Detection of Adverse Cardiac Events in Patients with Acute Myocardial Infarction

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ABSTRACT

Background: Myocardial infarction (MI) has an annual incidence rate of 600 occurrences per 100,000 people and affects over 1.5 million people. This study aimed to assess the major adverse cardiac events (MACE) in patients presenting with acute myocardial infarction (AMI). **Patients and methods:** A cohort study involved 180 patients with acute myocardial infarction attended to the coronary care unit at Department of Cardiology Zagazig University Hospitals and National Heart Institute. Patients were divided into: Group I: 155 patients with no MACE and Group II: 25 patients with MACE. All patients were subjected to full history taking, clinical examination and laboratory investigation. CHADS-VASc and GRACE scores were performed. **Results:** The mean age of the current study population was 56.2 (SD 9.9) years, 76.7% of them were males. The mean BMI was 27.9 (SD 3.1) kg/m^2. About 56.1% of patients were smokers and 45% were hypertensives. CHADs-VASc score of the current study patients was ranging from 0 to 4. The mean GRACE score was 135 (SD 23) ranging from 64 to 187. GRACE score was 0-108 in 12.8%, 109-140 in 50.6% and > 140 in 36.7% of the studied patients. Death occurred in 3.3% of patients. Among the current study patients 2.2%, 2.2%, 3.3% and 3.9% had stroke, stent thrombosis, MI and heart failure, respectively.

Conclusion: CHA2DS2-VASc and GRACE scores are simple and easily calculated scores that provides an additional consideration in predicting of MACE in patients with AMI.

Keywords: MACE, CHA2DS2-VASc Score, MI, GRACE Score, Zagazig University Hospitals, National Heart Institute.

INTRODUCTION

Nearly a quarter of the general population has one or more risk factors for heart disease. The majority of heart disease risk factors are connected to lifestyle and environmental variables, and many of the major cardiovascular diseases (CVD) risk factors are changeable through particular preventative actions. Extensive clinical and statistical research has revealed various risk factors for acute myocardial infarction (AMI) and heart attack [(1)].

Several risk factors have been recognized by the American Heart Association (AHA). Some factors are unchangeable. They include becoming older, being male, and having a family history of early coronary arterial disease (CAD). A person's lifestyle is another risk factor that may be adjusted, treated, or regulated to lower risk. High cholesterol, high blood pressure, smoking, a high-fat diet, physical inactivity, and obesity are among these risk factors [(2)]. Men over the age of 45 and women over the age of 55 are at a higher risk of AMI [(3)]. A family history of premature illness is a substantial independent risk factor for AMI, especially among younger people [(4)].

Significant adverse cardiac events sudden cardiac death (SCD) occurring from an AMI is the outcome of a chain of events beginning with the formation of the atherosclerotic plaque and concluding with the final event of an untreated fatal arrhythmia caused by abrupt ischemia [(5)]. Ischemic, mechanical, arrhythmic, embolic, and inflammatory abnormalities are among the complications of AMI [(6)].

Cardiogenic shock is a medical disease wherein heart failure leads to insufficient tissue perfusion. Despite having acceptable filling pressures, it is characterized by a decrease in cardiac output. Cardiogenic shock is commonly defined by the following criteria: PCWP > 15 mm Hg, Cardiac index 2.2 L/min/kg/m2, SBP 90 mm Hg for at least 30 minutes, or requirement for vasopressor or IABP to maintain SBP > 90 mm Hg [(7)].

Always lethal is left ventricular (LV) free wall rupture; non-fatal cases are typically brought on by pericardial adhesions already present (e.g. after cardiac surgery). The primary cause of death is immediate pericardial tamponade. Within the first five days following a MI, free wall rupture occurs in 50% of cases, and in more than 90% of cases, it does so within two weeks [(8)]. The posteromedial papillary muscle-involved inferior infarction commonly has the side effect of acute mitral regurgitation. It may be caused by a chordal rupture, a full or partial rupture of the papillary muscle, its malfunction, or LV dilatation. If a patient presents with moderate to severe or severe cardiogenic shock and is not promptly diagnosed and surgically treated, they are considered clinically significant [(9, 10)].

