THE EFFECTIVENESS OF MODIFIED HEART SCORE IN EVALUATING PATIENT PRESENTED WITH CHEST PAIN TO EMERGENCY DEPARTMENT HOSPITAL UNIVERSITI SAINS MALAYSIA

DR MUHAMMAD ASLAM AYOB

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Contents

ABSTRAK

KEBERKESANAN SKOR HEART MODIFIKASI UNTUK MENILAI PESAKIT YANG DATANG DENGAN SAKIT DADA KE JABATAN KECEMASAN HOSPITAL UNIVERSITI SAINS MALAYSIA.

Pengenalan : Sakit dada merupakan antara sebab utama pesakit mendapatkan rawatan di jabatan kecemasan. Untuk pesakit yang datang dengan sakit dada, proses diagnosis adalah untuk mengenal pasti pesakit yang berisiko tinggi atau rendah untuk mendapat serangan jantung. Kajian ini bertujuan untuk menilai keberkesanan skor HEART modifikasi.

Metodologi : Seramai 175 orang pesakit yang datang dengan sakit dada di Jabatan Kecemasan Hospital Universiti Sains Malaysia telah dinilai secara retrospektif. Skor HEART modifikasi telah dikira mengunakan data pesakit iaitu sejarah pesakit,EKG,umur,faktor risiko dan nisbah CKMB/CK. Titik akhir nilaian adalah kejadian komplikasi jantung dalam masa 6 minggu. Keberkesanan skor HEART modifikasi dinilai antara kumpulan pesakit yang berisiko rendah dan yang tidak berisiko rendah.

Keputusan : Daripada 175 pesakit, 30.9 peratus dikategorikan sebagai berisiko rendah mengikut skor HEART modifikasi (skor 0-3) .Walaubagaimanapun, 14.8% pesakit dari kumpulan risiko rendah mendapat komplikasi jantung. Min skor HEART modifikasi bagi pesakit berisiko rendah adalah 4.05, manakala pesakit bukan berisiko rendah adalah 6.01 dan sinifikan secara statistik (p<0.001). Terdapat juga perkaitan penting antara pesakit tidak berisiko rendah dan komplikasi jantung (x^2=22.35, p<0.001).

Kesimpulan : Skor HEART modifikasi boleh membantu doktor di jabatan kecemasan dalam merawat pesakit yang datang dengan sakit dada dengan lebih mudah. Skornya mudah digunakan dan tidak rumit untuk diingati. Skor HEART modifikasi boleh dipercayai untuk digunakan jika ujian troponin tiada dan skor asal HEART tidak digunakan. Skor modikasi HEART dapat mengenal pasti pesakit yang tidak berisiko rendah (skor 4-10). Walaubagaimanapun, skor ini tidak begitu berguna untuk pesakit yang berisiko rendah dan ujian lain perlu dilakukan bagi pesakit tersebut.

ABSTRACT

THE EFFECTIVENESS OF MODIFIED HEART SCORE IN EVALUATING PATIENT PRESENTED WITH CHEST PAIN TO EMERGENCY DEPARTMENT HOSPITAL UNIVERSITI SAINS MALAYSIA

Introduction: Chest pain is one of the most common reasons for patients visit to emergency department. The aim of diagnostic process in chest pain at emergency department is to identify both low risk and high risk patients for acute coronary syndrome. Our study objective is to evaluate the effectiveness of modified HEART score in patients presented with chest pain.

Methods: Total of 175 patients presented with chest pain at Emergency Department Hospital Universiti Sains Malaysia (EDHUSM) were evaluated retrospectively. The modified HEART score was calculated using patient's history, ECG, age, risk factor and CKMB/CK relative index. The endpoint was occurrence of major cardiac event (MACE) in 6 weeks' time. The efficiency of modified HEART score was compared between low risk and non-low risk group.

Result: Out of 175 patients evaluated, 30.9 percent of the patients was low risk (score 0-3) category of modified HEART score. However, 14.8% patients from low risk group developed MACE in 6 weeks' time. The mean of modified HEART score for MACE in 6 weeks was 6.01 for non-low risk and 4.05 for low risk group and statically significant (p value <0.001). There was also significant association between non-low risk group of modified HEART score and the occurrence of MACE (x^2=22.35, p<0.0.001).

