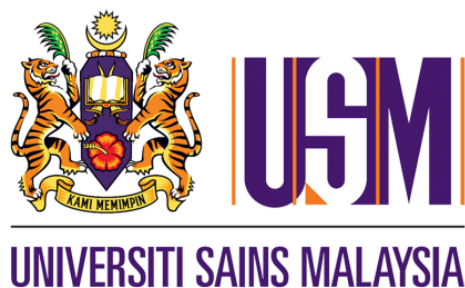# Correlation Between HEART Risk Score and Changes of Angiographic Findings in Patients with Acute Coronary Syndromes

by

DR CHAN XIN YI

Dissertation submitted in partial fulfillment of the requirements for the degree of Master of Medicine (Emergency Medicine)

UNIVERSITI SAINS MALAYSIA

2017

AKU JANJI

Diperakui bahawa disertasi yang bertajuk **Correlation Between HEART Risk Score and Changes of Angiographic Findings in Patients with Acute Coronary Syndromes** merupakan kerja dan penyelidikan yang asli daripada **CHAN XIN YI,** No Kad Pengenalan: **820205-10-5038,** No. Matrik: **PUM 0175/13** dari tempoh 2013 hingga 2017 adalah di bawah penyeliaan kami. Disertasi ini merupakan sebahagian daripada syarat untuk penganugerahan **Sarjana Perubatan Kecemasan**, segala hasil penyelidikan dan data yang diperolehi adalah hak milik terpelihara Universiti Sains Malaysia.

_____   _____

Tandatangan Pelajar   Tandatangan Penyelia Bersama,

                                           Pensyarah Pusat Pengajian Sains Perubatan

                                           University Sains Malaysia.

_____   _____

Tandatangan Penyelia Utama,   Tandatangan Ketua Jabatan,

Pensyarah Jabatan Kecemasan ,   Jabatan Kecemasan,

Pusat Pengajian Sains Perubatan,   Universiti Sains Malaysia.

Universiti Sains Malaysia.

Acknowledgement

TABLE OF CONTENTS

KORELASI DI ANTARA RISIKO 'HEART SCORE' DAN PENEMUAN PERUBAHAN ANGIOGRAFI DI KALANGAN PESAKIT AKUT KORONARI SINDROM

ABSTRAK

Pengenalan: Sakit dada merupakan antara simptom-simptom biasa yang menyebabkan pesakit mendapatkan rawatan di jabatan kecemasan dan ia mungkin berpunca daripada masalah jantung atau sebaliknya. Ia merupakan cabaran bagi doktor untuk membezakan punca sakit dada tersebut samaada boleh mengancam nyawa pesakit ataupun tidak. Risiko 'HEART SCORE' adalah sistem skor yang senang dan mudah digunakan untuk membezakan pesakit yang mempunyai risiko tinggi untuk mendapat akut koronari sindrom. Proses diagnostik ini adalah untuk mengklasifikasikan pesakit yang medapat rawatan di jabatan kecemasan dengan sakit dada berisiko tinggi atau tidak. Sementara itu, angiografi ialah satu prosedur invasif untuk menentukan tahap penyakit koronari, di mana 'stent' yang boleh dimasukkan sebagai kaedah rawatan. **Objektif:** Objektif umum kajian ini adalah untuk menentukan tahap 'HEART SCORE' untuk pesakit dengan sakit dada yang menjalani angiogram di Hospital Universiti Sains Malaysia (HUSM) dan Hospital Raja Permaisuri Bainun (HRPB). Objektif khusus kajian ini adalah untuk menentukan 1. korelasi di antara 'HEART SCORE' dan keputusan angiogram untuk pesakit dengan sakit dada yang mendapatkan rawatan di HUSM dan Hospital Raja Permaisuri Bainun. 2. Menentukan sensitiviti dan spesifikasi 'HEART SCORE' dalam menentukan tahap penyakit arteri koronari. **Method:** Satu kajian retrospektif telah dijalankan di HUSM dan HRPB. Rekod perubatan bagi tahun 2013 dan 2014 daripada kedua-dua hospital telah dikumpul dan dikaji semula. Sebanyak 126 rekod perubatan telah digunakan dalam kajian ini, 66 (HUSM) dan 60 (HRPB). Senarai pesakit dari kedua-dua hospital yang telah menjalani angiografi telah diperolehi. Skor HEART pesakit telah dikira pada masa ketibaan di ED dan keputusan angiografi untuk pesakit yang sama telah direkodkan.

