



Original Article

# CORRELATION OF CORONARY ARTERY CALCIUM SCORING WITH DEGREE OF CORONARY ARTERY DISEASE IN PATIENTS UNDERGOING COMPUTED TOMOGRAPHY CORONARY ANGIOGRAPHY.

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Submission Date: 21-03-2019

Revision Date: 22-08-2019

Publication Date: 20-09-2019

## Author's Contribution

BUAG: Conducted the study and wrote the article. MIF: Helped in review the article. MAK: Re-arranged data and corrected article. K: Tables and figures. TA were consultants in charge of the study and gave frequent advice, corrections and did the proof reading.

### All authors declare no conflict of interest.

This article may be cited as: Gill BUA, Farid MI, Sherwani MAK, Kamran, Abbas T. Correlation of coronary artery calcium scoring with degree of coronary artery disease in patients undergoing Computed Tomography coronary angiography. (J Cardiovasc Dis 2019;15(1):8 - 12)

## ABSTRACT:

**OBJECTIVE:** To establish the correlation of coronary artery calcium scoring with degree of coronary artery disease (CAD) in patients undergoing CT coronary angiogram.

**Study design:** Cross-sectional study.

**Setting:** Cardiology Department, Chaudhary Pervaiz Elahi Institute of Cardiology (CPEIC), Multan.

**Duration:** 25-June-2016 to 24-Dec-2016.

**SUBJECTS AND METHODS:** A total number of thirty (30) patients referred from OPD for CT coronary angiogram having no contraindication to CT angiogram were included in this study. Coronary artery calcium scoring was measured by CT and calculated by Agatston system of scoring i.e. 0-9, 10-99, 100-400, >400. All the data were entered and analyzed using SPSS-20. Descriptive statistics were applied to quantitative variables. While percentages and frequencies were statistically analyzed for qualitative variables. Effects modifiers were controlled through stratification. P-value <0.05 was a significant difference.

**RESULTS:** In this study the patients had mean age of 54.36 + 10.9 years. The males were 20 (66.67%) and females were 10 (33.33%). Mean coronary artery calcium score was 70.50 ± 105.49. There was a significantly positive correlation between CAC score and severity of CAD. The spearman's correlation coefficient was 0.860 and p-value was <0.001. Stratification of age and gender was done to determine the effect of these on association of CAC scoring and severity of lesion. A very weak correlation of CAC scoring and degree of stenosis in patients with age ranging from 61 to 75 years was seen.

**CONCLUSION:** Coronary Artery Calcium (CAC) scoring is an easy and trust worthy parameter for screening the patients with coronary artery disease. Low CAC score is related with no or minimum coronary artery stenosis while high CAC score demands further investigations.

**KEYWORDS:** Computed tomography coronary angiography, Coronary artery disease, Coronary artery calcium scoring.

(J Cardiovasc Dis 2019;15(1):8 - 12)

**INTRODUCTION:**

Coronary artery disease (CAD) is a known reason of morbidity and mortality in the world. Its frequency is growing in developing countries like Pakistan. Jafar et al. reported approximately 27% study population was suffering from CAD in Karachi Pakistan.<sup>1</sup> Diagnosis of CAD is challenging. CAC scoring serves as an indicator of atherosclerosis which can be assessed by non-contrast multi-detector computed tomography.<sup>2</sup> The studies have shown gradual increase in risk for ischemic events with gradual rise in calcium scoring in four of racial groups.<sup>3</sup> Asymptomatic patients with low coronary artery calcium is related to decreased risk of future cardiac events.<sup>4</sup> It has high inter-observer agreement.<sup>5</sup>

CT coronary angiography (CTCA) with its minimal invasiveness and side effects has revolutionized the diagnosis of CAD and its severity. It has elevated degree of accuracy in assessment of CAD.<sup>6</sup> CT coronary angiography is a dependable and speedy way of directly recognizing the level and gravity of coronary artery stenosis.<sup>7</sup> The results of CT coronary angiography are linked with clinical assessment to devise a diagnosis to guide treatment decisions.<sup>8-9</sup> CTCA is a key tool with escalating clinical worth for assessment of CAD or related stenosis as well as for highly developed risk stratification.<sup>10-11</sup>

CAC score is reliable tool to establish the occurrence and severity of CAD. It can be done with non-contrast CT scan and lesser exposure to X-ray radiation. It is cost effective especially in our country where people cannot afford the cost of expensive and invasive methods of detecting CAD. CACs score also helps to risk stratification and management of patients on high risk of atherosclerotic coronary artery disease. The studies comparing the degree to which CAC score and CTCA complement each other is limited in developing countries like Pakistan. We aimed to detect degree to which CAC score is linked with extent of coronary artery disease severity on CT coronary angiography.

