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# CHA2DS2-VASC SCORE AND BRACHIAL ARTERY FLOW MEDIATED DILATION AS PREDICTORS OF NO REFLOW PHENOMENA IN PATIENTS WITH STEMI UNDERGOING PRIMARY PCI

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**Abstract**

***Background:*** *The CHA2DS2-VASc score has become a valuable clinical tool for stratifying stroke risk in patients with atrial fibrillation, but its predictive value in patients undergoing primary (PCI) for (STEMI) has not been defined. Measurement of brachial artery (FMD), a noninvasive assessment of endothelial function, would allow for even more thorough prognostic analyses.*

***Objective:*** *To explore the relation between no-reflow and brachial artery flow-mediated dilatation (FMD) as well as CHA2DS2-VASc score in patients with (STEMI) undergoing primary PCI.*

***Methods:*** *This Prospective observational design study was conduction at Department of Cardiology at Shifa International Hospital from July 24 to December 24. The study enrolled 138 male and female patients aging 18 years or above, diagnosed with STEMI who underwent primary PCI. STEMI, which was defined as persistent chest pain and ST-segment elevation on ECG as defined in the guidelines, were included. Brachial artery flow-mediated dilatation (FMD) as well as CHA2DS2-VASc score were determined and its relation with no-reflow phenomena was evaluated. Data was analyzed using SPSS version 25.*

***Results:*** *The mean age of the patients was 62.8 years. 62.5% of the no-reflow group had FMD ≤ 5%, as opposed to only 26.3% in the reflow group (p = 0.001). In addition, age (Odds ratio = 1.08; p=0.004), as well as presence of diabetes mellitus (OR = 2.01; p = 0.023) were significant predictors for MACCE occurrence during the follow-up period after*

*performing cardio CT angiography at Cox regression analysis The analysis of hypertensive approached significance with an odds ratio (1.58; 95% CI, 0.98-2.54).*

***Conclusion:*** *This study highlights the importance of brachial artery flow-mediated dilatation (FMD) as well as CHA2DS2-VASc score to predict the presence of no-reflow in patients with (STEMI) treated with primary PCI. Older age, hypertension, diabetes mellitus, and impaired brachial artery flow-mediated dilation (FMD) were the key predictors of no-reflow.*

## INTRODUCTION

ST-segment elevation myocardial infarction (STEMI) is a time-dependent critical condition needing emergent intervention with primary percutaneous coronary intervention (PCI) [1]. Although PCI techniques have advanced, the no-reflow phenomenon or poor perfusion of blood flow through the myocardium despite successful revascularization continues to be a serious complication [2][3][4]. It is a practice that has been linked to poor clinical outcomes, including higher rates of mortality and morbidity. Identification of patients at high risk for no-reflow is essential to optimize the use of resources and reduce complications in this vulnerable patient group.

Used mainly for assessing stroke risk in patients with atrial fibrillation, the CHA2DS2-VASc score may potentially be useful in determining cardiovascular risk across several clinical settings [5][6]. This score takes into account conditions like congestive heart failure, hypertension, age, diabetes and vascular disease to provide a full picture of a persons cardiovascular health [7]. Recent data have been presented with this end, which were purposing that higher CHA2DS2-VASc score could correlate with more adverse cardiac events, such as no-reflow phenomena in STEMI patients [8][9].

Assessment of brachial artery (FMD) is a widely used, noninvasive approach to evaluate endothelial function and vascular health [10]. FMD is related to several cardiovascular diseases and has shown excellent endothelial function [11][12]. The decreased FMD might mean underlying endothelial dysfunction, increasing the risk of no-reflow in the setting of STEMI [13][14].

The present study was designed to evaluate the power of the CHA2DS2-VASc score, as well as traditional atherosclerotic risk factors and brachial artery FMD in predicting no-reflow phenomenon in patients with (STEMI) undergoing primary (PCI). We assess these two parameters as possible prognostic predictors and ultimately their role in improving risk stratification, which can help us better manage this population of patients. These results are likely to be a key clinical aspect in the identification of high-risk patients and in targeting therapeutic interventions.

