Clinical Use of cardiac Single Photon Emission Computed Tomography (SPECT)

Thesis

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List of Contents

Title	Page No.

List of Tables i

List of Figures iii

Introduction 1

Aim of the Work 3

Review of Literature

- Ischemic Heart Disease 4
- Myocardial Perfusion Imaging 20
- Appropriateness Use Criteria of Single Photon Emission Computed Tomography 42

Results 71

Discussion 82

Conclusion 87

Recommendations 88

Summary 89

References 91

Arabic Summary

List of Tables

Table No.	Title	Page No.
Table (1):	Pretest probability of CAD according to age, gender and chest pain	52
Table (2):	Detection of CAD: Symptomatic	56
Table (3):	Detection of CAD/Risk Assessment without Ischemic Equivalent	57
Table (4):	Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD	58
Table (5):	Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions*	59
Table (6):	Risk Assessment: Within 3 Months of an Acute Coronary Syndrome	59
Table (7):	Risk Assessment: Post-revascularization (Percut-aneous Coronary Intervention or Coronary Artery Bypass Graft)*	60
Table (8):	Assessment of Viability/Ischemia	60
Table (9):	Evaluation of Ventricular Function	60
Table (10):	Appropriate Indications (Median Score 7–9)	61
Table (11):	Uncertain Indications (Median Score 4–6)	63
Table (12):	Inappropriate Indications (Median Score 1–3)	64
Table (13):	Summed stress score according to cedars-sinai scoring system. Other centers may use alternative scoring systems with varying cutoffs for normal results	69
Table (14):	Shows age and gender distribution of both groups.	72
Table (15):	Shows the risk factor distribution among both groups.	73
Table (16):	Indications of SPECT in both groups	74
Table (17):	Shows the pretest probability in both groups.	75

List of Tables (Cont...)

Table No.	Title	Page No.
Table (18):	Shows the distribution of different categories according to FRS in both groups.	76
Table (19):	Pre-procedural ECG findings in both groups	76
Table (20):	Shows mode of stress in both groups.	77
Table (21):	Development of symptoms during exercise test in both groups	78
Table (22):	Shows the results of MPI in both groups	78
Table (23):	Appropriateness criteria in both groups	79
Table (24):	The number and percentage of each appropriateness criteria in both groups.	80
Table (25):	The number and percentage of each appropriateness criteria in relation to results of MPI in both groups.	81

List of Figures

Fig. No.	Title	Page No.

Figure (1): Percentage of patients in both groups 71

Figure (2): Appropriateness criteria in both groups 72

Figure (3): Appropriateness criteria in both groups. 79

List of Abbreviations

Abb.	Full term

ACC..... : American College of Cardiology.
AF ..... : Atrial Fibrillation.
AHA ..... : American Heart Association.
ALS ..... : Advanced Life Support.
AUC ..... : Appropriateness Use Criteria.
BP ..... : Blood Pressure.
CAD ..... : Coronary Artery Disease.
CHD ..... : Coronary Heart Disease.
CT ..... : Computed Tomography.
CVD ..... : Cardiovascular Disease.
DM ..... : Diabetes Mellitus.
ECG ..... : Electrocardiography.
FRS ..... : Framingham Risk Score.
GTN ..... : Glyceryl Trinitrate.
HR..... : Heart Rate.
IHD ..... : Ischemic Heart Disease.
ILS ..... : Immediate life support.
IVCD ..... : Intra-Ventricular Conduction Delay.
LBBB ..... : Left Bundle Branch Block.
MBq ..... : Millibecquerel=Millicuri(mci).
MI..... : Myocardial Infarction.
MPI ..... : Myocardial Perfusion Imaging.
MRI ..... : Magnetic Resonance Imaging.
NSTEMI ..... : Non S-T Elevation Myocardial Infarction.
PCI ..... : Percutaneous Coronary Intervention.
PET ..... : Positron Emission Tomography.

List of Abbreviations (Cont...)

Abb.	Full term

RBBB ..... : Right Bundle Branch Block.
RNI ..... : Radionuclide Imaging.
SDS ..... : Summed Difference Score.
SPECT ..... : Single Photon Emission Computed Tomography.
SPSS ..... : Statistical Package for Special Science.
SRS ..... : Summed Rest Score.
SSS..... : Summed Stress Score.
SVT ..... : Supraventricular Tachycardia.
Tc99m ..... : Technetium 99 m
UA..... : Unstable Angina.
VSD..... : Ventricular Septal Defect.
WHO ..... : World Health Organization.

