A COMPARATIVE STUDY OF RISK STRATIFICATION TOOLS FOR CHEST PAIN IN EGYPTIANS EMERGENCY PATIENTS

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ABSTRACT Introduction: Emergency department clinicians have a difficult task identifying which patients to admit and which patients to discharge home. Of the patients presenting to the emergency department for chest pain, 55 to 85 percent do not have a cardiac cause for their symptoms. Of those admitted for chest pain, more than 60 percent do not have acute coronary syndromes. Unnecessary admissions for chest pain in the U.S. alone cost billions of dollars annually. Moreover, the problem of (no monitored bed available) with increasing the length of stay at the emergency department. **Aim:** of the study was improving the management process in patients with Acute Coronary Syndrome and predicts their outcome at the emergency department. **Methods:** The study was carried out among 60 patients presenting with non-traumatic chest pain for which no definitive non-ischemic cause was found. Potentially eligible patients were identified in the ED triage area and assessed for study with follow-up throughout their hospital stays for Major Adverse Cardiac Events (MACE). **Results:** TIMI risk score has the highest predictive performance of all risk stratification tools, as AUG is greatest (0.93); also, it has the highest sensitivity for MACE (96.5%) Goldman risk score has the highest specificity for MACE (60%). The difference between the tools in the predictive ability for MACE was highly significant (p =0.0001). **Conclusion:** The results of this study confirm the value of an integrated approach that involves combined analysis of the clinical history, ECG, troponin levels and early exercise testing in emergency room patients with chest pain.

KEYWORDS: Acute coronary syndrome, chest pain, risk stratification.

INTRODUCTION

Acute coronary syndrome (ACS) refers to a spectrum of conditions compatible with acute myocardial ischemia and infarction due to an abrupt reduction in coronary blood flow. The most common symptom prompting the diagnosis of ACS is chest pain, often radiating to the left arm or angle of the jaw, pressure-like in character, and associated with nausea and sweating. The acute coronary syndrome usually occurs as a result of one of three problems: ST elevation myocardial infarction (30%), non-ST elevation myocardial infarction NSTE-ACS (25%), or unstable angina (38%). The working diagnosis of NSTE-ACS is a rule-out diagnosis based on the ECG, i.e. lack of persistent ST elevation. Biomarkers (troponins) further distinguish NSTE-ACS and unstable angina. Imaging modalities are used to rule out or rule in differential diagnoses. [1]

Risk factors for cardiac disease are elicited during the history. Traditional risk factors for coronary artery disease (CAD) include hypertension, hypercholesterolemia, cigarette smoking, diabetes, peripheral vascular disease, and family history of CAD, Personal

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history of CAD, male gender, and increasing age.[2]

The hallmark of ACS is the sudden imbalance between myocardial oxygen consumption and demand, which is usually the result of coronary artery obstruction through rupture of atheromatous plaque which induces thrombosis. The imbalance may also be caused by other conditions, including excessive myocardial oxygen demand in the setting of a stable flow-limiting lesion; acute coronary insufficiency due to other causes (e.g., vasospastic angina, coronary embolism, and coronary arteritis); and non-coronary causes of myocardial oxygen supply-demand mismatch.[3]

Some patients have a history of stable angina, whereas, in others, ACS is the initial presentation of coronary artery disease (CAD). It is estimated that in the United States, each year >780,000 persons will experience an ACS. Approximately 70% of these will have NSTE-ACS.[4]

Some risk scores have been developed to predict the short outcomes in patients with ACS. The TIMI (Thrombolysis in Myocardial Infarction) risk score for unstable angina/non-ST elevation myocardial infarction (UA/NSTEMI) is a simple semiquantitative score that includes seven variables to predict the 14-day risk of the composite endpoint of death, MI or urgent revascularization. Risk stratification tools are used to predict major incidents and aid the clinicians to prioritise patients for investigations, improve cost-effectiveness while minimising unnecessary treatment complications and reduce unnecessary admissions to inpatient monitored beds, without increasing complications, thereby potentially having a positive impact on access block.[5]

The National Heart Foundation of Australia risk stratification tool (HFA), perhaps the most prominent risk stratification utilised in Australia and Goldman risk score included ECG findings, age, time since symptom onset, prior history of angina or myocardial infarction, and pain characteristics (Table A). Of note, the rule did not include biomarker results. The rule achieved 88% sensitivity and 74% specificity in the validation cohort. [4] Appropriate disposition of emergency department (ED) patients with chest pain are dependent on the clinical evaluation of risk by detailed history, physical examination, serial ECGs, and cardiac enzymes. [6]

So The aim of this study was to compare the predictive performance for major adverse cardiac events (MACE) including acute myocardial infarction, recurrent ischemia requiring urgent revascularization, cardiogenic shock, ventricular arrhythmia requiring emergent intervention or high-grade atrioventricular block requiring treatment, cardiac arrest and all-cause mortality using risk assessment tools from the National Heart Foundation of Australia (HFA), the Goldman risk score and the Thrombolysis in Myocardial Infarction risk score (TIMI RS) within 30 days of ED attendance.

