Original paper

In-Hospital Mortality Of Acute Coronary Syndrome By Grace Score

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Abstract

Background: Patients with acute coronary syndrome (ACS) are liable to death during their hospitalization or thereafter. The Global Registry of Acute Coronary Events (GRACE) score is a simple tool that can predict mortality

Objective: To develop a risk prediction tool for estimating death in ACS. This may facilitate triage and management of patients with ACS

Design: Cross-sectional study

Setting: Azadi teaching hospital, Coronary Care Unit(CCU)

Patients and methods

400 patients with ACS admitted to CCU from Jan. 2012 to Jan. 2014 , were studied by applying GRACE score which uses readily identifiable clinical parameters like cardiac arrest on admission, age of the patient ,heart rate, systolic blood pressure and heart failure(according to Killip class), laboratory parameters like serum creatinine concentration, elevated cardiac markers, and lastly electrocardiogram(ECG) changes like ST segment elevation.

Results: According this score patients were grouped into low, medium and high risk groups .Out of 400 patients enrolled in the study, 34(8.5%) died during the period of admission, most of them in the medium and large groups

Conclusions This risk prediction tool is an easy method that can provide prediction of in-hospital mortality for ACS patients.

Keyword: ACS, GRACE, Mortality.

Introduction

Patients with ischemic heart disease fall into two large groups: patients with chronic coronary artery disease who most commonly present with stable angina and patients with ACS. These include patients with acute myocardial infarction with ST-segment elevation (STEMI) on their presenting ECG and those with non-ST-segment elevation ACS (NSTE-ACS). The latter include patients with non-ST - segment elevation myocardial infarction (NSTEMI), who, by definition, have evidence of myocyte necrosis, and those with unstable angina (UA), who do not. [1]

Risk stratification is important to predict early mortality and by identifying medium to high risk patients it guides the use of more complex pharmacological and interventional treatment(especially early in-patient coronary angiography)[2], since the magnitude of benefit of intensive therapy correlates with the patient's level of risk [3]

Regulatory authorities such as the National Institute for Health and Clinical Excellence (NICE) and guideline groups (American College of Cardiology/American Heart Association [ACC/AHA] and European Society of Cardiology) recommend treatments according to specific clinical and risk grouping, and trials show that certain benefits may be predominantly or exclusively restricted to higher-risk patients. [4-5]

Numerous risk scores have been developed but only a few of them have been used in practice. The most popular are the Platelet glycoprotein IIb/IIIa in Unstable angina: Receptor Suppression Using Integrilin Therapy (PURSUIT)and Thrombolysis in Myocardial Infarction risk scores (TIMI RS), and the Global Registry of Acute Cardiac Events risk score (GRACE) which was developed from an international registry. The GRACE score considered the most robust among several ACS risk prediction tools [6]

Keith Fox, Professor of Cardiology at the University of Edinburgh, and Professor Joel Gore of the University of Massachusetts established a10-year research programme and the largest multinational study of ACS,the result is the Global Registry of Acute Coronary Events(GRACE).

The study involved more than 100,000 patients in 30 countries ,and in 2011 the score was made available as an application, and it has since been downloaded more than 10,000 times.[7]

Eight independent risk factors combined into a scoring system, consisting of hemodynamic, laboratory, ECG and patient specific findings: Killip class for congestive heart failure, systolic blood pressure at presentation, heart rate at presentation, age, initial creatinine level, cardiac arrest at admission, ST-segment deviation on the index ECG and initial elevated cardiac enzyme & troponin levels[8]

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In-hospital death according to calculation of GRACE score were grouped into three:
Low risk group having <1 % mortality risk (which sums about 100 points)
Medium risk group having 1-9% mortality risk (which sums about 100-175 points)
High risk group having >9% mortality risk (which sums about 175-250 points). [2]

Patients And Methods

Patients with ACS (diagnosed clinically, by ECG and/or cardiac markers) admitted in the CCU of Azadi teaching hospital, through Jan/2012 to Jan /2014, were studied.

Among all patients admitted to the CCU during that period only 400 cases were enrolled in the study, were those receiving standard treatments of medicines in Kirkuk (including thrombolytic therapy in the first 12 hours for STEMI) otherwise those not fulfilling the criteria of diagnosis, or arriving CCU after 12 hours or not receiving the guideline treatment for ACS were not included.

