Value of Tc-99m SestaMIBI washout rate in detection of ischemia compared with standard myocardial perfusion imaging

Thesis Submitted for Partial Fulfillment of Master Degree in Nuclear Medicine

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2015

Acknowledgements

All praise and gratitude must be attributed to Allah; for encompassing me with his grace and his help and for providing me with all that I required to achieve this work.

I would like to express the deepest appreciation to my professor and my second mother Dr. Hosna Moustafa; Professor of Nuclear Medicine, Cairo University for her help, and her continuous support and encouragement during the different stages of this thesis, and for representing the spirit of higher quality and relevant education in our department.

I also deeply indebted to Dr. Mahasen Bbo Gabal, ass. Professor of Nuclear Medicine, Cairo University, for her constant supervision since day one of this work, and for her fruitful decisions and reading the manuscript circularly.

I also gratitude Mr. Sherif El-Maghraby; Physicist of Nuclear Medicine, Cairo university, who spent a lot of his time and effort to teach me and help me throughout all the work of the thesis.

Distinctive thanks to my colleagues at nuclear medicine department, Cairo University for their cooperation and valuable advices.

And I will stand long with Dr. Amr Amin; Professor of Nuclear Medicine, Cairo University who was the real owner of the idea of this work and really no words could express his actual stature, and we could just pray to GOD to encompass him with his eternal peace in his highly heavens.

Finally, I wish to express my sincere gratitude to my family for their spiritual support, patience and enthusiastic encouragement.

Abstract

Key words: Ischemia, ECG-gated cardiac SPECT, washout rate, SestaMIBI

We aimed in this study to estimate the rate of MIBI washout of myocardium in patients with clinical ischemia and comparing it to the degree of reversibility between stress and rest studies. This prospective study included 50 who underwent 2 days protocol ECG-gated SPECT Tc-99m SestaMIBI myocardial perfusion imaging, the washout rate is then calculated from the early and delayed rest images. The study showed that there is higher washout rate of MIBI in ischemic walls in all vascular territories with significant correlation with its degree of reversibility that could potentiate the results of stress study

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ABBREVIATIONS

^{201}TI	thallium-201
^{82}Rb	Rubidium-82
^{99m}Tc	technetium-99m
ATP	Adenosine triphosphate
BMI	Body mass index
BMIPP	123beta-methyl-iodophenyl pentadecanoic acid
CA	coronary angiography CA
CAD	Coronary artery disease
CCTA	Coronary computed tomography angiography
CCTA	Coronary computed tomography angiography
ceCMR	contrast enhanced Cardiac Magnetic Resonance
CHF	congestive heart failure
CMR	Cardiac Magnetic Resonance
ECG	Electrocardiogram
EDV	End diastolic volume
ESV	End systolic volume
FCH	Familial Combined Hyperlipidaemia
FDG	Fluorodeoxyglucose
FH	Familial Hypercholesterolemia
GWR	Global washout rate
HDL	High density lipoprotein
IDCM	Idiopathic dilated cardiomyopathy
IHD	Ischemic heart disease
LAD	left anterior descending artery
LCX	left circumflex artery
LM	left main coronary artery
LVEF	Left ventricular ejection fraction
MI	Myocardial infarction
MIBI	Methoxy-iso-butyl isonitrile
MIP	Maximum intensity projection
MPI	Myocardial perfusion imaging
MPR	myocardial perfusion reserve
MPS	Myocardial perfusion scintigraphy
MR	Magnetic Resonance
MUGAs	Multiple gated acquisitions
NICE	National Institute for Health and Care Excellence

PDA	posterior descending artery
PET	positron emission tomography
RCA	right coronary artery
ROC	Receiver operating curve
RWR	Regional washout rate
SDS	Summed difference score
SPECT	Single-photon computed tomography
SRS	Summed rest score
SSS	Summed stress score
WR	washout rate (WR)

