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Original Article

ADULT CARDIOLOGY

Association of CHA_2DS_2-VASc-HSF Score with Severity of Coronary Artery Disease in Patients with Non-ST Elevation Myocardial Infarction

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ABSTRACT

Objective: To find association between CHA_2DS_2-VASc-HSF score and severity of Coronary Artery Disease (CAD), assessed by Gensini score in Non-ST Elevation Myocardial Infarction (NSTEMI) patients.

Study Design: Analytical Cross-sectional study.

Place and Duration of Study: Armed Forces Institute of Cardiology/National Institute of Heart Disease, Rawalpindi Pakistan, from Jan to Jul 2023.

Methodology: Total one hundred and forty-seven patients were included using non-probability consecutive sampling. For the purpose of study, participants having NSTEMI, confirmed by elevated biomarkers, who had coronary angiography, were included in the study. ANOVA, Chi-square and Pearson Correlation were applied to find the significance level of study findings. $p<0.05$ was taken as statistically.

Results: Out of one hundred and forty-seven participants, most of the patients were male 104(70.7%). The CHA_2DS_2-VASc-HSF score showed a moderate positive correlation (r=0.422, $p<0.001$) with the Gensini score, indicating that as the CHA_2DS_2-VASc-HSF score increased, the severity of coronary artery disease also tended to increase. It was observed that with increasing age, severity of CAD significantly increased ($p<0.001$), while ejection fraction decreased with rising extent of CAD ($p=0.01$). Moreover, a rising disease burden as indicated by number of diseased, critical and total vessels was associated with higher Gensini score, consequently increased severity of CAD ($p<0.001$).

Conclusion: This research study supported the potential clinical utility of CHA_2DS_2-VASc-HSF as an adjunctive tool for risk stratification in CAD.

Keywords: CHA_2DS_2-VASc-HSF, Coronary artery disease, Gensini score, Non-ST elevation myocardial infarction.

How to Cite This Article: *Toru FK, Shabbir M, Paiker S, Anwar M, Khan IA, Kamran J, Shahzad SK. Association of CHA_2DS_2-VASC-HSF Score with Severity of Coronary Artery Disease in Patients with Non-ST Elevation Myocardial Infarction. Pak Armed Forces Med J 2023; 73(SUPPL-3): S495-499. DOI: https://doi.org/10.51253/pafmj.v73iSUPPL-3.10798*

INTRODUCTION

Coronary Artery Disease (CAD) stands as the primary reason for illness and death on a global scale. Based on data from the World Health Organization, approximately 9 million individuals lost their lives due to ischemic heart disease in 2019, accounting for 16% of the total global fatalities.[1] Acute Coronary Syndrome is a form of CAD that demands immediate attention due to its potentially fatal nature. This category comprises ST-Elevation Myocardial Infarction (STEMI), Non-ST Elevation Myocardial Infarction (NSTEMI), and unstable angina. Collectively, these conditions account for about thirty percent of overall mortality in individuals above the age of 35 years.[2] Although STEMI is more dangerous as it reflects infarction of the full thickness of the myocardium, there is now substantial evidence that a serious primary disease is also noticed in a vast number of patients presenting with NSTEMI.

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Recently, American College of Cardiology (ACC) reported 41% of CAD severity in patients having NSTEMI that requires an urgent treatment modality i.e. Coronary Artery Bypass Graft (CABG) or angioplasty.[3] The $CHADS_2$ and CHA_2DS_2-VASc scores are thoroughly validated instruments for evaluating the thromboembolism risk in patients with non-valvular atrial fibrillation. However, since these scores incorporate similar risk factors that contribute to the onset of CAD, studies have been conducted in assessing their utility in evaluating CAD severity. In a recent development, a fresh score called CHA_2DS_2-VASc-HSF has been formulated, incorporating hyperlipidemia (H), smoking (S), and family history of CAD (F), along with substituting male gender for female gender (Sc). These additions, supplement the existing risk factors for a more comprehensive assessment of CAD severity. CHA_2DS_2-VASc-HSF score was proved to be superior to CHA_2DS_2 and CHA_2DS_2-VASc in predicting severity of CAD in number of past studies. [4-6]

The existence of severe CAD specifies higher mortality and a worse prognosis.[7] The arteries that are affected can be resurrected with revascularization therapy (CABG or angioplasty). Gensini is a useful score in determining extent and severity of CAD but it entails an invasive approach i.e. coronary angiography for scoring.[8] In peripheral health setups, where facility for angiography is lacking, such patients with NSTEMI having severe underlying disease tend to be neglected and hence results in increased mortality. CHA_2DS_2-VASc-HSF is a simple scoring tool that can be easily remembered and readily calculated.[9] To ensure economical and effective CAD prevention and treatment at individual patient level, it becomes essential to stratify cardiovascular risks using straightforward techniques. Such cardiovascular risk assessment would play a significant role in guiding early referrals and allocation of healthcare resources in shaping informed decision-making processes.

