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ORIGINAL ARTICLE

Comparison of RCHA2DS2-VASc Score and CHA2DS2-VASc Score for Prediction of No-reflow Phenomenon in Patients with ST-segment Elevation Myocardial Infarction Undergoing Primary Percutaneous Coronary Intervention

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Abstract

Background: **During primary PCI, about 95% of blocked coronary vessels are reopened. Therefore, it is the best applicable reperfusion strategy for acute STEMI.**

Study aim: **The objective was to investigate the significance of the RCHA2DS2-VASc score and CHA2DS2-VASc score in predicting the no-reflow phenomenon in STEMI patients undergoing Primary PCI.**

Patients and methods: **In this cohort study, 80 patients with acute STEMI who had undergone Primary PCI (40 patients had no-reflow and 40 patients without no-reflow) who were admitted to the coronary care units of October 6 University Hospital and Al-Azhar University Hospitals between September 2021 and March 2022 were included.**

Results: **As regard to their comorbid conditions; renal failure was far more common with a statistical significance in patients who suffered from no-reflow. As regard the RCHA2DS2-VASc score as well as the CHA2DS2-VASc score, they have been significantly more in patients who suffered from no-reflow. Regarding the Receiver Operating Characteristic (ROC) curve, the cutoff point for the RCHA2DS2-VASc and CHA2DS2-VASc scores for prediction of the no-reflow phenomenon was found to be > 2 with an area under curve (AUC) 0.683 and 0.654, along with a sensitivity of 52.5% and 47.5%, respectively, accompanied by a specificity of 80% and a positive predictive value of 72.4 and 70.4, together with a negative predictive value of 62.7 and 60.4, respectively.**

Conclusion: **From this study we can conclude that RCHA2DS2-VASc score could predict no-reflow better than CHA2DS2- VASc score. In addition, those who had renal impairment were more liable to no-reflow phenomenon.**

Keywords: CHA2DS2-VASc, No-reflow phenomenon, Primary PCI, RCHA2DS2-VASc, STEMI

1. Introduction

ST-elevation myocardial infarction (STEMI) dominant reperfusion strategy has been primary percutaneous coronary intervention (PCI) for more than a decade and it continues to evolve.[1]

No-reflow phenomenon accounts for one of the main complications of primary PCI in individuals with acute STEMI, this phenomenon may be brought on by distal embolization, microvascular blockage, or prolonged myocardial ischemia, as well as damage. The no-reflow phenomenon, which affects 5−10% of patients after primary percutaneous coronary intervention,[2] is linked to several serious sequelae, including cardiac failure, strokes, and cardiac death, independent of the size of the infarct.

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While numerous risk variables have been expressed, there is no risk stratification approach that is universally approved for the no-reflow prediction.[3]

The primary problem with atrial fibrillation is thromboembolism, which is predicted by the CHA2DS2-VASc score, which is the total sum of many risk factors. The utilization of the CHA2DS2-VASc risk score is therefore advocated by the most recent recommendations for the prediction of thromboembolism in individuals suffering from atrial fibrillation. Furthermore, it has been demonstrated to be an indicator of unfavourable sequelae in post ACS patients.[4]

The CHA2DS2-VASc score's units are homogeneous to the usual risk factors for no reflow and are easily computed in everyday practice. In patients with STEMI, chronic kidney illness increases the risk of no reflow by causing a state of hypercoagulability. Consequently, a modified CHA2DS2-VASc score was established to involve cases suffering from chronic kidney disease, and it was named the RCHA2DS2-VASc score.[2]

The purpose of this research is to assess the significance of the RCHA2DS2-VASc score in the prediction of the no-reflow phenomenon in cases confirmed with STEMI undergoing primary PCI.

2. Patients and methods

Eighty patients with a diagnosis of acute STEMI who were admitted to the CCU at the October 6 University Hospital and the Al-Azhar University Hospitals in the period between September 2021 and March 2022 were the subjects of this cohort study, which was done prospectively. After the primary PCI procedure, we included forty patients with no-reflow and forty patients without no-reflow.