Patients with a substantial anterior ST-elevation myocardial infarction and anteroapical aneurysm development are more likely to have left ventricular thrombus. These infarcts often develop in the area of the left anterior descending coronary artery. Large sections of the LV muscle in these anteroapical infarcts are weakly contracting, and the intracavitary blood flow next to them is slower than it is in healthy parts [(11)]. Therefore, this study aimed to assess the major adverse cardiac events (MACE) within 6months in patients presenting with AMI.

PATIENTS AND METHODS

A cohort study involved 180 patients with AMI attended to the coronary care unit at Department of

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Cardiology Zagazig University Hospitals and National Heart Institute, from November 2020 to April 2021. According to occurrence of MACE, the patients were divided into two groups (group I: No MACE included 155 patients and group II: MACE included 25 patients).
Inclusion and exclusion criteria: Patients were presented with AMI [either ST-elevated myocardial infarction (STEMI) or NSTEMI] in age more than 18 years' old. While, patients with an active/chronic inflammatory disorder, unstable angina, history of coronary revascularization before trial entries were excluded.

Clinical Assessment:
All patients were subjected to full history taking, clinical examination and laboratory investigation. A detailed medical and cardiac history including cardiovascular risk factors including history of smoking: patients considered as smoker if they were using smoke in every rate. Hypertension diagnosed and /or treated with medications, diet and/or exercise. Hypertension was defined as elevated systolic blood pressure ≥ 140 mmHg, and/or elevated diastolic blood pressure ≥90 mmHg [(11)]. Diabetes Mellitus (DM) was diagnosed on basis of previous history of diabetes treated with or without medical therapy (Fasting blood sugar126 mg% or 2 hours post prandial blood sugar ≥ 200 mg%). Dyslipidaemia: Hypercholesterolemia was defined as cholesterol level >200 mg/dL and TG level >150 mg/dL or patients who were advised to use cholesterol / triglyceride- lowering drugs by their physician.

Electrocardiogram (ECG): was done on admission at a paper speed of 25mm/s and amplification of 10mm/mv.
CHA2DS2-VASc score: calculated for each patient on admission according to their demographic and echocardiographic characteristics.
The GRACE score: includes age as well as clinical (heart rate, systolic blood pressure, ST segment deviation, Killip class, and cardiac arrest) and laboratory (creatinine and cardiac biomarkers) parameters assessed at presentation to the hospital. It divides ACS patients into 3 risk groups: high (≥140), intermediate (110 to 139) and low (<110).

MACE Follow up:
1. **Death:** Sudden cardiac death (SCD) resulting from AMI is the result of a chain of events beginning with the development of the atherosclerotic plaque and ending with the terminal event of an untreated lethal arrhythmia provoked by sudden ischemia.
2. **Ischemic stroke:** is infrequent yet one of the most feared complications of acute myocardial infarction. Ischemic stroke burdens 0.9% of MI patients within 1 month and 3.7% within a year after an acute MI with a doubled 1-year mortality compared with those not complicated with stroke.
3. **Stent thrombosis:** is a thrombotic occlusion of a coronary stent. This is usually an acute process in contrast to restenosis, which is a gradual narrowing of the stent lumen due to neointimal proliferation.
4. **Myocardial infarction:** Recurrent MI or reinfarction is defined as recurrence of clinical signs and symptoms of ischemia in patients with previously diagnosed MI, with accompanying electrocardiographic changes and raised serum biomarker levels consistent with myocardial necrosis. Reinfarction is one of the major causes of morbidity and mortality in patients with known cardiac disease.
5. **Heart failure:** The term ischemic cardiomyopathy has been used to describe significantly impaired left ventricular ejection fraction [LVEF] ≤35 to 40 %) that results from coronary artery disease.

Ethical Consideration:
An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Written informed consent of all the participants was obtained. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis
Statistical analysis analyzed using Statistics version 26 (IBM© Corp., Armonk, NY) and MedCalc® Statistical Software version 20. The type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD. The values of CHADS-VASc or GRACE score were used for prediction of MACE. P value was set at ≤0.05 for significant results and <0.01 for high significant result.

