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BRIEF COMMUNICATION

Specificity of Myocardial Perfusion Imaging: Issues With Proposed MBS Item Review

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Myocardial perfusion scanning (MPS) is commonly used to assess patients with an intermediate to high risk of coronary artery disease. Concerns have been raised about the accuracy of this test. There is little recent data regarding the specificity of the MPS in the context of current medical therapy. The primary objective of this study is to determine the specificity of MPS in diagnosing obstructive coronary artery disease. A total of 184 patients fulfilled study criteria. The overall specificity of MPS for obstructive coronary artery disease was 54%.The only demographic variable that influenced specificity was gender: males with a specificity of 66% and females with a specificity of 29% (p-value = 0.001). These results suggest that the real world specificity of MPS is lower than previously indicated, particularly in the female population. The limitations proposed by the Cardiac Services Committee Report are therefore unlikely to improve patient outcomes.

Keywords Coronary angiography • Myocardial perfusion scintigraphy • Non-invasive assessment • Specificity

Introduction

An estimated six-hundred thousand Australians have coronary artery disease (CAD) [1]. Stress testing is an important diagnostic tool for the investigation of those with suspected CAD. Investigations that can be used to non-invasively assess and risk-stratify patients include electrocardiographic stress testing (EST) along with anatomical and functional cardiac imaging techniques. Myocardial perfusion scintigraphy (MPS) is a commonly used investigation, providing a functional assessment of relative myocardial perfusion and hence coronary blood flow [2]. In particular, MPS can be used in patients with an intermediate to high pre-test probability of CAD who are poor candidates for exercise stress tests (baseline ECG abnormalities or a paced rhythm), similar to stress echocardiography [3,4]. Recent proposed changes to the Medicare benefits schedule (MBS) in Australia and appropriate use criteria (AUC) in the United States suggest MPS demonstrating impaired perfusion in >10% of the myocardium be used as a threshold for coronary revascularisation. This must be predicated on MPS having a reasonable diagnostic accuracy.

The sensitivity of MPS is higher than EST [4]. The limitations of MPS include radiation exposure, higher cost, the need for specialist equipment and a low specificity with a high rate of false positive results in certain patient groups [5,6]. The specificity of single photon emission computer tomography (SPECT) MPS is estimated at around 73–75% for detecting greater than 50% stenosis [7,8]. There have been few studies comparing the specificity of MPS in different patient groups in the era of modern medical therapy.

Initial studies in the area of SPECT-MPS in women demonstrated decreased specificities compared to the male

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population [3,9]. Recent studies with modern techniques have suggested an improved specificity of MPS in women, equal that of males [10,11].

We sought to evaluate the local specificity of MPS in diagnosing obstructive coronary artery disease. We also sought to determine which demographic factors impacted on specificity.

Objectives

The primary objective of this audit is to determine the specificity of SPECT-MPS in the Hunter New England (HNE) Health network for angiographic stenosis greater than 50% in the left main coronary artery, and/or greater than 70% in the major epicardial arteries. The secondary objective is to identify patient demographics and comorbidities that influence the specificity of MPS, such as patients with left bundle branch block or previous revascularisation.

Materials and Methods

A retrospective cohort study was conducted, examining the coronary angiography results in patients with positive myocardial perfusion imaging from 2014 to 2016 in Hunter New England Health. Positive MPS were defined as scans where the reporting nuclear physician concluded there was inducible ischaemia. Patients with only fixed defects were excluded. Ethics approval was gained from the Hunter Research Ethics Committee. Obstructive coronary artery disease was defined as stenosis of greater than 50% in the left main coronary artery, or greater than 70% in subsequent divisions. Positive MPS studies were sourced from the Nuclear Medicine Department of the participating hospitals. The two myocardial perfusion scanners utilised were the Discovery™ NM 530c SPECT, GE Healthcare, U.S.A (John Hunter Hospital) and the Symbia™ T Series 16 slice SPECT, Siemens (Tamworth Rural Referral Hospital). All MPS studies were reported by nuclear medicine physicians. Equivocal MPS studies were excluded. This was cross-referenced with patients who underwent coronary angiography in the 12 months following MPS. A total of 184 patients were included in this study, 125 males and 59 females. Demographic and comorbidity data was sourced from digital medical records.