2.1. Inclusion criteria

The criteria for **type 1 MI** includes detection of a rise and/or fall of cTn with at least one value above the 99th percentile and with at least one of the following:

(1) Symptoms of acute myocardial ischemia;
(2) New ischemic electrocardiographic (ECG) changes;
(3) Development of pathological Q waves;
(4) Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischemic etiology;
(5) Identification of a coronary thrombus by angiography including intracoronary imaging or by autopsy.

2.2. Exclusion criteria

Terminal cancer, End Stage Renal Disease on dialysis.

2.3. Methods

The following procedures were performed on all patients: complete medical history taking, a full general examination, and a lab investigation: CBC. Electrolytes (Na, K), renal function test (urea, creatinine) and cardiac troponin, ECG, primary PCI.

All of the patients have undergone a coronary angiogram within the first 120 min of STEMI recognition and within 12 h of the onset of symptoms, utilizing a standard method. A 300-mg dose of acetylsalicylic acid was given before the PCI, followed by a 180-mg dose of ticagrelor. Following the decision to do a coronary procedure, patients who were not receiving enoxaparin were promptly administered 1 mg/kg of IV heparin. A booster dose of 0.3 mg/kg of enoxaparin will be given IV within 8 h of the initial 1 mg/kg enoxaparin dosage for those who received it.

All patients underwent direct stenting of Infarct-related artery (IRA) following the coronary angiogram. At the discretion of the operator, thrombus aspiration has been used in patients having a significant thrombus burden. A tirofiban infusions (0.15 mg/kg/min) has been administered to a select group of patients who had no bleeding tendency or contraindications. To treat PCI-related no-reflow, patients have been given an intracoronary vasodilator (particularly an adenosine or calcium channel blocker).

No-reflow angiographically according to TIMI flow is less than or equal to 2 or using a myocardial blush grade of 0–1, even though the infarct-related lesion (IRA) has been mechanically revascularized. The diagnosis was made in the complete absence of any sign of arterial dissection or the presence of thrombotic obstruction.[5] The definition of TIMI (*Thrombolysis In Myocardial Infarction)* flow grade has been defined as follows: Grade zero was described as no antegrade flow beyond the lesion, grade one as incomplete distal coronary bed filling beyond the lesion, grade two as slow antegrade flow despite complete opacification of the entire coronary bed, and grade three as opacification of the whole coronary bed with normal velocity.[6]

Myocardial blush grades have been described as follows: grade zero (no myocardial contrast density), grade one (minimal myocardial contrast density), grade two (moderate myocardial contrast density, which is less than the territory perfused by any non-IRA), and grade three (normal myocardial contrast density in comparison with any non-IRA territory).[7] Table 1.

As for the RCHA2DS2-VASc score, renal insufficiency, which was determined as an estimated GFR of less than 60 ml/min/1.73 m^2, was given an extra point.

All cases were allowed points according to the RCHA2DS2-VASc score demonstrated in Table 1.

2.4. Statistical analysis

Data have been gathered, revised, coded, and entered into IBM SPSS version 23 of the Statistical Package for Social Science. When the quantitative data were parametric, they were displayed as means, standard deviations, and ranges; when they were non-parametric, they were displayed as medians and interquartile ranges (IQR). Qualitative variables were also shown as percentages and numbers. As a result, the p value was deemed significant: a p value > 0.05 indicates nonsignificant (NS), a p value ≤ 0.05 indicates significance (S), and a p value < 0.01 indicates highly significant (HS).

3. Results

During the period from September 2021 to March 2022, eighty patients admitted to the CCUs of the October 6 University Hospital and Al-Azhar University Hospitals were enrolled in our investigation. Eighty STEMI patients, 64 of whom were male and 16 of whom were female, were studied. Their ages ranged from 34 to 80 years, with a mean age of 59.59 ± 10.51 years Tables 2–4.

The previous table demonstrates the significant relation between impaired renal function and IHD/PAD with occurrence of no-reflow. However, HF, HTN, DM and smoking had no significant relation to occurrence of no-reflow in the studied patients Table 5.

