Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 08, 2023

Original research article

Risk assessment by CHA2DS2-VASc Score and predict the prognosis in patients with coronary heart disease undergoing PCI

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Received Date: 06/05/2023, Accepted Date: 18/06/2023

Abstract

Background: The CHA2DS2-VASc is well-validated stroke risk prediction scores for atrial fibrillation (AF), but its role in risk stratification of major adverse cardiac events (MACEs) for non-AF patients undergoing percutaneous coronary intervention (PCI) is unknown.

Aims and Objectives: Primary endpoint of the study was risk assessment by CHA2DS2-VASc Score to predict the prognosis in patients with acute coronary syndrome undergoing PCI and comparison of CHA2DS2-VASc score with GRACE and TIMI risk score. The secondary endpoint of the study was short-term in-hospital mortality of all cause.

Methods: 350 patients without AF undergoing PCI were analysed in the Department of Cardiology, S.M.S medical college and attached group of hospitals, Jaipur. A composite of MACE including cardiovascular death, nonfatal MI, or stroke was defined as the primary study endpoint. Cardiovascular death was defined as death attributed to MI, congestive heart failure, or documented sudden cardiac death.

Results: MACE in hospital was present in 21 (6%) and Ischaemic stroke in 10 (2.6%). Myocardial infarction in 5 (1.4%) and death was reported in 12 (3.4%) of the participants. A significant relation was observed in MACE, Ischaemic stroke and death with categories of CHA2-DS2-VASc score. In patients without AF undergoing PCI we showed that the CHA2DS2-VASc score was comparable to the GRACE score which recommended by guideline which require ECG and cardiac enzyme information for prediction in-hospital mace. In our study the CHA2DS2-VASc score performed significantly better than TIMI-NSTEMI/UAP, TIMI-STEMI which requires angiographic information for prediction of in-hospital MACE.

Conclusion: These findings shall give clinicians confidence to use the CHA2DS2-VASc score for risk prediction and provide an opportunity for an early risk stratification before ECG, enzyme and angiographic information become available.

Keywords: Coronary heart disease, PCI, myocardial infarction

Introduction

Patients with acute coronary syndrome (ACS) have a wide range of risks for eventual cardiovascular (CV) morbidity and mortality [1]. Myocardial revascularization, particularly percutaneous coronary intervention (PCI), is considered one of the most successful therapeutic techniques for lowering death risk and improving prognosis in ACS patients. Patients with a clear diagnosis of ACS, however, are nonetheless at an elevated risk of unfavourable CV events even when treated with PCI and guideline-directed medical therapy [2-4]. As a result, effective clinical management in the future would be facilitated by accurate and early identification of such individuals at high CV risk [5-6]. Unfortunately, simple and practical risk assessment techniques for predicting unfavourable CV events in ACS patients following PCI are currently lacking.

CHA2DS2 and CHA2DS2-VASc score models are widely applied to predict the risk of subsequent thrombo embolic 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 [7]. The CHA2DS2-VASc score (congestive heart failure, hypertension, age [≥65 = 1 point, ≥75 = 2 points], diabetes, stroke/transient ischemic attack [TIA] [2 points], and vascular disease

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[peripheral arterial disease, previous myocardial infarction [MI] and aortic atheroma]) was developed from the CHADS2 score and has been used extensively to predict thromboembolic events in patients with nonvalvular atrial fibrillation and determine whether to use anticoagulant or antiplatelet drugs [6]. The components of these two scores are associated with atherosclerosis, vascular spasm and microvascular dysfunction, which overlap the risk factors of NRP [8].

Physicians are familiar with this scoring system since it may be generated using data from medical questionnaires. Furthermore, the CHADS2 score has been linked to post-stroke all-cause mortality in both patients with and without AF [2]. The CHADS2 score has also been demonstrated to have predictive significance for bad outcomes in patients with acute myocardial infarction (MI) [7-9]. Recently, the CHA2DS2-VASc score was proposed as an improved risk stratification for predicting stroke and thrombosis in AF [9].

To identify high-risk ACS patients who may benefit most from early aggressive therapy, the Global Registry of Acute Coronary Events (GRACE) and thrombolysis in myocardial infarction (TIMI) risk ratings were created. Both risk scores have become popular techniques for predicting MACE after an ACS. They are, however, complicated and necessitate immediate clinical, laboratory, ECG, and even angiographic assessment. Current study was design to validate the CHA2DS2-VASc score.