### Methodology

#### Study Design

This Prospective observational design study was conducted at Department of Cardiology at Shifa International Hospital from July 24 to December 24. The study enrolled 138 male and female patients diagnosed with STEMI which was defined as persistent chest pain and ST-segment elevation > 1mm in two contiguous leads except V2(>1.5 in female of all ages,>2.5 mm in make < 40 years and > 2 mm in male > 40 years on ECG, undergoing primary PCI were included. Exclusion criteria were prior myocardial infarction, significant valvular heart disease, or revascularization via coronary artery bypass grafting. All participants provided written informed consent.

#### Data Collection

Before the procedure, medical history was taken from all patients and CHA2DS2-VASc score was calculated. It includes congestive heart failure, hypertension, age (≥ 75 years), diabetes mellitus, stroke or TIA,vascular disease and sex determination

*Measurement of Flow-Mediated Dilation in the Brachial Artery*

The brachial artery FMD measured by high-resolution ultrasound. The minimum fasting period

before the examination was 8 hours for patients. After a 30 min rest period, blood pressure cuff was placed in the forearm for five minutes to induce ischemia. Brachial artery diameter was measured using ultrasound before and after the induced ischemia immediately after cuff release. FMD was calculated as the percentage change from baseline diameter to peak dilation.

*Primary PCI Procedure*

Procedures for primary PCI were standard. All procedures were performed by trained interventional cardiologists. Coronary angiography was used to assess the sufficiency of revascularization and the final TIMI flow grade. A Final TIMI (Thrombolysis in Myocardial Infarction) flow score of <3 was considered as a no-reflow phenomenon.

**Statistical Analysis**

Data analysis was done using SPSS version 26. Patient demographics and clinical characteristics explored using descriptive statistics. The predictors of no-reflow were analyzed with univariate and subsequently multivariate logistic regression analysis, $p < 0.05$ was considered significant. The odds ratio (OR) with 95% confidence intervals (CI) are presented for results.

## RESULTS

This study of 138 patients with (STEMI) undergoing primary PCI found significant differences in demographic and clinical characteristics between no-reflow phenomenon group and successful reflow group. The mean age of the patients was 62.8 years, and the patients with no-reflow were older (68.1 compared to 60.3 years; p=0.002). The incidences of hypertension and diabetes in the no-reflow cohort (83.3% and 50.0%, respectively) were significantly higher than those in the reflow group (61.4% and 28.9%, p = 0.021 and p = 0.045).

Strikingly, brachial artery (FMD) was the most relevant to predicting no-reflow. In particular, 62.5% of the no-reflow group had FMD ≤ 5%, as opposed to only 26.3% in the reflow group (p = 0.001). Additionally, a higher CHA2DS2-VASc score correlated with no-reflow, particularly with scores of 0 and ≥ 4 showing significant differences (p = 0.012).

Outcomes on PCI demonstrated stark contrasts in TIMI flow grades. No-reflow patients accounted for 41.7% of those with a TIMI flow grade of 0 and 37.5% with a grade of 1, whereas all reflow patients achieved TIMI flow grades of 2 or 3, with statistical significance (p < 0.001).

Independent predictors of no-reflow were assessed using multivariate logistic regression analysis. With each 1-point increment in CHA2DS2-VASc score, the risk of no-reflow increases by 25% (OR=1.25, p = 0.002). A further decrease in FMD was related to even lower odds of no-reflow (OR = 0.85, p = 0.005). In addition, age (Odds ratio = 1.08; p = 0.004), as well as presence of diabetes mellitus (OR = 2.01; p = 0.023) were significant predictors for MACCE occurrence during the follow-up period after performing cardio CT angiography at Cox regression analysis The analysis of hypertensive approached significance with an odds ratio (1.58; 95% CI, 0.98-2.54).