Table 2. The descriptive demographic data of the patients under study is shown in the previous table.

	Number = 80
Age (years)	
Mean ± SD	59.59 ± 10.51
Range	34–80
Sex	
Male	64 (80.0%)
Female	16 (20.0%)

The previous table demonstrates that there had been statistically significant differences in RCHA2DS2-VASc and CHA2DS2-VASc scores between no-reflow and reflow cases, with the no-reflow case score being higher than the reflow case score Figure 1.

ROC curves show that the cutoff point for RCHA2DS2-VASc and CHA2DS2-VASc scores for prediction of no-reflow was >2 with AUC 0.683 and 0.654, sensitivity in both groups of 52.5% and 47.5%, respectively, with a specificity of 80%, a positive predictive value of 72.4 and 70.4, and a negative predictive value of 62.7 and 60.4, respectively.

The univariate logistic regression analysis shows that renal impairment, RCHA2DS2-VASc >2, and CHA2DS2-VASc >2 were related to no-reflow, and the multivariate logistic regression analysis indicated that the most important factor related to no-reflow was RCHA2DS2-VASc score >2 with a p-value = 0.003 and an odds ratio (95% CI) of 4.421 (1.638–11.930).

4. Discussion

No-reflow has been associated with more significant myocardial damage and many more complications, including major adverse cardiovascular events (MACE), disregarding infarct size or extent.

Table 1. The previous table shows CHA2DS2-VASc score.[8]

Score	CHA_2DS_2-VASc Risk Criteria	
1 point	Congestive heart failure	Heart failure signs/symptoms and/or a ≤40% ejection fraction
1 point	Hypertension	Taking antihypertensive medication or having a systolic/diastolic blood pressure of ≥140/90 mm Hg
2 points	Age ≥75 years	
1 point	Diabetes mellitus	Fasting blood sugar levels of >126 mg/dl, blood sugar levels of ≥200 mg/dl, or usage of anti-diabetic medications
2 points	Stroke/Transient Ischemic Attack/Thromboembolic event	A prior stroke or transient ischemic attack.
1 point	Vascular illness (previous MI, PAD, or aortic plaque)	characterized by non-coronary artery circulation stenosis of at least 50%.
1 point	Age range: 65 to 74	
1 point	Sex category (ie, female sex)	

Table 3. The previous table compares reflow and no-reflow patients in terms of demographic data and demonstrates a significant relationship between mean age and the occurrence of no-reflow. It also reveals that there is no statistically significant relationship between sex and the occurrence of no-reflow.

	Reflow	No-reflow	Test value	*P* value	Sig.
	Number = 40	Number = 40			
Age (years)					
Mean ± SD	56.98 ± 10.81	62.20 ± 9.65	−2.281[b]	0.025	S
Range	34–77	43–80			
Sex					
Male	32 (80.0%)	32 (80.0%)	0.000[a]	1.000	NS
Female	8 (20.0%)	8 (20.0%)			

P value > 0.05: Nonsignificant; *P* value < 0.05: Significant; *P* value < 0.01: Highly significant.
[a] Chi-square test.
[b] : Independent *t*-test.

Table 4. Comparison between reflow and no-reflow patients in terms of co-morbidities and smoking status of the studied patients.

	Reflow	No-reflow	Test value[a]	*P* value	Sig.
	Number = 40	Number = 40			
Renal					
Normal	36 (90.0%)	27 (67.5%)	6.050[a]	0.014	S
Impaired	4 (10.0%)	13 (32.5%)			
Heart failure					
No	40 (100.0%)	39 (97.5%)	1.013[a]	0.314	NS
Yes	0 (0.0%)	1 (2.5%)			
Hypertension					
No	18 (45.0%)	15 (37.5%)	0.464[a]	0.496	NS
Yes	22 (55.0%)	25 (62.5%)			
Diabetes					
No	16 (40.0%)	11 (27.5%)	1.398[a]	0.237	NS
Yes	24 (60.0%)	29 (72.5%)			
Stroke tia TE					
No	40 (100.0%)	38 (95.0%)	2.051[a]	0.152	NS
Yes	0 (0.0%)	2 (5.0%)			
IHD/PAD					
No	40 (100.0%)	35 (87.5%)	5.333[a]	0.021	S
Yes	0 (0.0%)	5 (12.5%)			
Smoker					
No	15 (37.5%)	19 (47.5%)	0.818[a]	0.366	NS
Yes	25 (62.5%)	21 (52.5%)			

P value > 0.05: Nonsignificant; *P* value < 0.05: Significant; *P* value < 0.01: Highly significant.
[a] Chi-square test.