RESULTS
The present study showed the mean age of the current study population was 56.2 (SD 9.9) years ranging from 26 to 74 years, 76.7% of them were males while 22.3% were females. The mean BMI was 27.9 (SD 3.1) kg/m2. 56.1% of patients were smokers. 45.0% of the patients were hypertensive. DM and hyperlipidemia were detected in 40.0% and 50.3% of the patients, respectively. STEMI was detected in 69.4% of the patients **(Table 1)**.

Table (1): Characteristics of the studied patients.

Variable	Value
Age (years), mean ± SD (range)	56.2 ± 9.9 (26.0 to 74.0)
Sex, F/M	42/ 138
BMI (kg/m^2), mean ± SD (range)	27.9 ± 3.1 (19.5 to 36.0)
Smoking, n (%)	101 (56.1%)
Hypertension, n (%)	81 (45.0%)
DM, n (%)	72 (40.0%)
Hyperlipidemia, n (%)	90 (50.3%)
STEMI, n (%)	125 (69.4%)

SD = standard deviation, n = number.

The median CB-MB was 82.0 ng/ml (ranged from 42.0 to 118.0ng/ml). The median ALT and AST was 40 IU/l and 91.3 IU/l, respectively. The mean Creatinine level was 1.05 mg/dl, ranging from 0.80 to 1.30 **(Table 2)**.

Table (2): Results of biochemical work up in the studied patients.

Variable	Value
CB-MB (ng/ml), mean ± SD	82.0 ± 18.21
ALT (IU/l), mean ± SD	40.0 ± 4.61
AST (IU/l), mean ± SD	91.3 ± 22.31
Creatinine (mg/dl), mean ± SD	1.05 ± 0.15

CHADs-VASc score of the current study patients had a median of 2 (ranged from 0 to 4). The mean GRACE score was 135 (SD 23), ranging from 64 to 187. GRACE score was 0-108, 109-140 and > 140 in 12.8%, 50.6% and 36.7%, of the study patients, respectively **(Table 3)**.

Table (3): CHADs-VASc and GRACE scores in the studied patients.

Variable	Value
CHADs-VASc score, median (range)	2 (0 to 4)
GRACE score, mean ± SD (range)	135 ± 23 (64 to 187)
GRACE score 0-108, n (%) 109-140, n (%) ≥141, n (%)	 23 (12.8%) 91 (50.6%) 66 (36.7%)

SD = standard deviation, n = number.

MACEs were investigated and represented in table 4. Death occurred in 3.3% of patients. Among the current study patients 2.2%, 2.2%, 3.3% and 3.9% had Stroke, stent thrombosis, myocardial infarction and heart failure, respectively with total 25 patients that happened to have any MACE (13.9% of study population) **(Table 4)**.

Table (4): Incidence of MACE in the studied patients.

Variable	Value
Death, n (%)	6 (3.3%)
Stroke, n (%)	4 (2.2%)
Stent thrombosis, n (%)	4 (2.2%)
Myocardial infarction, n (%)	6 (3.3%)
Heart failure, n (%)	7 (3.9%)
Any MACE, n (%)	25 (13.9%)

There was a statistically significant association between CHADS-VASc score and occurrence of MACE. There was a statistically significant association between CHADS-VASc score and occurrence of MACE. Moreover, there was a statistically significant association between the combined CHA2DS2-VASc and GRACE score and occurrence of MACE (P <0.0001) **(Table 5)**.

Table (5): Receiver-operating characteristic (ROC) curve analysis for prediction of MACE using the CHADS-VASc score, GRACE score or both scores combined.

ROC parameter	Predictor		
	CHADS-VASc score	GRACE Score	CHADS-VASc score + GRACE Score
AUC	**0.794**	**0.791**	0.872
95% CI	**0.727 to 0.850**	**0.724 to 0.848**	0.814 to 0.917
z statistic	**6.893**	**7.138**	10.316
p-value	**<0.0001**	**<0.0001**	<0.0001
Youden index J	**0.50**	**0.48**	0.64
Best cutoff criterion	**>1**	**>137**	Combined
Sensitivity	**84%**	**92%**	92%
Specificity	66%	56%	72%

AUC: area under the ROC curve, SE: standard error, 95% CI: 95% confidence interval, Youde index (J): [sensitivity + specificity] -1.

