

# DIAGNOSTIC ACCURACY OF SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY BY TAKING CORONARY ANGIOGRAPHY AS GOLD STANDARD FOR THE DETECTION OF CORONARY ARTERY DISEASE

Badar Ul Ahad Gill<sup>1</sup>, Tariq Mehmood Khan<sup>2</sup>, Muhammad Tahir Mohyuddin<sup>3</sup>,  
Tariq Abbas<sup>4</sup>, Zahid Rafique Butt<sup>5</sup>, Bilal Ahsan Qureshi<sup>6</sup>, Ijaz Ahmed<sup>7</sup>

<sup>1-7</sup> Department of Cardiology,  
Chaudhry Pervaiz Elahi Institute of  
Cardiology, Multan, Pakistan

#### **Address for Correspondence:**

**Badar Ul Ahad Gill,**

Department of Cardiology, Chaudhry  
Pervaiz Elahi Institute of Cardiology,  
Multan, Pakistan

E-Mail: badargill1@hotmail.com

Date Received: October 05, 2015

Date Revised: November 26, 2015

Date Accepted: December 03, 2015

#### **Contribution**

BUAG conceived the idea, planned the study and drafted the manuscript. TMK and MHM helped acquisition of data and TA did statistical analysis. ZRB, BAH and IA critically revised the manuscript. All authors contributed significantly to the submitted manuscript.

#### **All authors declare no conflict of interest.**

This article may be cited as: Gill BUA, Khan TM, Mohyuddin MT, Abbas T, Butt ZR, Qureshi BA, Ahmed I. Diagnostic accuracy of single photon emission computed tomography by taking coronary angiography as gold standard for the detection of coronary artery disease. Pak Heart J 2016;49(01): 40-3.

## ABSTRACT

**Objective:** To determine the diagnostic accuracy of Single Photon Emission Computed Tomography by taking Coronary Angiography as gold standard for the detection of Coronary Artery Disease.

**Methodology:** It is a cross-sectional study conducted at the Department of Cardiology, Chaudhry Pervaiz Elahi Institute of Cardiology, Multan from September 2013 to March 2014. Patients with age  $\geq 40$  years belonging to either sex with at least one episode of chest pain lasting for  $\geq 30$  minutes were included in the study. All patients underwent SPECT Scan and the findings of SPECT were confirmed by performing Coronary Angiography of every patient.

**Results:** Out of 282 patients, 45.03% (n=127) were between 40-60 years and 54.97% (n=155) had  $>60$  years of age, with mean age of  $60.83 \pm 9.32$  years. Males were 52.13% (n=147). Results of single photon emission computed tomography by taking coronary angiography as gold standard for the detection of coronary artery disease showed 17.02% (n=48) were true positive, 2.48% (n=7) were false positive, 77.31% (n=218) were true negative and 3.19% (n=9) were false negative. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate was computed as 84.21%, 96.88%, 87.27%, 96.03% and 94.33% respectively.

**Conclusion:** We concluded that Single Photon Emission Computed Tomography, by taking Coronary Angiography as gold standard for the detection of Coronary Artery Disease, has a good diagnostic accuracy and can be used to curtail the financial burden of diagnosis.

**Key Words:** Coronary Artery Disease, Diagnostic Accuracy, Single Photon Emission Computed Tomography

## INTRODUCTION

Single Photon Emission Computed Tomography (SPECT) has an integral role in non-invasive detection of coronary artery disease, assessment of myocardial viability and stratification of risk.<sup>1</sup> It imparts improved sensitivity and specificity over standard exercise stress testing.<sup>2</sup> The sensitivity of SPECT is reported to be 87% and specificity is 73% in detection of coronary artery disease.<sup>3</sup> In one study conducted in Pakistan, Thallium scintigraphy has sensitivity of 89% and specificity of 79% but the sample size in this study was small as this study included only 60 patients and all of them were diabetic.<sup>4</sup>

Coronary angiography is an invasive procedure with serious risks.<sup>5</sup> In this technique, catheter is introduced through a peripheral artery to examine the entire coronary tree. More than 1.5 million coronary angiographies are performed yearly in the United States. Despite the advent of other imaging modalities, coronary angiography remains the gold standard for determining the presence of significant coronary artery disease.<sup>6</sup>

The burden of coronary artery disease is increasing day by day. More than one million people each year in United States sustain an acute myocardial infarction. In the United States, the annual death toll from coronary artery disease is higher than 8,00,000. Several studies in Pakistan and India have suggested substantial morbidity caused by coronary artery disease in this region. Overall prevalence of coronary artery disease is reported to be 11%.<sup>7</sup> SPECT scan is a non-invasive, outdoor procedure with lesser cost requiring lower levels of skill and very low level of complications as compared to coronary angiography.<sup>8,9</sup>

The aim of our study was to determine diagnostic accuracy of SPECT while taking coronary angiography as gold standard for determining CAD.