In spite of the presence of some treatment options for no-reflow, nothing has shown acceptable results. Furthermore, the success of these treatments differs from one patient to the other depending on the clinical state. Low rates of efficient treatment requests for a different strategy for managing cases of no-reflow.[9] As a result, there is a requirement for a quick, easy, and cost-effective way to improve the

Table 5. Comparison between reflow and no-reflow patients in terms of RCHA2DS2-VASc and CHA2DS2-VASc in the studied patients.

	Reflow	No-reflow	Test value[a]	*P* value	Sig.
	Number = 40	Number = 40			
RCHA2DS2-VASc					
Median (IQR)	2 (1–2)	3 (2–4)	−2.882	0.004	HS
Range	0–5	0–6			
CHA2DS2-VASc					
Median (IQR)	2 (1–2)	2 (1–3)	−2.432	0.015	S
Range	0–4	0–5			

P value > 0.05: Nonsignificant; *P* value < 0.05: Significant; *P* value < 0.01: Highly significant.
[a] : Mann–Whitney test.

Table 6. Univariate and multivariate logistic regression analysis for factors related to no-reflow.

	Univariate				Multivariate			
	P value	Odds ratio (OR)	95% C.I.for OR		*P* value	Odds ratio (OR)	95% C.I.for OR	
			Lower	Upper			Lower	Upper
Renal	0.019	4.333	1.271	14.777	–	–	–	–
RCHA2DS2-VASc >2	0.003	4.421	1.638	11.930	0.003	4.421	1.638	11.930
CHA2DS2-VASc >2	0.011	3.619	1.341	9.765	–	–	–	–

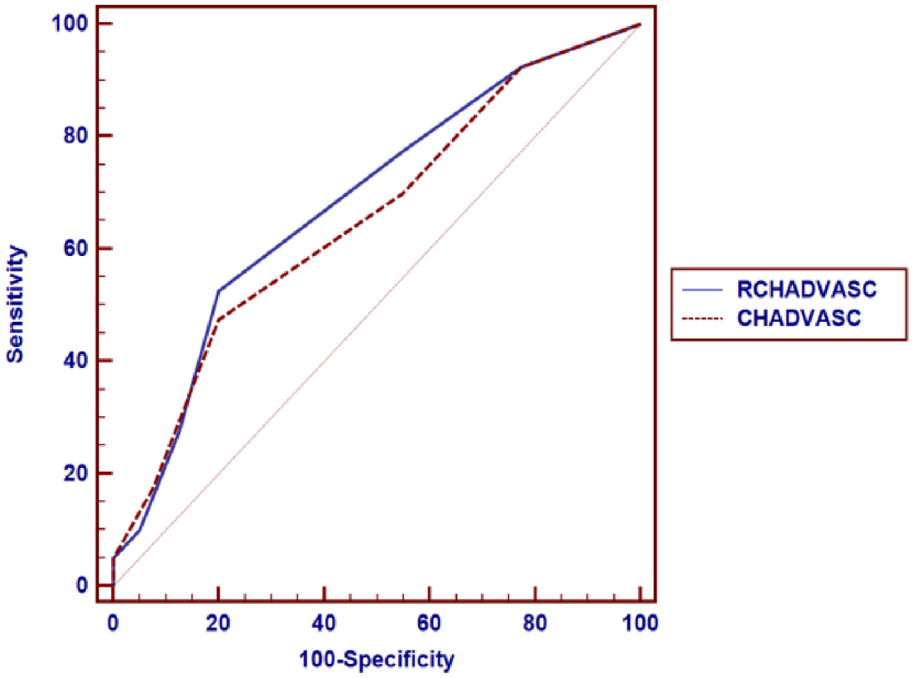

Figure 1. Prediction of no-reflow using the ROC curve for RCHA2DS2-VASc and CHA2DS2-VASc.