'HEART SCORE' terdiri daripada 5 komponen; ia itu sejarah, elektrokardiogram (ECG), umur, faktor-faktor risiko dan troponin. Bagi setiap komponen 0, 1 atau 2 mata diberikan. Pesakit kemudian dikategorikan ke dalam kumpulan berisiko rendah di mana jumlah 'HEART SCORE' pesakit dari 0-3 mata dan kumpulan berisiko tinggi di mana tahap skor pesakit adalah 4 mata dan ke atas. Sementara itu, keputusan angiografi membekalkan maklumat arteri jantung (koronari) dan ditentukan dengan peratusan stenosis (kawasan sempit di dalam saluran darah).**Keputusan:** Daripada 126 pesakit, 96 adalah lelaki (76.2%) dan 30 adalah wanita (23.8%). Purata umur adalah 55.8 (SD 10.67) tahun. Purata 'HEART SCORE' dalam kajian ini adalah 5.43 (SD 1.84) mata daripada jumlah markah sebanyak 10 mata. Lapan belas daripada 126 pesakit dikategorikan sebagai pesakit yang berisiko rendah. Keputusan angiografi menunjukkan sebanyak 81 pesakit mempunyai stenosis lebih daripada 70% dan 45 pesakit mempunyai stenosis kurang daripada 70%. Keputusan analisis menunjukkan bahawa setiap peningkatan sebanyak 1 skor dalam pengiraan 'HEART SCORE', kebarangkalian pesakit untuk mempunyai stenosis di mana lebih daripada 70% meningkat sebanyak 2.03 kali ganda [OR = 2.03 (1.44; 2.85)]. Terdapat korelasi positif yang lemah di antara jumlah 'HEART SCORE' dan stenosis dalam ketiga-tiga saluran darah utama dalam jantung [left anterior descending coronary artery (LAD) ($r=0.385$, $p= 0.001$), left circumflex artery (LCX) ($r=0.387$, $p=0.001$ and right coronary artery (RCA) ($r= 0.477$, $p=0.001$)] . Sensitiviti skor HEART untuk meramal stenosis lebih daripada 70% adalah 96.3% manakala spesifikasi hanya 33.3%. Area under the ROC curve $r=0.648$ [CI95% 0.542-0.755; $p <0.006$]. **Kesimpulan:** 'HEART SCORE' boleh digunakan dalam klinikal untuk meramalkan keseriusan penyakit arteri koronari. 'HEART SCORE' juga adalah system skor yang sangat sensitif untuk meramalkan pesakit yang mempunyai stenosis yang 70% atau lebih.

CORRELATION BETWEEN HEART RISK SCORE AND CHANGES OF ANGIOGRAPHIC FINDINGS IN PATIENTS WITH ACUTE CORONARY SYNDROMES

ABSTRACT

Introduction: A common symptom that patients present in the Emergency & Trauma Department (ED) is chest pain which can be due to a cardiac or non-cardiac cause. It is difficult for clinicians to differentiate a life threatening chest pain from other possible causes. The HEART score is a simple and convenient tool to risk stratify patients with chest pain. This diagnostic process is to classify both low and high risk patients presented to the ED with chest pain. Meanwhile, an angiography is an invasive procedure to determine the severity of coronary disease, in which a stent can be inserted as a treatment method. This study aims to determine the correlation between HEART score and angiography findings in acute coronary syndrome patients. **Objective:** General objective of this study was to determine HEART SCORE level in patient with chest pain who underwent angiogram in Hospital Universiti Sains Malaysia (HUSM) and Hospital Raja Permaisuri Bainun (HRPB). The specific objective in this study were to determine 1. Correlation between HEART score and angiogram finding in patient who presented to HUSM and Hospital Raja Permaisuri Bainun with chest pain. 2. Sensitivity and specificity of HEART score in determine severity of coronary artery disease. **Methods:** A retrospective study was conducted in HUSM and HRPB. Medical records for year 2013 and 2014 from both hospitals were traced and reviewed. A total of 126 medical records were used in this study, where 66 were from HUSM and 60 from HRPB. The list of patients from both hospitals of those who had undergone an angiography was acquired. Patients' HEART scores were calculated on admission and the angiography results of the same patients were recorded. The HEART score is composed of 5 components: history,

electrocardiogram (ECG), age, risk factors and troponin. For each component 0, 1 or 2 points is given. Patient were then categorized into low risk group where total HEART score of the patient range from 0-3 and high risk group where patient score 4 and above. Meanwhile, the angiography result provides information of heart (coronary) arteries and was determined by the percentage of stenosis (narrowed area inside blood vessels). **Results:** Out of 126 patients, 96 of them were male (76.2%) and 30 were female (23.8%). The mean age was 55.8 (SD 10.67) years. The mean HEART score in this study was 5.43 (SD 1.84) points out of total score of 10 points. Eighteen out of 126 patients were categorised as low risk patients. An angiography results of 81 patients showed stenosis more than 70% and 45 patients showed stenosis less than 70%.

The result of analysis showed that every increase of 1 score in the HEART score calculation, the odd of the patient to has stenosis which more than 70% increase 2.03 times [OR=2.03 (1.44; 2.85)]. There was a weak positive correlation between the total HEART score and stenosis in all the 3 major vessels in the heart [left anterior descending coronary artery (LAD) (r=0.385, p= 0.001), left circumflex artery (LCX) (r=0.387, p=0.001 and right coronary artery (RCA) (r= 0.477, p=0.001)] . The sensitivity of HEART score to predict stenosis more than 70% is 96.3% while the specificity is only 33.3%. Area under the ROC curve r=0.648 [CI95% 0.542-0.755; p <0.006]. **Conclusion:** HEART score can be used in clinical to predict the severity of coronary artery disease. HEART score as well as a very sensitive tool to predict patient who has stenosis which is 70% or more.

CHAPTER 1

INTRODUCTION

1.1 Background

According to Global status report on non-communicable disease (NCD) by WHO in 2010, estimated deaths from the diseases will increase approximately 15% globally between 2010 and 2020. South-east Asia is one of the regions that predicted increase by over 20%. In 2014, death due to NCD in Malaysia was 146000 which accounted for 73% of total death. Interestingly, thirty-six percent out of 73% death was due to cardiovascular disease.