Statistical Analysis

Count variables are displayed as count (percentage). Continuous variables are displayed as mean (standard deviation) or median (interquartile range). Student t tests were used to compare continuous variables and Chi square or Fisher's exact test were used to compared categorical variables. Areas of ischaemia were categorised into ''Anterior or anterolateral'', ''Lateral'', ''Inferior or Inferolateral'' and ''Global''.

Table 1 Baseline information and demographics.

Baseline information and demographics	
Patients (n)	184
Age (years ± SD)	66 ± 11
Sex (% male)	68%
Type 2 Diabetes mellitus (n,%)	80, 43%
Hypertension (n,%)	139, 76%
Smoker* (n,%)	30, 16%
Obese (n,%)	80, 43%
Previous cardiac bypass surgery (n,%)	28, 15%
Previous percutaneous coronary intervention (n,%)	38, 21%
Impaired left ventricular function (n,%)	52, 29%
Time from MPS to angiogram (days ± SD)	73 ± 73

*Current or previous smoker.

Results

Between 2014 and 2016, a total of 184 patients were identified as having a positive MPS and subsequent angiogram. Of the myocardial perfusion scans performed 68.8% were adenosine (n = 123), 25.5% were exercise (n = 47) and 7.6% were dipyridamole (n = 14). The isotope used was thallium chloride 201. Demographics and co-morbidities are listed in Table 1. Overall, the specificity for a positive MPS correlating with an obstructive angiographic stenosis was 54%.

There was a statistically significant difference in specificity between sexes, males 66% and females 29% (p-value = 0.001). No other variables significantly influenced specificity, including co-morbidities, previous percutaneous coronary intervention (PCI) or coronary artery bypass grafting surgery (CABG), obesity, presence of atrial fibrillation or systolic function. The location of ischaemia did not influence specificity (p = 0.61).

Of the 184 patients, 99 had obstructive coronary artery disease. Of these 99 patients with obstructive disease, 70% had obstructive disease in more than one coronary territory. At completion of the study 60 (32.6%) proceeded to have revascularisation: 18 patients received PCI and 42 patients underwent CABG (Table 2).

Discussion

Our study showed that MPS, as performed in our institution, has a much lower specificity than has previously been reported [12,13]. As a consequence MPS inappropriately increases the demand for coronary angiography with the attendant cost, radiation exposure and complication implications.

At a time when the Cardiac Services Committee Report is recommending significant changes to the way physicians investigate patients at risk of coronary artery disease this audit serves as a timely reminder of the limitations of MPS in this role.

The current recommendations by the Committee advise the use of an exercise stress test (EST) as a screening test with those testing positive then progressing to functional imaging

Table 2 Results from study and analysis of various subgroups.

Results		
Group	Result	p value
Specificity if lesion ≥ 50% stenosis (%)	73%	
Specificity if lesion ≥ 70% stenosis* (%)	54%	
Specificity of female patients	29%	0.0001
Specificity of male patients	66%	
Location of ischaemia		
Anterior/Anterolateral (n = 82)	52%	0.61
Lateral (n = 53)	55%	
Inferior/Inferolateral (n = 47)	55%	
Global (n = 2)	100%	
Obstructive disease		
One vessel	15.8%	
Two vessels	15.2%	
Three or more vessels	22.8%	
Proceeded to percutaneous coronary intervention	10.9%	
Proceeded to cardiac bypass surgery	22.8%	

*Stenosis ≥ 50% left main or ≥ 70% in subsequent divisions.

or angiography. Our audit indicates that MPS, in our health district, is less specific than EST (particularly in females) and subsequent referral for MPS after a positive EST will provide little, if any additional diagnostic information. Consideration should be given as to whether MPS should be recommended as follow up investigation after EST.

This study has several limitations. First, this is a retrospective study and is therefore open to confounding. It should be noted that referral bias has a significant impact on specificity. Second, angiographic stenosis is no longer the gold standard to diagnose haemodynamically significant CAD. Contemporary assessment of coronary artery lesions requires further intra-coronary haemodynamic or imaging assessment, including the ability to assess microvascular resistance [14]. Third, we focussed on specificity and therefore are unable to comment on sensitivity of MPS. The sensitivity of MPS has been reported in the literature as around 84% [15,16]. The majority of studies use ≥50% stenosis as the mark of significant coronary artery disease.

Conclusions

In conclusion, MPS has a low specificity for obstructive coronary artery stenosis at our institutions. The use of this test as proposed by the Cardiac Services Committee's Report is therefore unlikely to improve patient outcomes.

Conflict of interest

No authors have any relevant conflicts of interest to declare.

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