risk classification of STEMI patients at risk of the no-reflow phenomenon and assist physicians in more easily selecting the optimal therapeutic strategy.[2]

CHA2DS2-VASc score is a clinical estimator of thromboembolic events and it is recommended by the latest clinical guidelines for evaluation of need for oral anticoagulation in cases suffering from non-valvular AF.[8] The points on that scale are connected with atherosclerosis, vascular spasm, and micro-vascular dysfunction, all of which are common risk factors for no-reflow.[10]

Eighty patients who have been admitted to the CCU of the October 6 University Hospital and the Al-Azhar University Hospitals during the period from September 2021 to March 2022 have been registered in our research.

We evaluated 80 STEMI patients, 64 of whom were males and 16 of whom were females, ranging in age from 34 to 80 years old, with a mean age of 59.59 ± 10.51. While *Ipek* et al.[6] studied 1781 patients with age ranged from 57 to 62, 338 were females and 1443 were males, while *Barman* et al.[11] studied 391 patients with mean age of 55.50 ± 8.95, 98 were females and 293 were males.

The main findings of our study were that both scores have served as independent risk factors for the no-reflow phenomenon, with the RCHA2DS2-VASc score of a cutoff value > 2 having a specificity of 80% and a sensitivity of 52.5% in predicting the phenomenon of no-reflow. In our study, we investigated the significance of the CHA2DS2-VASc and the RCHA2DS2-VASc scores in the no-reflow phenomenon prediction in patients diagnosed with STEMI. While a CHA2DS2-VASc score of >2 had a specificity of 80% and a sensitivity of 47.5% for predicting no-reflow, these findings were in agreement with those of Ipek et al.,[6] who discovered that a CHA2DS2-VASc score of ≥2 could be employed as a cutoff value with a specificity of 59% and a sensitivity of 66%. While *Zorlu and Cemal*[2] found that a RCHA2DS2-VASc score of ≥2 exhibited an 83% sensitivity and a 62% specificity. Also, *Barman* et al.[11] found that CHA2DS2-VASc score has an 80.9% sensitivity and a 74.6% specificity as an indicator of

no-reflow. We believe that the variation in the sensitivity of those studies is likely due to abundance of comorbid conditions as smoking, hypertension and diabetes mellitus in the control groups.

Also, our study revealed that renal failure (calculated GFR of <60 ml/min/1.73 m^2) was significantly related to the no-reflow phenomenon with a p value of 0.014. These findings matched those of *Sensoy* et al.,[12] who discovered that renal failure serves as an indicator of the no-reflow phenomenon with a *P* value of 0.02, and also matched those of *Zorlu and Cemal*,[2] who found that renal failure can predict the no-reflow phenomenon with a *P* value of <0.01.

Our research also discovered that the CHA2DS2-VASc and R2CHADS2 VASc scores were significantly positively correlated. The R2CHADS2 score, which is used to calculate the risk of no-reflow, is one of several components that both scoring systems share, so this is not surprising. Nevertheless, because the CHA2DS2-VASc has previously been verified and is presently being used, the addition of kidney failure might not yet have an impact on clinical decisions or results.

Because of the high morbidity and mortality linked to thromboembolism, it's critical to attempt to control changeable risk factors like kidney function.

According to the study's results, the RCHA2DS2-VASc score may reasonably predict the risk of no-reflow in STEMI patients better than the CHA2DS2-VASc score.

5. Conclusion

From the present study we conclude that both scores can predict the occurrence of no-reflow phenomenon that had a statistical significance as they shared similar points. However, RCHA2DS2- VASc score can predict no-reflow better than CHA2DS2-VASc score. Those who had renal impairment were more liable to no-reflow phenomenon.

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Conflict of interest

The authors declared that there were no conflicts of Interest.

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