

Presence and severity of Coronary Atherosclerosis in patients with zero calcium score on Computed Tomography Coronary Angiography

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ABSTRACT

Aim: To find out the severity of coronary plaques on computed tomography coronary angiography (CTCA) in patients with zero calcium score.

Methodology: Prospective descriptive study of 245 selected patients, who had a zero coronary calcium score and underwent CT coronary angiography on 128 slice Toshiba's Multidetector CT scanner (MDCT), from Dec 2012 to January 2018 at a hospital in Peshawar. Images were assessed on Vitrea workstation for calculation of plaque burden and vessel analysis was done using automated and manual select vessel option. The presence of plaques and extent of stenosis were evaluated. Retrospective interpretation of prospectively acquired data was done using and SPSS.

Results: 130 patients (53%) had atherosclerotic disease; 23 (9.3% of total patients) had significant (>50%) coronary stenosis, out of which 10 patients had >70% stenosis. 107 (43.6% of total patients) had non-significant (<50%) coronary stenosis. 115 (46.9%) patients had normal coronary arteries.

Conclusion: In patients with zero calcium score, atherosclerosis was seen in 53% patients and 9.3% had significant coronary artery disease. Hence, zero calcium score does not absolutely exclude the coronary artery disease.

Keywords: Calcium score, coronary computed tomography angiography, non-calcified plaque

INTRODUCTION

Coronary artery calcium (CAC) is a specific feature of coronary atherosclerosis and coronary artery disease (CAD)¹. CAC scoring by computed tomography (CT) has been the subject of interest since it was first reported as a clinical tool in 1990. Image findings on CT are calcified plaques, which can be intraluminal, along the luminal surface or can involve the entire vessel length, mostly seen in diabetic subjects. The underlying etiology of calcium in vessels is mostly inflammation, propagated by apolipoproteins and oxidized phospholipids in the artery wall, which is instrumental for both development of atherosclerosis and vascular calcification.²

CAC is widely available and reproducible means of assessing risk for major cardiovascular outcomes, especially in asymptomatic population. It is cost-effective. Initial studies have evaluated the ability of calcium scoring on CT to detect the possibility of CAD in symptomatic men and women. With greater availability of coronary CT scanners, improvements in study design and increased attention to the post-test prognosis of patients who have undergone coronary CT, CAC measurement is now considered a useful test for improving coronary risk assessment³.

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METHODOLOGY

This is a hospital based observational descriptive study. 245 cases who underwent CT coronary angiography from Dec 2012 to January 2018 at a private hospital in Peshawar. In this study, both genders with a zero calcium score were included. All included patients were referred for CT coronary angiography with symptoms of atypical chest pain or equivocal result on ETT. Patients with atrial fibrillation, allergy to iodinated contrast and poor breath hold were excluded from the study. Coronary CT angiography was performed on 128 slice Toshiba's Multidetector CT scanner (MDCT) in the craniocaudal direction to cover the heart from the pulmonary trunk through the apex with a 1.25-mm collimation, which can be reconstructed at 0.75- 1 mm intervals with a targeted field of view and pitch of 3 or 6 depending on patient's ability to hold their breath. Patients received an oral dose of 50 mg metoprolol, one dose night before and other dose the same morning before CCTA. Heart rate and ECG were monitored during the CT angiography. Calcium score was calculated by using the Agatston method as part of the standard departmental protocol.

Images were assessed on Vitrea workstation for calculation of plaque burden (calcium score) and vessel analysis was done using automated or manual select vessel option. Individual vessels were assessed and luminal stenosis defined by manually selecting the patent lumen on vessel's cross-section and longitudinal reconstructed images. The presence of plaques and extent of stenosis were evaluated in patients with zero coronary artery calcium score.

Patients were divided into three groups depending on the severity of luminal stenosis i.e. group A with normal angiography, group B with non-significant disease causing < 50% luminal stenosis and Group C with significant disease causing >50% luminal stenosis.

RESULTS

The detail of results is given in table 1 and Fig 1.

Table 1: Gender distribution with coronary stenosis

Gender	Group A (Normal)	Group B (<50%)	Group C (>50%)	Total
Male	71	55	14	140
Female	46	50	9	105
Total	105	117	23	245

Fig 3: CT coronary angiography with zero coronary calcium score.

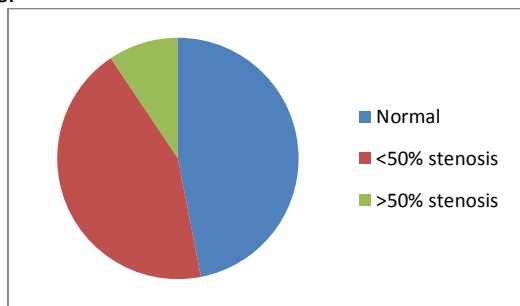


Fig 1 (a-d): Coronary CT angiography of a 38 year old female with atypical chest symptoms. Coronary calcium score was zero. Multiplanar oblique reconstruction images of left anterior descending artery (LAD) showing a soft plaque in proximal LAD causing severe luminal stenosis (arrow).