Furthermore, the 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 were cardiovascular disease.(Hou Tee Lu1, 2013)

Acute Coronary syndrome (ACS) is define as a clinical spectrum of a disease that ranging from ST elevation myocardial infarction (STEMI), non ST elevation myocardial infarction (NSTEMI) and unstable angina.

1.2 Literature review

Chest pain is one of the most common presentations in emergency department (ED) (Six *et al.*, 2008). Despite the improvement of diagnostic tools missed diagnosis of ACS is still a problem among healthcare provider(Clifford J. Swap, 2005a). It is a huge challenge for doctors that work in the ED to differentiate ACS from non-cardiac causes of chest pain such as pneumonia, muscular skeletal pain, gastrointestinal symptoms and psychiatric disorder. Doctors who work in the ED also need to differentiate ACS from other life threatening condition that mimic ACS such as aortic dissection, pulmonary embolism, tension pneumothorax and cardiac tamponade (Clifford J. Swap, 2005a; B.E. Backus, 2013). The diagnosis of Non-ST-elevation ACS (nSTE-ACS) can be made

quickly if typical changes in electrocardiogram (ECG) and/or increased levels of myocardial markers in plasma is present. Diagnosis should be made fast and efficient in order to administrate treatment early. It is important to make a quick diagnosis as patients benefit significantly from early treatment (Six *et al.*, 2008).

Significant amount of undifferentiated chest pain patient who presented to ED may need of risk stratification to prevent unnecessary burden to health care system and at the same time to avoid missed diagnosis that lead to patient mortality (Richard Lyona, 2007). Several risk stratification score has been validated for this purpose. The thrombolysis In Myocardial Infarction (TIMI) and platelet glycoprotein IIb/IIIa in unstable agina: Receptor Suppression Using Integrilin (PURSUIT) scores were developed from large clinical trials of NSTE-ACS. The more recent Global Registry of Acute Coronary Events (GRACE) score was developed from the registry, with a population of patients across the entire spectrum of ACS (Pedro de Arau´jo Gonc¸alves, 2005).

Meanwhile, HEART score was developed base on clinical experience and medical literature. It is very easy to use as HEART is an acronym of its component: history, ECG, age, risk factor and troponin (Appendix 2) Unlike other risk score such as TIMI and GRACE which designed for patients that proven to have ACS, HEART score is use to risk stratify patient who presented to ED with chest pain. It will help emergency doctor to differentiate low risk patients that is fit for discharge (B.E. Backus, 2013). Clinical HEART pathway was created based on the HEART score. Patients was risk stratified in to low risk (0-3) and high risk (4-10) in the study. This study showed that using clinical HEART pathway can reduce the rate of objective cardiac testing, length of stay of patient which subsequently facilitate early discharge of patient. (Simon A. Mahler, 2015) Coronary angiography is a special x-ray imaging of heart vessels. It is use to determine the extent of severity of coronary artery disease in ACS patient. Balloon angioplasty and stent insertion may be done as a treatment option after coronary angiogram was done.

There were few studies reported the correlation between risk score and angiogram findings in ACS patients. Most of the studies comparing between risk score in predicting severity of coronary artery disease (Tatsuya Nakachi, 2010; Elizabete Silva dos Santos, 2013; Mazhar Mahmood, 2013a; Mehmet Akif Cakar, 2014; Adem Bekler, 2015). The usual risk score that being used was TIMI, GRACE and PURSUIT risk score.

1.3 The research question

a. What is the HEART score and mean HEART score in patient who presented to HUSM and Hospital Raja Permaisuri Bainun with chest pain?

b. What is the angiogram finding in patient who presented to HUSM and Hospital Raja Permaisuri Bainun with chest pain?

c. Is there any correlation between HEART score and angiogram finding in patient who presented to HUSM and Hospital Raja Permaisuri Bainun with chest pain?

d. What are the sensitivity and specificity of HEART score in determining the severity of coronary artery disease?

1.4 Objectives

1.4.1 General

a. To determine the usefulness of HEART score to predict the severity of coronary artery disease in acute coronary syndrome patient.

1.4.2 Specific

b. To determine correlation between HEART score and severity of coronary artery disease.

c. To determine the sensitivity and specificity of HEART score in prediction of severity of coronary artery disease in acute coronary syndrome patient.

1.5 Methodology

    1.5.1 Method

This was a retrospective study which involved 2 major hospital in Malaysia; Hospital Universiti Sains Malaysia (HUSM) and Hospital Raja Permaisuri Bainun. List of patients' name were acquired from the catheterization laboratory from both of the hospital from year 2013 to 2014. Medical record of the patient was traced from the medical record department after getting permission from the director of the hospital. Patient was selected for this study based on the inclusion criteria which is: patient who presented to ED and had underwent coronary angiography. Those patients record which is incomplete were excluded from this study. For those patients who underwent coronary angiography but not admit through ED were also excluded in this study.

All the demographic information such as age, gender, ethnicity and patients' comorbities were extracted and recorded in the data collecting sheets. Information that require for HEART score calculation and coronary angiographic findings of the same patient were also recorded in the data collection sheets.