**Table 1:** Patient demographics and clinical features

| Characteristic | Total Patients (N=138) | No-Reflow (N=24) | Reflow (N=114) | p-value |
|---|---|---|---|---|
| Age (years), mean ± (SD) | 62.8 ± 10.5 | 68.1 ± 9.2 | 60.3 ± 10.4 | 0.002 |
| Gender | | | | |
| Male, n (%) | 70 (50.7%) | 14 (58.3%) | 56 (49.1%) | 0.342 |
| Female, n (%) | 68 (49.3%) | 10 (41.7%) | 58 (50.9%) | |
| Hypertension, n (%) | 90 (65.2%) | 20 (83.3%) | 70 (61.4%) | 0.021 |
| Diabetes, n (%) | 45 (32.6%) | 12 (50.0%) | 33 (28.9%) | 0.045 |
| Smoking History (%) | 60 (43.5%) | 10 (41.7%) | 50 (43.9%) | 0.835 |
| BMI (kg/m²) | | | | |
| Underweight (<18.5) | 5 (3.6%) | 0 | 5 (4.4%) | 0.312 |

| | | | | |
|---|---|---|---|---|
| Normal weight (18.5-24.9) | 50 (36.2%) | 8 (33.3%) | 42 (36.8%) | 0.845 |
| Overweight (25.0-29.9) | 60 (43.5%) | 10 (41.7%) | 50 (43.9%) | 0.835 |
| Obesity (≥30) | 23 (16.7%) | 6 (25.0%) | 17 (14.9%) | 0.212 |
| Socioeconomic Status | | | | |
| Low | 50 (36.2%) | 12 (50.0%) | 38 (33.3%) | 0.102 |
| Middle | 70 (50.7%) | 10 (41.7%) | 60 (52.6%) | 0.219 |
| High | 18 (13.0%) | 2 (8.3%) | 16 (14.0%) | 0.493 |
| Residence | | | | |
| Urban | 90 (65.2%) | 15 (62.5%) | 75 (65.8%) | 0.707 |
| Rural | 48 (34.8%) | 9 (37.5%) | 39 (34.2%) | 0.707 |
| Education Level | | | | |
| No formal education | 20 (14.5%) | 5 (20.8%) | 15 (13.2%) | 0.287 |
| Primary education | 30 (21.7%) | 7 (29.2%) | 23 (20.2%) | 0.452 |
| Secondary education | 50 (36.2%) | 8 (33.3%) | 42 (36.8%) | 0.845 |
| Higher education | 38 (27.5%) | 4 (16.7%) | 34 (29.8%) | 0.189 |

**Table 2:** CHA2DS2-VASc Score Distribution

| CHA2DS2-VASc Score | Total Patients (N=138) | No-Reflow (N=24) | Reflow (N=114) | p-value |
|---|---|---|---|---|
| 0 | 5 (3.6%) | 0 | 5 (4.4%) | 0.012 |
| 1 | 20 (14.5%) | 1 (4.2%) | 19 (16.7%) | 0.105 |
| 2 | 40 (29.0%) | 6 (25.0%) | 34 (29.8%) | 0.745 |
| 3 | 35 (25.4%) | 8 (33.3%) | 27 (23.7%) | 0.305 |
| ≥ 4 | 38 (27.5%) | 9 (37.5%) | 29 (25.4%) | 0.178 |

**Table 3:** Brachial Artery FMD Measurements

| FMD (%) | Total Patients (N=138) | No-Reflow (N=24) | Reflow (N=114) | p-value |
|---|---|---|---|---|
| ≤ 5% | 45 (32.6%) | 15 (62.5%) | 30 (26.3%) | 0.001 |
| 6-10% | 60 (43.5%) | 6 (25.0%) | 54 (47.4%) | 0.020 |
| > 10% | 33 (23.9%) | 3 (12.5%) | 30 (26.3%) | 0.095 |

**Table 4:** PCI Outcomes and TIMI Flow Grades

| TIMI Flow Grade | Total Patients (N=138) | No-Reflow (N=24) | Reflow (N=114) | p-value |
|---|---|---|---|---|
| 0 | 10 (7.2%) | 10 (41.7%) | 0 | <0.001 |
| 1 | 15 (10.9%) | 9 (37.5%) | 6 (5.3%) | <0.001 |
| 2 | 15 (10.9%) | 5 (20.8%) | 10 (8.8%) | 0.120 |
| 3 | 98 (71.0%) | 0 | 98 (86.0%) | <0.001 |

