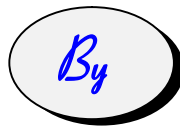


**Coronary Calcium Scoring by Multislice Computed Tomography.
Correlation with Myocardial Perfusion Imaging in Type 2
Diabetic Patients with Suspected
Coronary Artery Disease.**

**Thesis
Submitted in Partial Fulfillment of
MD Degree in Critical Care Medicine**



Wael Sami Gamal
MBBCh., MSc (Critical Care Medicine)

Supervisors

Prof. Dr. Alia Abd El-Fattah, MD

Professor of Critical Care Medicine,
Critical Care Medicine Dept.,
Cairo University

Prof. Dr. Ashraf selim, MD

Professor of radiology,
Radiodiagnosis Dept.,
Cairo University

Prof. Dr. Hisham Al-Aassar, MD

Professor of Critical Care Medicine,
Critical Care Medicine Dept.,
Cairo University

Prof. Dr. Ahmed Abd Al-Aziz, MD

Assist. Professor of Critical Care Medicine,
Critical Care Medicine Dept.,
Cairo University

**Faculty of Medicine
Cairo University
2010**

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Abstract

Coronary artery calcium (CAC) provides evidence of coronary atherosclerosis. The relationship between CAC detected by multidetector computed tomography (MDCT) and inducible ischemia detected by myocardial perfusion imaging (MPI) in 23 diabetic patients with suspected coronary artery disease were studied. A moderately positive correlation has been found. Ischemic MPI was associated with atherosclerosis by CAC, but is rarely seen for CAC score 0. CAC score of 0 appears to obviate the need for subsequent noninvasive testing. Normal MPI patients, frequently have low CAC. CAC scoring and stress MPI should be thus considered complementary approaches.

Key Words: Myocardial perfusion imaging - multidetector computed tomography-diabetes mellitus-coronary calcium.

List of Tables

Table (1)	Interpretation and Recommendations for CT Heart Scanning and CACP Scoring
Table (2)	Effective doses for natural and common diagnostic procedures
Table (3)	Semiquantitative scoring system: 5-point model
Table (4)	Gender and mean age distribution of patients
Table (5)	Risk factors for CAD
Table (6)	Types of symptoms
Table (7)	Patients with and without resting ECG changes.
Table (8)	Classification of patient according to ECG response to stress.
Table (9)	Classification of patients according to Framingham risk score
Table (10)	Patients with normal and abnormal CV autonomic reflexes
Table (11)	Classification of patients according to fundus examination
Table (12)	Patients with and without proteinuria.
Table (13)	Patients with positive and negative MPI
Table (14)	Subgroups of patients according to MPI Severity
Table (15)	EF in patients with abnormal and normal MPI.
Table (16)	CAC in males and females
Table (17)	CAC in patients above and below 60 years
Table (18)	CAC in males and females above and below 60 years
Table (19)	Coronary lesions $\geq 60\%$ (significant) and $\leq 60\%$ by CTA
Table (20)	Coronary lesions $\geq 60\%$ (significant) and $< 60\%$ by C.A

Table (21)	Relation of symptoms to stress ECG and different coronary imaging modalities.
Table (22)	CAC score in pts with and without abnormal ECG changes
Table (23)	Relation between resting ECG and MPI
Table (24)	Relation between resting and stress ECG
Table (25)	Relation between resting ECG and obstructive coronary lesions on CTA and C.A.
Table (26)	Relation between stress ECG and different coronary imaging modalities
Table (27)	CAC in patients with low, moderate, and high Framingham risk score
Table (28)	CAC score of 0 and > 0 and Framingham risk score
Table (29)	SSS in patients with low, moderate, and high Framingham risk score
Table (30)	Obstructive CTA and C.A. lesions in patients with low, moderate to high Framingham risk score
Table (31)	CAC in patients with positive and negative MPI
Table (32)	Severity of ischemia (SSS) versus CAC score
Table (33)	Agreement between MPI and CTA
Table (34)	Agreement between +ve MPI and CTA $\geq 60\%$ on territorial
Table (35)	Agreement between MPI and C.A
Table (36)	Agreement between +ve MPI and C.A $\geq 60\%$ on territorial level (for 23 patients)
Table (37)	CAC 0 versus CAC > 0 and MPI
Table (38)	CAC 0 versus CAC > 0 and SSS
Table (39)	CAC ≤ 100 versus CAC > 100 and MPI
Table (40)	CAC ≤ 100 versus CAC > 100 and SSS