The study was aimed to recruit NSTEMI patients and find association between CHA_2DS_2-VASc-HSF score and CAD severity as evaluated by Gensini score. The benefit of this study would be the ability to recognize people with NSTEMI who must be categorized as high risk and refer them to centers where coronary revascularization facilities are available so that the clinical outcomes in these patients can be improved.

METHODOLOGY

This Analytical Cross-sectional study was carried out at the Armed Forces Institute of Cardiology/ National Institute of Heart Diseases, Rawalpindi Pakistan, from January to July 2023 prospectively after ethical approval from Institutional Ethical Review Board (Ltr#9/2/R&D/2023/239).

WHO sample size calculator was used to calculate sample size by using 10.71% prevalence of NSTEMI within the general population.[10] Confidence level and margin of error were kept at 95% and 5% respectively. The resulting sample size was (n=147)

Inclusion Criteria: For the purpose of study, patients presenting with NSTEMI, aged over 18 years, having elevated cardiac biomarkers, and undergoing coronary angiography were selected. The study encompassed both male and female participants.

Exclusion criteria: Patients with a history of previous CABG, renal or liver failure, as well as hematological diseases or malignancies were excluded.

Non-probability consecutive sampling was used to select participants. Data was gathered after approval from ethical review committee and written informed consent was taken from patients using a close-ended questionnaire. Patients' biodata and variables such as number of critical lesion and total lesions were documented. Zero was taken as <50% stenosis and was considered as normal coronaries. Critical lesion was termed as ≥70% stenosis involving proximal part of any of the three main coronary arteries or ≥50% of Left Main Stem (LMS) stenosis. Total Occlusion was considered if there was 100% stenosis with no antegrade flow of contrast distal to the lesion. Other variables associated with CHA_2DS_2-VASc-HSF score were also noted. The Gensini score, a tool for assessing severity of CAD was calculated by an experienced consultant cardiologist blinded to clinical details, by assessing each angiography report indivi-dually. Subsequently, the patients were categorized into three sets based on the tertiles of Gensini score: 1st tertile (Gensini score<11 points; Mild CAD), 2nd tertile (Gensini score 11-38 points; moderate CAD), 3rd tertile (Gensini score >38 points; severe CAD), depicting increase in CAD extent with increase in Gensini score.[8]

The statistical analysis was done utilizing IBM Statistical Package for the Social Sciences (SPSS) version-28:00. Quantitative variables were presented as mean along with its standard deviation (SD), while qualitative variables were depicted using frequency and percentages. The Chi-square test was utilized to analyze qualitative variables. Correlation analysis was employed to evaluate correlation between CHA_2DS_2-VASc-HSF score and Gensini score. One-way ANOVA was applied to compare numerical variables against categorical (polychotomous) variables. $p<0.05$ was taken as statistically significant.

RESULTS

A total of one hundred and forty seven patients with NSTEMI who underwent PCI were studied and data was managed and analyzed to evaluate the pa-tients' demographics, comorbid, risk assessment scoring. Table-I depicted the prevalence of key qualita-tive values representing risk factors and comorbidities among the study participants with NSTEMI. The data revealed that Diabetes Mellitus (DM) was present in 82(55.7%) patients followed by Hypertension (HTN) 78(53.1%) and hyperlipidemia 65(44.2%). Additionally, Congestive Heart Failure (CHF) was observed in 50(34.0%) patients, while a positive family history of CAD and cigarette smoking were reported in 50(34.0%) and 49(33.3%) patients, respectively. These findings highlighted the significant prevalence of these

risk factors and comorbidities in NSTEMI patients, underscoring their importance in the assessment and management of this condition.