PATIENTS AND METHODS

Research design: This study was conducted at a single centre, cross-sectional prospective, observational study of adults presenting to the emergency department with non-traumatic chest pain.

The site of the study: - The study was carried out in Emergency department of Suez Canal University Hospital.

Inclusion criteria:

1. Age: more than 18 years old.
2. Gender: males& females.

Exclusion criteria:

1. The presence of definitive non-ischemic cause of chest pain.
2. Patients with trauma.
3. Patients with ECG criteria for ST-elevation MI on arrival.
4. Cardiac arrest on arrival to Emergency department.
5. Inability to provide informed consent.

Sample size estimation:

The sample size was calculated using the following equation; $n = \left[\frac{Z\alpha/2}{E}\right]^2 \star P(1-P)$ [7]

Where

n=sample size

$Z\,\alpha/2 = 1.96$ (The critical value that divides the central 95% of the Z distribution from the5% in the tail)

p = Prevalence/proportion of disease = 69% ()

Sn = Sensitivity = 90%

E = Margin of error/width of confidence interval = 10%

So, by calculation, the number of cases is equal to 51 cases. Adding a drop-out rate of 18% gives a total number of 60 patients which is the sample size.

Methods of the study:

All patients included in the study had their cardiac risk determined by each of three methods of risk stratification utilising findings on presentation to the ED (Table A). The HFA and Goldman tools classify patients into risk groups with nominal descriptors (e.g., high, low), while the TIMI risk tool derives a score out of seven through detailed history, physical examination, serial ECGs and cardiac troponins. The primary outcome of interest was MACE within 30 days of ED presentation. MACE components were defined utilising the American College of Cardiology Clinical Data Standards definitions [14] and included:-

a) Acute myocardial infarction (prevalent and incident),

b) Recurrent ischemia requiring urgent revascularization,

c) Cardiogenic shock,

d) Ventricular arrhythmia requiring emergent intervention or

e) High-grade atrioventricular block requiring treatment,

f) Cardiac arrest and all-cause mortality.

Follow-up was undertaken by both phone calls with the patient or employing a structured interview at 72 h 30 days if available.

Data analysis& management

Data collected throughout every patient coded, entered and analysed using Microsoft Excel software. Data import into SPSS (Statistical Package for Social Sciences) software program version 13.0 for analysis. According to the type of data, the following tests used to test differences for significance; Chi-square, t-test. Chi-square test and non-parametric tests used to compare categorical variables. P value will be set at <0.05 for significant results.

Ethical consideration

1. Approval of authority.
2. Agreement of participant without obligation.
3. Confidentiality of data.

Table A Risk stratification tools.