**METHODOLOGY:**

It was a cross-sectional study done at Ch. Pervez Elahi Institute of Cardiology Multan from 25-June-2016 to 24-Dec-2016. After endorsement from ethical committee of the hospital 30 adult patients of 18-75 years of age of both genders having chest pain for at least one month duration referred from OPD for CT coronary angiography having no contraindication to CT angiography were selected by non-probability consecutive sampling. Patients with

tachycardia heart rate > 80 bpm, Atrial fibrillation i.e. absence of p waves on ECG with Irregular Pulse rate, Atrioventricular blocks with PR interval >200 msec or AV dissociation, long duration kidney disease with serum creatinine > 2 mg/dl, Acute MI (acute coronary event i.e. STEMI, NSTEMI, UA diagnosed by clinical symptoms consistent with ECG changes and Cardiac Biomarkers Elevation), Acute Heart failure i.e. patient unable to lie flat due to shortness of breath and patients with pregnancy i.e.gestational amenorrhea of at least 1 month duration were excluded from the study. Coronary artery calcium score was calculated by a non-contrast CT scan. Coronary artery disease was labeled as presence of atherosclerotic plaque determined by visual estimation in coronary arteries resulting in coronary artery stenosis. Coronary artery calcium scoring was calculated by computed tomography and calculated by Agatston system of scoring i.e. 0-9, 10-99, 100-400, >400. Luminal cross sectional area stenosis of coronary vessels was divided as Normal <10%, Mild 10-49%, Moderate 50-70% and Severe > 70%. The CAC was manually labeled. CT angiography was done on Toshiba Aquilion 128-row detector CT scanner (Toshiba Medical Systems, Japan) using non-ionic contrast. Scan was performed with breath held from the pulmonary hilum to the base of the heart.

**Table 1. Descriptive Statistics for Coronary Artery Calcium Score.**

Calcium Score	Value
Mean	70.50
Standard Deviation	105.49
Minimum	0.00
Maximum	500

**Table 2. Frequency of Severity of Coronary Artery Disease.**

Disease Severity	RCA	LCX	LAD	LMS
Normal	16 (53.3%)	15 (50%)	14 (46.7%)	28 (93.3%)
Mild	7 (23.3%)	9 (30%)	6 (20%)	0 (0%)
Moderate	2 (6.7%)	2 (6.7%)	4 (13.3%)	0 (0%)
Severe	5 (16.7%)	4 (13.3%)	6 (20%)	2 (6.7%)

**Table 3. Association of Calcium Score severity with Severity of Coronary Artery Stenosis.**

Correlations				
			Calcium Score	Degree of Stenosis
Spearman's rho	Calcium Score	Coefficient Correlation	1.000	.860**
		Significant (2-tailed)	.	<0.001
		N	30	30
Degree of Stenosis	Degree of Stenosis	Coefficient Correlation	.860**	1.000
		Significant (2-tailed)	<0.001	.
		N	30	30

\*\* . Correlation is significant at the 0.01 level (2-tailed).

**Table 4. Stratification of Gender and its Effects on Association of Calcium Score severity with Severity of Coronary Artery Stenosis.**

**A) For male gender.**

Correlations			Calcium Score	Degree of Stenosis
Spearman's rho	Calcium Score	Coefficient Correlation	1.000	0.853**
		Significant (2-tailed)	.	<0.001
		N	20	20
Degree of Stenosis	Degree of Stenosis	Coefficient Correlation	0.853**	1.000
		Significant (2-tailed)	<0.001	.
		N	20	20

\*\* . Correlation is significant at the 0.01 level (2-tailed).

**B) For female gender.**

Correlations			Calcium Score	Degree of Stenosis
Spearman's rho	Calcium Score	Correlation Coefficient	1.000	0.961**
		Sig. (2-tailed)		<0.001
		N	10	10
Degree of Stenosis	Degree of Stenosis	Correlation Coefficient	0.961**	1.000
		Sig. (2-tailed)	<0.001	
		N	10	10

\*\* . Correlation is significant at the 0.01 level (2-tailed).

CT angiography observations were analyzed by radiologist and cardiologist separately on Vitrea 2 Working station (Vital Images, USA). The degree of stenosis was classified as normal, mild, moderate and severe. All data was collected on research proforma and was further analyzed.

The data was analyzed by SPSS version 20. Variables like quantitative eg. age, calcium scoring were portrayed by using mean and standard deviation. Spearman's rho correlation coefficient was done to see the correlation between the degree of stenosis and calcium scoring severity. Data was presented in form of frequency tables. Data were stratified for age and gender. Post-stratification spearman's rho correlation was calculated. Significant P-value was less than 0.05.

**RESULTS:**

The mean age of the patients in this study was 54.36 + 10.9 years. The minimum age was 27 years and maximum age was 75 years. There were 20 (66.67%) males and 10 (33.33%) females in this study. Mean coronary artery calcium score was 70.50 + 105.49. The minimum CAC score was 0.00 and maximum score was 500 (Table 1).

