Myocardial Perfusion gated SPECT in prognostic stratification of patients with ischemic heart disease, Pilot Study.

Thesis

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« بسمِ اللهِ الرحمن الرحيمِ»

« قُـل اللهُـمّ مٰـلك المُـلكِ تُـؤتِى المُـلكَ
مَن تَشاءُ وتَنزعُ المُلكَ مِمّن تَشَاءُ وتُعِـزّ
مَن تَشاءُ وتُـذِلّ مَن تَشاءُ بِيدِك
الخَيــرُ إِنّــك عَلــىٰ كُــلّ شــىءِ
قديرُ. »

»« سورة ٰالِ عمران اٰية ٢٦»«

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DEDICATION

I dedicate this work to the soul of my father

To My wife's help &

My lovely son & beauty daughter

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List of Abbreviation

ACS	Acute coronary syndrome
ACS	Acute coronary syndrome
AHA	American heart association
AMI	Acute myocardial infarction
ASE	American Society of Echocardiography
AV-	Atrioventricular
BP	Blood pressure
CABG	Coronary artery bypass grafting
CAD;	Coronary artery disease
CK	Creatine kinase
CMR	Cardiovascular magnetic resonance
CMR	Cardiovascular Magnetic Resonance
Co	Carbon Monoxide
DSE	Dobutamine stress echocardiography
EBCT	Electron beam computerized tomography
ECG	Electrocardiogram
EDV	End diastolic volume
EF	Ejection fraction
ERNA	Equlibrium radionuclide angiography
ESV	End systolic volume
FDG	Floride deoxy glucose
Fig	Figure
FPRNA	First pass radionuclide angiography
GSPECT	Gated SPECT
h	Hour
HDL-C	High density lipoprotein-C
HDL-C	high-density lipoprotein cholesterol
HLA	horizontal long axis
HR	Heart rate
IV	Intravenous
K^+	Potassium ion
keV	Kilo electron Volts
Kg	Kilogram
LAD:	Left anterior descending artery
LBBB	left bundle branch block
LBBB	left bundle branch block
LCX:	Left circumflex artery
LDL-C	Low density lipoprotein-C
LDL-C	low-density lipoprotein cholesterol
LVEF	Left ventricular ejection fraction
LVH	Left ventricular hypertrophy

LVVs	Left ventricular volumes
MBF	Myocardial blood flow
MBq	Mega becquerel
mCi	Milli Curie
MI	Myocardial infarction
min	Minute
MPHR	Maximum predicted heart rate
MPI	Myocardial perfusion imaging
MPS	Myocardial perfusion scintigraphy
MRI	Magnetic resonance imaging
MSCT	Multislice computerized tomography
Na^{+}	Sodium ion
$^{13}NH_3$	Nitrogen thirteen Ammonia
PCI	Percutaneous coronary intervention
PDA	posterior descending artery
PET	Positron emission Ttomography
RCA:	Right coronary artery
RPP	Rate pressure product
RV	Right ventricle
SA	Short axis
SD	Standard deviation
SDS	Summed difference score
SPECT:	Single photon emission computed tomography
SRS	Summed rest score
SSS	Summed stress score
STD	ST segment depression
STE	ST segment elevation
TID	Transient ischemic dilatation
^{201}Tl :	Thallium 201
^{99m}Tc	Technetium-99m
^{99m}Tc sestamibi	^{99m}Technetium hexakis-2-methoxyisobutyl isonitrile
^{99m}Tc-NOET	^{99m}Tc (N- ethoxy-N-ehtyl-dithiocarbamato) nitride
VLA	Vertical long axis
WMA	Wall motion abnormalities
µg	Micogram

Abstract

^{99m}Tc- MIBI gated SPECT imaging is a powerful tool for prediction of future cardiac events. Fixed perfusion defect, diabetes mellitus (DM) and ejection fraction (EF) were independent predictors of cardiac events. EF is the most powerful factor as an independent predictor of cardiac events over perfusion parameters. Higher event rate occur more with patients who had history of DM with fixed perfusion defects and EF less than 50%. Patients with normal perfusion have an excellent event-free survival rate during follow-up. The results of our study could be used to guide the decision process after nuclear testing either by referring to intervention or conservative management.

Key Words Gated SPECT**,** Ejection fraction, Diabetes mellitus

Introduction and Aim of the Work

Evaluation of the left ventricular (LV) perfusion and function is important in clinical cardiology. Quantifying the degree and extent of the LV functional abnormalities permits a systematic assessment of the disease process on the myocardial performance, provides an objective basis for the risk stratification and therapeutic strategy and allows for the sequential follow-up of the therapeutic response. Since its introduction in the late 1980s, electrocardiographically (ECG) gated myocardial perfusion SPECT (GSPECT) has been increasingly used for the assessment of the LV function in the clinical setting. ECG gating of a standard myocardial perfusion SPECT acquisition allows for the quantitative or semi quantitative assessment of the LV function simultaneously with the evaluation of the LV perfusion ***(Cullom et al., 1998.).***

Left ventricular dysfunction is the most important predictor of mortality following myocardial infarction. In patients who have myocardial infarction (MI) with an ejection fraction (EF) below 30%, mortality is markedly increased at one year. The measurement of ventricular volumes (LVVs) and EF is clinically important, because volume changes may be critical for analysis of patients with heart failure ***(saman et al., 1999)***.