Risk tool	Risk category	Features
HFA (16)	High risk	Presentation with clinical features consistent with ACS and any of: • Repetitive or prolonged (>10 min) ongoing chest pain/discomfort • Elevation of at least one cardiac biomarker (troponin or CK-MB) • Persistent of dynamic ST depression $\geq$ 0.5 mm or new T wave inversion $\geq$ 2 mm • Transient ST segment elevation ($\geq$ 0.5 mm) in more than two contiguous leads • Hemodynamic compromise: systolic BP 1 and/or new onset mitral regurgitation • Sustained ventricular tachycardia or syncope • Left ventricular systolic dysfunction (LVEF <40%) • Prior PCI within 6 months or prior CABG • Presence of known diabetes or chronic kidney disease (eGFR <60 ml/min) with typical symptoms of ACS
	Intermediate risk	Presentation with clinical features consistent with ACS and any of: • Chest pain or discomfort within the past 48 h that occurred at rest or was repetitive or prolonged (but currently resolved) • Age >65 years • Known coronary artery disease: prior MI with LVEF $\geq$ 40% or known coronary lesion >50% stenosis • No high-risk ECG changes • Two or more of: known hypertension, family history, active smoking and hyperlipidemia • Presence of known diabetes or chronic kidney disease (eGFR <60 ml/min) with atypical symptoms of ACS • Prior aspirin use AND NOT meeting the criteria for high-risk NSTEACS
	Low risk	Presentation with clinical features consistent with ACS without intermediate- or high-risk features • Onset of angina symptoms within the last month • Worsening in severity or frequency of angina • Lowering in angina threshold
TIMI RS (19)	1 point for each positive factor	• Age >65 years • Documented prior coronary artery stenosis >50% or prior cardiac catheterization with known disease or PCI or prior CABG or documented prior myocardial infarction • 3 or more conventional cardiac risk factors (hypertension, diabetes, cholesterol elevation, family history of coronary artery disease/MI, history of tobacco use) • Use of aspirin in the preceding 7 days • 2 or more angina events in the past 24 h • ST-segment elevation or depression >1 mm • Elevated cardiac biomarkers
Goldman (6)	Very low risk	No ECG evidence of acute ischemia/MI and none of the following urgent factors: Rales above both lung bases Systolic BP <100 mmHg Unstable IHD (worsening of previously stable angina, new onset of post-infarction angina or angina after a coronary revascularization procedure or pain that was the same as associated with a prior MI)
	Low risk	No ECG evidence of acute ischemia/MI and 1 of above urgent factors
	Moderate risk	No ECG evidence of acute ischemia/MI and 2 or 3of above urgent factors OR ECG evidence of acute ischemia AND 0 or 1 of above urgent factors
	High risk	ECG evidence of AMI alone OR ECG evidence of acute ischemia with 2 or 3 of above urgent factors
Abbreviations: ACS acute coronary syndrome, BP blood pressure, CABG coronary artery bypass graft, CK-MB creatine kinase-MB, ECG electrocardiograph, eGFR estimated glomerular filtration rate, LVEF left ventricular ejection fraction, MI myocardial infarction, NSTEACS non-ST elevation acute coronary syndrome, PCI percutaneous coronary intervention.		

4. Explanation of our project to the participants. Informed consent will be taken from each patient or his relatives before taking any data or doing any intervention.
5. Explanation of the aim in a simple manner to be understood by the common people.
6. The right of the patient to refuse involving in the research and he will have his usual treatment.
7. The right of the participant to withdraw from the study at any time without giving any reason.
8. Results of the study will announce all participants.
9. The right of the patient to have a copy from the informed consent.
10. Signature or fingerprints of the patient or his relatives.
11. The researcher phone number and all possible communicating methods will be identified to the participant.

-The cost of the study was on the researcher 'expenses.

-Some of the investigations were done routinely in the hospital to the patient.

Questionnaire

Number:

Name:

Age:

Sex:

A-Complaint and History of present illness:

- chest pain duration, frequency,
- others sweating, vomiting, tingling, palpitations, dyspnea
- Smoker.
- Co-morbid diseases: D.M, hypertension, chronic kidney disease (CKD), prior PCI, prior CABG
- Family history of IHD

B-Examination:

-Checking vital signs (blood pressure-pulse-respiratory rate-temperature).

-Systemic examination

-Getting or reviewing a 12-lead ECG within 10 minutes and check for ST-segment deviation in contiguous leads in comparison with old ECG if available.

-IV line with laboratory sampling for cardiac enzymes (troponins, CK-MB) and others if needed

B- The general treatment steps as appropriate:-

-Starting oxygen at 4 L/min and maintain oxygen saturation > 90%.

- Giving aspirin (160 to 325 mg).

-Administering nitroglycerin, sublingual, spray, or IV.

- Giving the patient morphine (IV).

-additional according to local policy

D- The processing time:

E-Fate of the patient :(Admission, Discharge, Died)

g) F- Follow up on day 0, three, and 30 of the patient for MACE:

- acute myocardial infarction (prevalent and incident),
- recurrent ischemia requiring urgent revascularisation,
- cardiogenic shock,
- ventricular arrhythmia requiring emergent intervention or
- high-grade atrioventricular block requiring treatment, Cardiac arrest and all-cause mortality

RESULTS

The present study aimed at evaluation of the patients with chest pain using three chest pain scores for a month for major adverse cardiac events. A total of 65 patients with non-traumatic chest pain presented to ER of Suez Canal University Hospital were selected. Eligible patients will be identified in the ED triage area and assessed for study inclusion by the attending clinician.

Table 1 shows the demographic parameters of the sample, the mean age of the sample was 55 years old, the majority of the sample were males with 70.8% frequency, and 72.3% of the sample were married.

Table 1 showing demographic characteristics. (n=65)

Age (Years)	Mean±SD	55±13.5
	Range	25– 81
Gender	Male	46 (70.8%)
	Female	19(29.2%)
Marital Status	Single	7 (10.8%)
	Married	47 (72.3%)
	Divorced	3 (4.6%)
	Widowed	8(12.3%)

Table 2 shows the Prevalence of MACE in our study was 43.1% (28 patients). Nine patients out of the 28 had multiple major events. Myocardial Infarction was the most frequent major event (20%)

Table 3 shows risk factors for major events, the most prevalent risk factor was smoking (56.9%). Patient with history ischemic heart disease had the highest risk for MACE (OR=7.3).

