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Canadian Acute Coronary Syndrome (C-ACS) Scores in Assessing Risk of Death during Treatment in Acute Myocardial Infarction Patients at Haji Adam Malik Medan General Hospital

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Abstract:-

Introduction: There are several clinical scores for risk stratification of patients with Acute Myocardial Infarction (AMI) such as the *Global Registry of Acute Coronary Events* (GRACE) score, but it is not simple to use. The C-ACS score is a simple score that only consists of age, Killip class, systolic blood pressure, and heart rate that can easily and quickly predict mortality risk. The aim of this study was to assess the predictive value of the C-ACS score for mortality risk during hospitalization in patients with AMI.

Method: This study is an ambispective cohort study of 112 AMI patients undergoing treatment at Adam Malik General Hospital from July 2020 to December 2020. At the time of admission, the C-ACS scores and GRACE scores were calculated for each patient. The C-ACS score variables are: age (≥75 years); Killip class >1, systolic blood pressure <100 mmHg and heart rate > 100x/minute. Then study subjects were followed during hospitalization to assess the incidence of mortality. Statistical analysis was performed using the mean difference and receiver operating curve (ROC).

Result: There were a total of 112 patients consisting of 89 IMAEST patients, 23 IMANEST patients. The mean age of the patients was 57.25±10,36 years with a mortality rate during hospitalization of 11.6%. Bivariate analysis showed a significant relationship between C-ACS scores and mortality during hospitalization (p = 0.003) with OR value 8.65 (95% CI 2.26- 35.7). The discriminatory performance of the C-ACS score reached an area under curve (AUC) value of 0.816 and the calibration performance showed a value of R^2 = 0.43 with a p-value in the Hosmer Lemeshow test of 0.240. Meanwhile, the GRACE score provides better discrimination and calibration performance with an AUC value of 0.914 and a calibration plot (R^2) = 0.49 with the results of the Hosmer Lemeshow test getting a p value of 0.269.

Conclusion: The C-ACS score is asimple and useful risk stratification for predicting the risk of mortality during hospitalization in patients with AMI.

Keywords:- *C-ACS score, mortality, AMI, MACE, risk stratification.*

I. INTRODUCTION

Cardiovascular disease still ranks first as the highest cause of death in the world, with an estimated 17.9 million people dying each year, and 75% of all cases occur in developing countries, especially in the lower middle class.[1]

One of the cardiovascular emergency problems is acute coronary syndrome (ACS), can occur due to sudden obstruction due to atherosclerosis of the coronary arteries. Acute coronary syndrome (ACS) can cause an irreversible heart muscle necrosis condition, leading to immediate or later death.[2]

Major Cardiovascular Events (MACE) are complications and an undesirable aspect in cardiovascular disease. A study from Taiwan said during the follow-up period with an average of 32 months found that there were 558 out of 1,520 patients with ACS there will be an incidence of MACE.[3] While at the *National Heart Center Harapan Kita*, there were 63.4% who experienced the incidence of MACE and about 36.6% who did not experience MACE in 93 patients treated April to June 2006.[4]

Rapid and accurate risk stratification is required by clinicians for the identification of patients at high risk for the incidence of complications and determining patients who require intensive treatment and early intervention. The two most commonly used scores are the Global Registry in Acute Coronary Events (GRACE) and Thrombolysis in Myocardial Infarction (TIMI).[5]

One scoring system, the Canadian – Acute Coronary Syndrome risk score (C-ACS) is a simple, semi-sanctionative ordinal risk score, which includes variables available at the time of initial contact in the hospital. Unlike many other risk assessment tools, the C-ACS score does not use a calculation tool as in grace risk scores.

A C-ACS score is a quick and simple score used for early risk assessment of acute coronary syndrome patients. Because this risk score is simple and easy to calculate, this risk score can be applied quickly by emergency specialists without further training.[7] Although with ease and practicality, not many medical personnel apply this score to predict MACE. So, in this study, we analyzed the accuracy of C-ACS scores in predicting MACE on SKA.

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II. METHOD

A. Study Population

The study included all patients with a diagnosis of STEMI who were admitted to the H. Adam Malik Medan Hospital starts from July up to December 2020 according to inclusion and exclusion criteria. Subjects who experienced complications of PCI intervention (MI type 4), patients with CKD, patients with COVID-19, patients with incomplete examination data will not be included in the study. The sample were acquired consecutively.

B. C-ACS Score Evaluation

This study was an analytical retrospective study that uses data from medical records. Researchers examined medical records to look at patient data profiles, anamnesis, physical examination, electrocardiography (ECG), blood laboratory results, and major cardiovascular events (MACE). The MACE in this study is one of the following four events; death, acute heart failure, cardiogenic shock, and malignant arrhythmias. The C-ACS score was evaluated by calculation of the age component (≥ 75 years), killip score > 1, blood pressure < 100 mmHg and pulse pressure > 100x / minute. C-ACS score 0 is categorized as low risk of death while C-ACS score ≥ 1 is categorized as high risk of mortality.