Table-I: Baseline Features of the Study Participants (n=147)

Clinical History	Frequency(%)
CHF	50(34.0%)
HTN	78(53.1%)
DM	82(55.8%)
History of CVA	7(4.7%)
Vascular Disease	48(32.6%)
Hyperlipidemia	65(44.2%)
Smoker	49(33.3%)
Family history of CAD	50(34.0%)

CHF=Congestive Heart Failure; HTN=Hypertension; DM=Diabetes Mellitus; CAD=Coronary Artery Disease; CVA=Cerebrovascular accident

showed that maximum of the study participants were males 104(70.7%). It was observed that with increasing age, severity of CAD significantly increases and EF reduces with CAD severity (p=0.013). Moreover, a rising disease burden as indicated by number of diseased, critical and total vessels was associated with higher Gensini score, consequently increased severity of CAD (p<0.001) (Table-II).

Mean difference of CHA_2DS_2 (p<0.001), CHA_2DS_2-VASc (p<0.001) and CHA_2DS_2-VASc-HSF (p<0.001), among Gensini scoring group varied significantly. Therefore, these findings underscored the significance of utilizing these risk evaluation instruments to

Table-II: Demographic and Angiographic Features of the Study Participants (n=147)

Variables		Gensini Score			*p*-value
		Mild CAD (Total=16) Frequency(%)	Moderate CAD (Total=26) Frequency(%)	Severe CAD (Total=105) Frequency(%)	
Gender	Male	11(10.6%)	14(13.5%)	79(76.0%)	0.09
	Female	5(11.6%)	12(27.9%)	26(60.5%)	
Age (years); (Mean±SD)		46.50±16.8	63.31±9.81	65.16±10.86	-
Ejection Fraction(%) (Mean±SD)		54.69±8.46	50.19±11.44	46.90±10.27	0.013
Number of Diseased Vessels	0*	11(68.8%)	2(7.7%)	-	-
	1	4(25.0%)	9(34.7%)	16(15.2%)	<0.001
	2	1(6.3%)	12(46.2%)	17(21.0%)	
	3	-	3(2.5%)	60(57.1%)	
	4	-	-	7(6.7%)	
Number of Critical Lesions*	0*	16(100.0%)	12(46.2%)	30(28.6%)	<0.001
	1	-	14(53.8%)	46(43.8%)	
	2	-	-	19(18.1%)	
	3	-	-	8(7.6%)	
	4	-	-	2(1.9%)	
Number of Total Lesions*	0*	16(100.0%)	25(96.2%)	54(51.4%)	<0.001
	1	-	1(0.8%)	40(38.1%)	
	2	-	-	10(9.5%)	
	3	-	-	1(1.0%)	

**0=<50% stenosis, **Critical lesion= ≥70% stenosis involving proximal part of any of the three main coronary arteries or ≥50% of Left Main Stem stenosis, ***Total Occlusion= 100% stenosis with no antegrade flow of contrast distal to the lesion*

Table-III: Relationship between CHADS-scoring with CAD severity as assessed by Gensini score (n=147)

Variables	Gensini Score			Correlation Coefficient (r)	*p*-value
	<11 points (Mild CAD) (Total=16)	11-38 points (Moderate CAD) (Total=20)	>38 points (Severe CAD) (Total=105)		
CHADS2 Score (Mean±SD)	0.56±0.96	1.70±1.23	1.77±1.09	0.248	<0.001
CHA2DS2-VASc (Mean±SD)	1.06±1.73	3.00±1.70	2.76±1.52	0.160	<0.001
CHA2DS2-VASc-HSF (Mean±SD)	2.38±.80	4.12±1.58	4.40±1.48	0.422*	<0.001

Study participants were classified into 3 tertiles of Gensini score: 1st tertile (Gensini score <11 points, mild CAD; n=16), 2nd tertile (Gensini score 11-38 points, moderate CAD; n=26), 3rd tertile (Gensini score >38 points, severe CAD; n=105). Findings in Table-II anticipate the degree of CAD severity among patients with NSTEMI. Mean values of CHADS-scoring increased with increasing Gensini score predicting increased severity of CAD. There was moderate correlation between CAD severity assessed by Gensini

score and CHA_2DS_2-VASc-HSF score (r=0.422, p<0.001), indicating that as the CHA_2DS_2-VASc-HSF score increased, the severity and extent of CAD, as measured by the Gensini score, also tended to increase. This highlights the potential of the CHA_2DS_2-VASc-HSF score as a valuable predictor of CAD presence and severity in patients having NSTEMI (Table-III).