## METHODOLOGY

It is a cross-sectional study conducted at Department of Cardiology, Chaudhry Pervaiz Elahi Institute of Cardiology, Multan from September 2013 to March 2014. A total of 282 patients of age  $\geq 40$  years belonging to either sex with at least one episode of chest pain lasting for  $\geq 30$  minutes were included in this study. All the patients underwent Single Photon Emission Computed Tomography by Consultant Cardiologist having at least 3 years post fellowship experience. The findings of SPECT were confirmed on coronary angiography. The demographic information of these patients like name, age, sex, address and hospital registration number along with findings of SPECT and coronary angiography was recorded. The data was entered into SPSS version 15.0 and analyzed through it. The quantitative variable like age was presented in mean and standard deviation. Frequency and percentages were

**Table A**

SPECT Scan	Coronary Angiography	
	Coronary Artery Disease Detected (+ve)	Coronary Artery Disease not Detected (-ve)
Coronary Artery Disease Detected (+ve)	True positive (a)	False positive (b)
Coronary Artery Disease not Detected (-ve)	False negative (c)	True Negative (d)

calculated for presence or absence of coronary artery disease through SPECT and coronary angiography findings.

Effect modifiers like age and sex were controlled by stratification and chi-square test was applied to see the effect of these on outcomes. Level of significance was taken at  $p < 0.05$ .

Diagnostic accuracy, sensitivity, specificity, positive predictive value, negative predictive value was calculated by using the table A.

## RESULTS

Age distribution of the patients showed that 45.03% ( $n=127$ ) were between 40-60 years and 54.97% ( $n=155$ ) had  $>60$  years of age, with mean age of  $60.83 \pm 9.32$  years. (Table 1)

Gender distribution of the patients showed that 52.13% ( $n=147$ ) were male and 47.87% ( $n=135$ ) were females. (Table 2)

Results of single photon emission computed tomography showed that 17.02% ( $n=48$ ) were true positive, 2.48% ( $n=7$ ) were false positive, 77.31% ( $n=218$ ) were true negative and 3.19% ( $n=9$ ) were false negative, sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate were computed as 84.21%, 96.88%, 87.27%, 96.03% and 94.33% respectively. (Table 3)

**Table 1: Age Distribution of The Patients (n=282)**

Age(in years)	No. of Patients n	Percentage %
40-60	127	45.03
>60	155	54.97
<b>Total</b>	<b>282</b>	<b>100</b>

**Table 2: Gender Distribution of The Patients (n=282)**

Gender	No. of Patients n	Percentage %
Male	147	52.13
Female	135	47.87
Total	282	100

## DISCUSSION

Ischemia is an predictor of harmful outcome such as future myocardial infarctions, and detection of ischemia is an integral part of the diagnostic strategy in the present guidelines.<sup>10-13</sup> In addition, a normal single-photon emission tomography (SPECT) perfusion scan indicates a good prognosis with a low rate of cardiac events.<sup>14-16</sup> Noninvasive imaging modalities such as SPECT, CMR, and PET perfusion imaging are, therefore, increasingly being performed for the detection and risk stratification of obstructive CAD.

Data representing the diagnostic accuracy of SPECT by taking coronary angiography as gold standard in Pakistan is very scarce which emphasises to conduct a study. Our study will be helpful in the management of those patients

who do not want to undergo any coronary intervention like coronary angiography for their disease. The findings of our study are in agreement with other study showing the sensitivity of SPECT to be 87% and specificity is 73% in detection of coronary artery disease.<sup>3</sup> Another study conducted in Pakistan, Thallium scintigraphy has sensitivity of 89% and specificity of 79% but the sample size in this study was small as this study included only 60 patients and all of them were diabetic, however, the sample size in our study was larger which confirms the diagnostic accuracy of SPECT for diagnosis of ACS.<sup>4</sup>

A recent meta-analysis focused to determine the accuracy of diagnosis of the 3 most commonly used noninvasive myocardial perfusion imaging modalities, single-photon emission computed tomography (SPECT), cardiac magnetic resonance (CMR), and positron emission tomography (PET) perfusion imaging for the diagnosis of obstructive coronary artery disease (CAD), they concluded that SPECT, CMR, and PET all showed a high sensitivity, while an extensive range of specificity was observed. SPECT is easily available and most reliably validated.

## CONCLUSION

We concluded that Single Photon Emission Computed Tomography, by taking Coronary Angiography as gold standard for the detection of Coronary Artery Disease, has a good diagnostic accuracy and can be used to curtail the financial burden of diagnosis.