C. Statistical Analysis

Statistical analysis of this study will be conducted using the SPSS software program. The data will be presented in numerical and categorical form. Bivariate tests on numerical and categorical variables were performed with an independent t-test on normal-distributing data or a Mann Whitney test when the data was not normally distributed. Bivariate analysis tests between categorical data were conducted with chi-square tests or fisher exact tests. Predictive ability of C-ACS scores and GRACE scores were analyzed with receiver operating characteristic curve (ROC) analysis to get the under the curve (AUC) area of both scoring systems. Sensitivity, specificity, and AUC scores from both scoring systems will be compared. The Hosmer-Lemeshow test was also conducted to assess the fit-to-model aspects of both scoring systems.

III. RESULTS

The total number of study subjects was 112. The average age of the subject was 57 years. The number of male patients was 88 (78.6%) and the female sex was 24 (21.4%). We found 61 people (54.5%) had hypertension, 73 people (65.2%) had diabetes mellitus, 60 people (53.6%) had dyslipidemia, and 87 people (77.7%) subjects who smoked. From clinical parameters, the median systolic blood pressure is 120 mmHg while diastolic blood pressure is 80 mmHg, and the average pulse frequency is 85 times / minute. From the results of echocardiography examination obtained the median ejection fraction of the left ventricle 44.5%. From killip classes found subjects with Killip I numbered 80 (71.4%), Killip II amounted to 30 subjects (26.8%), Killip III amounted to 2 subjects (1.8%) and no Killip IV class was found. Based on the diagnosis the number of subjects with IMAEST is 89 (79.5%) and IMANEST as many as 23 (20.5%). Grace's average score is 115 while the average score of C-ACS is 0.65.

Characteristics	**N=112**
Demographics and risk factors	
Age	57.25 ± 10.361
Sex (n %)	
Male	88 (78.6 %)
Female	24 (21.4 %)
Body Mass Index	24.557 ± 3.18
Hipertension (n %)	61 (54.5 %)
Diabetes Melitus (n %)	73 (65.2 %)
Dyslipidemia (n%)	60 (53.6 %)
Clinical Characteristics	
Pulse Frequency	85.71 ± 23.623
Systolic Blood Pressure	120 (80 – 220)
Diastolic Blood Pressure	80 (50 – 130)
Killip Class (n %)	
Killip I	80 (71.4 %)
Killip II	30 (26.8 %)
Killip III	2 (1.8 %)
Mean of GRACE Score (SB)	115 ± 28
Mean of GRACE C-ACS Score	0.65 ± 0.925
Median LVEF (Min-Max)	44.5 (21-67)
Diagnosis	
STEMI	89 (79.5%)
NSTEMI	23 (20.5%)
Vessel Disease (n %)	
1VD	63 (56,3 %)
2VD	19 (16,9 %)
3VD	30 (26,8 %)

Table 1: Distribution of demographic and clinical characteristics of the research subject

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There were several types of MACEevents in this study. We found acute heart failure in 29 people (25.9%), cardiogenic shock in 9 people (8.0%),malignant arrhythmias 8 people (7.1%), and cardiovascular death occurred in 13 people (11.6%).

MACE	**N=112**
MACE, (n%)	
Yes	47 (42,0%)
No	65 (58,0%)
MACE types (n %)	
Death	13 (11,6 %)
Acute Heart Failure	29 (25,9 %)
Cardiogenic Shock	9 (8,0 %)
Malignant Arrhythmia	8 (7,1 %)

Table 2: Distribution of MACE characteristics of research subjects

From observations during patient care at the hospital, major cardiovascular events were found in 47 patients (42%) and patients who did not have major cardiovascular events in 65 patients (58%). Deaths during treatment occurred in 13 patients (11.6%). Differences in the characteristics of patients who experienced mortality and were shown in Table 2.