DISCUSSION

Myocardial Infarction (MI) represents a significant global burden, contributing substantially to mortality rates. It is noteworthy that majority of the cardiovascular disease-related deaths occur in developing countries. As per the implications for prognosis of MI patients, there is a compelling need to identify a straightforward, cost-effective, yet precise marker that can aid in predicting patients' outcomes accurately.[11]

Managing CAD involves categorizing individuals based upon their risk profile and preventing them through modification of these risk factors. $CHADS_2$ and CHA_2DS_2-VASc scores are helpful in evaluating thromboembolic risk in non-valvular Atrial Fibrillation (AF). Given the shared risk factors with CAD, these scores could potentially contribute to the evaluation of coronary artery lesion severity. To enhance CAD severity determination, the CHA_2DS_2-VASc-HSF score has been formulated which includes male sex, hyperlipidemia, family history, and smoking, in addition to the CHA_2DS_2-VASc score components.[12] GENSINI is a well-validated angiographic tool for classifying the anatomic severity and extent of CAD.[13-15]

There was a moderate positive correlation between CHA_2DS_2-VASc-HSF score and extent and severity of CAD marked by Gensini score (r=0.422; p<.001).Our findings align with previous studies that have examined the utility of the CHA_2DS_2-VASc-HSF score in evaluating the extent of CAD. For instance, a study conducted by Al Farabi MJ *et al.*, exhibited a moderate to strong positive correlation (r=0.612, p=0.001) between the CHA_2DS_2-VASc-HSF score and CAD severity in patients having stable Coronary Artery Disease.[16] Another study conducted by Sc AAM *et al.*, also demonstrated a positive correlation (r=0.4811; p<0.01) between the CHA_2DS_2-VASc-HSF score and the extent of coronary artery stenosis in a sample of patients having stable angina.[17] Similarly, a study conducted by Andriando A *et al*. observed a significant relationship (r=0.612, $p\leq$ 0.001) between the CHA_2DS_2-VASc-HSF score and the presence of multivessel disease in patients with ACS.[18] These consistent results across different patient populations enhance the generalizability and reliability of current study's findings. The consistent positive correlations observed in these studies, along with our own findings, highlighted the potential clinical use of the CHA_2DS_2-VASc-HSF score as an adjunctive tool for assessing the severity of CAD in different patient populations.

Nevertheless, it is crucial to acknowledge that certain studies have presented contradictory outcomes concerning the link between the CHA_2DS_2-VASc-HSF score and the severity of CAD. `For instance, a study conducted by Al-shorbagy AN *et al.*, found no significant correlation between the CHA_2DS_2-VASc-HSF score and the extent of CAD in Acute Myocardial Infarction patients.[19] These conflicting results may be attributed to differences in sample characteristics, study designs or the definition and assessment of CAD severity and extent.

LIMITATIONS OF STUDY

The research was carried out within a solitary center, which could potentially introduce selection bias and restrain the applicability of the findings to larger population. The cross-sectional nature of our study prevents us from establishing a cause-and-effect association between the CHA_2DS_2-VASc-HSF score and the CAD severity. Future studies with larger, multi-center cohorts are recommended to validate our findings.

Conducting longitudinal studies with subsequent follow-up evaluations would offer stronger evidence concerning the prognostic significance of CHA_2DS_2-VASc-HSF in forecasting outcomes and directing therapeutic interventions for patients with NSTEMI.

CONCLUSION

This research investigation identified a notable correlation between the CHA_2DS_2-VASc-HSF score and extent of CAD among patients with NSTEMI. The CHA_2DS_2-VASc-HSF score exhibited superior predictive capability for CAD severity compared to both CHA_2DS_2 and CHA_2DS_2-VASc scores. These findings support the potential clinical utility of the CHA_2DS_2-VASc-HSF as an adjunctive tool for risk stratification in CAD, hence enabling for early referral by primary care physicians to the cardiologist.

ACKNOWLEDGEMENT

I am deeply grateful to my supervisor for his guidance, patience and support who provided insight and expertise that greatly assisted my research project. I also want to share my gratitude for Comdt Exec Dir AFIC/NIHD and R&D dept for their support and contribution in completion of the research paper.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript:

FKT, MS & SP: Study design, Drafting the manuscript, Data interpretation, Critical review, Approval of the final version to be published.

MA & IAK: Data acquisition, Data analysis, Approval of the final version to be published.

JK & SKS: Critical review, Study concept, Approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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