Table (41)	Normal and abnormal MPI in different CAC groups
Table (42)	SSS in different CAC groups
Table (43)	CAC = 0 versus CAC > 0 and CTA
Table (44)	CAC $\leq$ 100 versus CAC > 100 and CTA
Table (45)	CAC = 0 versus CAC > 0 and C.A
Table (46)	CAC $\leq$ 100 versus CAC > 100 and C.A
Table (47)	Agreement between CTA and C.A
Table (48)	Agreement between +ve MPI , CTA $\geq$ 60% and C.A $\geq$ 60% (for 21 patients).
Table (49)	Sensitivity and specificity of MPI and CTA for detection of obstructive coronary lesions compared to C.A. as a gold standard.
Table (50)	Our study and other studies at CAC =0 and greater than 0
Table (51)	Our study and other studies at CAC lower and greater than 100
Table (52)	Our study and other studies at CAC lower and greater than 400
Table (53)	CAC and presence of obstructive CAD, comparison between our study and prior studies
Table (54)	CTA and detection of functionally significant lesions compared to MPI
Table (55)	Our CTA results compared to others for detection of CAD.

List of Figures

Figure (1)	Fixed and adaptive- array detectors.
Figure (2)	Isotropic voxel
Figure (3,3")	SPECT myocardial perfusion imaging: 20-segment models
Figure (4)	SPECT myocardial perfusion imaging: 17 -segment models
Figure (5)	SPECT myocardial perfusion imaging: coronary artery territories in 17 and 20 segment models.
Figure (6)	Schematic representation of ECG-gated SPECT acquisition and processing
Figure (7)	Gender of patients
Figure (8)	Number of patients with positive and negative MPI
Figure (9)	Gender and mean CAC
Figure (10)	Mean CAC in patients above and below 60 years
Figure (11)	No. of patients and lesions in different CTA results
Figure (12)	No. of patients and lesions in different CA results
Figure (13)	Symptoms and mean CAC
Figure (14)	Symptoms and different coronary imaging modalities
Figure (15)	Relation between stress ECG and different coronary imaging modalities
Figure (16)	Relation between stress ECG and CAC
Figure (17)	Relation between Framingham risk category and CAC
Figure (18)	CAC score of 0 and > 0 and Framingham risk score
Figure (19)	Relation between SSS and Framingham risk score
Figure (20)	CAC in patients with positive and negative MPI.
Figure (21)	Correlation between SSS and CAC score
Figure (22)	Agreement between MPI and CTA
Figure (23)	Agreement between +ve MPI and CTA $\geq 60\%$ on territorial level
Figure (24)	Agreement between MPI and C.A
Figure (25)	Agreement between +ve MPI and C.A $\geq 60\%$ on territorial level
Figure (26)	MPI results in patients with CAC=0 and CAC > 0
Figure (27)	SSS in patients with CAC =0 and CAC > 0
Figure (28)	MDCT for patient No. 7 with CAC=0
Figure (29)	Normal myocardial perfusion display of pt No.7

Figure (30)	Volume rendering reconstruction of pt No 7 showing normal coronaries
Figure (31)	Normal RCA of pt No.7 by MDCT (curved MPR) and conventional coronary angiography (C.A)
Figure (32)	Normal LAD of pt No.7 by MDCT(curved MPR) and conventional C.A.
Figure (33)	Myocardial perfusion display of pt No.2 showing mild ischemia at anterior wall
Figure (34)	3 D display of pt No.2 showing mild ischemia at anterior wall
Figure (35)	MDCT of pt No.2 with CAC score = 0
Figure (36)	MDCT shows insignificant lesion in D2 and C.A shows significant lesion of pt No.2
Figure (37)	MPI results in patients with $CAC \leq 100$ and $CAC > 100$
Figure (38)	SSS in patients with $CAC \leq 100$ and $CAC > 100$
Figure (39)	myocardial perfusion display of pt No.18 showing total reversibility at LAD and LCX±RCA territory
Figure (40)	Polar map of pt No.18 showing total reversibility at LAD and LCX±RCA territory
Figure (41)	MDCT showing heavy coronary calcification $CAC = 2280$ HU in pt No.18
Figure (42)	C.A showed diffusely diseased LAD and RCA of the same patient (No 18)
Figure (43)	Myocardial perfusion display of pt No.12 showing moderate ischemia at the anterior wall.
Figure (44)	Polar map with the SSS of pt No. 12 showing moderate ischemia at the anterior wall.
Figure (45)	MDCT of pt No.12 showing calcified plaques in mid LAD and proximal LCX with $CAC = 73$ HU
Figure (46)	contrast enhanced MDCT of pt No.12 showing total LAD occlusion
Figure (47)	C.A of pt No.12 showing total LAD occlusion
Figure (48)	CTA in patients with $CAC = 0$ and $CAC > 0$
Figure (49)	CTA in patients with $CAC \leq 100$ and $CAC > 100$
Figure (50)	C.A in patients with $CAC = 0$ and $CAC > 0$
Figure (51)	C.A in patients with $CAC \leq 100$ and $CAC > 100$
Figure (52)	Agreement between CTA and C.A
Figure (53)	Agreement between +ve MPI , $CTA \geq 60\%$ and C.A
Figure (54)	Sensitivity , specificity, PPV, NPV, and accuracy of MPI and CTA