Table 4 shows the distribution of main ECG changes and cardiac biomarkers in the sample, T wave inversion was 43.1%. Cardiac biomarkers elevation has the same risk.

Table 5 shows the mean duration of chest pain was 15 minutes, 43% of patients had two attacks of chest pain. The mean time from the start of chest pain to reach ER was 15.2 hours.

Table 6 shows that dyspnea or shortness of breath is the most common associated symptom in 29 patients 44.6%, while other symptoms were equal ratio 16% to 20%

Table 7 show Systolic Blood pressure ranges from 80 to 190 mmHg with mean 126 mmHg. Mean heart rate was 83beast/min.

Roc curve with table 8 showed that TIMI risk score has the highest predictive performance of all risk stratification tools, as AUG is greatest (0.93); also, it has the highest sensitivity for MACE (96.5%) Goldman risk score has the highest specificity for MACE (60%). The difference between the tools in the predictive ability for MACE was highly significant (p =0.0001).

Table 9 showed that 44 patients were admitted on the day of presentation with chest pain, 4 of them had MACE (incidence 6%)

Table 10 revealed that After three days of presentation 21 patients (32%) had MACE. 35 patient was discharged free of symptoms and had no MACE while five patients still admitted to medical treatment, the table shows the distribution of type of MACE.

Table 2 Distribution of Major adverse cardiac Events (MACE). (n=65)

MACE	Positive	55±13.5
	Negative	25– 81
Type of MACE	Acute Myocardial Infarction	13 (20%)
	Ischemia Needs Urgent Revascularization	3 (4.6%)
	Cardiogenic shock	4 (6 %)
	Ventricular Arrhythmias	9 (13.8%)
	High-grade A-V block	2 (3%)
	Cardiac Arrest	6(9%)

Table 3 Distribution of Risk Factors for MACE in the Sample

	Frequency	**p-value**	**OR**
Smoking	37 (56.9%)	0.04	2.9
Hypertension	14 (21.5%)	0.07	3.0
Hyperlipidemia	15 (23.1%)	0.016	2.4
Diabetes Mellitus	21 (32.3%)	0.034	3.1
IHD	20 (30.8%)	0.001	7.3
Family history	15 (23.1%)	0.749*	1.2

p-value was calculated using chi-square test.

OR = Odds Ratio. IHD = Ischemic Heart disease.

*=none statistically significant result at 95% confidence interval.

Table 4 ECG and cardiac biomarkers as a predictor for MACE.

	Frequency	**p-value**	**OR**
S-T depression	19 (29.2%)	0.036	3.2
T wave Inversion	28 (43.1%)	0.046	2.7
Troponin (I) Elevation	23 (35.4%)	0.03	3.0
CK-MB Elevation	27 (41.5%)	0.026	3.1

p-value was calculated using chi-square test.

OR = Odds Ratio. IHD = Ischemic Heart disease.

*=none statistically significant result at 95% confidence interval.

Table 11 revealed that After one month of presentation, three patients had MACE

Table 12 revealed that According to this table, the high-risk group of patients had the higher incidence of MACE (60%), only 15% of the low-risk group developed MACE.

Table 13 showed that According to Goldman risk score, the high-risk group of patients had the higher incidence of MACE 88%.while 12% of the very low-risk group experience MACE

DISCUSSION

Our study showed that the demographic parameters of the sample as follows the mean age of the sample was 55 years old, the majority of the sample were males with 70.8% frequency, and 72.3% of the sample were married.

Elbaih AH. et al. (2016) conducted an observational cross-sectional study for six months to evaluate ACS patients management compared to Advanced Cardiac Life Support guidelines with total 94 patients were enrolled in the study and found that males experienced ACS more than females by a percentage 70.2%, 29.8% respectively. Moreover, the median age for the selected sample was 56.04±10.8 years. Moreover, this is matching with our study. [8]

This also closely matches the 2014 AHA/ACC Guidelines which states that the median age at ACS presentation is 68 years (range 56 to 79), and there is male predominance to a female with the ratio is approximately 3:2. Also, Women with suspected ACS are less likely to have obstructive CAD than men. When obstructive CAD is present in women, it tends to be less severe than it is in men.

Concerning risk factors for major events, the most prevalent risk factor was smoking (56.9%). Patient with history ischemic heart disease had the highest risk for MACE (OR=7.3).

