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LETTERS TO THE EDITOR

Annularity of Aorto-Iliac Arterial Calcification and Risk of All-Cause and Cardiovascular Mortality

Arterial calcification is associated with cardiovascular disease (CVD) risk. Whether different patterns of calcification are differentially associated with CVD risk is unknown. We assessed the association of increasing severity of annular calcification in the thoracic aorta (TA), abdominal aorta (AA), and common iliac arteries (CIA) with all-cause and cardiovascular mortality.

We conducted a case-cohort study (1) nested in a cohort of 5,197 individuals who self-referred for whole-body computed tomography. The study population is described elsewhere (2). We selected a subcohort at random (n = 395) and all-cause (n = 298) and CVD mortality (n = 90) cases during a median follow-up of 9.4 years. We scored calcium in the TA, AA, and CIA in categories of annularity (none, 1° to 90°, 91° to 180°, 181° to 270°, 271° to 360°) in body cross-section, scored using the slice with the highest degree of annular calcification in each artery. The between-observers Cohen kappas were 0.64 (95% confidence interval [CI]: 0.43 to 0.85), 0.87 (95% CI: 0.73 to 1.00), and 0.96 (95% CI: 0.88 to 1.00) for presence and/or absence of calcification in the TA, AA, and CIA, respectively, and linear weighted kappas for all 4 categories were 0.64 (95% CI: 0.45 to 0.83), 0.84 (95% CI: 0.76 to 0.92), and 0.81 (95% CI: 0.71 to 0.92) in a random sample of 50 computed tomography scans. We determined the correlation between annularity and modified Agatston quantification (mAgatston) (the Agatston score [3] calculated from 6-mm instead of 3-mm slices), and the associations with mortality using Cox proportional hazards models adapted to the case-cohort design through Prentice weighting (1). We adjusted for age, sex, smoking status, dyslipidemia, body mass index, diabetes, hypertension, and mAgatston. Multiple imputation techniques were used to handle missing baseline data (percentage missing was 7.8% on average for all variables in the full cohort).

Among the 395 individuals in the subcohort, mean age was 56.6 ± 11.1 years and 41.3% were women. Individuals with higher degrees of annular calcification were older, had higher systolic blood pressure, were more often smokers, and had higher mAgatston scores than did individuals with lesser annularity. Higher degrees of annularity were most common in the AA (29.4% more than 90°), followed by the CIA (18.7%) and the TA (4.1%). Correlations between annularity and mAgatston scores in the AA, CIA, and TA were 0.94 (95% CI: 0.93 to 0.95), 0.89 (95% CI: 0.87 to 0.91), and 0.82 (95% CI: 0.79 to 0.84), respectively. Greater AA annularity was significantly associated with all-cause mortality (hazard ratio >270° vs. none: 2.31; 95% CI: 1.08 to 4.95; p for trend: 0.002), independent of cardiovascular risk factors (**Table 1**). CIA and TA annularity were not significantly associated with mortality after multivariable adjustment. CVD mortality results were similar, but the lower numbers of cases resulted in less precision and statistical power (results not shown).

Annularity in the AA may be a useful simple tool to improve CVD risk prediction, above and beyond the Agatston score and other CVD risk factors. This may be because of the mechanical consequences of (near) complete calcification on arterial compliance and associated increases in left ventricular afterload or perhaps because annularity measures not only atherosclerosis but also medial arterial calcification. The latter pattern of calcification is known to be more prevalent in chronic kidney disease, diabetes, and advanced age; is characteristically circumferential; and is associated with CVD (4).

