KASR ALAINY

THE ROLE OF GATED MYOCARDIAL PERFUSION SPECT IN EVALUATION OF MYOCARDIAL VIABILITY IN ISCHEMIC CARDIAC PATIENTS, COMPARED TO ECHOCARDIOGRAPHY

Thesis

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To my father, Mother

&

My Husband

&

My Dear Sons Ali & Omar.

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Abstract

Background

201-Tl myocardial single-photon emission computed tomography (SPECT) is recognized to be an excellent tool for identifying viability after myocardial infarction, but being expensive and needing a longer time for imaging are among its main limitations. Hence this study was designed to evaluate the effectiveness of low dose dobutamine echocardiography and Tc-99m myoview gated SPECT in assessment of myocardial viability in comparison to 201-Tl.

Patients and Methods

35 patients (34 males and 1 females) were included in this study to identify viable myocardium by defining akinetic or dyskinetic segments and compare the wall motion of segments in the echocardiography and myoview with that in the gold standard 201-Tl scan together with comparison of the perfusion in Myoview with 201-Tl scan.

Results

We compared the segments in patients; we had 560 segments in the myoview, 201-Tl SPECT and echocardiography. Low dose dobutamine echocardiography identified 325/560 segments (**58%**) as viable myocardium compared to 525/560 (**83.3%)** by Tc-99m Myoview gated SPECT while 201-Tl identified 536/560 (**85 %**) viable segments. Sensitivity, specificity PPV and NPV for low dose dobutamine echocardiography and Tc-99m Myoview gated SPECT were [60.6 %, 100%, 100%, 30.8%] and [98%, 100%, 100% and 93.5%] respectively.

Conclusion

Tc-99m gated SPECT scan in better than the low dose echocardiography in assessment of myocardial viability.

Key Words

Myocardial viability, Tc-99m gated SPECT scan, echocardiography, and 201-Tl.

List Of Abbreviations

-ve	Negative
+ve	Positive
µCi	Micro Curie
µg	Micro gram
µL	Micro liter
ECG	Electrocardiography
2D	two-dimensional
3D	three-dimensional
^{18}F	Fluorine-18
^{99m}Tc	Technetium-99m
l23-I	Iodine-123
ATP	adenosine triphosphate
CBC	Complete blood picture
CABG	coronary artery bypass graft
CAD	Coronary artery disease
cm	Centimeter
CMR	Cardiac magnetic resonance imaging
CT	Computed Tomography
DTPA	Diethylenetriaminepentacetic
ESV	End systolic volume
EDV	End diastolic volume
FDG	18-Fluorodeoxyglucose
H	Hour
EF	Ejection fraction
HB	Hemoglobin
ICD	implantable cardioverter defibrillator
Min	minute
K counts	Kilo counts
KeV	Kilo electron Volt
Kg	Kilogram

LVEF	Left ventricular ejection fraction
LV	Left ventricle
Mcg	Microgram
MBq	Mega Bequeral
mCi	milliCurie
MSCT	multislice CT
Mm	Milli meter
MCE	myocardial contrast echocardiography
MRS	magnetic resonance spectroscopy
MRI	Magnetic Resonance Imaging
NYHA	New York Heart Association
PET/CT	Positron Emission Tomography/CT
PET	Positron Emission Tomography
31 P	phosphorus-31
PCr	Phosphocreatine
RBCs	Red blood cells
S	Second
SPECT	Single photon emission computed tomography
$	United state dollar
STIR	Short TI inversion recovery
SD	standard deviation
MI	Myocardial infarction
T1	Commonly used term that describes an MRI signal
201- Tl	Thallium-201
Tc-99m	Technethium 99m
US	Ultrasonography
QGS	Quantitative gated SPECT
QPS	Quantitative perfusion SPECT

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الدراسات العليا

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الطبيب / مروة السيد عبد الحي السويدي
توطئة للحصول على درجة الماجستير / الدكتوراه
في الطب النووي

تحت عنوان : باللغة الانجليزية : The Role of Gated Myocardial Perfusion SPECT in Evaluation of Myocardial Viability in Ischemic Cardiac patient Compared To Echocardiography.

باللغة العربية : دور المسح الذري المقطعي لبطين حمويه عضلة القلب في مرضى وعيوب الشرايين التاجيه مقارنة بالموجات الصوتية باستخدام عقار الدوبيوتامين

بناء على موافقة الجامعة بتاريخ ٥ / ٨ / ٢٠١٢ تم تشكيل لجنة الفحص والمناقشة للرسالة المذكورة أعلاه على النحو التالي :-

١. عمرو محمد امين عبد الغني ..... عن المشرفين
٢. سامي عبد الفتاح ابو الفضل ..... ممتحن داخلي
٣. اسلام كوني عبد العزيز ..... ممتحن خارجي