Major event occurrence during follow-up about hypertension 65% of studied patients while Major event occurrence during follow-up about DM 34.7%.

Elbaih AH. et al. (2016) states that every Egyptian patient enrolled in this study has at least one or more risk factors. Hypertension and D.M were the highest among STEMI more than 12 hrs. Patients with a percentage of 59% and 51.3% respectively, while smoking was the greatest among STEMI less than 12 hrs. Patients with such a percentage of 66.7% are closely agreed with our study. [9]

Kou-Gi Shyu. et al. (2011) agreed with our study in that hypertension and diabetes mellitus were the commonest risk factors for ACS by a percentage (64.0%) and (36.0%) respectively.[10]

Elbaih AH. et al. (2016) also concluded that mortality was higher in patients with random blood glucose more than 300 mg/dl (68.4%), and for patients had ranged from 250 to 300 mg/dl mortality was (10.5%), and the patients with glucose level range from 200 to 250 mg/dl were (10.5%) which implies the importance of this risk factor as mentioned in our study. [8]

This was in agreement with Chi Yuen et al. (2011) who found that hyperglycemia on admission is a prognostic factor for short and long-term mortality in acute coronary syndromes (ACS) whether the patient has diabetes or not. [11]

Emad Eldin Ismail et al. (2016) found that Diabetes was the most significant predictor that indicates a poorer prognosis for

Table 5 Analysis of chest pain

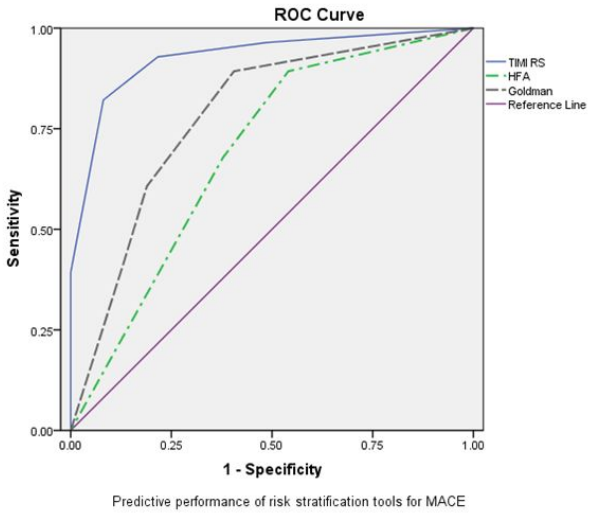
Time from start of pain to reach ER (hours)	Mean	15.2
	Median	6
	Range	1 –72
Duration of pain (minutes)	Mean	15.1
	Median	10
	Range	2 –60
Frequency of attacks	1	18 (27.7%)
	2	28 (43.1%)
	3	16 (24.6%)
	4	3(4.6 %)

Table 6 Associated symptoms with chest pain

Sweating	11 (16.9%)
Nausea/Vomiting	13 (20%)
Syncope	13 (20%)
Dyspnea	29 (44.6%)

Table 7 show hemodynamics of patients on presentation to ER.

Systolic Blood Pressure	Mean ± SD	126 ± 24
	Range	80– 190
Heart Rate	Mean ± SD	83 ± 20
	Range	35– 160



Predictive performance of risk stratification tools for MACE

acute coronary syndrome in patients with diabetes. [12]

The 2014 AHA/ACC Guidelines states that DM, extracardiac arterial disease, hypertension are associated with poorer prognosis in both STEMI and NSTEMI patients. On the contrary to our study Smoking is linked to a lower risk of death in ACS, and this is attributed to that the younger age of smokers with ACS and less severe CAD.

Concerning Prevalence of MACE in our study was 43.1% (28 patients). Nine patients out of the 28 had multiple major events. Myocardial Infarction was the most frequent major event (20%).

I-Ting Tsai et al. (2017) conduct a prospective study that enrolled 1,644 patients with CAD. During a mean follow-up period of 32 months, 558 of the 1,520 patients developed at least one MACE. The incidence of MACE was 36.7% (558 of 1,520 patients) which is similar to our study. [13]

Mohammad Abul Ehsan et al. (2012) conduct a prospective study which was aiming to predict 30 days Major Adverse Cardiac Events (MACE) by using TIMI risk index. Total 279 patients with ACS were included in the study. Of them, 132 were UA/NSTEMI group, and 147 were in STEMI group. Major adverse events of TIMI risk index group was 19.2% in UA/NSTEMI group. In STEMI group major adverse cardiac events of TIMI risk index 24.1%. Increasing TIMI risk index was associated with increased risk of major adverse cardiac events. [14]