A paper form was prepared by the publisher that included all the eight parameters with point score against each one, it was derived from the standard chart shown below taken from reference textbook. [2]

The first step was filling the form for each patient. After entering data to the form, the points were calculated. Then the points were summed according to the second part of the chart. And lastly we looked up the risk corresponding to total points as shown in figure No.1

Killip class	Points	SBP (mmHg)	Points	Heart rate (beats/min)	Points	Age (years)	Points	Serum creatinine level (µmol/L)	Points	Other risk factors	Points
I	0	≤ 80	58	≤ 50	0	≤ 30	0	0–34	1		
II	20	80–99	53	50–69	3	30–39	8	35–70	4	Cardiac arrest at admission	39
III	39	100–119	43	70–89	9	40–49	25	71–105	7		
IV	59	120–139	34	90–109	15	50–59	41	106–140	10	ST-segment deviation	28
		140–159	24	110–149	24	60–69	58	141–176	13		
		160–199	10	150–199	38	70–79	75	177–353	21	Elevated cardiac enzyme levels	14
		≥ 200	0	≥ 200	46	80–89	91	≥ 353	28		
						≥ 90	100				

Killip class	+	SBP	+	Heart rate	+	Age	+	Creatinine level	+	Cardiac arrest at admission	+	ST-segment deviation	+	Elevated cardiac enzyme levels	=	Total points

Total points	≤ 60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	≤ 250
Probability of in-hospital death (%)	≤ 0.2	0.3	0.4	0.6	0.8	1.1	1.6	2.1	2.9	3.9	5.4	7.3	9.8	13	18	23	29	36	44	≤ 52

Figure 1. Standard GRACE score chart

Since then we made this a routine practice in our hospital CCU and the doctor on duty can easily assess the score for each patient.

Then the results were analyzed.

Although the main aim was for in-hospital mortality prediction, we made use of two other outcomes from the study, one was planning for further intervention (those with medium to high score were asked to have early intervention), and the second it was used as a guide for CCU bed occupancy, as patients with low scores were safely referred to the general ward when CCU beds were fully occupied (since the number of beds are only eight in a governorate serving round >2 million people)

Results

The study population comprised 400 patients. (Male being 312(78%) and 88 cases (22%) were females.

Age ranged between 33-78 years with statistical mean SD 54±10.4 years (Most females, 84 cases were above the age of 50)

Cardiac arrest on admission reported in 12 cases (3%)

Heart rate ranged from 56 to 110 BPM with mean SD 89±16.6 BPM and more than half of cases had a heart rate of more than 100 BPM

Systolic blood pressure ranged from 65 to 180 mmHg with mean SD 101±19.2 mmHg and hypotension (systolic BP <90mmHg) was found in all high risk group patients (48 cases or 12%)

There were significant difference in Age, SBP,HR, and creatinine level between the three groups of the study (Low, Medium, High) according to Grace score as shown in Table (1). ST elevation was found in 276(69%) cases while NSTEMI in 52 cases and UA 72 cases.

Cardiac enzymes & troponin elevated in 328cases (82 %)

Serum creatinine was normal in all cases

Heart failure was as follows

Killp Grade1 in 280 (70%)

Killip Grade 2 in 65 (16.2%)

Killip Grade 3 in 41 (10.2%)
Killip Grade 4 in 14 (3.5%)
According to GRACE risk calculation, our patients were divided into three risk groups:
Low risk patients constituted 269 cases (67.25%)
Medium risk patients constituted 83 cases (20.75%)
High risk patients constituted 48 cases (12%)
To improve the hypothesis that the in-hospital deaths is higher in high risk patient the publisher used Chi square test Table (2), the result showed that there were significant difference in mortality rate between (low, medium, high) risk patients.
The number of in-hospital deaths among the 400 studied, were 34 cases.
2 in the low risk group 6 in the intermediate group and 26 in the high risk group.

By calculation of Confidence interval for proportion of mortality rate in high risk patient,the confidence interval was ±14, the range of true population proportion were 39.9 % to 68.1% with desired confidence interval (95%)
Generally high and intermediate risk patients were those with ST elevation MI , with features of heart failure especially Killip grade 3 and 4,and hypotensive patients.

Discussion

NICE guideline, published in 2010, and guidelines from the European Society of Cardiology, American Heart Association and American College of Cardiology (2012) all recommend that the GRACE risk score is to be used because of its superior performance [8]. We applied the GRACE score to our CCU patients and to our knowledge, this is the first time it is applied in our country (Iraq)

Table 1. Comparison between Age (year), SBP(mmHg), HR (beats /minute and serum creatinine(mg/ml) between the three groups of the study

Parameters	Low Risk patient(269) Mean±SD	Medium risk Patient(83) patientMean±SD	High risk patient(48) Mean±SD	signification	P Value
Age(year)	48.4±8.55	52.71±6.61	64±9.2	Sig. between (1,2) (2,3),(1,3)	<0.0001
SBP (mmHg)	130±5	100±5	75±10	Sig. between (1,2) (2,3),(1,3)	<0.0001
Heart rate(BPM)	90±20	88±17.9	90±14.6	NS (1,2),(2,3) Sig (1,3)	<0.001
Serum creatinine mg/ml	12.3±20	14.2±8.2	16.1±7.9	NS (1,2),(2,3),(3,1)	

(1=low risk patient, 2= medium risk patient, 3= high risk patient)

Table 2. Comparison between the three groups of the study in mortality rate.