The diagnostic role of myocardial perfusion SPECT in patients with coronary artery diseases (CAD) is well recognized. Gating provides additional information that cannot be obtained by perfusion imaging alone. For example, a normal perfusion study in a patient

undergoing screening generally carries an excellent prognostic value ***(Saman et al., 1999).***

Electrocardiography-gated mode for simultaneous assessment of myocardial perfusion and LV function in GSPECT allows better clinical risk stratification using assessment of ventricular function variables in addition to perfusion findings. Validation studies indicate that measurement of LVVs and EF by this approach are highly accurate ***(Lipke et al., 2004).***

An abnormally low LVEF in such patients may alert the physician to look for other co morbidities, whereas a normal function and perfusion obviate the need for further invasive cardiac investigations. In patients with 3-vessel coronary disease, perfusion abnormalities may not always be evident in all vascular territories because of the globally reduced perfusion. In a recent study that included 143 patients with angiographically proven 3-vessel disease, combined perfusion-function assessment by GSPECT has been shown to yield significantly more abnormal segments in comparison with perfusion alone ***(Lima et al., 2003).***

Combined perfusion-function analysis can also differentiate ischemic from nonischemic, dilated cardiomyopathy. Although both the perfusion and the LV function are abnormal in patients with ischemic cardiomyopathy, LV dysfunction is present without any significant perfusion abnormalities in patients with nonischemic cardiomyopathy ***(Daniaset et al., 1998).***

Three gamma (γ)-camera imaging techniques are available to measure the ventricular function: first-pass radionuclide angiography (FPRNA), equilibrium gated radionuclide angiography (ERNA), and

GSPECT. During a GSPECT study, a perfusion tracer is injected. The tracer is taken up by the LV myocardium. Definition of the LV myocardium and LV cavity is achieved by delineating the epicardial and endocardial edges on the perfusion image. LV global and regional contractile function is quantitated based on the changes in the LV volume, excursion of the endocardium, and brightening of the myocardium from the end-diastolic image to the end-systolic image, as identified by the ECG. Because right ventricle (RV) myocardium is not adequately visualized on the perfusion images, GSPECT is not suitable for accurate RV function measurement ***(Nichols et al., 1997)***.

A number of studies have demonstrated the clinical usefulness of GSPECT. Because patients with known or suspected CAD constitute the majority of those referred for perfusion imaging, most of the studies have been performed on CAD patients. The value of GSPECT in detection of 3-vessel CAD and assessment of ischemic severity is well documented. The role in risk stratification, prognostication, viability assessment, and follow-up after revascularization is still evolving ***(Hida et al., 2003.)***.

Aim of the work

In this study, we aim to assess the feasibility of ^{99m}Tc-MIBI myocardial perfusion gated SPECT quantitative and qualitative parameters in prognostic risk stratification of an Egyptian population with known or suspicious coronary artery diseases.

Anatomy of the Coronary Arteries

The left ventricle is a rather carrot-shaped structure, whose long axis points downwards, forwards and to the left. It has a base and an apex and 3 walls (anterior, posterior and lateral) besides the septum. The ventricular septum is divided into a smooth proximal membranous part and a trabeculated distal muscular part ***(Hartnell and Raphael., 2001).***

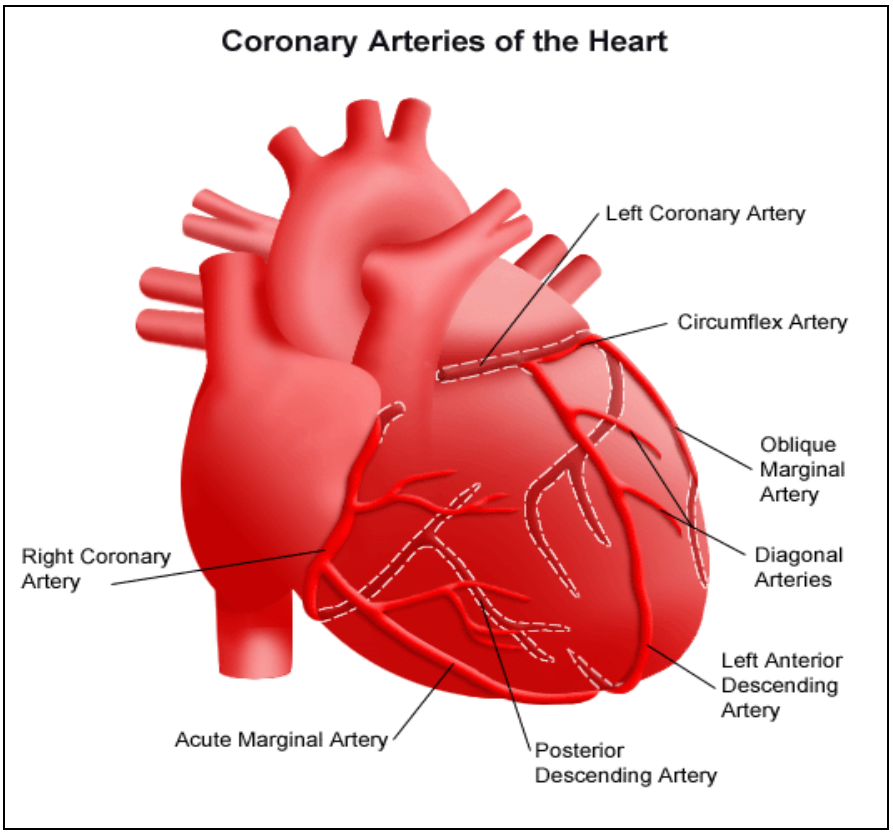

Figure 1 ***Coronary arterial supply of the heart. Quoted from (www.cardio.com).***

The human coronary circulation has two major arterial vessels, the right and the left coronary arteries, which arise from the corresponding sinuses of the aortic valve apparatus. Both arteries have a tendency to