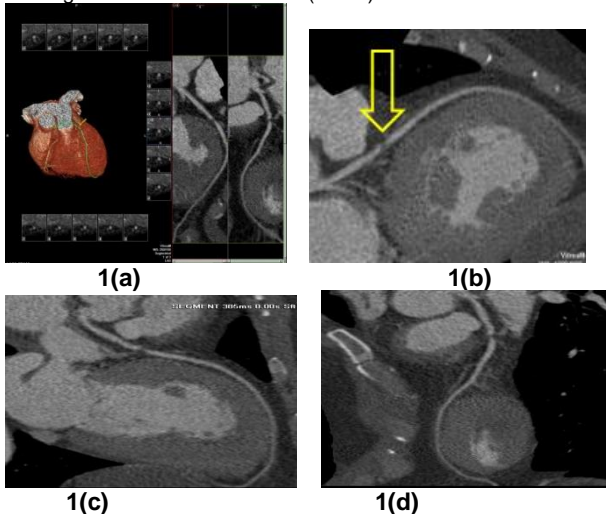


Fig 2 (a): Sagittal oblique reconstruction of CT coronary angiography in a 47 year old male with shortness of breath and chest pain. His calcium score was zero. CT coronary angiography confirmed a soft plaque in mid LAD causing severe luminal stenosis. (b) Magnified view of vessel showing true cross sectional view of the involved vessel. Note that the plaque is better visualized on the cross sectional view (multiple arrows pointing at the significant atherosclerotic plaque).



DISCUSSION

Coronary artery calcium scoring has been considered to be pathognomonic of coronary atherosclerosis. It represents the plaque burden. Review of literature shows that large clinical trials have found incremental predictive value of CS with cardiac computed tomography (CT) and thus based on these findings, the coronary artery calcium score has been used for risk prediction of future cardiovascular events^{4,6} Study conducted in 2018¹ showed 9.3% frequency of atherosclerotic plaque in coronary arteries and 4.3 % patients had obstructive coronary artery disease. Another study conducted by Kim and fellows⁴ showed that the prevalence of obstructive CAD by CCTA was 4.3% in their patients with zero CAC. These are much closer to our results that show 9.3% (23/245) of our patients with CAC of zero had significant CAD. It is also worth mentioning that in our study, analysis of atheroma in the CCTA with contrast phase revealed that 2/23 patients had plaques with some degree of calcification that were not detected by the CAC. In our study (Table.1), men had a much higher prevalence of obstructive CAD than women (14 were male and 9 were female).

There were few limitations of the study, which should be acknowledged. Firstly, it is a single center study with all subjects from same ethnic background. Thus, it is uncertain whether its results can be equally applicable to the general practice. Further larger studies, including multicenter and multiethnic studies, are needed to elucidate our findings.

The results of our study rejected the previously known fact that calcium score of zero completely rules out presence of significant coronary artery atherosclerosis. Thus, suggesting that in patients with calcium score of zero and atypical chest symptoms, CT coronary angiography should be done. Early detection and treatment of coronary artery disease (CAD) can reduce incidences of acute myocardial infarction. Identifying the coronary arterial plaque pattern can provide more effective treatment methods. Non-calcified plaque has been shown to have a higher tendency to regress in response to established medical therapies⁵.

CONCLUSION

In patients with zero calcium score, atherosclerosis was seen in 53% patients and 9.3% had significant coronary artery disease. Hence, zero calcium score does not absolutely exclude the coronary artery disease.

REFERENCES

1. Greenland P, Blaha MJ, Budoff MJ et al. Coronary Calcium Score and Cardiovascular Risk. *J Am Coll Cardiol* 2018;72:434-47.
2. Agatston AS, Janowitz WR, Hildner FJ et al. Quantification of coronary artery calcium using ultrafast computed tomography. *J Am Coll Cardiol*. 1990;15:827– 32.
3. Greenland P, Bonow RO. How Low-Risk Is a Coronary Calcium Score of Zero? The Importance of Conditional Probability. *Circulation*. 2008;117(13):1627-9.
4. Kim YJ, Hur J, Lee H et al. Meaning of zero coronary calcium score in symptomatic patients referred for coronary computed tomographic angiography. *European Heart Journal Cardiovascular Imaging* 2012; 13:776–85.
5. Nicholls SJ, Tuzcu M, Wolski K et al. Coronary artery calcification and changes in atheroma burden in response to established medical therapies. *Journal of the American College of Cardiology*. 2007;49: 263
6. Greenland P, Bonow RO, Brundage BH et al. ACCF/AHA 2007 clinical expert consensus document on coronary artery calcium scoring by computed tomography in global cardiovascular risk assessment and in evaluation of patients with chest pain: a report of the American College of Cardiology Foundation Clinical Expert Consensus Task Force. *J Am Coll Cardiol* 2007;49:378–402.