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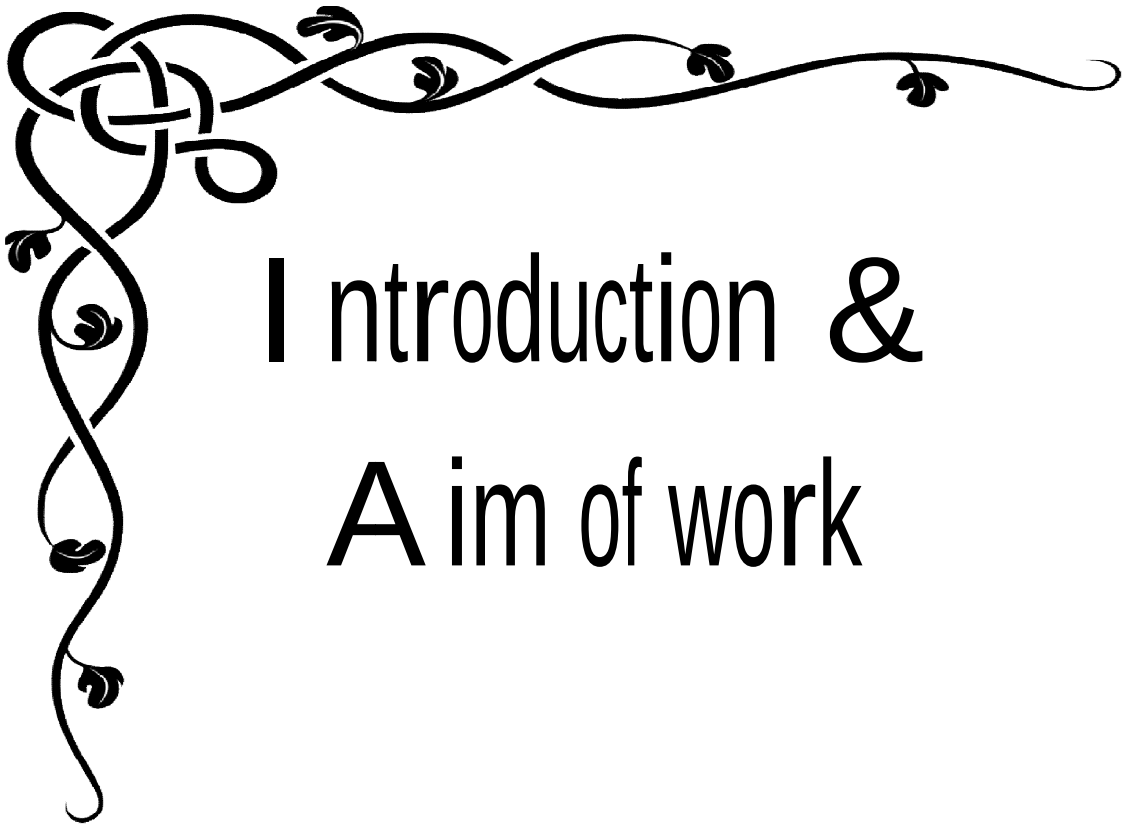


Introduction & Aim of work

Introduction

Coronary artery disease (CAD) is the leading cause of death in adults in the USA, accounting for approximately a third of all deaths in subjects over the age of 35 years.[1] Advanced CAD may exist with minimal or no symptoms and can progress rapidly to an abrupt closure of the artery, possibly resulting in sudden death as initial presentation of coronary heart disease in 18% of patients.[2] Fortunately, over the past 20 years, the mortality rate owing to CAD has decreased. This is, in part, a result of better detection of patients with known or suspected CAD and better subsequent treatment. [3]