Aim and Objectives

- To demonstrate the clinical utility of CHA2DS2- VASc score in risk assessment of patients with STEMI regarding adverse clinical outcomes.
- The secondary endpoint of the study was short-term in-hospital mortality of all cause and compare of CHA2DS2-VASc score with GRACE and TIMI risk score.

Material and Methods

Study location: The study was conducted in the Department of Cardiology, S.M.S medical college and attached group of hospitals, Jaipur.

Study design: Hospital based prospective observational study.

Study duration: From February 2020 to December 2021.

Sample size: The sample size was computed using the incidence of MACE 8.1 from Hioki H *et al*. study with a 95% confidence interval and a 3% absolute error. A total sample size came to 330 and after considering the non-response we finally took the overall sample size of 350.

Study population: All patients with MI and underwent for PCI in the Department of Cardiology, S.M.S medical college and attached group of hospitals, Jaipur. A convenient sampling technique was used to enrolled the patients in study till the sample size completion and 350 patients were selected for the study.

Eligibility criteria

Inclusion criteria

- All patients of MI aged above 18 years and old and underwent for PCI.
- Patients giving consent.

Exclusion criteria

- No coronary stenotic lesion (recanalised vessel).
- No stent was deployed (only POBA done).
- No consent given.

Methodology

This Prospective observational cohort study included all patients (n=350) who were consecutively admitted for a diagnosis of ACS and underwent PCI between Feb 2020 to December 2021. ACS includes ST elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI) and unstable angina pectoris (UAP).

Patients were divided into three groups according to low, intermediate and high CHA2DS2-VASc score. Then comparison of groups with respect to baseline characteristics. Angiographic results of reperfusion were inspected to evaluate the association of high CHA2DS2-VASc score.

The secondary endpoint of the study was short-term in- hospital mortality of all cause.

Coronary angiography to be performed for all patients in addition to standard med ICAL treatment of acute coronary syndrome.

A creatinine clearance under 60 mL/min/1.73 m2, calculated by Cockroft equation accompanied with previous history of renal failure and sonographic characteristics to be defined as chronic kidney disease.

Cardiogenic shock as a systolic blood pressure of less than 90 mm Hg or mean arterial pressure under 70

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accompanied with impaired organ perfusion.

Angioplasty technique: PCI was performed with the standard technique as per the department protocol, and coronary stents were used whenever required. The infarct related artery was the only target of the procedure. The use of glycoprotein IIb/IIIa inhibitors was left to the discretion of the operator. TIMI flow and Myocardial Blush Scores were graded in the angiograms taken immediately after PCI in the best view showing the infarct related artery (left lateral for LCA and right oblique for RCA). Finally, TIMI flow grade was calculated.

Definitions

The CHA2DS2-VASc score was the sum of 1 point each for the presence of-

- Congestive heart failure.
- Hypertension.
- Diabetes mellitus.
- Age of 65 to 74 years.
- Female sex.
- Vascular diseases (history of MI, peripheral arterial disease, or complex aortic plaques).
- 2 points for.
- Age ≥ 75 years.
- A history of stroke or transient ischemic attack (TIA).
- Congestive heart failure, hypertension, diabetes mellitus and hyperlipidemia was diagnosed based on patient's past medical history.

ST elevation MI

On the basis of history of a typical chest pain lasting at least 30 min and ST elevation 0.1 mV in all leads (except V2-V3). In leads, V2 and V3 these cut off values apply: 0.2 mV for men 40 years, 0.25 mV in men under 40 years, 0.15 mV in women. Furthermore, new left bundle branch block (LBBB) or meeting the Sgarbossa's Criteria.

The GRACE risk score: Using parameters of age, Killip class, heart rate, systolic BP, ST-segment deviation and cardiac arrest at admission, elevated biomarkers of myocardial necrosis, and baseline creatinine level, was calculated (low [1-108], intermediate [109-140], and high [>140]).