**Table 3 : Diagnostic Accuracy of Single Photon Emission Computed Tomography By Taking Coronary Angiography As Gold Standard For the Detection of Coronary Artery Disease (n=282)**

SPECT Scan	Coronary Angiography		Total
	Coronary Artery Disease Detected (+ve)	Coronary Artery Disease Not Detected (-ve)	
Positive	True positive(a) 48 (17.02%)	False positive (b) 7 (2.48%)	a + b 55(19.50%)
Negative	False negative(c) 9 (3.19%)	True negative (d) 218 (77.31%)	c + d 227 (80.50%)
Total	a + c 57 (22.21%)	b + d 225(79.79%)	282 (100%)

Sensitivity =84.21%, Specificity =96.88%,Positive predictive value =87.27%,  
Negative predictive value= 96.03% , Accuracy rate = 94.33%

## REFERENCES

1. Jaarsma C, Leiner T, Bekkers SC. Diagnostic performance of noninvasive myocardial perfusion imaging using single photon emission computed tomography, cardiac magnetic resonance and positron emission tomography imaging for the detection of obstructive coronary artery disease: a meta analysis. *J Am Coll Cardiol*. 2012;59:1719-28.
2. Fiechter M, Ghadri JR, Kuest SM. Nuclear myocardial perfusion imaging with a novel cadmium-zinc-telluride detector SPECT/CT device: first validation versus invasive coronary angiography. *Eur J Nucl Med Mol Imaging*. 2011;38:2025-30.
3. James EU, Vasken D, Robert OB. Nuclear cardiology. In: Robert OB, Braunwald E, Douglas LM, Douglas PZ, Peter L, editors. Braunwald's heart disease. Missouri: Saunders;2012;293-339.
4. Aslam M, Zia S, Asim A, Iqbal SK. Accuracy of thallium scintigraphy versus coronary angiography for coronary artery disease in diabetics. *J Coll Physicians Surg Pak*. 2010;20(1):6-9.
5. Douglas PS, Patel MR, Bailey SR. Hospital variability in the rate of finding obstructive coronary artery disease at elective, diagnostic coronary angiography. *J Am Coll Cardiol*. 2011;58:801-9.
6. Ragosta M, Bishop AH, Lipson LC. Comparison between angiography and fractional flow reserve versus single photon emission computed tomographic myocardial perfusion imaging for determining lesion significance in patients with multivessel coronary disease. *Am J Cardiol*. 2007;99:896-902.
7. Thomas AG, Michael JG. Global burden of cardiovascular disease. In: Robert OB, Braunwald E, Douglas LM, Douglas PZ, Peter L, editors. Braunwald's heart disease. Missouri: Saunders;2012;1-18.
8. Melekian N, De Bondt P, Tonino P. Fractional flow reserve and myocardial perfusion imaging in patients with angiographic multivessel coronary artery disease. *J Am Coll Cardiol Intv*. 2010;3:307-14.
9. Herald FL, Roland H, Bernd JP, Meinrad G. Radionuclide Imaging a molecular key to the atherosclerotic plaque. *J Am Coll Cardiol*. 2008;52(1):1-12.
10. Hachamovitch R, Berman DS, Shaw LJ, et al. Incremental prognostic value of myocardial perfusion single-photon emission computed tomography for the prediction of cardiac death: differential stratification for risk of cardiac death and myocardial infarction. *Circul* 1998;97:535-43.
11. Jahnke C, Nagel E, Gebker R, et al. Prognostic value of cardiac magnetic resonance stress tests: adenosine stress perfusion and dobutamine stress wall motion imaging. *Circul* 2007;115:1769-76.
12. Wijns W, Kolh P, Danchin N, et al. Guidelines on myocardial revascularization: the Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardiothoracic Surgery (EACTS). *Eur Heart J* 2010;31:2501-55.
13. Smith SC Jr., Feldman TE, Hirshfeld JW Jr., et al. ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/SCAI Writing Committee to Update the 2001 Guidelines for Percutaneous Coronary Intervention). *J Am Coll Cardiol* 2006;47:1-121.
14. Yoshinaga K, Chow BJ, Williams K, et al. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? *J Am Coll Cardiol* 2006;48:1029-39.
15. Metz LD, Beattie M, Hom R, Redberg RF, Grady D, Fleischmann KE. The prognostic value of normal exercise myocardial perfusion imaging and exercise echocardiography: a meta-analysis. *J Am Coll Cardiol* 2007;49:227-37.
16. Lerakis S, McLean DS, Anadiotis AV, et al. Prognostic value of adenosine stress cardiovascular magnetic resonance in patients with low-risk chest pain. *J Cardiovasc Magn Reson* 2009;11:37.