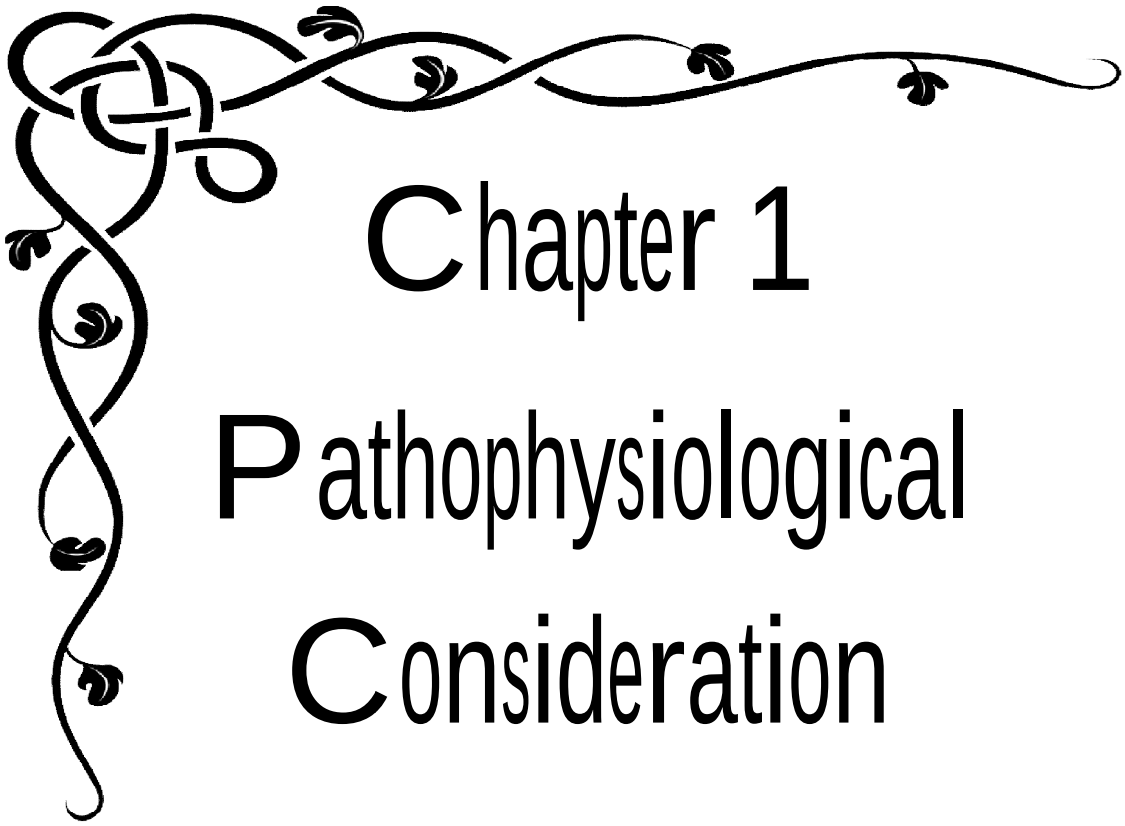
Clinicians are increasingly using noninvasive imaging to determine the presence, site and myocardial ischemia. The development and widespread use of noninvasive imaging techniques have contributed to the improvement in evaluation of patients with known or suspected coronary artery disease and safe guide for treatment options.

Single-photon computed tomography (SPECT) myocardial perfusion imaging are well-established noninvasive techniques that provide incremental value over clinical risk factors for the detection of CAD. Washout rate of 99mTc-sestamibi was suggested as diagnostic tool that helps in detection of CAD [4]. It has been reported that delayed images within few hours can uncover enhanced washout rate (WR) in impaired myocardium [5] [6], it has also been studied that delayed MIBI scan with higher image contrast between normal and ischemic regions due to enhanced MIBI WR in ischemia regions may be more sensitive to detect the severity of myocardial ischemia than the early scan.[7] Such rapid WR was observed in ischemic myocardium deducing that the ability of myocyte to retain the tracer was impaired. [8]

Aim of the work

- Estimation the washout rate of SestaMIBI for normal and ischemic myocardium.

- Comparing the washout rate of SestaMIBI for ischemic myocardium by the degree of reversibility of stress induced perfusion defect.



Chapter 1

Pathophysiological Consideration

Pathophysiology of CAD

Ischemic Heart Disease is defined by a *joint International Society and Federation of Cardiology and World Health Organization task force* as 'myocardial impairment due to an imbalance between coronary blood flow and myocardial requirements caused by changes in the coronary circulation.[9]Coronary artery disease is thought to arise from normal repair processes in response to chronic injuries to the arterial endothelium. It is often the result of local shear stress at bending points and bifurcations of the arterial tree.[10] These stresses are enhanced by hypertension, hypercholesterolemia, glycation end-products of diabetes, tobacco smoke, and other circulating vasoactive amines, immune complexes, and possibly infectious agents.[11] However, it is only presented after marked progression of the initial pathology which briefly shown in Table 1.

Table 1 Clinical picture corresponding to the stage of atherosclerosis

Stage	Pathology		Presentation
I	Intimal thickening	Isolated foam cells (macrophages)	Asymptomatic
II	Fatty streak	Accumulation of intracellular lipid in smooth muscle cells lipid and connective tissue deposition	Asymptomatic
III	Atheroma	Large extracellular Intimal lipid core.	Usually asymptomatic; can also be associated with stable angina
IV	Advanced atheroma	Fibrous layer deposition with extensive calcification in the lipid core	Usually presented with stable angina but may be asymptomatic
V	Complicated atheromatous lesion	Intramural hemorrhage and/or overlying thrombus	Acute coronary syndrome

Quoted from Stary et al (1995) [12]