The TIMI risk score: It was also used for risk assessment. TIMI-STEMI was calculated using age, Killip class, heart rate >100bpm, systolic BP<100mmHg, weight, time of beginning of pain to treatment, history of diabetes, hypertension and angina (low [0-3], intermediate [4-6], and high [7-14]). TIMI-NSTEMI/UAP13 was calculated based on age, ≥3 CAD risk factors, history of CAD with stenosis ≥50%, Aspirin use, severe angina, ST-segment deviation and cardiac maker (low [0-2], intermediate [3-4], and high [5-7]).

Dyslipidemia: It was identified as a serum total cholesterol concentration ≥220 mg/dl (≥5.72 mmol/L), a low-density lipoprotein (LDL) cholesterol concentration≥140 mg/dl(≥3.63 mmol/L), triglycerides ≥150 mg/dL (≥1.7 mmol/L), or receiving lipid -lowering therapy.

Chronic kidney disease (CKD): It was defined as an estimated glomerular filtration rate (eGFR) <60 ml/min per 1.73 m2 calculated using the Modification of Diet in Renal Disease formula.

MACE: A composite of MACE including cardiovascular death, nonfatal MI, or stroke. Cardiovascular death was defined as death attributed to MI, congestive heart failure, or documented sudden cardiac death. Stroke was referred to ischemic stroke, which was defined as the presence of a new neurological deficit lasting for at least 24h with definite evidence of infarction detected by magnetic resonance imaging or computed tomography.

Statistical Analysis

Data analysis was done using licensed SPSS software version 21.0 (Chicago, Illinois). Univariate analyses were done initially and the results were presented with the help of tables, text and charts. Descriptive statistics were used to calculate frequencies of categorical variables, and measures of central tendencies and dispersion were used to describe continuous variables. Independent t-test was used to compare the continuous variable and chi-square and Fishers exact test was used for categorical variables. Univariate regression analysis was done and a statistically significant variable were taken for multivariate analysis to identify the independent risk factor for MACE. Components of the CHA2-DS2-VASc score were left out of the multivariate analysis since they were thought to be interrelated.

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A p-value <0.05 was considered as statistically significant.

Ethical issues

Approval from Institutional Ethical Committee of SMS medical college & Hospital was taken before the start of the study. Written and informed consent was obtained from the participants before proceeding the study. Each eligible subject was explained about the purpose of the study by the investigator and an informed consent was obtained, prior to inclusion. They were assured of complete confidentiality of information, and the option of withdrawing from the study at any point of time. The study did not involve any method that puts the subjects, family members or the investigator at risk.

Results

The current study was done on a sample size of 350 participants. Based on the CHA 2-DS2- VASc score the participants were stratified into 3 groups as those having a score of 0-2, 3-4 and ≥ 5. The mean age of the participants was 65.2±12.4 years and majority of the participants 262 (74.8%) were males. The higher mean age in the groups with higher CHA2-DS2-VASc score was statistically significant. The proportion of females was also significantly higher in the CHA2-DS2-VASc score groups with higher score (Table 1)

Comorbidities

The mean BMI was in the overweight category at 23.8±3.9. The difference in BMI between the 3 groups based on CHA2-DS2-VASc score was also significant. Diabetes mellitus was prevalent in (40.5%) of the participants. Majority 264 (75.4%) of the participants also had hypertension. Majority of the participants 196 (56%) had d yslipidaemia and CKD was found in 4 (1.1%) participants and the difference between the three groups was also statistically significant. The prevalence of diabetes mellitus, hypertension, CKD and LVD increased significantly in the groups with higher CHA2-DS2-VASc score. LVD was present in 148 (142.3%) of the participants. (Table 1)

Medical history

In our study, 92 (26.3%) participants had prior De novo lesion Prevalence of medical histories like prior CABG, prior CHF, prior angina, prior PCI and prior CVD was significantly higher in groups having higher CHA2-DS2-VASc score. The mean HDL and LDL values were 42.1±13.6 mg/dl and 118±40.3 mg/dl respectively. The level of mean LDL was also seen to be significantly lower in groups with higher CHA2-DS2-VASc score. (Table 1)

Distribution of lesions

The overall proportion of those having LAD, LCA, RCA and Left main artery and multi- vessels ds was 182 (52.0%), 58 (16.6%), 131 (37.4%), 16 (4.6%) and 148 (42.3%). There was no significant relation observed between the presence of these lesions and CHA2-DS2-VASc score. Our study finding also revealed that GRACE score and TIMI risk score were significantly increases with CHA2-DS2-VASc score (Table 1).