HEART score of the patient were calculated upon patient's admission to the ED. Then subsequently all the patients divided into high and low risk group (score 4 and more is high risk group).

From the coronary angiographic finding, all the patient were categorized into how many vessel disease (single vessel disease, 2 vessels disease and 3 vessels disease) and stenosis which is less than 70 percent or more than 70 percent.

A software named G power 3.17 was used to calculate the sample size for this study. We used 0.05 as our alpha level and 0.8 as our level of statistical power during the calculation. Total sample size needed for this study was 107 with 30 % drop off rates.

1.5.2 Ethical consideration

This research had obtained ethical approval from The Human Research Ethics Committee of USM and National Medical Research and Ethics Committee (MREC) of the Ministry of Health (MOH) Malaysia via the National Medical Research Registry (NMRR). This study had registered with the National Medical Research Register and approved by the Clinical Research Centre and National Institute of Health of Malaysia.

1.5.3 Inclusion criteria

Patients who presented to ED with chest pain and had undergone angiogram

1.5.4 Exclusion criteria

a. Patient who did NOT presented/admitted to/through ED hospital HUSM/ Hospital Raja Permaisuri Bainun

b. Unavailability of medical records to review OR incomplete patient's data sheet.

c. Patients diagnosed with ACS who did not present with chest pain

d. Patient who has been diagnose to have ST elevation ACS

1.6 References

Adem Bekler, B. A., Emine Gazi, Ahmet Temiz, Ahmet Barutçu, Ömer Güngör, Muhammed Turgut Alper Özkan, Sedat Özcan, Sabri Gazi, Bahadır Kırılmaz (2015). Comparison of the GRACE risk score and the TIMI risk index in predicting the extent and severity of coronary artery disease in patients with acute coronary syndrome. *Anatol J Cardiol* **15,** 801-806.

B.E. Backus, A. J. S., J.C. Kelder, M.A.R. Bosschaert, E.G. Mast, A. Mosterd, R.F. Veldkamp, A.J. Wardeh, R. Tio i, R. Braam, S.H.J. Monnink, R. van Tooren, T.P. Mast, F. van den Akker, M.J.M. Cramer, J.M. Poldervaart, A.W. Hoes, P.A. Doevendans (2013). A prospective validation of the HEART score for chest pain patients at the emergency department. *International Journal of Cardiology***,** 1-6.

Clifford J. Swap, J. T. N. (2005). Value and Limitations of Chest Pain History in the Evaluation of Patients With Suspected Acute Coronary Syndromes. *THE JOURNAL OF AMERICAN MEDICAL ASSOCIATION,* **294(20),** 2623-2629.

Elizabete Silva dos Santos, L. d. F. A. F., Daniela Menezes Fonseca, Hugo José Londero,Rogério Martins Xavier, Marcos Paulo Pereira, Luiz Minuzzo, Roberta de Souza, Ari Timerman (2013). Correlation of Risk Scores with Coronary Anatomy in Non-ST-elevation Acute Coronary Syndrome. *Arq Bras Cardiol,* **100(6)**.

Hou Tee Lu1, R. B. N. (2013). Ethnic differences in the occurrence of acute coronary syndrome: results of the Malaysian National Cardiovascular Disease (NCVD) Database Registry (March 2006 - February 2010). *BMC Cardiovascular Disorders,* **13**.

Mazhar Mahmood, A. S. A., Parveen Akhtar, Khan Shah Zaman (2013). Comparison of the TIMI and the GRACE risk scores with the extent of coronary artery disease in patients with non-ST-elevation acute coronary syndrome. *Journal of Pakistan Medical Association,* **63(6),** 691-695.

Mehmet Akif Cakar, S. S., Ercan Aydin, Mehmet Bulent Vatan, Nurgul Keser, Ramazan Akdemir, Huseyin Gunduz (2014). Relation between the GRACE score and severity of atherosclerosis in acute coronary syndrome. *Journal of Cardiology,* **63(1),** 24-28.

Pedro de Arau´jo Gonc¸alves, J. F., Carlos Aguiar, Ricardo Seabra-Gomes (2005). TIMI, PURSUIT, and GRACE risk scores: sustained prognostic value and interaction with revascularization in NSTE-ACS. *European Heart Journal,* **26,** 865-872.

Richard Lyona, A. C. M., David Caesar, Sarah Gray, Alasdair Gray (2007). Chest pain presenting to the Emergency Department——to stratify risk with GRACE or TIMI? *Resuscitation,* **74,** 90-93.

Six, A., Backus, B. & Kelder, J. (2008). Chest pain in the emergency room: value of the HEART score. *Netherlands Heart Journal,* **16(6),** 191-196.

Tatsuya Nakachi, M. K., Kiyoshi Hibi, Toshiaki Ebina, Kengo Tsukahara, Jun Okuda, Satoshi Morita, Tetsuji Kaneko, Satoshi Umemura, Kazuo Kimura (2010). COMPARISON OF GRACE RISK SCORE VERSUS TIMI RISK SCORE ON ANGIOGRAPHIC FINDINGS IN PATIENTS WITH NON-ST-SEGMENT ELEVATION ACUTE CORONARY SYNDROME. *Journal of the american college of cardiology,* **55(10s1).**

CHAPTER 2

MANUSCRIPT

2.1 TITLE PAGE

Can HEART score predict the severity of Coronary artery disease?