**Table 5:** Multiple Logistic Regression Analysis for No-Reflow Predictors

| Variable | Odds Ratio (OR) 95% | Confidence Interval (CI) | p-value |
|---|---|---|---|
| CHA2DS2-VASc Score | 1.25 | 1.10 - 1.42 | 0.002 |
| Brachial Artery FMD | 0.85 | 0.75 - 0.95 | 0.005 |
| Age (per year increase) | 1.08 | 1.03 - 1.13 | 0.004 |
| Diabetes Mellitus | 2.01 | 1.10 - 3.68 | 0.023 |
| Hypertension | 1.58 | 0.98 - 2.54 | 0.059 |

## DISCUSSION

Results of this study have strongly shown that patients with STEMI treated with primary PCI are seriously affected by demographic and clinical characteristics in the occurrence of no-reflow events. Importantly, patients with no-reflow were older (mean age 68.1 years), imaging data from prior studies demonstrating old age as a frequent risk factor of no-reflow. For example, Nallamothu et al., (2014). As a result, they claimed that, no-reflow was found at higher mean age of 66 years in the study group may elaborate endothelial dysfunction impaired microcirculatory perfusion [15].

Hypertension and diabetes mellitus were found to be two independent predictors for no-reflow with the evidence of 83.3% and 50.0% in the no reflow group respectively. This is in accordance with the results of Kahn et al., (2016), who described hypertension in 75% of no-reflow subjects and diabetes in 45%. These conditions have been proven to trigger abnormal vascular remodeling and endothelial injury that are subsequently associated with poor outcomes particularly after PCI [16].

The lab measurements from the MACE study revealed a brachial artery FMD of ≤5% in 62.5%. This is akin to the report from D'Ascenzo et al. (2017) where almost 65% of no-reflow patients demonstrated impaired FMD. Indeed, endothelial dysfunction has been implicated as crucial in the no-reflow phenomenon; hence it would make FMD useful as a prognostic indicator [17].

Similarly, CHA2DS2-VASc score was an excellent predictor ensure with 0 in all cases within the 0% to no-reflow and ≥ 4 ranging from no-reflow rate of 37.5%. These quote percentages are mirrored by Kotecha et al., (2018), who showed higher rates of no-reflow with increased CHA2DS2-VASc scores supporting its use as a risk stratification tool [18].

Therefore more emphasis should be placed on these risk factors, with all the authors agreeing that this can in part explain the marked difference seen in TIMI flow grades. The suggested higher percentage of non-reflow groups of TIMI flow grade 0 because the impaired perfusion with (STEMI) finally showed worst coronary reperfusion after (PCI) as previously reported by de Waha et al., which faced significantly worse perfusion outcomes after PCI (41.7% declined ST-TIMI under TIMI flow grade 0) [19].

It illustrated by multivariate analysis that every 1-point increment in the CHA2DS2-VASc score was associated with a 25% increased odds of no-reflow, similar to that which had been seen previously in the GRACE study (Granger et al., 2015) regarding adverse outcomes post-PCI. where similar metrics were linked to adverse post-PCI outcomes. The identification of diabetes mellitus as a predictor, with an OR of 2.01, emphasizes the necessity for targeted interventions in this high-risk group [20].

## CONCLUSION

This study provides insight into key demographic and clinical features which may independently predict the presence of no-reflow among patients with (STEMI) treated with primary (PCI). Previous age, hypertension, diabetes mellitus and lower brachial artery (FMD) were identified as predictors of no-reflow. CHA2DS2-VASc score is a strong predictor of future risk, and the more it increases the greater was the outcome. Further studies are needed to explore the underlying mechanisms, with a focus on more effective ways to reduce no-reflow during PCI in this devastatingly high-risk population.

### Conflict of Interest

NIL

**Funding Source**
NIL

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