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

Thesis
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By

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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 foud. 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.

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

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

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

SCONTENT

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]