Conclusion: The modified HEART score can assist clinician with quick and reliable predictor outcome without complicated calculation technique. It is a useful alternative to original HEART score for the center without troponin test. The MHS was reliable to identify patients with non-low risk (score 4-10). On the other hand, the MHS cannot be dependable to risk stratified low risk patient and further testing needed for this group of patient.

1.0   INTRODUCTION

Non-communicable disease death are estimated to increase about 15 percent globally between 2010 and 2020.South east Asia is one of the regions   that was predicted to have an increase over 20 percent. (1) Based on World Health Organization (WHO) – non communicable disease (NCD) country profile (2014).Total death in Malaysia about 146000.NCD are estimated to be accounted for 73% of total death in Malaysia in which 36 percent out of 73 were due to cardiovascular diseases.

National Health and Morbidity Survey (2006) Malaysia showed that the leading cause of death in both gender is coronary artery disease. In year 2009, 147 834 patients (6.91% of total admission) admitted to ministry of health (MOH) hospitals due to cardiovascular disease. (2)

Acute coronary syndrome (ACS) is a clinical spectrum of ischaemic heart disease ranging from unstable angina, non-ST segment elevation myocardial infarction (NSTEMI) and ST elevation myocardial infarction. In unstable angina, myocardial necrosis is absent and cardiac biomarkers are normal. In myocardial infarction both NSTEMI and STEMI, cardiac biomarkers are raised. (3)

 ACS is diagnosed based on history, 12 lead electrocardiogram and raised cardiac biomarker.(4) Diagnosis need to be accurate to avoid mismanagement of ACS or missing other life threatening causes of chest pain. Patients presenting with undifferentiated chest pain account for a significant proportion of the emergency department (ED) workload. An accurate and reliable method of risk stratifying in these patients is therefore required to determine which patients are at higher risk of significant cardiac events.

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It is a challenge for emergency doctor to diagnose acute coronary syndrome as younger age group presented with heart disease in Malaysia. (5) Apart from younger age, female, old age and underlying diabetes mellitus often present with atypical symptoms and possess diagnosis challenge.(6)

The HEART score recently developed decision rules designed to identify ED patients with symptoms suggestive of ACS for early discharge without objective cardiac testing (stress testing or cardiac imaging). Low risk patient can be identified in ED and discharged home. (7) Early discharge for low risk ACS patient can reduce unnecessary admission, cost and reduce hospital overcrowding.(8) However, missed diagnosis can lead to wrongful discharge and ultimately in out-of hospital sudden death when unstable angina becomes a myocardial infarction. For moderate and high risk patient, early treatment significantly benefit them.(9)

HEART score uses troponin as one of its component. However in Malaysia, troponin testing is still not widely used as cardiac marker, CKMB is the preferred cardiac marker even though several studies show that troponin is superior to CKMB. In this study, the last component of HEART score (troponin) will be replaced by CKMB relative index.

Prior to the introduction of cardiac troponins, the biochemical marker of choice for the diagnosis of acute MI was the CK-MB isoenzyme. CK-MB first appears 4-6 hours after symptom onset, peaks at 24 hours, and returns to normal in 48-72 hours .(10) The relative index calculated by the ratio of CK-MB (mass) to total CK can assist in differentiating false-positive elevations of CK-MB arising from skeletal muscle. The CK-MB/CK relative

index was introduced to improve the specificity of CK-MB elevation for myocardial infarction. (11)

The endpoint of this study was the occurrence of a major adverse cardiac event (MACE), within six weeks of initial presentation. MACE consists of acute myocardial infarction, percutaneous coronary angiography, coronary artery bypass grafting, coronary angiography revealing procedurally correctable stenosis managed conservatively, and death due to any cause.

2.0 OBJECTIVE

2.1   GENERAL OBJECTIVE

1. To determine the effectiveness of modified HEART score in evaluating patient presented with chest pain in Emergency Department Hospital Universiti Sains Malaysia (EDHUSM)

2.2   SPECIFIC OBJECTIVE

1. To determine modified HEART score in patient presented with chest pain to ED HUSM

2. To compare the mean modified HEART score between major adverse cardiac event (MACE) and no MACE group.

3. To determine the proportion of patients with low risk modified HEART score who develop MACE in 6 weeks' time

4. To determine the association of modified HEART score with MACE in 6 weeks' time

3.0   MANUSCRIPT

THE EFFECTIVENESS OF MODIFIED HEART SCORE IN EVALUATING PATIENT

PRESENTED WITH CHEST PAIN TO EMERGENCY DEPARTMENT HOSPITAL

UNIVERSITI SAINS MALAYSIA

Author:

Muhammad Aslam Bin Ayob

Emergency resident,

Department of Emergency Medicine,

School of Medical Sciences, Universiti Sains Malaysia,

16150 Kota Bharu, Kelantan.

Andey B Rahman

Lecturer of emergency medicine,

Department of Emergency Medicine,

School of Medical Sciences, Universiti Sains Malaysia,

16150 Kota Bharu, Kelantan.

Corresponding Author:

Muhammad Aslam b Ayob,

Department of Emergency Medicine, School of Medical Sciences, Health Campus,

Universiti Sains Malaysia, 16150 Kota Bharu, Kelantan, MALAYSIA

Email: hilvelsum@yahoo.com; Tel: +609-7676721; Fax: +609-7673219

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3.1   ABSTRACT

Introduction: Chest pain is one of the most common reasons for patients visit to emergency department. The aim of diagnostic process in chest pain at emergency department is to identify both low risk and high risk patients for acute coronary syndrome. Our study objective is to evaluate the effectiveness of modified HEART score in patients presented with chest pain.

Method: Total of 175 patients presented with chest pain at Emergency Department Hospital Universiti Sains Malaysia (EDHUSM) were evaluated retrospectively. The modified HEART score was calculated using patient's history, ECG, age, risk factor and CKMB/CK relative index. The endpoint was occurrence of MACE in 6 weeks' time. The efficiency of modified HEART score was compared between low risk and non-low risk group.

Result: Out of 175 patients evaluated, 30.9 percent of the patients was low risk (score 0-3) category of modified HEART score. However, 14.8% patients from low risk group developed MACE in 6 weeks' time. The mean of modified HEART score for MACE in 6 weeks was 6.01 for non-low risk and 4.05 for low risk group and statically significant (P value <0.001). There was also significant association between non-low risk group of modified HEART score and MACE (x^2=22.35, P<0.0.001).

Conclusion: The modified HEART score can assist clinician with quick and reliable predictor outcome without complicated calculation technique. It is a useful alternative to original HEART score for the center without troponin test. The MHS was reliable to identify patients with non-low risk (score 4-10). On the other hand, the MHS cannot be

dependable to risk stratified low risk patient and further testing needed for this group of patient.

3.2   INTRODUCTION

Chest pain is one of the most common reasons for patient to seek medical attention in the emergency department (ED). (12) Acute coronary syndrome (ACS) need to be differentiated from other causes of cardiac and non-cardiac causes of chest pain. In a number of cases, diagnosis can be made quickly especially when patient presented with ST-segment elevation acute myocardial infarction (STEMI). However STEMI patients represent only a small percentage of all patients presented with chest pain. There are variety of diseases that can mimic ACS such as pulmonary embolism, aortic dissection, pleural irritation, pneumonia and musculoskeletal pain .(13)

ACS include unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI) and ST elevation myocardial infarction (STEMI). The diagnosis of ACS is based on typical history of chest pain, ECG changes and elevation of cardiac biomarker.(14) Compared to STEMI, NSTEMI patient tend to be older and have more co-morbidity. (15)

The challenge in ED is not only to recognize the patient with highest risk, but also to identify patients with non-urgent disease. These patient may be discharged safely with minimal testing or intervention. Non-ST elevation acute myocardial infarction (NSTEMI) is an important cause of chest pain, and accurate diagnosis and risk stratification in ED must be a clinical priority. This diagnosis can be made quickly in case of typical changes

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in electrocardiogram (ECG) and increased in the level of cardiac biomarker in plasma. However absence of such finding not always exclude NSTEMI. The process to diagnose NSTEMI in early stages of disease is very challenging. It is important to make a quick and accurate diagnosis as patient will benefit greatly from early treatment and intervention. (16). Conversely missed diagnosis and treatment inefficiencies are associated with increased morbidity, mortality and cost.

