEMI without atrial fibrillation and it was very good predictor for complications among STEMI without AF group.

Elmenshawy et al^[18], reported that regarding diagnostic accuracy of CHA2DS2-VASc Score in prediction of severity of high thrombus grade, the best cutoff point was score >4 with 72% sensitivity and 66% specificity

Aksoy et al^[16] found that ROC curve analysis showed that the CHA2DS2-VASc score (C-statistic: 0.698; 95% CI: 0.631-0.765; $P < 0.001$) was significant predictors of AF following STEMI, with sensitivities of 56% and 75% and specificities of 71% and 54%, respectively.

The current study showed that by applying univariate logistic regression analysis, Kilip class >1 and CHA2DS2-VASc score were independent predictors of short-term adverse outcomes in patients with STEMI with atrial fibrillation. Whilst by applying multivariate logistic regression, only

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predicting short term outcomes in STEMI patient and useful in predicting high syntax score.

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