DISCUSSION

A technique that quantifies risk and the likelihood that a patient may experience a further ischemia or fatal event in the near future is the Global Registry of Acute Coronary Events (GRACE) score [(12)].

The CHA2DS2-VASc score (congestive heart failure [CHF]; hypertension; age ≥75 years [doubled]; type 2 diabetes; previous stroke or transient ischemic attack [doubled]; vascular disease; age 65–74 years; and sex [female] category) has been originally recommended for the assessment of the risk of thromboembolic event in patients with atrial fibrillation (AF) [(13)].

In the current study, incidence AMI had male predominance. This comes in agree with **Kabekkodu *et al.* [(14)] and Kundi *et al.* [(15)].** This could be explained by increased incidence of hypertension and percent of smoking among male patients. In contrary to this study, Millet *et al.* reported higher incidence of MI among female patients and it was associated with increased BMI in this group [(16)].

About 56.1% of these study patients were smokers. A study of **Millet *et al.* [(16)]** reported that compared with never smoking, current and former smoking were each associated with an increased risk of AMI in both sexes**.** Similar to this study finding, **Kundi *et al.* [(15)]** found that 44.6% of AMI patients were smokers**.**

In this study, 45.0% of the patients was hypertensives. Meanwhile, compared with normal blood pressure, the risk of MI increased with AHA hypertension stage in both sexes and was consistently higher among women than men in many studies [(16, 17)]. The difference is that the present study had male

predominance, with no control group included to determine whether hypertension is a risk factor or not.

DM and hyperlipidemia were detected in 40.0% and 50.3% of the current study patients, respectively. In contrast **Arnold *et al.*** [18] who conducted a study and it was found that the frequency of DM among AMI patients was only 30%**.** Also, **Anand *et al.*** [19] found that the frequency of DM among AMI patients was 18%**.**

According to the current study results, STEMI was detected in 69.4% of the patients. Similarly, **Chen *et al.*** [20] reported that STEMI occurred in 55.6% of AMI patients**.** According to **Kundi *et al.*** [15] study results STEMI was detected in 50% of patients**.** In a previously conducted study **Anand *et al.*** [19] reported that STEMI was detected in 76% of AMI patients**.**

As regards the CHADs-VASc score of the current study patients was ranging from 0 to 4. Similarly, **Shehata *et al.*** [17] in a previously conducted study found that CHADs-VASc score among acute coronary syndrome was 3.39 (SD 1.22)**.**

Regarding the GRACE score of this study population, it was found that the mean GRACE score was 135 (SD 23) ranging from 64 to 187. In the present study GRACE score was 0-108 in 12.8% of patients, 109-140 in 50.6% and > 140 in 36.7% of the study population. According to **Chen *et al.*** [20] study results the mean GRACE score was higher than that found in the current study. It was 164 (ranging from 134 to 197)**.**

According to **Moady *et al.*** [21] study results, only 14% of ACS patients were classified with high GRACE score (≥140)**.**

MACEs were investigated. Death occurred in 3.3% of patients. Among the current study population 2.2%, 2.2%, 3.3% and 3.9% had stroke, stent thrombosis, myocardial infarction and heart failure, respectively with total 25 patients that happen to have MACE (13.9% of study population). According to **Huang *et al.*** [22] study results, it was reported that MACE occurred in 41.9% of AMI patients which is much higher incidence. Among AMI patients, death occurred in 29.5%. 8.7% had nonfatal myocardial infarction and 3.7% had ischemic stroke. They reported that they had much higher incidence of MACE than other studies in spite of large sample size as his populations had multiple combined risk factors**.**

In the other hand, **Shuvy *et al.*** [23] reported similar results to our findings**. Peng *et al.*** [24] and **Ma *et al.*** [25] reported lesser incidence of MACE (6%).

Our study in agree with **Shuvy *et al.*** [23] revealed a beneficial value of addition of the CHA2DS2-VASc score to the GRACE risk score in ACS patients as it improves risk stratification of patients with low and intermediate GRACE scores and identifies a subgroup of patients with higher short-and long-term mortality rate**.**

CONCLUSION

CHA2DS2-VASc and GRACE scores are simple and easily calculated scores that provides an additional consideration in predicting of MACE in patients with AMI.

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