The HEART score was designed to aid in the risk stratification in patient with undifferentiated chest pain in ED. The HEART score is composed of five parameter of clinical judgment: History, ECG, Age, Risk factor and Troponin. Each of the component of HEART score will be appreciated as 0, 1 or 2 point. The lowest score is 0 and the highest is 10. (17). From validation study, HEART score provide clinicians with quick and reliable predictor without computer-required calculation to help in risk stratification of patients in ED who is present with chest pain.(18)

HEART score uses troponin as one of its component. However in Malaysia, troponin testing is still not widely used as cardiac marker. CKMB is the preferred cardiac marker even though several studies show that troponin is superior to CKMB. In this study, the last component of HEART score (troponin) will be replaced by CKMB/CK relative index.

Prior to the introduction of cardiac troponins, the biochemical marker of choice for the diagnosis of acute MI is the CK-MB isoenzyme. CK-MB first appears 4-6 hours after symptom onset, peaks at 24 hours, and returns to normal in 48-72 hours .(10) The relative index calculated by the ratio of CK-MB (mass) to total CK can assist in differentiating false-positive elevations of CK-MB arising from skeletal muscle. The CK-MB/CK relative

index was introduced to improve the specificity of CK-MB elevation for myocardial infarction. (11)

3.3   METHODS

The study was performed in Hospital Universiti Sains Malaysia (HUSM). It was a retrospective cross sectional study to look for association between Modified Heart Score (MHS) and major adverse cardiac event (MACE). The end point is occurrence of MACE within 6 weeks' time from initial presentation. MACE consist of acute myocardial infarction, percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), coronary angiography revealing correctable stenosis managed conservatively and death due to any cause.

Medical records were traced from patient that presented with chest pain to emergency department HUSM from January 2015 to December 2015. Inclusion criteria was age more than 18 years old, irrespective of medical condition. Patients presented with STEMI, traumatic chest pain and patient with ACS that did not present with chest pain as symptom were excluded. The ethic committee approved the study and informed consent procedure was waived as it was a retrospective non-interventional study.

Patient's data record were traced from record office, and data extracted were combined in a data sheet form. Patient's history was taken from emergency clerking sheet and was determined as highly suspicious, moderately suspicious and slightly or non-suspicious. Highly suspicious history included presence of typical symptom of angina, pain that

occurred at rest, concomitant symptoms and reaction to sublingual nitrate. If the history was highly suspicious, 2 score would be granted. If the patient have no specific symptom but also had chest pain, the patient were categorized as moderately suspicious and 1 point was given. However, if the patient had no symptoms or chest pain, the history was classified as non-suspicious and 0 score was given. Only ECG during admission were used and classified as significant ST-depression (score 2), nonspecific repolarization disturbance (score 1) or normal (score 0). For age group it was categorized as more than 65 years old (score 2), between 46 to 64 years old (score 1) and 45 years old and below (score 0). The following risk factors were taken into account; smoker, diabetes mellitus, hypertension, hypercholesterolemia, family history of coronary artery disease and obesity. Patient's risk factor were determined and categorized, as 3 or more risk factor (score 2), 1 or 2 risk factor (score 1) or none (score 0).

For CKMB/CK relative index, initial investigation at emergency department was used and calculation was made. CKMB/CK ratio of 5% and above were given score 2, 3% to 4.9 % score 1, and below 3 % score 0 respectively. The relative index calculated by the ratio of CK-MB (mass) to total CK can assist in differentiating false-positive elevations of CK-MB arising from skeletal muscle. A ratio of less than 3 is consistent with a skeletal muscle source, while ratios greater than 5 are indicative of a cardiac source. Ratios between 3 and 5 represent a gray zone.

The Modified HEART (MHS) score was calculated on admission data only. The scoring of MHS was based on original HEART Score (HS) except for the last component. The MHS also had 5 component, which was history, ECG, age, risk factor and CKMB/CE relative

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index. Each component yield maximum 2 point and minimum 0 point. Follow up data was retrieved and determine whether patient had MACE or not.

The Human Research Ethics Committee Universiti Sains Malaysia approved this study (USM/JEPeM/15030103). The Director of HUSM gave permission to review the ECG and medical records. All data were managed and analyzed by IBM SPSS version 24.Chi-squared test was used to evaluate the association of the established MHS cut point ($\leq$3 versus $\geq$4) with MACE at 6 weeks' time. A descriptive comparison of the patients by MACE status at 6 weeks was performed using the Student 2-sample t test. P values <0.05 have been considered statistically significant throughout the study. Analysis was conducted using SAS version 9.4 software.