Table 1: Comparison of baseline characteristics according to CHA2-DS2-VASc score (N=350)

Variables	Overall	Score 0-2	Score 3-4	Score ≥ 5	p-value
Sample size	N=350	n=140	n=126	n=84	-
Age (in years)	65.2±12.4	58.6±10.3	67.6±11.8	74.6	0.0001
Female	88 (25.1%)	10 (7.1%)	32 (25.4%)	46 (54.8%)	0.0001
BMI	23.8±3.9	24.1±3.6	24.6±3.8	23.1±4.4	0.0001
Smoker	157 (44.9%)	79 (56.4%)	51(40.5%)	27 (32.1%)	0.0001
SBP	128±14	126±16	134±12	138±14	0.0001
DBP	72±13	74±10	75±14	71±15	0.0001
HR	82±14	77±12	85±15	100±14	0.0001
Trop-T	0.80±0.1	1.2±0.08	0.78±0.1	0.50±0.2	0.0001
HbA1C	6.5±1.4	6.2±1.2	7.1±1.5	7.4±1.7	0.0001
Baseline creatinine	0.62±1.9	0.52±1.5	0.5±1.7	0.89±2.1	0.0001
Estimated glomerular filtration rate (ml/min/1.73m2)	83±15	84±14	72±16	64±18	0.0001
Comorbidities					
DM	142 (40.5%)	31(22.1%)	63 (50%)	48 (57.1%)	0.001
Dyslipidaemia	196 (56%)	78 (55.7%)	62 (49.2%)	56 (66.7%)	0.0001
Hypertension	264 (75.4%)	89 (63.6%)	98 (77.8%)	77 (91.7%)	0.0001
LVD	148 (42.3%)	35 (25%)	58(46.0%)	55 (62.5%)	0.0001
CKD	4 (1.1%)	0 (0%)	1 (0.8%)	3(3.6%)	0.0001
Medical history					

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Prior CHF	21 (6.0%)	5 (3.6%)	8 (6.3%)	8 (9.5%)	0.0001
Prior CVD	31 (8.9%)	2 (1.4%)	10 (7.9%)	19 (22.6%)	0.0001
Prior angina	68 (19.4%)	15 (10.7%)	30 (23.8%)	23(27.4%)	0.0001
HDL (mg/dl)	42.1±13.6	41.9±13.2	42.4±12.9	42.3±13.8	0.562
LDL (mg/dl)	118±40.3	132.2±43.2	120.5±38.9	102±32.1	0.0001
Prior Aspirin use	84 (24%)	18(12.28%)	23(18.25%)	43(51.10%)	0.0001
Distribution of lesions					
LAD	182 (52.0%)	72 (51.4%)	68 (53.4%)	42 (50%)	0.673
LCA	58 (16.6%)	24 (17.1%)	21 (16.7%)	13 (15.5%)	0.732
RCA	131 (37.4%)	52 (37.1%)	43 (34.1%)	36 (42.1%)	0.173
Left main artery	16 (4.6%)	8 (5.7%)	6 (4.8%)	2 (2.4%)	0.834
Multi vessels disease	148 (42.3%)	41 (29.3%)	57 (45.2%)	50 (59.5%)	0.0001
GRACE score	143±12.5	124±22	158±16	162±10	0.001
TIMI STEMI score	7 (4-9)	5 (3-6)	7 (4-9)	8 (5-9)	0.001
TIMI NSTEMI score	5 (4-6)	4 (2-5)	5 (3-6)	6(4-6)	0.001
Type of MI					
NSTEMI	94(26.85%	18(12.85%)	34(26.98)	42(50.00)	
STEMI	214(61.14)	114(81.42)	80(63.49)	20(23.81)	
UA	42(12%)	8(5.71)	12(9.52)	22(26.19)	
AWMI	140(40.00)	74(64.92)	54(42.85)	12(14.29)	
Thrombolysis	96(27.24%)	61(43.58%)	28(22.2)	7(8.33%)	
Killip Class					
I	295(84.29)	135(96.43)	107(84.92)	53(63.09)	
II-III	55(15,71)	5(3.57)	19(15.08)	31(36.90)	