Concerning the correlation between ECG and cardiac biomarkers our study showed that distribution of main ECG changes and cardiac biomarkers in the sample, T wave inversion was 43.1%. Cardiac biomarkers elevation has the same risk. Moreover, Major event occurrence during the follow-up about troponin elevation at first visit to ED was 37.9%

Elbaih AH. et al. (2016) agrees that the high level of cardiac enzymes on admission is a strong risk factor for worse outcome in all patients admitted with ACS. There is highly statically significant different "<0.042" on comparing between death in various levels of cardiac biomarkers. [8]

This was in agreement with Galla et al. "2013": who found that: CK-MB is a valuable biomarker for myocardial ischemia and a good predictor of bad prognosis. [15]

Mokhtari A et al.(2016) conclude that A single negative cardiac troponin result at ED presentation when combined with a non-ischemic ECG result and a non-high risk history identified 29% of chest pain patients at a very low risk of 30-day major adverse cardiac events.[16]

Emad Eldin Ismail et al. (2016) point to that ST-segment depression was an indicator of poor prognosis which was found in 24% of patients and was associated with a higher probability of infarction and major events during follow-up which joining our study at that point.[12]

Concerning Major Events in Each Risk group according to HFA score our study showed that, the high-risk group of patients had the higher incidence of MACE (60%), only 15% of the low-risk group developed MACE. Moreover, for Goldman score our study showed that the high-risk group of patients had the higher incidence of MACE 88%. However, as regards the TIMI risk score our study showed that TIMI score has the highest predictive performance of all risk stratification tools, as AUG is greatest (0.93); also, it has the highest sensitivity for MACE (96.5%) Goldman risk score has the highest specificity for MACE (60%). The difference between the tools in the predictive ability for MACE was highly significant (p = 0.0001). Moreover, this result is supported with Burkett et al. (2014) who enrol Two hundred eighty-one patients in his study. Moreover, concluding that MACE was 14.1%. Area under the curve (AUC) of the HFA, TIMI RS and Goldman tools for the end of MACE was 0.54, 0.71 and 0.67, respectively, The TIMI risk score had the highest AUC of the three tools, with an AUC of 0.71 (95% CI 0.63-0.79), while the Goldman tool had an AUC of 0.67 (95% CI 0.57-0.77). The

Table 8 Comparative performance of risk stratification tools.

	Cutoff Used	Sensitivity% (95%CI)	Sensitivity% (95%CI)	AUC (95% CI)	p value
TIMI RS	TIMI RS≥ 1	96.5% (83– 100)	51% (34– 68)	0.93 (0.86-0.99)	0.001
HFA	All patient with intermediate to high risk	89.3% (72– 98)	46 % (29.5– 63)	0.69 (0.56-0.82)	0.009
Goldman	All patients with low to high risk	89.3% (72– 98)	60% (42– 75)	0.78 (0.67-0.9)	0.001

p-value was calculated using chi-square test. HFA = National Heart Foundation of Australia risk stratification tool. TIMI RS = Thrombolysis in Myocardial infarction risk score. AUC = area under the curve. CI = Confidence Interval.

Table 9 Fate of patients on the first day of presentation (n=65)

Discharge (Free)	21 (32%)		
Admission	44 (68%)		
MACE	4 (6%)	**AMI (PCI)**	2 (3%)
		Arrhythmia (Medical TTT)	2 (3%)

difference between the tools in the predictive ability for MACE was highly significant (p = 0.0002). [17]

Erik P et al. conducted a meta-analysis on the Diagnostic accuracy of the TIMI risk score in patients with chest pain in the emergency department they included prospective cohort studies that validated the TIMI risk score in emergency department patients. They performed a meta-regression to determine whether a linear relation exists between TIMI risk score and the cumulative incidence of cardiac events.10 prospective cohort studies (with a total of 17 265 patients) in the systematic review. Data were available for meta-analysis in 8 of the ten studies. They concluded that the consistent performance of the TIMI risk score in the risk stratification of patients in the emergency department with potential acute coronary syndromes. For every 1000 patients in the lowest risk category (TIMI score of zero), 20 will experience a cardiac event within 30 days of the visit to the emergency department. [18]

Charles V et al. conducted ED-based prospective observational cohort study was conducted in 3,929 adult patients presenting with chest pain syndrome and warranting evaluation with an electrocardiogram. These patients had TIMI risk scores determined at ED presentation the result showed The TIMI risk score at ED presentation successfully risk stratified this unselected cohort of chest pain patients concerning 30-day adverse outcome, with a range from 2.1%, with a score of 0, to 100%, with a score of 7. They concluded that The TIMI risk score might be a useful tool for risk stratification of ED patients with chest pain syndrome. [19]