3.4   RESULTS

175 patients presented with chest pain in emergency department HUSM (EDHUSM) were recruited to our study (table 1). Out of 175 patients, 54 patient were scored 0-3 and categorized as low risk according to modified HEART score (MHS). It was 30.9% from total population. The remaining 121 patients scored 4 and above were classified as non-low risk (intermediate & high risk).

Mean modified HEART score in MACE group was 2.049 more than in no MACE group and it was statistically significant ($p < 0.001$, 95% CI 1.375, 2.722)

From table 3, there were 8 patients (14.8%) from low risk group of MHS developed MACE in 6 weeks' time. Meanwhile 46 (84.6%) did not had MACE. Non-low risk group showed that 64 patients (54%) developed MACE and 57 (48%) did not.

Table 4 used Pearson chi square to examine whether the expected count in each cell if null hypothesis is true (in this case there is no association with the modified HEART score risk group and presence of MACE). The higher the differences between observed and expected count, the higher the resultant statistics (in this case X^2). In this study, there is statically significant association between modified HEART score and MACE ($X^2=22.35$, $p<0.001$) There is statically significant association between modified HEART score and MACE ($X^2=22.35$, $p<0.001$)

3.5   DISCUSSION

Modified HEART score was developed for patients presented with chest pain to emergency department. The original HEART score comprised of 5 components which were history, ECG, age, risk factor and troponin. However, in MHS the last component which is troponin is replaced by CKMB/CK relative index. Creatine kinase (CK) is an enzyme found in most tissues. Total CK rise may be due to myocardial event, trauma, neuromuscular disorder or cocaine use. CK-MB is one of isozyme of CK and almost exclusively produced by heart muscle. (19) In the scenario that cause elevation of CK, an elevation of CKMB/CK relative index will aid in differentiating myocardial injury from other causes of total CK elevation such as muscle injury. (20) CKMB/CK relative index had better specificity for diagnosis of myocardial injury compared to absolute CKMB level.(11) In modified Heart score, an elevation of CKMB/CK ratio more than 5 percent will yield score as 2, while 3-4.9 percent elevation as 1 as and less than 3 percent as 0. From this CKMB/CK relative index replacing the last component of original HEART score, modified HEART score was created.

The use of modified HEART score (MHS) in patients presented to ED HUSM yield around 30 percent of patient into the low risk group, with 0-3. The rest of the patients were non-low risk (intermediate and high) with the score of 4-10. The use of MHS provide clinician with useful tool to assist in risk stratifying and diagnosing patient presented with chest pain within 2 hour of arrival as MHS can be easily memorize and does not require complex calculation. Apart from that, MHS uses CE/CKMB ratio which already available across lab around the country.

From this study conducted at EDHUSM, the mean MHS in MACE group was 6.01 and the mean in non-MACE group was 4.05. Patients in the low risk group were less likely to develop MACE in 6 weeks compared to non-low risk group and the finding were significant (p<0.001). This analysis showed that patients who had higher MHS were more likely to develop MACE.

The study also revealed that, 8 (14.8%) patient from low risk group developed MACE in 6 weeks' time. The remaining 46 (84.6%) patients in low risk group did not developed MACE. In the meantime, in non-low risk group, 64(53%) patients developed MACE. The validation study of original   HEART score had 2 percent risk to develop MACE from low risk group. Other validation study of HEART score in India showed that MACE risk in low risk group was around 2.2 percent. In low risk group of MHS, however 14.8 percent patients developed MACE as compared only 2 percent to other study that use original HEART score. We can conclude that the MHS score performance to predict patient in low risk group to develop MACE was not as good as original HEART score. MHS cannot be used as reliable clinical tool to discharge patient from emergency department even the patient were placed on low risk group. Patients may need further investigation before decision regarding disposition was made.

 The study revealed that patients from non-low risk group were more likely to developed MACE compared to low risk group. As alternative, MHS can be used to direct the patients for treatment and disposition in patients who presented with chest pain and had MHS that was intermediate and high (non-low risk). It may help emergency doctors to begin early treatment and aid in the decision regarding the disposition of the patient. With this, only patients with low risk group of MHS need further work up at emergency department.