MACE in hospital was present in 21 (6%) and Ischaemic stroke in 10 (2.6%). Myocardial infarction in 5 (1.4%) and death was reported in 12 (3.4%) of the participants. A significant relation was observed in MACE, Ischaemic stroke and death with categories of CHA2-DS2-VASc score. (Table 2)

Table 2: Incidence of MACE

Variables	Overall	Score 0-2	Score 3-4	Score ≥ 5	p-value
MACE	36 (10.3%)	11(7.9%)	11 (8.7%)	14 (16.7%)	0.0001
Ischaemic stroke	10 (2.6%)	2 (1.4%)	2 (1.6%)	6 (7.1%)	0.0001
MI	5 (1.4%)	1 (0.7%)	1 (0.8%)	3 (3.6%)	0.678
Death	9 (2.58%)	1 (0.7%)	2 (1.58%)	6(7.15%)	0.0001

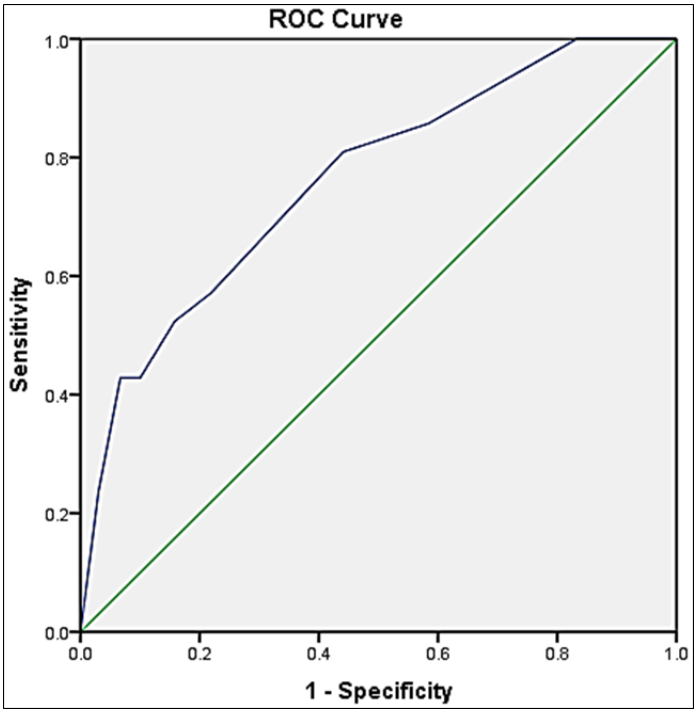

Fig 1: Showing MACE in different categories of CHA2-DS2-VASc score

ROC curve for CHA2-DS2-VASc score to predict. MACE showed accuracy of 76.2% which was found to be statistically significant.

Area	Std. Error	p-value	Asymptotic 95% Confidence Interval

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			Lower Bound	Upper Bound
.762	.055	.000	.655	.869