Mortality	Low risk patient	Medium risk patient	High risk patient	Total	Chi X²
Yes	2	6	26	34	**The Ch²=149.6 ,the p value <0.0001, the result is significant at p<0.5**
No	267	77	22	366	
	269	83	48	400	

We found most of our patients were lied in the low risk group which outnumber the others by comprising 269 cases (67.25%) while medium risk groups were 83 cases (20.75%) and high risk group constituted 48 cases (12%), in other words, low risk patients comprised nearly two third of cases while non-low risk patients (intermediate and high) comprised one third.

Regarding in-hospital mortality, we found in our study two patients died in low risk group (269) comprising 0.7 %,and this was concordant with the predicted mortality in low risk group according to GRACE score which is less than 1% .

In the intermediate group, we had six cases died in this group (83) comprising a mortality rate of 7.2 % also in the range of the predicted mortality according to GRACE score in which mortality is 1-9 %.

In high risk group, we had twenty six cases died out of 48 in this group, comprising 54% of the cases again going with the predicted risk of GRACE score , which is a mortality rate of >9 %.

GRACE scoring were dependent on 8 risk factors [2], but we found variability in significance of each one, and so we analyzed the significance of the eight factors individually.

1-Regarding history of cardiac arrest, it has been mentioned that cardiac arrest in the setting of an ACS is associated with significant morbidity and mortality, and is associated with higher rates of in-hospital complications and was an independent predictor of in-hospital mortality [10] but we found few cases with history of cardiac arrest (3%) and this factor was statistically not significant in our study.

2-Regarding age, it has been mentioned that age is associated with higher incidence of both ACS-related cardiac ischemic event and complications [3] and this was consistent with our findings: the higher the age, the higher the mortality risk.

3-Regarding heart rate, this factor was not significant in our study as a small proportion had tachycardia. Reviewing the literature we found a study done for significance of tachycardia in acute MI between 2 groups found 25 percent in the group with isolated sinus tachycardia had subsequent urgent complications during the hospitalization compared with 7 percent in the control group [11] and in support of our finding in a statement by Dr. Stephen W. Smith, University of Minnesota mentions that ACS and STEMI generally do not cause tachycardia unless there is cardiogenic shock.[12]

4-Systolic blood pressure constantly affected outcome. We found in our study that hypotension was a consistent finding in all high risk patients. It has been mentioned that the lower the systolic BP, the higher the mortality specially in patients with ST elevation. Also infarction of ≥40% of the LV myocardium usually results in cardiogenic shock and carries a high mortality rate. [13]

5-Features of heart failure especially Killip grade 3 &4 was consistently associated with higher mortality in our study. This was consistent with a study by Philippe Gabriel Steget el[14], who studied13707 patients, and found 1778 patients (13%) had heart failure at hospital admission and that was associated with a marked increase in mortality rates during hospitalization (12.0%)

6-Regarding ST-segment elevation, we found majority of cases of ACS were ST elevation type, and most mortalities (26 cases out of 48) i.e. 54% were within this group. This was explained by the fact that a transmural infarction has more extensive myocardial damage compared to NSTEMI and UA, since patients with STEMI usually have complete occlusion of an epicardial coronary artery[15].

7-Regarding cardiac biomarkers (enzymes and troponins), the presence of serum markers as a variable alone appears to identify the patient as being high risk [3],and an elevated level of troponin correlates with an increased risk of death[16] Our results showed that when

they increased (in both ST elevation and non ST elevation MI), they were associated with higher risks .

8-Lastly regarding serum creatinine, although it is included as a parameter, and although it has been shown that the creatinine level at admission is an independent predictor of in-hospital mortality in patients with ACS [17], but we could not find significant correlation with mortality in our study probably explained by Marenzi G1 et el [18], who found in ACS patients, that it is the daily serum creatinine value and its change pattern are stronger predictors of in-hospital mortality than the initial serum creatinine value only.

In summary we can see that the most significant and important factors were features of heart failure and the presence of hypotension

Next came the type of MI, i.e.ST elevation and so was the elevation of cardiac enzymes and increasing age.

History of cardiac arrest and hear rate on admission were not significantly affecting the score.

The least significant was serum creatinine, it was normal in all our cases and did not score any point in the risk score

Conclusion

1. GRACE score is an important prognostic tool that can be easily applied to each patient admitted with ACS.
2. Among the 8 risk parameters, heart failure and hypotension, alone or in combination were among the most constant two risk factors.
3. As else were, it can be used a guide for intervention therapy
4. In hospitals with limited CCU beds as in ours, it can be used by as guiding rule for referring patients out of CCU to the general ward

Recommendation

1. GRACE score should be applied in every CCU for mortality risk prediction.
2. It can be used to guide patient triage and management across the spectrum of patients with ACS.
3. In -hospitals with limited CCU beds as in ours it can help to set a strategy for bed occupancy.

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