Several risk score for evaluation of chest pain have been published before. (21) The most prestige were TIMI and GRACE score. Both of the scores were created for risk stratification of patients admitted for ACS to coronary care unit and may take observation for some time to complete the score. Many guideline such as European and American recommend usage of this score at emergency level for evaluation of chest pain, although it was not designed for this purpose. (22) However, HEART score was designed for wider evaluation of patient presented with chest pain to emergency department. HEART score uses only admission data and can be completed within 1 or 2 hour upon patient's arrival. The score was validated in 2013. (17) The original HEART study reported short term MACE between 0.6-1.4 percent in low risk patient. Low percentage of MACE, permitted low risk patient to be discharged from ED without further testing.

HEART score was used widely in our setting to assist clinicians regarding treatment and disposition in patients presented with chest pain. Apart from HEART score, clinician relied on gestalt to make clinical decision for diagnosing ACS in patients with chest pain presented in the ED.(23) However, with the impressive finding in the validation study of HEART score, many hospital in our country still did not include the score in our protocol or guidelines. One of the reason was the expensive and limited supply of troponin testing. Troponin test is only used in low risk patients and rarely in non-low risk patient. Application of MHS in total population can identify around 70 percent of the patients with non-low risk group that may not need further testing at emergency level. Only 30% of the patients needed extensive investigation such as troponin.

This study has limitation. CKMB level start to rise 6 hours post ischemia, peak within 12 to 24 hours and normalize within 3 days. If the patient come too early and blood is taken

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for investigation, it cannot detected the CKMB level. Troponin elevations are almost always specific for cardiac injury. A number of well-done studies have shown that troponin measurements have enhanced prognostic value compared with CK-MB measurements in patients with acute coronary syndrome (ACS). We believe that insensitivity of CKMB leads to higher number of patient in low risk group developed MACE in MHS. Apart from that, population factor also may contribute to these factor, as currently no validation study of HEART score done in Malaysia

It would be interesting to do the prospective study of MHS in our setting to look further in the potential of the scoring system. In our retrospective study, patient's history might not accurate as it were extracted from folder, not directly interview by investigator. There might be some inconsistency in history and also patient's risk factor. These factor might contributed to higher percentage of patient develop MACE in low risk group.

3.6   CONCLUSION

In conclusion, the modified HEART score for the chest pain at emergency department provide clinicians with quick and useful predictor outcome after arrival of patients. In patients with MHS score 4-10 (non-low risk), admission may highly indicated and aggressive treatment needed. For low risk patient, MHS score 0-3, which predict occurrence of MACE around 14.8 percent, further work up was warranted. MHS is suitable to use as ruling in criteria for ACS patients.

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4.0 TABLES AND FIGURES

Table 1. Modified HEART Score in Patient Presented With Chest Pain to ED HUSM

Variable	Frequency	%
Low risk (0-3)	54	30.9
Non- low risk (4-10)	121	69.1
Total	175	100.0

Table 2: Mean, differences of modified HEART score in MACE and non-MACE group

Variable	Group	Mean (SD) N=175	Mean diff (SD)	t- statistic	p-value
MHS	MACE	6.01 (1.77)	2.05(0.341)	6.01	0.001
	No Mace	4.05 (1.02)			

Table 3: Proportion of modified HEART with development of MACE in 6 weeks' time

Variable	MACE		Total
	Yes n (%)	No n (%)	n (%)
Low risk	8 (14.8)	44 (85.2)	54(30.9)
Non-low risk	64(53.0)	57 (47.0)	121(69.1)
Total	72(41.1)	103(58.9)	175

Table 4: Association between modified HEART score risk group and presence of MACE status

Variable	MACE		X^2(df)	P-value*
	YES	NO		
Non-Low Risk	64(49.8)	57(71.2)	22.35(1)	<0.001
Low risk	8(22.2)	46(31.8)		

*Pearson Chi-Square

5.0 ACKNOWLEDGEMENT

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6.0 GUIDELINES TO AUTHORS OF SELECTED JOURNAL

The selected journal is Hong Kong Journal of Emergency Medicine

Instruction to Authors

The Hong Kong Journal of Emergency Medicine is a peerreviewed bi-monthly biomedical publication of the Hong Kong College of Emergency Medicine and The Hong Kong Society for Emergency Medicine and Surgery. The Journal publishes original research articles, review articles, case reports, and educational information related to all aspects of clinical practice and emergency medicine research in the hospital and prehospital settings. The Journal is indexed in EMBASE/Excerpta Medica, Science Citation Index Expanded (SCIE) and Scopus.

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