Betsy L et al. conducted a secondary analysis of a prospective cohort study that enrolled 4743 patients who presented to the ED with potential ACS. Demographics, history, and components of the TIMI, GRACE, and PURSUIT scores were obtained. Follow-up was conducted by structured record review and phone. They concluded that the TIMI risk score had the best discriminatory ability to predict 30-day cardiovascular events. During initial hospitalisation, 28 patients died, 163 patients had AMI, and 155 had revascularization procedures. At 30-day follow-up, a total of 59 patients had died, 172 patients had a nonfatal AMI, and 175 patients had a revascularization. [20]

Elbaih AH et al. concluded that in patients with chest pain, the combination of clinical, electrocardiographic and biochemical data available on admission to the emergency service allows rapid prognostic stratification. Early exercise testing is advisable for the final stratification of low-risk patients. Chart review after 30 days for the composite primary outcome of death, acute myocardial infarction (AMI) or urgent coronary revascularization. A total of 148 (18.6%) patients had a 12-h troponin level above the diagnostic cut-off for AMI; 226 (28.4%) patients had ischemic ECG changes; 527 (66.2%) patients had neither AMI nor ischemic ECG changes. At the 30-day follow-up, death, AMI or the need for reperfusion therapy had occurred in 137 (17.2%). They concluded that the modified TIMI risk score that gives greater weight to ischemic ECG changes and troponin elevations provides superior risk stratification to the original TIMI risk score.[8]

The good use of diagnostic tests should involve evaluation of pre-test probability, and this is relevant to evaluate patients with undifferentiated chest pain in ED. Reliable identification of low risk patients, allow fast tracking and early disposition or progression to further assessment. Risk stratification scores are a proven method of differentiating such low-risk patients. Also scores are generally more wide spread among physicians than using clinical sense alone.

Although the study had some limitations that should be considered on interpreting the results, TIMI risk stratification score seems to be the most appropriate and easily applicable tool for undifferentiated chest pain patients with acceptance of both emergency and cardiology stuff in fast tracking the patients. There is need for validated risk stratification tools for the ED chest pain that examine not only their safety in terms of their sensitivity, but also their flow and efficiency impacts.

Table 10 Fate of patients on the third day of presentation (n=65)

No MACE	40 (61.5%)	**Free (from the start)**	21 (32%)		
		Discharged (Free)	14 (22%)		
		Medical TTT*	5 (7.5%)		
MACE	21 (32%)	**AMI**	7 (10.5%)	**PCI***	5 (7.5%)
				Medical TTT	2 (3%)
		Arrhythmia	4 (6%)	**Defibrillation.**	1 (1.5%)
				Medical TTT	3 (4.5%)
		Death	6 (9%)		
		Ischemia	2 (3%)		
		A-V Block (pacemaker)	2 (3%)		
Medical TTT	4 (6%)				
Medical TTT: medical treatment, PCI: percutaneous coronary intervention.					

Table 11 Fate of patients after one month from presentation (n=59)

No MACE	37 (63.5%)	**Free (from before)**	35 (59%)
		Discharged (Free)	2 (3%)
MACE	3 (4.5%)	**AMI (Medical TTT)**	2 (3%)
		Ischemia (PCI)	1 (1.5%)
Medical TTT	19 (32%)		

Summary

Chest pain is a common complaint being faced in ED. It can be caused by several life-threatening causes such as ACS, aortic dissection, tension pneumothorax, pulmonary embolism, and oesophagal rupture beside other benign causes, so Quick and accurate risk stratification of patients with chest pain in the ED is essential to avoid patients come to harm soon after discharge.

Acute coronary syndrome (ACS) refers to a spectrum of conditions compatible with acute myocardial ischemia and infarction due to an abrupt reduction in coronary blood flow usually present with chest pain. ACS Accounts for around 10% of annual ED visits, and up to 25% of hospital admissions.

ACS includes unstable angina, non-ST elevation myocardial infarction NSTE-ACS, and ST-elevation myocardial infarction STE-ACS.

The pathophysiology mechanism of ACS is atherosclerosis which may progress rapidly into total occlusion through plaque disruption or plaque haemorrhage.

History is taking including detailed analysis of chest pain pattern, associated symptoms, particular risk factors such as DM, hypertension, hyperlipidemia, tobacco smoking, previous coronary artery disease, illicit drugs and family history.

The structured physical examination which is sometimes not conclusive nor specific for ACS, 12 leads ECG is mandatory and should be done and interpreted before 10 minutes from the patient arrival, but sometimes it is normal or non-conclusive with non-specific changes.