Characteristics	**Mortality in-hospitalization (n=13)**	**Survival (n=99)**	***P value***
Age	67.73 ± 11.18	55.97 ± 9.55	0.002[a]
Sex (n %)			
Male	10	78	1.00[c]
Female	3	21	
BMI	22.04 ± 3.19	24.90 ± 3.04	0.004[a]
Pulse	96.27 ± 25.86	84.36 ± 22.91	0.032[a]
Systolic Blood Pressure	100 (80 -170)	130 (80 – 220)	0.011[b]
Diastolic Blood Pressure	70 (50 – 100)	80 (50 – 130)	0.034[b]
Hypertension			
Yes	7	54	0.958[c]
No	6	45	
Diabetes Melitus			
Yes	7	66	0.547[c]
No	6	33	
Dyslipidemia			
Yes	4	56	0.145[c]
No	9	43	
Smoking			
Yes	11	76	0.745[c]
No	2	23	
GRACE Score	158.58 ± 30.80	109.43 ± 23.19	< 0.001[a]
LVEF	39.0 (30-60)	45.0 (21-67)	0.009[b]
Hemoglobin	11.64 ± 1.72	13.68 ± 2.08	0.001[a]
Leucocyte	16033.33 ± 4082.33	13067.23 ± 4190.21	0.104[a]
Platelet	266545.00 ± 58024.76	271186.81 ± 61523.57	0.408[a]
Creatinine	2.20 (0.85-5.30)	1.02 (0.51-7.18)	0.001 [b]
Random BG	187 (102 – 547)	147 (83 – 499)	0.816[b]
CKMB	95.00 (6 – 536)	88.00 (13 – 684)	0.304[b]
Troponin I	13.7 (1.40 – 32.00)	3.84 (0.02 – 32.00)	0.011[b]
HbA1C	6.60 (4.9 – 14.4)	6.8 (4.8 – 15.4)	0.103[b]
HDL	35.91 ± 16.79	38.48 ± 12.57	0.691[a]
LDL	107.55 ± 38.50	123.70 ± 39.76	0.328[a]

Table 3: Comparative data of mortality and non-mortality groups during treatment

There were 13 people (22.8%) who experienced MACE during treatment in the C-ACS 0 score group, while 34 people (61.8%) experienced MACE during treatment in the C-ACS score group ≥ 1 1. A total of 12 people (21.8%) in the C-ACS score group ≥ 1 experienced death and only 1 person (1.8%) experienced death in the C-ACS score group 0. While from grace score found a death rate of 12 people (18.5%) in grace group > 108 (moderate-high risk). While there was a death rate of 1 person (2.1%) in the GRACE

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group ≤ 108 (low risk). The study found a significant association between death during treatment and a C-ACS score (value p = 0.003) and an odds ratio of 8.65.

	GRACE ≤ 108*(n:47)*	GRACE >108 *(n:65)*	*P Value*	*OR*	*95% CI*
MACE	11 (23.4%)	36 (55.4%)	0,001	4,06	1,76-9,35
Death	1 (2.1%)	12 (18.5%)	0.018	10.41	1.30 – 83.19
Acute Heart Failure	6 (10.6%)	24 (36.9%)	0,004	4,91	1,71-14,12
Cardiogenic Shock	1 (2.1%)	8 (12.3%)	0.109	6,45	0,77- 53,5
Malignant Arrhythmia	3 (6.4%)	5 (7.7%)	0.005	1.22	0,27-5,38

Table. 4: GRACE score association with MACE

	C-ACS 0 *(n:57)*	C-ACS ≥ 1 *(n:55)*	*P Value*	*OR*	*95% CI*
MACE	13 (22.8%)	34 (61.8%)	<0,001	5,48	2,40-12,49
Death	1 (1.8%)	12 (21.8%)	0.003	8.65	2.26 – 35.7
Acute Heart Failure	8 (14.0%)	21 (38.2%)	0,007	3.78	1,50-9.53
Cardiogenic Shock	4 (7.0%)	5 (9.1%)	0.955	1,32	0,33- 5,21
Malignant Arrhythmia	0 (0%)	8 (14.5%)	0,009	0.85	0,76-0,95

Table5: C-ACS score association with MACE

From this study, it was found that the C-ACS score discrimination score was assessed by the Receiver Operating Characteristic (ROC) method, with an AUC score of 0.816 with a confidence interval of 0.705 – 0.928 (CI 95%, p<00.001) with excellent discriminatory quality. For grace score discrimination scores against MACE treatments assessed by receiver operating characteristic (ROC) method, with AUC scores of 0.914 with confidence intervals of 0.813 – 1.00 (CI 95%, p<00.001) with strong discriminatory quality.

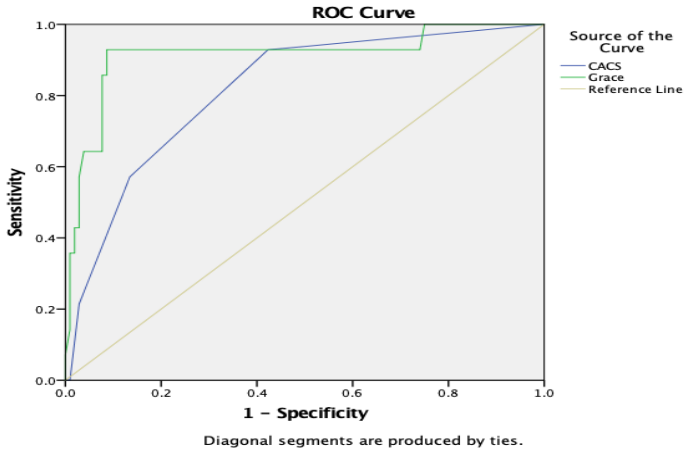

Fig. 1: ROC curve comparison of AUC score C-ACS and GRACE score against death during hospitalization