Regarding severity of coronary artery disease, right coronary artery was normal in 16 (53.3%) patients. There was mild stenosis of right coro-

nary artery disease in 7 (23.3%) patients, moderate stenosis in 2 (6.7%) patients and severe in 5 (16.7%) patients. Left circumflex artery was normal in 15 (50.0%) patients, mild stenosis was diagnosed in 9 (30.0%) patients, moderate stenosis in 2 (6.7%) patients and severe stenosis was present in 4 (13.3%) patients. Left anterior descending (LAD) artery was normal in 14 (46.7%) patients. There was mild stenosis of LAD in 6 (20.0%) patients, moderate in 4 (13.3%) patients and severe disease of LAD was present in 6 (20.0%) patients. Left main stem (LMS) artery was normal in 28 (93.3%) patients, there was no patient with mild and moderate LMS stenosis, while severe disease was diagnosed in 2 (6.7%) patients (Table 2).

Spearman's rho correlation was done to find the relationship of CAC scoring with severity of coronary artery disease. There was an important positive correlation between CAC scoring and severity of CAD. The spearman's correlation coefficient was 0.860 and p-value was <0.001 (Table 3).

Stratification of age to determine the effect of age on association of CAC scoring and degree of stenosis. For age group 27-48 years, there was significant correlation in CAC score and degree of stenosis with correlation coefficient 1.0 and p-value <0.001. There was also an important positive correlation between CAC score and degree of stenosis for age group 49-60 years. The correlation coefficient was 0.842 and p-value was 0.001. But there was a very weak correlation in between CAC score and degree of stenosis in patients with age ranging from 61 to 75 years. The correlation coefficient was only 0.138 and p-value was 0.74.

Stratification of gender was done to determine the effect of gender on association of CAC score with degree of stenosis of coronary arteries. There was a significant positive correlation in CAC score and degree of stenosis in male gender with correlation coefficient 0.853 and p-value <0.001 (Table 4A). In female gender, there was also a significant positive correlation of CAC score with degree of stenosis. The p-value was <0.001 and correlation co-efficient was 0.961 (Table 4B).

**DISCUSSION:**

Computed tomography coronary angiography is frequently used as screening and diagnostic modality of coronary artery disease. Calcium scoring is basically used for risk stratification purpose. Coronary calcium scoring is very cheap and easily available tool and is precise in assessing the degree of stenosis, it may lead to decrease in the number of patients undergoing diagnostic coronary



angiography. So, there is a requirement to evaluate CTCA and CACS as diagnostic tool.<sup>12</sup>

CAC scoring is found to be an indicator for atherosclerotic process and a forecaster of cardiac problems. It can be used to establish, identify and to see the severity of coronary artery calcification.<sup>14</sup>,<sup>15</sup> The more the score higher chances of plaque burden and increased probability of cardiac events. CAC scoring is helpful to see the patients with disease and to locate the lesion in coronary arteries.<sup>16,17</sup>

One retrospective study done at Karachi shows positive correlation between coronary artery calcium scoring and degree of stenosis on CT coronary angiography with Spearman's rho correlation coefficient  $r=0.791$ .<sup>12</sup> Another study shows correlation of CAC scoring with extent and complexity of CAD done determined with Syntax score and GensiniScore with  $r=0.577$ ,  $p<0.001$  and  $r=0.299$   $p<0.001$  respectively.<sup>13</sup>

The worth of CAC in assessing prognosis in patients without symptoms is free of traditional risk factors in studies such as the Multi-Ethnic Study of Atherosclerosis (MESA).<sup>18</sup> In patients with symptoms, the relation between presence of CAC and obstructive CAD has been recognized with high sensitivity and low specificity. Therefore, more hard work have been done for CAC utilization as a useful tool for obstructive CAD before CCA.<sup>19,20</sup>

The specific conclusion of this study recommends that rising CAC scoring shows a relationship with the degree of CAD. Moreover it also shows that the high levels of CAC score do not specifically

exclude or rule in severe CAD. Schmermund et al described that CAC scoring highlighted using the Agatston method estimates the angiographic severity of CAD in patients with symptoms.<sup>21</sup> Degree of CAD was inferred as the percentage of significant narrowing of lumen. Budoff et al also showed same results in symptomatic patients.<sup>22</sup> Werkhoven et.al perceived major CAD in 4% of patients with a CCS of 0 compared to 8% shown by Cademartiri et al. and Akram et al. In our study, CCS between 10 and 99 was significantly related with either no or mild stenosis. On the other hand, the transitional CAC scores were not so conclusive. Lau et. al concluded that a CAC score more than or equal to 400 amplified the sensitivity of CTCA from 93% to 100%.<sup>23</sup> Consequently, this lead to diagnose the disease which cannot be assessed at CTA. In this study there were only 2 patients with CAC score more than 400 and these patients were suffering from severe coronary artery disease. It is found that there is a noteworthy correlation between CAC score and severity of coronary artery disease with correlation coefficient 0.860. In the study Bhulani et al. correlation coefficient was 0.791.<sup>12</sup>

#### **CONCLUSION:**

Coronary Artery Calcium (CAC) scoring is an easy and trust worthy parameter for screening the patients with coronary artery disease. Low CAC score is related with no or minimum coronary artery stenosis while high CAC score demands further investigations.

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