The Role of Mean Platelet Volume as a Predicting Factor of Asymptomatic Coronary Artery Disease

Thesis

Submitted in partial fulfillment for the Master Degree in Cardiology

By

Mohamed Mohsen Mohamed
M.B,B.Ch.

Under Supervision of

Prof. Dr./ Samir Saleh Wafa
Professor of Cardiology
Faculty of Medicine – Ain-Shams University

Dr./ Khaled Foad
Lecturer of Cardiology
Faculty of Medicine – Ain-Shams University

Ain Shams University
Faculty of Medicine
2012

بسم الله الرحمن الرحيم

قَالُوا سبحانك لاَ علم لَنا إلاّ ما

علّمتنا إنك أنت الْعليم الْحـ كـ يم

صدق الله العظيم

سورة البقرة آية (٣٢)

Acknowledgement

First and foremost, I feel always indebted to ***Allah****, the Most Kind and the Most Merciful.*

I would like to express my sincere gratitude to ***Prof. Dr./ Samir Saleh Wafa****, Professor of Cardiology, Faculty of Medicine – Ain-Shams University, under his supervision, I had the honor to complete this work, I am deeply grateful to him for his professional advice, guidance and support.*

I wish also to express my gratitude to ***Dr./ Khaled Foad****, Lecture of Cardiology, Faculty of Medicine – Ain-Shams University, for his great efforts, kind advice, support and encouragement throughout the whole work.*

I would like to dedicate this thesis to my Great ***Wife,***

and Sunshine Mother*; for whom I will never find*

adequate words to express my gratitude.

Table of Contents

List of Abbreviations

ABI	: Ankle-Brachial Index
ACS	: Acute Coronary Syndrom
AMI	: Acute Myocardial infarction
CAC	: Coronary Artery Calcification
CAD	: Coronary artery Disease
CBC	: Complete Blood Count
CCTA	: Coronary Computed Tomography Angiography
CHD	: Coronary Heart Disease
CIMT	: Carotid Intima-Media Thickness
CRP	: C-Reactive Protein
EBCT	: Electron Beam Computed Tomography
FH	: Family history
HDL-C	: High Density Lipoprotein-Cholesterol
HTN	: Hypertension
HU	: Hounsfield units
LAD	: Left anterior descending artery
LCX	: Left circumflex
LDL-C	: Low Density Lipoprotein-Cholesterol
MDCT	: Multi Detector Computed Tomography
MPR	: Multi Planar Reformation
MPV	: Mean Platelet Volume
NCEP	: National Cholesterol Education Program
RCA	: Right coronary artery
SCF	: Slow coronary flow
SHAPE	: Screening for Heart Attack Prevention and Education
SIS	: Segment Involvement Score
TC	: Total Cholesterol
TFC	: TIMI frame count

List of Tables

List of Figures

Introduction

Atherosclerosis and its complication as acute myocardial infarction (AMI) are regarded as one of the most important causes of death in industrial societies ***(Ridker & Libby, 2005).***

Although there are some known risk factors for coronary artery disease (CAD) such as age, cigarette smoking, diabetes mellitus, hypertension, hypercholesterolemia and family history of myocardial infarction ***(Ridker & Libby, 2005).*** The detection of some other factors to determine the true risk of acute coronary syndrome (ACS) seems necessary. Since platelets play an important role in forming intra coronary thrombosis, they are considered a principal cause of AMI ***(Ridker & Libby, 2005).***

An increase platelet size is concomitant with a rise in platelet reactivity. The mean platelet volume (MPV) has a direct relation with the indicators of platelet activity such as glycoprotein Ib and glycoprotein IIb/IIIa receptors ***(Endler et al., 2002).***

Platelet has been known as an implicating factor in the patho-physiology of the atherosclerotic disease.Larger platelets aggregate more rapidly with collagen, ***(Smith et al., 1999)*** contain more dense granules ***(Karpatkin & Strick, 1972)*** and

produce more thromboxane A2 ***(Giles et al.,1994)*** and,so, are more hemostatically active ***(Thompson et al., 1983).*** As larger platelet are more reactive, mean platelet volume (MPV) is known as to reflect the state of thrombogenesis, and act as a marker of platelet function and activation ***(Khandekar et al., 2006).***

Aim of the Work

To investigate the association of mean platelet volume (MPV) and subclinical coronary artery disease by Multidetector computed tomography (MDCT) in asymptomatic individuals.