NMRR-15-556-25308

Authors

1. DR. CHAN XIN YI

Current post:

- Postgraduate Student (Emergency Medicine) in Pusat Pengajian SainsPerubatan Universiti Sains Malaysia Kelantan

- Under Training in Department of Emergency and Trauma Hospital Raja Permaisuri Bainun

Education:

- Degree in Medicine in Crimea State Medical University (CSMU), 2008

- Postgraduate Program in Universiti Sains Malaysia (still in the program)

Address:

Hospital Raja Permaisuri Bainun

Jalan Raja Ashman (Jalan Hospital),

30450 Ipoh,

Perak Darul Ridzuan

Telephone/Fax number:

05-2085000/ 05-2531541

Email Address:

chanxy82@gmail.com

2. Dr. MOHD HASHAIRI FAUZI

Current post:

- Senior Lecture & Emergency Medicine Specialist, School of Medical Sciences, USM, Kota Bharu, Malaysia

Education:

- Masters of Medicine, MMED (Emergency Medicine), USM, 2010
- Medical Doctor (MD), USM, 2002

Address:

Hospital Universiti Sains Malaysia

Universiti Sains Malaysia Kampus Kesihatan, Jalan Raja Perempuan Zainab 2

16150 Kota Bharu Kelantan.

Telephone office number:

09-767 3219/ 09-767 6979

Email Address:

hashairi@usm.my

3. DR ADI OSMAN

Current post:

- Consultant Emergency Physician and Head of Department of Emergency and Trauma Hospital Raja Permaisuri Bainun

Education:

- Postgraduate in Universiti Sains Malaysia (USM), 2002
- Fellowship in emergency critical care & critical ultrasound, Italy, 2010

Address:

Hospital Raja Permaisuri Bainun

Jalan Raja Ashman (Jalan Hospital), 30450 Ipoh,

Perak Darul Ridzuan

Telephone/Fax number:

05-2085000/ 05-2531541

Email Address:

osman.adi@gmail.com

Word count: 3180

2.1 ABSTRACT

INTRODUCTION

Chest pain is one of the common symptoms that bring patient to the emergency department (ED). The HEART score is a simple tool to risk stratify patients with chest pain. This study aims is to determine the predictive value of HEART score in the severity of coronary artery disease (CAD).

METHODOLOGY

A retrospective study was conducted in Hospital Universiti Sains Malaysia (HUSM) and Hospital Raja Permaisuri Bainun (HRPB) between the January 2013 and December 2014. A total of 126 medical records were used in this study. Patients' HEART scores were calculated on admission and the angiography results of the same patients were recorded. Patient were then categorized into low risk and high risk group. Angiography result provides information regarding percentage of stenosis.

RESULTS

The mean HEART score in this study was 5.43 (SD 1.84) points out of total score of 10 points. Eighteen out of 126 patients were categorised as low risk patients. An angiography results of 81 patients showed stenosis more than 70%. The result of analysis also showed that, for every increase of the HEART score by 1, the odd of the patient to have stenosis ($\geq$70%) will increase by 2 times [OR=2.03 (1.44; 2.85)]. The sensitivity of HEART score to predict stenosis more than 70% is 96.3% while the specificity is only 33.3%. Area under the ROC curve r=0.648 [CI95% 0.542-0.755; p <0.006]

CONCLUSION

HEART score has a positive relation with the degree of stenosis in CAD patients. It also a useful tool to guide physician in determine which patient has high degree of stenosis.

Key words

Acute coronary syndrome, HEART score, chest pain, coronary angiography

2.3 Introduction

Background

Increased awareness of acute coronary syndrome (ACS) among the population had made chest pain one of the most common complaint in emergency department (ED). Despite advanced technologies, we still miss out a small amount of patients who had ACS. (McCarthy BD, 1993; J. Hector Pope, 2000; Body, 2008; Ernest Moy, 2015) Missed diagnosis of ACS in ED may be attributed to many factors such as patients' early presentation, atypical symptoms and overcrowded environment. The consequences of missed diagnosis of ACS will bring catastrophic outcome, not only to the patient but to the doctor as well. (Lard Wilhelmsen, 1998; Michael Wilson, 2014) Many scoring system had been used to risk stratify the patient. However, most of the scoring system were used after the diagnosis of ACS had been made. The HEART score was designed to help physician in ED to identified patient who had high risk of having ACS. (B.E. Backus, 2011; B.E. Backus and F. van den Akker, 2013)

Many studies had been done to determine the predictive value of risk score. Some of the studies were done to determine which risk score were better in predicting the severity of coronary artery disease (CAD).(Jessica L. Mega, 2005; Allahyar Golabchi, 2010; Tatsuya Nakachi, 2010; Elizabete Silva dos Santos, 2013; Mazhar Mahmood, 2013a; Adem Bekler, 2015; Gaurav Khandelwal, 2015) However, there was no study done regarding the predictive value of HEART score in severity of CAD till date.

Goals of This Investigation

The aim of this study was to determine the predictive value of HEART score in predicting the severity of CAD based on the angiographic findings among patients who had non ST elevation ACS.