بعد فحص الرسالة بواسطة كل عضو منفردا وكتابة تقارير منفردة لكل منهم انعقدت اللجنة مجتمعة في يوم الاحد بتاريخ ١٢ / ٨ / ٢٠١٢ بقسم ..... مدرج .....
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قرار اللجنة : قررت اللجنة قبول الرسالة

توقيعات أعضاء اللجنة :-

المشرف الممتحن	الممتحن الداخلي	الممتحن الخارجي

Introduction

During the past decade, numerous studies have demonstrated that nuclear cardiology techniques involving single photon methods as well as positron emission tomography (PET) provide important information about myocardial viability in patient with left ventricular dysfunction at present, several clinically reliable physiological markers of viability can be used for this purpose. These include indices of regional coronary blood flow, regional wall motion and regional systolic wall thickening (**Cuocolo et al, 1992).**

These are accurate markers for viability when they are normal or nearly normal but have major limitations in the identification of viable myocardium when severely reduced or absent. In the setting of hibernating myocardium, by definition, indices of regional perfusion and systolic function (regional wall motion and thickening) will be severely reduced or absent despite of maintenance of tissue viability, thus these indices are imprecise in differentiating hibernating myocardium from myocardial scarring (**Dilsizian et al, 1994).**

Although measures of baseline systolic function are imprecise indicators for viability, contractile reserve is maintained in viable hibernating myocardium, and this index can be assessed readily with low dose dobutamine echocardiography. Numerous studies attest to the accuracy of dobutamine echocardiography in unmasking dysfunction but viable myocardium and in predicting recovery of function after revascularization. This remains an exciting area in current investigation (**Dilsizian et al, 1994).**

Because retention of 201-Tl with time is an active process that is a function of cell viability and cell membrane activity. 201-Tl is a marker of myocardial viability. Tc-99m sestamibi, like 201-Tl, requires intact

sarcolemmal and mitochondrial process of retention. This agent has been shown to be an excellent marker of cellular viability. In both experimental and clinical settings in which Tc-99m sestamibi delivery to dysfunctional myocardium is adequate. It can be considered as a marker of myocardial viability rather than a pure marker for perfusion. However Tc-99m sestamibi does not redistribute as avidly as does 201-Tl. Subsequent studies have provided consistent and convincing evidence indicating the role of Tc-99m sestamibi for viability assessment in patient with left ventricular dysfunction (**Dilsizian et al, 1994).**

As is the case with 201-Tl imaging, myocardial regions with systolic dysfunction that manifest reversible ischemia during Tc-99m sestamibi imaging have a very high likelihood of recovery of function after revascularization. Also, there is inverse relationship between regional Tc-99m sestamibi activity during rest and the extent of interstitial fibrosis measured in myocardial biopsy specimens. This observation translates into a continuous relation, similar to that observed during 201-Tl imaging, between regional Tc-99m sestamibi activity and the likelihood of improvement in regional function after revascularization (**Cuocolo et al, 1992).**

Regional Tc-99m sestamibi activity at rest correlates more strongly with 201-Tl redistribution images rather than when resting Tc-99m sestamibi and rest-redistribution 201-Tl images are compared in the same patients, therefore reversibility of stress induced defects, the severity of resting defect or nitrate enhanced Tc-99m sestamibi imaging at rest would optimize the use of Tc-99m sestamibi for detecting ischemic viable but dysfunctional myocardium (**Dilsizian et al, 1994).**

Aim of the work

To evaluate the role of gated SPECT myocardial perfusion scan in comparison with dobutamine echocardiography in assessment of myocardial viability.

Chapter 1

Basic consideration of Myocardial Ischemia

Myocardial ischemia is the result of transient imbalance of myocardial oxygen supply and demand, leading to symptoms and signs, which can be used as diagnostic markers **(Nesto and Kowalchuck, 1987).**

Effects of ischemia:

Irrespective of its cause, myocardial ischemia in a coronary territory is associated with three clinical manifestations: -

1. Abnormal regional left ventricular function,
2. ECG changes,
3. Angina.

The loss of normal contractile activity in that vascular bed rapidly results in asynergy, which is recognizable at echocardiography **(Kerber et al., 1975)**. Acute coronary occlusion provokes paradoxical motion (systolic bulge or dyskinesia) in the central ischemic zone, reduced contraction (akinesis or hypokinesis in the adjacent zone) and compensatory hyperkinesis in the surrounding unaffected myocardium **(Lew et al., 1985)**.

Ischemia induced alteration of systolic function occur very rapidly. During coronary angioplasty, **Wijns et al., 1986** showed a regional increase in left ventricular stiffness within 20 seconds of coronary occlusion. Indeed, left ventricular distensibility decreases before the onset of systolic failure **(Aroesty et al., 1985)**.

The sequence of functional events induced by ischemia begins with diminished left ventricular compliance, followed by decreased myocardial contractility and increased left ventricular end diastolic pressure. These changes are evidenced at echocardiography by alterations of transmitral flow pattern, abnormal regional systolic function and eventual left ventricular cavity enlargement and reduction of overall left ventricular function **(Armstrong, 1988).**