INTRODUCTION

Throughout the period from 1993 to 2001, there has been an explosive growth in cardiovascular imaging with stress testing demonstrating 6.1% annual increase versus 2% for cardiac catheterization, 0.8% for percutaneous intervention, and 0.1% for acute myocardial infarctions in population-based study of the United States Medicare patients ***(Lucas et al., 2006).***

In response to these developments, the American College of Cardiology pioneered appropriateness criteria for single-photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) in 2005. The criteria were developed to account for evidence-based clinical relevance of stress perfusion imaging and were the first cardiology specific document to address appropriateness. The criteria relied on the modified RAND/UCLA methodology to identify 52 common clinical scenarios that were divided by level of appropriateness into appropriate, uncertain, and inappropriate indications ***(Patel et al., 2005, Brindis et al., 2005).***

SPECT criteria were reviewed in 2007 with new designations suggested for some indications ***(Ward et al., 2007).*** An update on appropriateness criteria was published in May 2009 ***(Hendel et al., 2009).***

Despite these developments, the clinical use of the appropriateness criteria has not become standard of practice for physicians. Gibbons et al. have investigated performance of appropriateness criteria for stress SPECT and stress echocardiography in 284 and 298 patients, respectively ***(Gibbons et al., 2008)***. Overall, 64% of stress studies were appropriate, 14% of SPECT and 18% of stress echocardiography studies were performed for inappropriate indications, and approximately 10% of all patients were unclassifiable.

In a prospective multicenter trial, the appropriateness criteria were evaluated in 7 physician practices of various size inpartnership with United HealthCare. Overall, 14% of all studies were inappropriate, most in asymptomatic individuals ***(Hendel, 2009).***

Aim of the Work

Is to evaluate appropriateness use criteria and the downstream use of resources as defined by patient outcomes in different nuclear centers.

ISCHEMIC HEART DISEASE

Ischemic Heart Disease is one of the groups of conditions which are known as cardiovascular disease - the others being cerebrovascular disease, hypertension ,heart failure and rheumatic disease ***(World Health Organization, 2009).*** 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 ***(Warrell et al., 2004).***

Throughout the UK, Europe, the US and most of the developed world, cardiovascular disease is the leading cause of death, with around 30% of annual worldwide deaths resulting from these conditions. Of these, approximately 44% are directly due to ischemic heart disease. Whilst cardiovascular diseases have traditionally been considered as diseases of the 'developed' world, the prevalence of these conditions is decreasing in developed countries due to improvements in prevention, diagnosis and treatment, and changes in lifestyle such as the reduction in smoking rates. In contrast, due to increasing rates of urbanization and adoption of 'western' culture, the prevalence of cardiovascular disease in developing countries is rapidly increasing ***(World Health Organization, 2009).*** It is expected that over 80% of the future increase in

worldwide mortality rates for heart disease will be in third world and developing countries, with prevalence rates in developed countries falling or remaining static.

Definition of Ischemic Heart Disease

Ischemic heart disease (I.H.D.) is a condition which results from reduced blood supply to the heart muscle. This usually involves impairment of blood flow through the coronary arteries, most commonly caused by atherosclerotic narrowing, but occasionally due to arterial spasm ***(Warrell et al., 2004).***

The reduction in blood supply to the heart muscle can result in a number of clinical presentations:

- Chronic stable angina (angina pectoris)
- Acute coronary syndromes such as myocardial infarction and unstable angina
- Chronic ischemic heart disease such as silent myocardial ischemia.
- Sudden cardiac death

Definition of Chronic Stable Angina

Chronic stable angina was first identified by Heberden in 1768 who described the condition as resulting in a pain that had a “sense of strangling and anxiety”, further stating that individuals suffering from angina “are seized while they are

walking (more especially if it be uphill, and soon after eating) with a painful and most disagreeable sensation in the breast, which seems as if it were to extinguish life, if it were to increase or continue; but the moment they stand still, this uneasiness vanishes.…The pain is sometimes situated in the upper part, sometimes in the middle, sometimes at the bottom of the os sterni, and often more inclined to the left than to the right side. It likewise very frequently extends from the breast to the middle of the left arm" ***(Heberden, 1768 as cited in Warrell et al., 2004).***

Definition of Myocardial Infarction

The new European Society of Cardiology and American College of Cardiology definition of myocardial infarction ***(Thygesen et al., 2007)*** states that the term can be applied when there is evidence of myocardial necrosis consistent with myocardial ischemia, listing a number of criteria which if met, means the formal diagnosis of myocardial infarction can be used. These criteria include:

Detection of a rise and/or fall of cardiac biomarkers (usually troponin) to assess the degree of necrotic damage to the myocardium, together with evidence of one or more of the following symptoms:

Symptoms of ischaemia

- ECG changes indicating new ischaemia (e.g. left bundle branch block)
- Development of pathological Q waves on an ECG
- Imaging results indicating loss of myocardial tissue or abnormal wall motion.

Clinical Features

The first sign that a person has suffered a myocardial infarction may be sudden death – over 50% of all myocardial infarctions are rapidly fatal ***(Capewell et al., 2001).*** In those who survive, the features are:

- Prolonged chest pain, similar in nature to angina, lasting several hours, in over 80% of patients. Pain may be slight or absent in the elderly and diabetics.
- Tachypnoea, breathlessness (and hyperventilation).
- Anxiety and apprehension.
- Sweating, nausea, sometimes vomiting and occasionally hiccoughs.
- Fall in BP, bradycardia and often elevation of the JVP; but sinus tachycardia in ⅓ of patients.
- Audible and palpable atrial gallop (A fourth heart sound due to forceful atrial ejection).