In this study, calibration values with Hosmer Lemeshow test on C-ACS scores on IMA patients showed R2 = 0.43 with a value of p = 0.240 and for GRACE score the calibration value with the Hosmer Lemeshow test got a value of R2 = 0.49 with a value of p = 0.269 as seen in Table 6. The p>0.05 value showed that there was no meaningful difference between the observed mortality rate and the predicted mortality rate by both score systems, so it was considered accurate.

Score	Discrimination test		Hosmer-Lemeshow Test	
	AUC	CI 95 %	R^2 Hosmer-Lemeshow	P Value
GRACE	0.914	0.813 – 1.00	0.49	0.269
C-ACS	0.816	0.705 – 0.928	0.43	0.240

Table 6: Comparison of C-ACS score performance and GRACE score against Death

IV. DISCUSSION

The study is the first to assess C-ACS scores as a predictor of death during treatment in IMA patients in North Sumatra of Asian race that differs from the initial study. The study also assessed GRACE scores and conducted a comparison of prognosis ability in assessing mortality during treatment with C-ACS scores in IMA patients.

It was found that the average age of the study subjects was 57 years. This is in contrast to previous studies with an average age score of 68 years.[8] As many as 77.7% of the subjects in this study were smokers, 54.5% had hypertension, and 65.2% had diabetes. This is higher when compared to previous studies, where it found risk factors from a study sample in the form of 57% of smokers, 34.2% hypertension, 29% diabetes. Thus, it is seen that patients in Asia have a younger average age than patients in Europe. This can be attributed to the number of risk factors for coronary heart disease that is more commonly suffered by Asians than Caucasians, such as the prevalence of Asian diabetes which is 2.5 times greater than the Caucasian race, and the number of smokers who are more.[9]

The sex in the study was dominated by male. Other studies have also shown that men suffer more IMA than women with a 4:1 ratio. This is because men have higher risk factors for the occurrence of IMA compared to women.9 The percentage of deaths during treatment in this study was higher compared to the results of the Khalil et al study (2018). This can be due to a higher prevalence of risk factors, and higher complications, lower reperfusion measures, and still low socio-economic rates.[7]

In this study, the average score of C-ACS was 0.65 while the average GRACE score was 115, which is lower than khalil's study, in 2018 with an average C-ACS score of 0.68 and an average GRACE score of 138. This is because the average age in this study is lower than in previous studies which can affect C-ACS scores and GRACE scores.[7]

In this study, the incidence of death in 13 people (11.6%), where there was 1 person (1.8%) experienced death during treatment in the C-ACS score group 0, while 12 people (21.8%) in the C-ACS score group ≥ 1. This is similar to the study by Khalil, in 2018 which assessed the ability of C-ACS scores in the IMA population where the percentage of deaths during treatment was highest in the C-ACS score group ≥ 1, which was 16.7% compared to the C-ACS score of 0 which was not found to be a death rate with a p-value of 0.001.[7]

In this study, acute heart failure was the most common KKvM, which was 21 people (38.2%) in the C-ACS score group ≥ 1. This is in accordance with those studied by Kaul in 2013 where acute heart failure during treatment was the most common complication of the group of patients with a diagnosis of SKA which is 34.2%.[10]

In this study, plot calibration on the C-ACS score showed a value of R2 = 0.43 with the Hosmer Lemeshow test getting a value of p = 0.240. The p>0.05 value showed that there was no meaningful difference between the mortality rate during observed treatment and the predicted mortality rate based on the C-ACS (expected) score, so it was assessed to be accurate. The discriminatory performance seen from the AUC score showed good results. AUC C-ACS scores in IMA patients obtained in this study reached 0.816 (CI 95%: 0.705-0.928).

In the previous study, the AUC C-ACS score was >0.75.Another study also assessed the performance of C-ACS score in SKA patients with an AUC of 0.68. Thus, when compared to previous studies, the performance of C-ACS scores in this study showed almost the same results and was good for good use in IMA patients.[11]

V. CONCLUSION

The C-ACS score has an advantage in clinical value, is simpler, is easy to use, can be used on first medical contacts, and can also be used as a predictor of mortality events during treatment in MI patients. There was a link between C-ACS scores as predictors of mortality incidence during treatment in MI patients at Haji Adam Malik Hospital. (p-value < 0.05). The C-ACS score has discriminatory performance and calibration that is not much different from the grace score so it can be used as an alternative prediction model for simpler calculations.

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