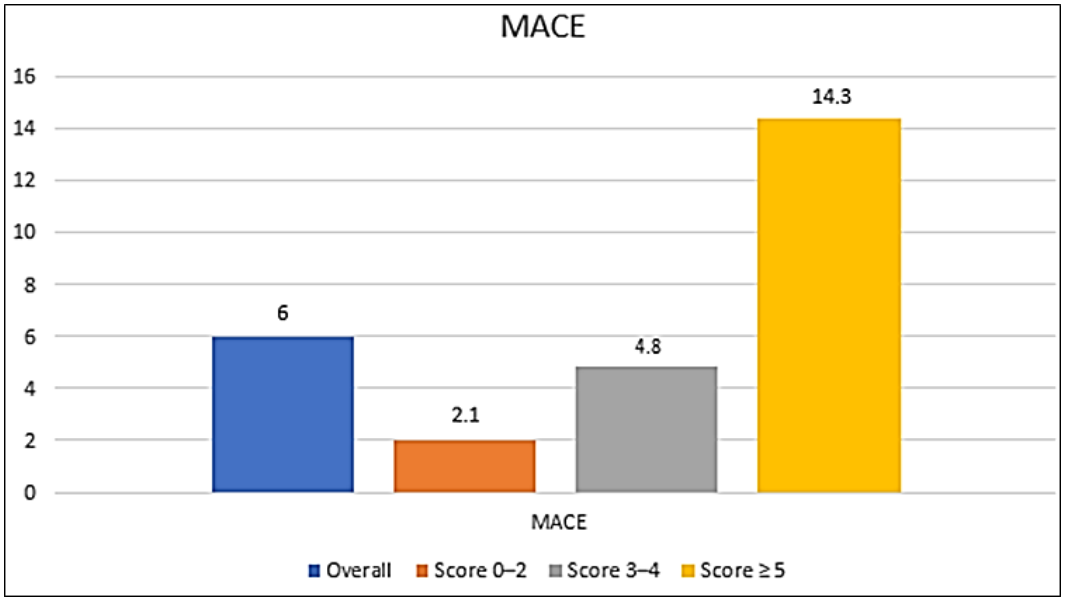

Fig 2: Showing prevalence of ischaemic stroke in different categories of CHA 2-DS2-VASc score

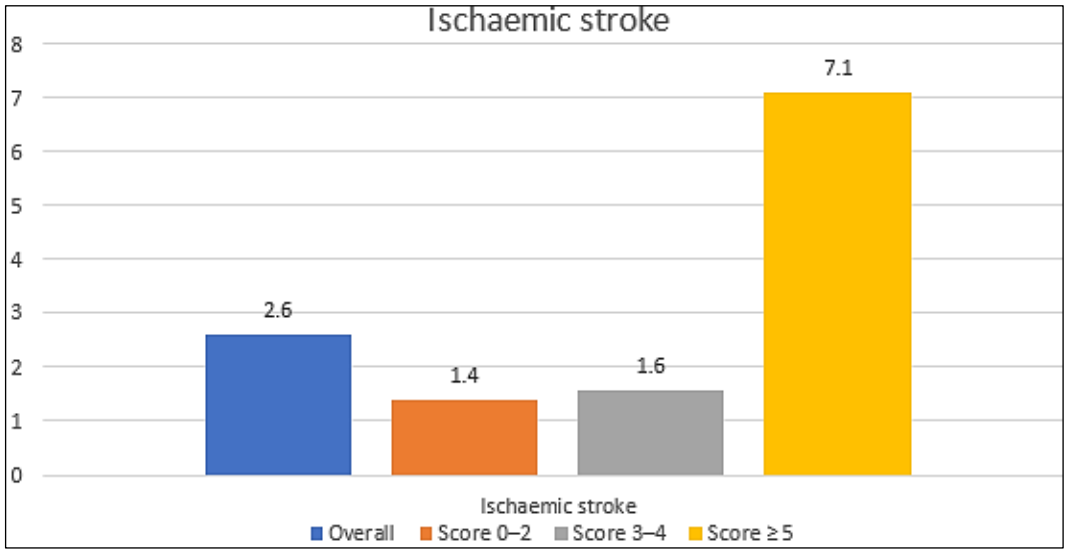

Fig 3: Showing prevalence of myocardial infarction in different categories of CHA2-DS2-VASc score