List of Abbreviation

<i>ACC</i>	:	American College of Cardiology
<i>ACE</i>	:	Angiotensin Converting Enzyme
<i>Apo E (A)</i>	:	Apolipoprotein E (A)
<i>ASNC</i>	:	American Society of Nuclear Cardiology
<i>BMP</i>	:	Bone Morphogenetic Protein
<i>CAC</i>	:	Coronary Artery Calcium (calcification)
<i>CACP</i>	:	Coronary Artery Calcified Plaque
<i>CAD</i>	:	Coronary Artery Disease
<i>Cbfa1</i>	:	Core-binding factor α -1
<i>CCR2</i>	:	CC Chemokine Receptor 2
<i>CT(A)</i>	:	Computed Tomography (angiography)
<i>CVCs</i>	:	Calcifying Vascular Cells
<i>D (2,3,4)</i>	:	Dimension (2,3,4)
<i>DIAD</i>	:	Detection of silent myocardial Ischemia in Asymptomatic Diabetic subjects
<i>DM</i>	:	Diabetes Mellitus
<i>EBCT</i>	:	Electron Beam Computed Tomography
<i>ECs</i>	:	Endothelial Cells
<i>ECG</i>	:	Electrocardiogram
<i>ED</i>	:	Emergency Department
<i>EDV</i>	:	End Diastolic Volume
<i>EETs</i>	:	Epoxyeicosatrienoic acid
<i>EF</i>	:	Ejection Fraction
<i>eNOS</i>	:	Endothelial Nitric Oxide Synthase

<i>ENPP-1</i>	:	Ecto-Nucleotid Pyrophosphatase/Phosphodiesterase-1
<i>ER-α</i>	:	Estrogen Receptor- α
<i>ESV</i>	:	End Systolic Volume
<i>FH</i>	:	Family History
<i>FRS</i>	:	Framingham Risk Score
<i>Gla</i>	:	Glutamic Acid
<i>HDL</i>	:	High Density Lipoprotein
<i>HMG-Co A</i>	:	Hydroxymethylglutaryl Coenzyme A
<i>HTN</i>	:	Hypertension
<i>HU</i>	:	Hounsfield Unit
<i>IL</i>	:	Interleukin
<i>L/T</i>	:	Lesion/ Territory
<i>LAD</i>	:	Left Anterior Descending
<i>LCX</i>	:	Left Circumflex Artery
<i>LDL</i>	:	low Density Lipoprotein
<i>LVEF</i>	:	Left Ventricular Ejection Fraction
<i>LM</i>	:	Left Main coronary artery
<i>LV</i>	:	Left Ventricle
<i>mA</i>	:	Milli-Ampere
<i>MAR</i>	:	Myocardium At Risk
<i>M-CSF</i>	:	Macrophage-Colony Stimulating Factor
<i>MDCT</i>	:	Multi-Detector Computed Tomography
<i>MGP</i>	:	Marrix Gla Protein
<i>MIP</i>	:	Maximum Intensity Projection
<i>MMP</i>	:	Matrix Metalloproteinases
<i>MPCs</i>	:	Mononuclear Phagocytic Cells

<i>MPR</i>	:	Multiplanar Reconstruction
<i>MRI</i>	:	Magnetic Resonance Imaging
<i>mSv</i>	:	Milli Sievert
<i>MUGA</i>	:	Multiple Gated Acquisition nuclear ventriculography
<i>NCP</i>	:	Non Calcified Plaque
<i>NO</i>	:	Nitric Oxide
<i>No.</i>	:	Number
<i>OLCs</i>	:	Osteoclast-Like Cells
<i>OPG</i>	:	Osteoprotegerin
<i>OPN</i>	:	Osteopontin
<i>PTH</i>	:	Parathyroid Hormon
<i>Pts</i>	:	Patients
<i>RANK(L)</i>	:	Receptor Activator of Nuclear factor Kappa (Ligand)
<i>RCA</i>	:	Right Coronary Artery
<i>RV</i>	:	Right Ventricle
<i>SMCs</i>	:	Smooth Muscle Cells
<i>SPECT</i>	:	Single Photone Emission Computed Tomography
<i>SSS</i>	:	Summed Stress Score
<i>SV</i>	:	Stroke Volume
<i>Tc-99m</i>	:	Technetium-99m
<i>Tl-201</i>	:	Thalium-201
<i>TNF</i>	:	Tumor Necrosis Factor