2.4 Materials and Methods

Setting, Study Design and Sample Selection

A retrospective study was conducted in Malaysia which involved 2 major hospitals. They were Hospital Universiti Sains Malaysia (HUSM), Kelantan and Hospital Raja Permaisuri Bainun (HRPB), Perak. We extracted a list of patients who underwent coronary angiographies for the year 2013 to 2014 from the catheterization laboratory of each hospital. Medical records were then traced from the record department of each hospital after obtaining permission.

The participants were recruited to this study based on the inclusion criteria which was: The patients who presented to the ED with chest pain and had underwent coronary angiographies. The patients who were excluded from this study were: 1) Patients with incomplete medical records. 2) The patients who underwent coronary angiographies but were not admitted through the ED. 3) Patients diagnosed with ACS who did not present with chest pain. 4) Patient who has been diagnose to have ST elevation ACS.

Till date there were no study done to determine the correlation between HEART score and the severity of CAD; a software named G power 3.17 was used to calculate the sample size for this study. We used 0.05 as our alpha level, 0.3 as clinical margin and 0.8 as our level of statistical power during the calculation. Total sample size needed for this study was 107 with 30 % drop off rates.

This research had obtained ethical approval from The Human Research Ethics Committee of USM and National Medical Research and Ethics Committee (MREC) of the Ministry of Health (MOH) Malaysia (NMRR-15-556-25308).

Data Collection and Processing

The relevant data were extracted from medical record to calculate HEART score of a patient during the initial presentation to ED. The coronary angiographic finding of the same patient was also documented. All those information were recorded using a data

collecting sheet which included patients' demographic data (age, ethnicity and gender), patients' presenting history, ECG, risk factor for CAD, troponin level and coronary angiographic findings.

HEART score consist of 5 components: history, ECG, age, risk factor for CAD and level of troponin. Each component would be score as 0, 1 or 2 based on the criteria stated. HEART score of the patients upon arrival in ED was calculated and subsequently categorized into high risk group which had a score 4-10 and low risk group which had a score 0-3.

Based on patients' coronary angiographic findings, patient were categorized into how many vessel disease (single vessel disease, 2 vessels disease and 3 vessels disease) and stenosis which is less than 70 percent or more than 70 percent.

Those extracted information were subsequently recorded into data set using IBM SPSS Statistics software version 22 by a single researcher for statistical analysis.

Primary Data analysis

Demographic characteristic were presented for all variables. Categorical variables were presented as frequency and percentage while continuous variables were presented as mean and standard deviation. Chi-square test were used for comparisons between categorical variables, while independent t-test was used for continuous variables. Simple and multiple analysis using logistic regressions was performed to control for confounding factors. Sensitivity and specificity were calculated using MedCalc for Windows, version 16.4.3 (MedCalc Software, Ostend, Belgium). Statistical significance was set as $p \leq 0.05$.

2.5 Result

Characteristics of Study Subject

After went through total 735 medical records from HUSM and 279 medical records from HRPB, total of 126 medical records which fulfilled the inclusion criteria from year 2013 to 2014 were used in this study. Out of 126 medical records, 66 of them were from HUSM and 60 were from HRPB.

The mean age of the patients were 56 years. They were with predominantly male, (76.2%). Malay race was the majority (59.5%) in this study, followed by Indian (26.2%) and Chinese (14.3%). The mean duration from patient's presentation to ED till the coronary angiography was 66 days (SD±58.51)

Demographic characteristics and risk factor of patients are presented in table 1.

The mean HEART score in this study population was 5.53 (SD±1.84) with 108 (85.7%) out of 126 was categorized as high risk group. A total of 99 patients were detected to have stenosis in at least one of the major heart vessel regardless of the degrees of stenosis. Out of the 126 patients, 81 of them were found to have stenosis which is 70% or more in at least one of the major heart vessel.

Main Result

A multiple regression was conducted to determine if the variables can predict the severity of the CAD and HEART score level.

Based on the analysis, the male gender had 6 times [OR=6.10 (1.58; 23.64)] higher odd to fall into the high risk group than the female. The diabetic patients had 5 times [OR=5.11 (1.14; 22.99)] higher odd to fall into the high risk group compared to the non-diabetic.

When we analysed the variables with regards to the severity of CAD, we noted that Chinese had 8 times [OR=8.35 (1.18; 59.15)] higher odd to had stenosis of more than 70% as compared to the Malays. Patients with diabetes mellitus had 2 times

[*OR*=2.03(1.44; 2.85)] higher odd than those without, while hypertensive patients had 5 times [*OR*=5.64 (1.53; 20.75)] higher odd as compared to the patients without.

The result of analysis also showed that, for every increase of the HEART score by 1, the odd of the patient to have stenosis (≥70%) will increase by 2 times [*OR*=2.03 (1.44; 2.85)] of the precedent score.

Additional result

In this study, the HEART score's sensitivity to detect a stenosis (≥70%) was 96.3% (CI: 89.56% to 99.23%) and its specificity was 33.3% (CI: 20.00% to 48.95%). The HEART score had a positive predictive value of 72.2% (CI: 62.78% to 80.41%) and a negative predictive value of 83.3% (CI: 58.58% to 96.42%). It also had positive likelihood ratio of 1.44 (CI: 1.17 to 1.78) and a negative likelihood ratio of 0.11 (CI: 0.03 to 0.36).