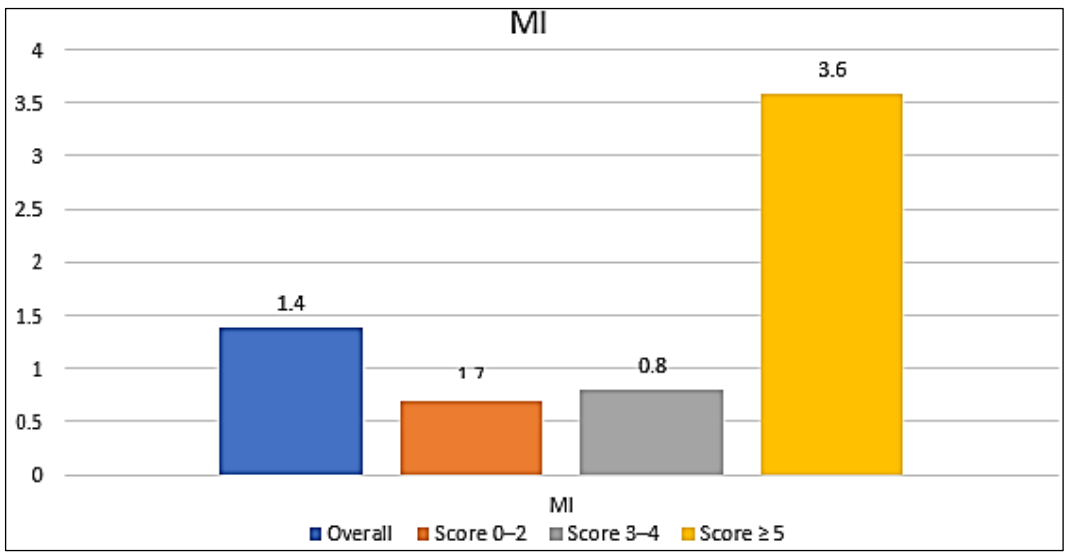

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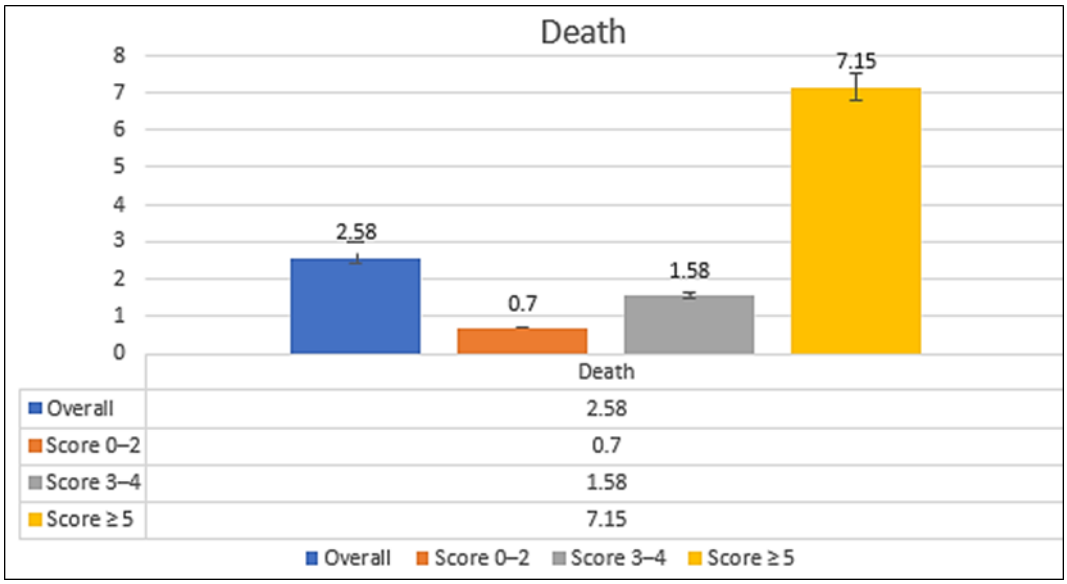
Fig 4: Showing occurrence of death in different categories of CHA2-DS2-VASc score



Univariate regression analysis showed that other than female gender, HR and prior H/O CHF, all variables found to be significantly associated with risk of MACE however in multivariate analysis high CHA2 DS2-VASc score, LDL, number of vessels involved and use of aspirin were associated with MACE.