General Principles of Computed Tomography Imaging

Imaging techniques are essential to assess many aspects of acquired and congenital cardiovascular diseases. Computed tomography (CT) is a rapidly developing and newly emerging tool for assessment of ischemic heart disease including visualization of the coronary arteries as well as the myocardium. CT also allows evaluation of the consequences of coronary artery stenosis, such as perfusion defects in the myocardium or functional changes in contraction. Other applications of current CT imaging include the assessment of congenital heart disease, large vessel disease, pulmonary embolism and pulmonary vein imaging ***(Jacob et al., 2006)***.

Overview:

The basic principle of CT is that emitted by the X-ray source in the form of a fan beam pass through the cross-section of the patient, who is located within the scan field of view. The patient's anatomical structures attenuate these X-rays before they are registered by a detector array, which typically consists of 500-1000 detector elements in a row, located on the opposite side to produce thin sections while avoiding unnecessary photon scatter (to keep radiation exposure and image noise to a minimum) ***(Ohnesorge and Flohr, 2007)***. The data recorded by the detectors are digitized into picture elements **(pixels)** with known dimensions. The gray-scale information contained in each

individual pixel is reconstructed according to the attenuation of the X-ray beam along its path using a standardized technique termed "filtered back projection." Gray-scale values for pixels within the reconstructed tomogram are defined with reference to the value for water and are called "Hounsfield units" (HU), or simply "CT numbers" ***(Budoff, 2006)***.

CLINICAL IMAGING PROTOCOLS:

MDCT systems can operate in either the sequential (prospective triggered) or helical mode (retrospective gating). These modes of scanning are dependent upon whether the patient on the CT couch is stationary (axial, or sequential mode) or moved at a fixed speed relative to the gantry rotation (helical mode) ***(Budoff and Gopal, 2006)***.

Prospective Triggering

The prospectively triggered image uses a "step and shoot" system, that has long been used in conjunction with EBCT and single-slice spiral CT ***(Becker et al., 2000)***. This obtains images at a certain time of the cardiac cycle, which can be chosen in advance, usually during diastole, this time window can be defined in terms of milliseconds from the R wave of the ECG, or as a percentage of the cardiac cycle. It does not require a helical mode of acquisition, but every scan is performed after discrete displacements of the table and then only one image per detector per cardiac cycle is obtained. This reduces contrast requirements, but does not allow for CT angiographic images, as motion artifacts may plague these images ***(Alomar et al., 2006)***.

Prospective ECG triggering is the most dose-efficient method of ECG-synchronized scanning, as only the very minimum of scan data needed for image reconstruction is acquired. However, usually only relatively thick slices are used for prospectively triggered acquisition, to maintain a reasonably short single breath-hold. Thus, resulting data sets are often not suitable for 3D or multiplanar reformation (MPR) reconstruction of small cardiac anatomy. In addition, prospective ECG-triggered scans are sensitive to changes in heart rate during acquisition, so significant fluctuation or arrhythmia can have a severe effect on image quality ***(Becker et al., 2000b)***.

Retrospective Gating:

Retrospective ECG gating overcomes the limitations of prospective ECG triggering with regard to scan time and spatial resolution, and can provide more consistent image quality for examination of patients with changing heart rate during the scan. This technique requires multislice spiral scanning with slow table speed and simultaneous recording of the ECG trace that is used for retrospective assignment of image reconstruction ***(Ohnesorge et al., 2000)***. The ECG is used to add R peak markers to the raw data set. A simultaneous ECG is recorded during the acquisition of cardiac images. The ECG is retrospectively used to assign source images to the respective phases of the cardiac cycle (ECG gating). The best imaging time to minimize coronary motion is from 40% to 70% of the cardiac cycle (early to mid-diastole). The actual phase used can