2.6 Limitations

This was a retrospective study which was bound to have certain limitations. This study only involved 2 hospitals in Malaysia. Therefore it cannot represent the whole population of Malaysia. Its dependency on the accurate documentation and record keeping was an unavoidable issues in this study. BMI of the patient was not included during the calculation of HEART score because lack of information in the medical record. This study also prone to selection or information bias. Thus the calculation of the HEART score might not be accurate

2.7 Discussions

Risk scores were design to help physician in risk stratifying their patient. It can also aid physician in the decision making in term of choices of management of their patient. Thrombolysis in Myocardial Infarction (TIMI) risk score and Global Registry of Acute Coronary Events (GRACE) risk score were 2 most commonly used risk score in the study.

HEART score is easier to use in emergency setting compare to TIMI and GRACE score due to the easy and accessible information needed to calculate the score.

All the study had done to determine the predictive value of TIMI, GRACE and PRUSUIT score in CAD severity. Some previous studies even compared the risk scores to determine which were the more accurate and suitable to be used in clinical practice.(Tatsuya Nakachi, 2010; Elizabete Silva dos Santos, 2013; Mazhar Mahmood, 2013b; Adem Bekler, 2015) All of them show positive result. Till date there is no study was done to determine the predictive value of HEART score.

Based on the result of our study, first we found that HEART score has a positive correlation with the severity of CAD. Which every increase of 1 score, the odd of patient to have a lesion which stenosis more than 70% will increase by 2. The higher the score the higher chances of a patient to have more severe disease.

Second HEART score had a sensitivity of 96.3% (95% CI: 89.56% to 99.23%) in identifying patients who had coronary artery stenosis of 70% and more. High sensitivity can help physician to rule out ACS patient. Thus to minimise the risk of missed diagnosis. But the specificity of HEART score is very low {33.3% (CI: 20.00% to 48.95%)} which will contribute to the rate of false positive result. If based on the sensitivity we might subject patient to objective cardiac testing which will in turn increase the financial burden to the patient and to the hospital.

Even though other risk scoring system are able to predict the severity of CAD however HEART score is feasible and practical to be use in ED setting. The information needed to calculate HEART is easily obtained in ED setting. Thus, HEART score not only can

help emergency physician to identified patient who has high risk on having Major Adverse Cardiac event (MACE) but also can be used to determine which patient will benefit from early intervention.

The HEART score is a very sensitive tool risk stratify patients with cardiac causes of chest pain. It also had a positive correlation with higher degree stenosis.

2.8 References

1.   Ernest Moy MB, Rosanna Coffey, Anika L. Hines, David E. Newman-Toker. Missed diagnoses of acute myocardial infarction in the emergency department: variation by patient and facility characteristics. Diagnosis. 2015;2(1):29-40.

2.   McCarthy BD BJ, D'Agostino RB, Selker HP. Missed Diagnoses of Acute Myocardial Infarction in the Emergency Department: Results From a Multicenter Study. Annals of Emergency Medicine. 1993;22:579-82.

3.   J. Hector Pope TPA, Robin Ruthazer, Robert H. Woolard, James A. Feldman, Joni R. Beshansky, John L. Griffith, Harry P. Selker. Missed Diagnoses of Aute Cardiac Ischemia in the Emergency Department. The New England Journal of Medicine. 2000;342 (16):1163-70.

4.   Body R. Emergent diagnosis of acute coronary syndromes: Today's challenges and tomorrow's possibilities. Resuscitation. 2008;78:13-20.

5.   Michael Wilson JW, Jeremiah Schuur, Kelli O'Laughlin, David Cutler. Hospital and Emergency Department Factors Associated With Variations in Missed Diagnosis and Costs for Patients Age 65 Years and Older With Acute Myocardial Infarction Who Present to Emergency Departments. Academic Emergency Medicine. 2014;21:1101-8.

6.   Lard Wilhelmsen AR, Marianne Hegman, Georg Lappas. "Nonspecific" Chest Pain AssociateG with High Long-Tern Mortality: Results fiom the Primary Prevention Study in Goteborg, Sweden. Clinical Cardiology. 1998;21:477-82.

7.   B.E. Backus AJS, J.C. Kelder,M.A.R. Bosschaert,E.G. Mast,A. Mosterd,R.F. Veldkamp,A.J. Wardeh,R. Tio,R. Braam,S.H.J. Monnink,R. van Tooren,T.P. Mast, F. van den Akker MJMC, J.M. Poldervaart,A.W. Hoes,P.A. Doevendans. A prospective validation of the HEART score for chest pain patients at the emergency department. International Journal of Cardiology. 2013;168(3):2153-8.

8.   B.E. Backus AJS, J.H. Kelder, W.B. Gibler, F.L. Moll, P.A. Doevendans. . Risk Scores for Patients with Chest Pain: Evaluation in the Emergency Department. Current Cardiology Reviews. 2011;7(1):2-8.

9.   Adem Bekler BA, Emine Gazi, Ahmet Temiz, Ahmet Barutçu, Ömer Güngör, Muhammed Turgut Alper Özkan, Sedat Özcan, Sabri Gazi, Bahadır Kırılmaz. Comparison of the GRACE risk score and the TIMI risk index in predicting the extent and severity of coronary artery disease in patients with acute coronary syndrome. Anatol J Cardiol 2015;15:801-6.