Table 3: Hazards regression analysis for MACE

	Univariate Regression			Multivariate Regression		
	HR	**95% CI**	**p-value**	**HR**	**95% CI**	**p-value**
CHA2 DS2 -VASc score	1.78	1.51-1.93	0.0001	1.62	1.41-1.72	0.0001
Age	1.13	1.10-1.14	0.0001			
Women	1.06	0.83-1.23	0.432			
Body mass index	0.92	0.87-0.97	0.0001	0.94	0.95-1.02	0.121
Current smoker	1.36	1.12-1.58	0.0001	0.81	0.65-1.10	0.110
Systolic blood pressure	1.12	1.08-1.18	0.001	0.		
Heart rate	1.58	1.32-1.74	0.001			
Diabetes mellitus	0.81	0.73-0.93	0.0001			
Hypertension	0.84	0.76-0.97	0.0001			
Chronic kidney disease	0.22	0.13-.34	0.001	0.89	0.68-1.25	0.457
Hemoglobin A1c	1.10	1.08-1.25	0.0001			
Peak troponin-T	0.94	0.92-0.99	0.0001	0.95	0.93-0.99	0.0001
Prior chronic heart failure	0.64	0.45-1.42	0.467			
Prior myocardial infarction	0.41	0.31-0.58	0.0001			
Prior cerebrovascular accident	0.68	0.51-0.82	0.0001			
Prior peripheral vascular disease	0.34	0.26-0.42	0.001			
Low density lipoprotein-cholesterol	0.74	0.61-0.82	0.0001	0.79	0.68-0.86	0.0001
Estimatedglomerular filtration rate	0.97	0.95-0.99	0.0001	.98	0.95-1.01	0.682
Number of vessel coronary disease	1.62	1.28-1.84	0.0001	1.12	1.10-1.40	0.001
Aspirin	2.12	1.82-2.98	0.0001	1.62	1.24-2.30	0.001
Beta-blocker	1.42	1.18-1.62	0.001	1.10	0.92-1.21	0.268

Discussion

The current study was done on a sample size of 350 participants and analysis suggests that CHA2DS2VASc score is significantly associated with cardiovascular outcomes. It is well established that increased CHA2DS2-VASc score independently associated with risk of subsequent MACE. A number of observational study 10 have shown the relationship of each individual component of CHA2DS2-VASc on CVD outcomes. However, how well the CHA2DS2-VASc score using only demographic and clinical risk variables can predict future MACE comparing other risk stratification tools that include cardiac enzyme, ECG changes and angiographic information had not been evaluated. We showed that the CHA2DS2-VASc score was comparable to the GRACE score which recommended by guideline 11 and TIMI-STEMI, both require ECG and cardiac enzyme information for prediction of both in-hospital and follow-up MACE Stratification based on CHA2-DS2-VASc score showed association with cardiovascular disease and their risk factors. In accordance with our finding, the results of Kim KH, *et al*., also showed that CHA2DS2VASc score can be used as a risk-stratification system in AMI

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irrespective of presence of atrial fibrillation and type of treatment strategy. A study reported that hypertension, diabetes mellitus, and congestive heart failure are long-term prognostic predictors after AMI8. Malmberg *et al.* [11] reported that diabetes mellitus was an independent predictor for all-cause mortality, as well as cardiovascular death, recurrent myocardial infarction, stroke, and congestive heart failure in unstable angina or non-Q-wave myocardial infarction patients. Our study also showed higher prevalence of diabetics in higher risk category.

In the study it was also observed that CHA2DS2VASc risk score is an easy tool to use. Similar observation was reported by Kim KH, *et al*., [12] also that CHA2DS2VASc risk score is easy to use and helps to identify those with a higher risk of cardiovascular disease.

The current study also revealed a significant increase in occurrence of Ischaemic stroke with higher CHA2-DS2-VASc score hence showing that CHA2-DS2-VASc score can be used in prediction of stroke as it was intended to in non-AF acute ACS patients. In accordance with our results Kim KH, *et al*., also concluded that CHA2DS2-VASc score is an independent predictor for long-term prognosis in AMI patients and can be used as a risk-stratification system. In addition to the CHA2DS2-VASc score, the multivariate analysis also identified higher levels number of coronary artery disease were significantly associated with increased risk of MACE. Unexpectedly, higher levels of peak troponin-I and LDL-C at time of ACS were associated with lower risk of MACE. There was a possibility that higher troponin-I or LDL-C as indications for more aggressive secondary prevention post ACS and PCI. This explanation is supported by the recent published ODYSSEY Outcome trial [13].

Limitations

In our study it was observed that baseline characters like age, gender, BMI, LDL values, prevalence of Diabetes mellitus, Hypertension, were different among the risk groups. First, enrolled ACS patients without known AF, but we cannot rule out the possibility of asymptomatic paroxysmal AF. We did not perform ambulatory electrocardiography to capture AF.

- Nevertheless, Kim *et al*. reported that the CHA2DS2-VASc score had an impact on all-cause mortality in AMI patients irrespective of presence of AF.
- Second, there is no follow up done in our study. Mid-term and longer follow-up studies are needed to confirm our findings.
- Finally, this is a single-center study which might not reflect heterogeneity of the ACS population and the cardiology practice.

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