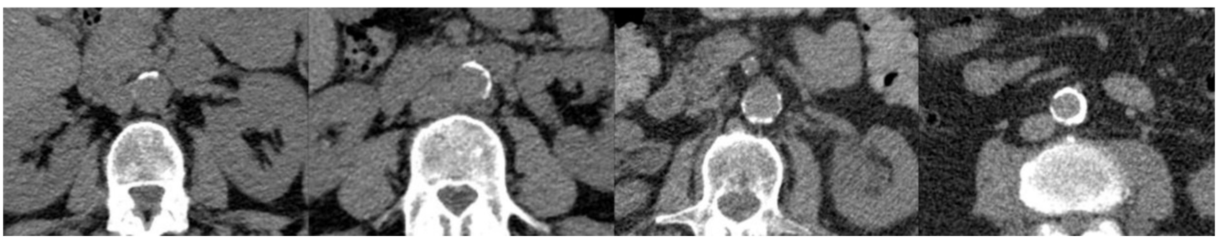
Strengths of this study include its evaluation in a general population setting with a varied degree of atherosclerotic disease burden. The availability of mAgatston scores in multiple vascular beds allowed us to evaluate the cross-sectional correlations of the 2 scoring methods in different vascular beds. Comprehensive CVD risk factor measurements allowed us to evaluate the unique contribution of annularity above and beyond standard clinical risk factors. Limitations include the use of data not originally collected for research purposes, resulting in missing values for some variables. Annularity scoring was measured on body cross-sections, whereas centerline-based cross-sectional imaging could provide more precise scoring.

In conclusion, we found that a simple method of scoring annular calcification in the aorta and CIA correlated highly with mAgatston score quantification in community-living individuals. Nonetheless, greater annular calcification in the AA was associated with higher mortality risk, above and beyond the mAgatston score and CVD risk factors. Assessment of patterns of calcification may add to the risk information provided by the mAgatston score and standard CVD risk factors.

TABLE 1 Associations of Annularity of Calcification in the AA With Total Mortality

	Model 1		Model 2		Model 3		Model 4	
	HR (95% CI)	p Value	HR (95% CI)	p Value	HR (95% CI)	p Value	HR (95% CI)	p Value
None	1.00		1.00		1.00			
1°–90°	1.09 (0.60–2.01)	0.771	0.86 (0.45–1.65)	0.658	1.08 (0.46–2.56)	0.859		
91°–180°	1.68 (0.84–3.38)	0.143	1.21 (0.57–2.58)	0.614	1.76 (0.51–6.07)	0.374		
181°–270°	2.31 (1.08–4.91)	0.03	1.39 (0.62–3.13)	0.422	2.12 (0.53–8.55)	0.291		
271°–360°	3.43 (1.65–7.13)	0.001	2.31 (1.08–4.95)	0.032	3.66 (0.86–15.65)	0.080		
p Value for trend		<0.001		0.002		0.006		
z Score log (1 + mAgatston)					0.81 (0.47–1.41)	0.461	1.35 (1.01–1.80)	0.045

Model 1 is adjusted for age and sex. Model 2 is adjusted for age, sex, smoking status, dyslipidemia, body mass index, diabetes, and hypertension. Model 3 is adjusted as model 2 + adjustment for the log(1+ mAgatston score). Model 4 is adjusted as model 2 but instead of the circularity scoring, the log(1+ mAgatston score) is modeled as a predictor variable.



Illustrated are, left to right: 1° to 90°, 91° to 180°, 181° to 270°, 271° to 360°. Examples are of the infrarenal AA.
AA = abdominal aorta; CI = confidence interval; HR = hazard ratio; mAgatston = modified Agatston.

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Left Ventricular Longitudinal Strain and Strain Rate Values According to Sex and Classifications of Sports in the Young University Athletes Who Participated in the 2015 Gwangju Summer Universiade

Left ventricular (LV) strain values measured by 2-dimensional speckle tracking echocardiography (2DSTE) represent global and regional myocardial functions. These values can give prognostic information, detect subclinical LV changes, and distinguish physiologic adaptation from pathologic hypertrophy. Because highly trained athletes can have altered cardiac structures, it is difficult to differentiate normal adaptation from pathologic changes. In this regard, 2DSTE can be a useful tool for the screening of athletes (1). Because the differences in myocardial deformation according to sex and classifications of sports have been poorly studied in university athletes, we investigated the impact of sex and classifications of sports on LV deformation in 1,120 (22 ± 2 years of age; 649 men) young athletes during the 2015 Gwangju Summer