SCONTENT

Item	Page
Introduction	1-4
Aim of Work	5
Review:	6-84
<i>Chapter I: Calcification and coronary atherosclerosis.</i>	6-29
	30-59
<i>Chapter II: Multidetector computed tomography and coronary artery disease.</i>	60-84
<i>Chapter III: Gated single photon emission computed tomography and diabetes mellitus.</i>	
Patients & Methods	85-101
Results	102-149
Discussion	150-168
Summary	169-172
Conclusion	173-174
References	175-218
Arabic Summary	٣-١

Introduction

Diabetes is a major cause of mortality and morbidity worldwide, and its prevalence is increasing at alarming proportions. A close relationship between type 2 diabetes and the development of coronary artery disease (CAD) exists,⁽¹⁾ and cardiovascular disease is the main cause of death in this patient population.⁽²⁾ Coronary artery disease (CAD) accounts for 70% of the deaths among diabetic patients.⁽³⁾ Patients with diabetes have a 2-to-4-fold higher risk of cardiac events than their nondiabetic counterparts. In fact, the risk of myocardial infarction in diabetic patients without previous CAD is comparable to the risk of reinfarction in nondiabetics subjects with previous CAD.⁽¹⁾

Noninvasive testing, including myocardial perfusion scintigraphy has been used to detect CAD in diabetic patients,⁽⁴⁾ and a clear association between abnormal test results and worse outcome has been demonstrated, similar to that in the general population.⁽⁵⁾ Nonetheless, after normal findings, elevated event rates are still observed in diabetic patients compared with nondiabetic individuals,⁽⁵⁾ indicating a need for further refinement of prognostication in this population. The higher event rates in patients with diabetes compared with those in patients without diabetes could be related to differences in coronary plaque burden and composition. Therefore, direct visualization of coronary plaque burden could be a useful

tool for risk stratification. Indeed, using invasive techniques, a considerably higher extent of CAD and plaque burden have been demonstrated in the presence of diabetes.⁽⁶⁾

Arterial calcium development is intimately associated with vascular injury and atherosclerotic plaque. Coronary artery calcified plaque (CACP) is an active process and can be seen at all stages of atherosclerotic plaque development.⁽⁷⁾

Symptomatic patients with a high pre angiographic likelihood for significant CAD are expected to have substantially higher coronary calcium quantities.⁽⁸⁾ The calcium score parallels the increasing prevalence of clinical coronary artery disease increasing with age and it may be used to estimate the degree of angiographic lumen narrowing irrespective of age and gender.⁽⁹⁾ However, the role of calcium quantification for risk assessment especially in an elderly high-risk population remains controversial.⁽¹⁰⁾

To date, atherosclerosis has been noninvasively assessed by EBCT and non contrast MDCT in patients with type 2 diabetes using coronary calcium scoring, which reveals extensive atherosclerosis.⁽¹¹⁾ Still, coronary calcium scoring may seriously underestimate coronary plaque burden as noncalcified lesions are not recognized.⁽¹²⁾ More recently, contrast-enhanced multislice computed tomography (MSCT) coronary angiography has become available, which allows, in contrast to calcium scoring, detection of both calcified and noncalcified coronary lesions.⁽¹³⁾

As a result, the technique potentially allows a more precise noninvasive evaluation of coronary atherosclerosis, which in turn could be valuable for improving risk stratification.

Retrospectively electrocardiographically (ECG) gated multislice or multidetector computed tomographic (MDCT) coronary angiography is a robust noninvasive imaging modality with high spatial and temporal resolution that enables accurate diagnosis or exclusion of coronary artery disease (CAD). It is the noninvasive imaging examination of choice for patients who have angina pectoris with inconclusive stress test results and low to intermediate risk of CAD.^(14,15)

Although myocardial perfusion imaging has been available in routine clinical settings since the 1970s, the development of gated single-photon emission tomography (gated SPECT) over the past two decades has made possible a combined assessment of myocardial perfusion and left ventricular function. This additional information on ventricular function has proven to be useful for both the diagnosis and prognosis of CAD.⁽¹⁶⁾

Patients with diabetes are at risk of cardiovascular mortality and are more likely to have silent ischemia and less likely to survive a myocardial infarction than non diabetic individuals. This risk is 7-fold greater in diabetic patients with myocardial perfusion defects than in diabetic patients for whom scintigraphic data are normal.⁽¹⁷⁾