



Aortic root calcification and cardiac risk factors in patients with coronary calcium score greater than zero using multidetector computed tomography

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Abstract *Background:* Vascular calcification is a marker of atherosclerotic burden and is associated with increased risk of cardiac events. The aim of this study was to investigate the relationship between clinical cardiac risk factors and aortic root calcification (ARC) in patients with a coronary calcium score (CCS) > 0, as assessed by multidetector computed tomography (MDCT).

Methods: Between January and December 2013, 196 consecutive Iraqi patients who underwent MDCT for assessment of coronary disease were recruited. Of these, 69 patients with a CCS > 0 were enrolled in the study. For analytical purposes, patients were divided into two groups by ARC score: patients with ARC > 0 (ARC group, n = 32) and those with ARC = 0 (non-ARC group, n = 37).

Results: The overall prevalence of ARC was 46%. Mean ARC was 174 ± 28.5 (range, 10–500). A significant correlation was observed between ARC and male sex ($r = 0.380$, $P = 0.032$) and between ARC and age ≥ 65 years ($r = 0.353$, $P = 0.047$). These correlations persisted even after multivariate adjustment for other cardiac risk factors. There were no significant

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correlations between ARC and other cardiac risk factors, and the only significant between-group difference in the distribution of cardiac risk factors was in patient age.

Conclusion: ARC was significantly correlated with older age and male sex in patients with CCS > 0.

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Introduction

Arterial calcification is an active systemic process that involves multiple mechanisms responsible for calcium deposition in different arterial beds. It accompanies advanced atherosclerosis, which leads to increased cardiovascular morbidity and mortality.¹

A growing body of evidence suggests that both thoracic aortic calcification and coronary calcification have histological relationships to atherosclerosis² and that both have predictive value for atherosclerotic burden and cardiovascular disease morbidity and mortality.^{3,4}

Because evaluation of calcifications of the aortic root and thoracic aorta is not a standard part of routine cardiovascular workup, little information exists regarding the association between aortic root calcification (ARC) and coronary atherosclerotic burden and risk factors. In our previous work, we found that ARC was significantly correlated with coronary calcification and atherosclerotic burden, suggesting that ARC can be used as an additional imaging marker for assessment of coronary atherosclerosis.⁵

In this study, we investigated the relationship of clinical cardiac risk factors (hypertension, smoking, diabetes mellitus, hyperlipidemia, family history of premature coronary disease, obesity, male sex, and older age) and ARC in patients with coronary atherosclerosis (CCS > 0) using multi-detector computed tomography (MDCT).

Materials and methods

This cross-sectional study was carried out at the Cardiology Center at Al-Sader Teaching Hospital between January and December 2013. Informed consent was obtained from all study participants. The study was approved by our institution's ethics committee.

Between January and December 2013, we recruited 196 consecutive patients who underwent 64-slice MDCT angiography for assessment of coronary artery disease (CAD) at our institution. All patients had intermediate pretest probability of ischemic heart disease, based on age, sex, and cardiac symptoms. Of 196 patients, 69 with coronary atherosclerosis (CCS > 0) were found to be eligible and were enrolled in the study.

For analytical purposes, patients were divided into two groups by ARC score: patients with ARC score >0 (ARC group, n = 32) and those with ARC score = 0 (non-ARC group, n = 37). A standardized questionnaire was employed by physicians at the time of coronary MDCT

angiography to obtain a history of conventional cardiac risk factors for CAD from each patient. Risk factors included a family history positive for premature CAD (occurring before the age of 55 years in men and before 65 years in women); current smoking history (more than 10 cigarettes per day in the last year); history of hypertension or use of anti-hypertension medications; hyperlipidemia, defined as total cholesterol \geq 200 mg/dL or a serum triglyceride \geq 50 mg/dL or use of lipid-lowering drugs; history of diabetes mellitus or use of insulin or glucose-lowering drugs; and obesity (body mass index \geq 30). Patients with two or more cardiac risk factors were considered to have multiple risk factors.

CT scan protocol

CT coronary angiography was performed with a 64-slice scanner (Aquilion 64, v. 4.51 ER 010; Toshiba Medical Systems, Tochigi, Japan). Before multi-slice CT angiography was performed, a non-contrast CT was acquired to measure the calcium score according to the Agatston method for total heart calcium (summed across all lesions identified within coronary arteries) using a sequence scan with a slice thickness of 3 mm. Coronary calcification area was defined as at least three contiguous voxels with a CT density >130 Hounsfield units. When the patient's heart rate was more than 65 bpm, a β -blocker (metoprolol; 20–60 mg orally) was administered before the scan. A bolus of 80 ml contrast medium (Omnipaque; 350 mg/ml iodine) was injected intravenously at a rate 5 ml/s, followed by 30 ml of normal saline. The scan was obtained from the aortic arch to the level of the diaphragm during a single breath hold. Using retrospective ECG-gating and ECG-dependent tube current modulation, the following parameters were performed: collimation, width 32.5 \times 32.5 cm; slice thickness, 0.5 mm; rotation time, 0.35 s; tube voltage, 120 kV; maximum effective tube current, 890 mA; and table feed, 0.3 mm/rotation at 75% of R–R cardiac cycle. Examination time took \sim 10 s.

CT images were reconstructed using a smooth kernel (B25f) with a slice thickness of 0.5 mm (increment of 0.3 mm). CT data sets were transferred to a dedicated workstation (Vitrea 2 Workstation; Vital Image, Plymouth, MN, USA) for image analysis.

Aortic root calcification analysis

The aortic root was defined as the part of the aorta lying within 3 cm from the caudal aspect of the aortic annulus containing sinuses of Valsalva and the sinotubular junction. The total calcium score of the aortic root was calculated

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