Most significant cardiac enzymes which are cardiac troponins and CK-MB which may be elevated due to extracardiac causes as renal failure and sepsis.CK-MB was advocated to diagnose reinfarction, but now troponin has subsumed that rule (>20% increase in the value of the second sample.

Other tests include chest radiology; stress ECG, Echocardiography, cardiac imaging, and other necessities that should be obtained in suspected in suspected cases. First aid for suspected ischemic chest pain includes chewing aspirin, which reduces the mortality in these situations, Nitrates unless contraindicated, oxygen, an opioid analgesic.

Different risk scoring systems facilitate the decision-making. They are developed on statistical analysis of variables collected in observational studies. They are focusing on identification of high-risk patients.

In this study, there is a comparison between three chest pain scores Thrombolysis in myocardial infarction risk score (TIMI RS), National Heart Foundation of Australia (NHF of Australia), and Goldman risk score.

This study was designed to compare the predictive performance for Major Adverse Cardiac Events (MACE) including AMI; recurrent ischemia requires urgent vascularization, cardiogenic shock, ventricular arrhythmia requiring emergent intervention, high-grade AV block requiring intervention, and all-cause mortality using risk assessment tools within 30 days of attendance after fulfilling the ethical aspects.

The result is that there is a statistically significant difference regarding gender where males affected more than females with mean age of 55 years. Twenty-eight patients are suffering from

Table 12 Major Events in Each Risk group according to HFA score (n=65)

HFA Group	Patients	Major Adverse Cardiac Events		
		Event	Patient No.	Patients (%)
Low Risk	20 (30.7%)	AMI	1	15%
		Ischemia	1	15%
		Arrhythmia	1	15%
Moderate Risk	12 (18.3%)	AMI	5	58%
		Arrhythmia	2	58%
		A-V block	1	58%
High Risk	33 (51%)	AMI	7	60%
		Ischemia	2	60%
		Arrhythmia	6	60%
		Cardiogenic shock	4	60%
		A-V block	1	60%
		Arrest	6	60%

Table 13 Major Events in Each Risk group according to Goldman score (n=65)

HFA Group	Patients	Major Adverse Cardiac Events		
		Event	Patient No.	Patients (%)
Very Low Risk	25 (38.4%)	AMI	1	12%
		Ischemia	1	12%
		Arrhythmia	1	12%
Low Risk	16 (24.6%)	AMI	4	50%
		Ischemia	2	50%
		Arrhythmia	2	50%
Moderate Risk	7 (11%)	AMI	2	57%
		Arrhythmia	2	57%
		Arrest	1	57%
High Risk	17 (26%)	AMI	6	88%
		Arrhythmia	4	88%
		Cardiogenic shock	4	88%
		A-V block	2	88%
		Arrest	5	88%

MACE.

Forty-four patients were admitted on the day of presentation,4 of them experience MACE. After three days 21 patients (32%) had MACE. After one month, 3patients had MACE. Moreover, TIMI risk score (with cut off more than or equal to 1) has the highest predictive performance of all tools as AUC 0.93.

Limitations of the study

The present study had exposed to some obstacles such as 1) some patients refused to participate in this study others were difficult to reach for follow-up, 2) Some ER physicians knew about this study, 3) This study was performed in one center (Emergency Department of Suez Canal University Hospital), 4) Unavailability of specialized equipment all the day long such as PCI, 5) Some ACS patients shifted between physicians in the ER.

CONCLUSION

The results of this study confirm the value of an integrated approach that involves combined analysis of the clinical history, ECG, troponin levels and early exercise testing in emergency room patients with chest pain. Accurate diagnosis of ACS is lifesaving and requires a careful assessment of both the patient's history, physical examination, 12-lead ECG, and cardiac biomarker assays. Age 55 years or older, diabetes mellitus, a history of ischemic heart disease, ST-segment depression and troponin elevation were markers of a poor prognosis. The summation of these findings, which are easy to obtain in the emergency room, allow effective risk stratification.

RECOMMENDATIONS

To increase health education about risk factors for ischemic heart diseases (especially; modifiable risk factors). To conduct health programs that increase knowledge about early manifestations of coronary diseases and the appropriate first aid. To supply more facilities to hospitals to increase their ability to manage acute and massive complications of coronary diseases. Start using

TIMI RS in all patients with chest pain suspected to be cardiac sound. Perform more researches about risk stratification of chest pain scores till reach ideal one arise that should be accurate and simple.

COMPETING INTERESTS

The authors declare no conflict of interest.

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