10.   Allahyar Golabchi MS, Hamid Sanei,Mohammad Reza Akhbari,Aliakbar Tavassoli, Seied Mostafa Seiedhosseini, Pejman Khosravi, Ali Reza Alisaeedi. Can TIMI Risk Score Predict Angiographic Involment in Patients With ST-Elevation Myocardial Infarction? ARYA Atherosclerosis Journal. 2010;6(2):69-73.

11.   Elizabete Silva dos Santos LdFAF, Daniela Menezes Fonseca, Hugo José Londero,Rogério Martins Xavier, Marcos Paulo Pereira, Luiz Minuzzo, Roberta de Souza, Ari Timerman. Correlation of Risk Scores with Coronary Anatomy in Non-ST-elevation Acute Coronary Syndrome. Arq Bras Cardiol. 2013;100(6). Epub 517.

12.   Jessica L. Mega DAM, Marc S. Sabatine, Xue-Qiao Zhao, Steven M. Snapinn, Peter M. DiBattiste,C. Michael Gibson, Elliott M. Antman, Eugene Braunwald, Pierre The´roux. Correlation between the TIMI risk score and high-risk angiographic findings in non–ST-elevation acute coronary syndromes: Observations from the Platelet Receptor Inhibition in Ischemic Syndrome Management in Patients Limited by Unstable Signs and Symptoms (PRISM-PLUS) trial. American Heart Journal. 2005;149(5):846-50.

13.   Gaurav Khandelwal AJ, Monika Rathore. Prediction of Angiographic Extent of Coronary Artery Disease on the Basis of Clinical Risk Scores in Patients of Unstable Angina. journal of clinical and diagnostic research. 2015;9(11):13-6.

14.   Tatsuya Nakachi MK, Kiyoshi Hibi, Toshiaki Ebina, Kengo Tsukahara, Jun Okuda, Satoshi Morita, Tetsuji Kaneko, Satoshi Umemura, Kazuo Kimura. COMPARISON OF GRACE RISK SCORE VERSUS TIMI RISK SCORE ON ANGIOGRAPHIC FINDINGS IN PATIENTS WITH NON-ST-SEGMENT ELEVATION ACUTE CORONARY SYNDROME. Journal of the american college of cardiology. 2010;55(10s1).

15.   Mazhar Mahmood ASA, Parveen Akhtar, Khan Shah Zaman. Comparison of the TIMI and the GRACE risk scores with the extent of coronary artery disease in patients with non-ST-elevation acute coronary syndrome. Journal of Pakistan Medical Association. 2013;63(6):691-5.

16.   Mazhar Mahmood ASA, Parveen Akhtar, Khan Shah Zaman. Comparison of the TIMI and the GRACE risk scores with the extent of coronary artery disease in patients with non-ST-elevation acute coronary syndrome. journal of pakistan medical association. 2013;63(6).

17.   Simon A. Mahler BCH, David C. Goff Jr, James W. Hoekstra, Chadwick D. Miller. Can the HEART Score Safely Reduce Stress Testing and Cardiac Imaging in Patients at Low Risk for Acute Coronary Syndrome? Crit Pathw Cardiol. 2011;10(3):128-33.

18.   Simon A. Mahler RFR, Brian C. Hiestand, Gregory B. Russell, James W. Hoekstra, Cedric W. Lefebvre, Bret A. Nicks, David M. Cline, Kim L. Askew, Stephanie B. Elliott, David M. Herrington,Gregory L. Burke, Chadwick D. Miller. The HEART Pathway Randomized Trial:

Identifying Emergency Department Patients With Acute Chest Pain for Early Discharge. Circ Cardiovasc Qual Outcomes. 2015; 8(2):195-203.

19.   Simon A. Mahler CDM, Judd E. Hollander, John T. Nagurney, Robert Birkhahn, Adam J. Singer, Nathan I. Shapiro, Ted Glynn, Richard Nowak, Basmah Safdar, Mary

Peberdy, Francis L. Counselman, Abhinav Chandra, Joshua Kosowsky, James Neuenschwander, Jon W. Schrock, Stephen Plantholt, Deborah B. Diercks, W. Frank Peacock. Identifying patients for early discharge: Performance of decision rules among patients with acute chest pain. International Journal of Cardiology. 2013 168:795-802.

2.9 Tables and figure

Table 1 Demographic characteristics, and risk factor for coronary artery disease.

Variables	Means (SD)	n (%)	*P* Value
Age	56 (10)	100	<0.001
Race			
Malay	75	59.5	0.050
Chinese	18	14.3	
Indian	33	26.2	
Gender			
Male	96	76.2	0.041
Female	30	23.8	
Smoker			
NS	87	69.0	0.113
CS	22	17.5	
RS	3	2.4	
EX-S	14	11.1	
DM			
Yes	58	46.0	0.001
No	68	54.0	
HPT			
Yes	80	63.5	0.001
No	46	36.5	
HPL			
Yes	38	30.2	0.356
No	88	69.8	

*NS= nonsmoker, CS= current smoker, RS= recent smoker, EX-S= ex-smoker,

DM=diabetes mellitus, HPT= hypertension, HPL= hypercholesterolemia