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Prognostic Value of Number and Site of Calcified Coronary Lesions Compared With the Total Score

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OBJECTIVES This study sought to evaluate the long-term prognostic value of the number and sites of calcified coronary lesions and to compare the accuracy of number of calcified lesions with the extent of total calcium score.

BACKGROUND There is a strong relationship between mortality and total coronary artery calcium (CAC) score. It is not known whether the number of calcified lesions or their location influences outcome.

METHODS A total of 14,759 asymptomatic patients were referred for evaluation of CAC scanning using electron beam tomography. Univariable and multivariable Cox proportional hazards models were developed to estimate time to all-cause mortality at, on average, 6.8 years (n = 281).

RESULTS Risk-adjusted annual mortality was 0.19% (95% confidence interval 0.18% to 0.21%) for patients without any calcified lesions. For patients with >20 lesions, annual risk-adjusted mortality exceeded 2% per year. Mortality rates were significantly higher for left main lesions as compared to other coronary arteries with annual mortality rates of 1.3%, 2.1%, 9.2%, and 13.6% for 1 to 2, 3 to 5, and ≥6 lesions, respectively ($p < 0.0001$). For left main CAC scores of 0 to 10, 11 to 100, 101 to 399, and 400 to 999, annual risk-adjusted mortality was 0.33%, 0.81%, 1.73%, and 7.71%, respectively ($p < 0.0001$). All 4 patients with a CAC score of ≥1,000 in the left main died during follow-up. However, patients with more frequent calcified lesions also had higher CAC scores. Specifically, ≥81% of patients with >10 calcified lesions also had a CAC score ≥100. With exception, for patients with CAC scores ≥1,000, annual mortality was dramatically higher at 3.0% to 4.5% for those with 1 to 5 calcified lesions as compared with 1.1% to 2.0% for those with 6 or more lesions ($p < 0.0001$).

CONCLUSIONS We report that mortality rates increased proportionally with the number of calcified lesions. Although predictive information is contained in the number of calcified lesions, its added statistical value is minimal. With exception, patients with frequent lesions in the left main or those with a few large calcified lesions have a particularly high mortality risk. (J Am Coll Cardiol Img 2008; 1:61–9) © 2008 by the American College of Cardiology Foundation

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The coronary artery calcium (CAC) score, commonly measured by the Agatston method, is a strong predictor of cardiovascular events (1). Cardiovascular death or nonfatal myocardial infarction rates increase with higher CAC scores. However, what is currently unknown is the relative contribution of lesion count or location as an important prognostic variable. In the angiographic literature, the severity of coronary stenosis in the left main or left anterior descending coronary arteries carries a greater relative hazard for cardiovascular events (2,3). Similar results have been reported with computed tomography (CT) angiography (4,5). To date, whether the location of CAC has clinical outcome significance is not known.

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Spotty calcium is a marker of vulnerable plaque and has been the focus of a number of recent articles (6–9). Ehara et al. (7) showed that small calcium deposits were significantly more frequent in culprit lesion segments of patients with acute coronary syndrome when compared with patients with stable angina. Furthermore, multivariable analyses showed that acute myocardial infarction and positive remodeling were independent predictors of a spotty calcification pattern (7). However, no prior investigation has examined whether the number of calcified plaques predicts long-term cardiovascular outcomes. Moreover, the independent and comparative accuracy of the number of calcified lesions versus the extent of the calcium score is unknown.

ABBREVIATIONS AND ACRONYMS

CAC = coronary artery calcium

CI = confidence interval

CT = computed tomography

EBT = electron beam tomography

ROC = receiver-operating characteristic

METHODS

Patient selection criteria. A total of 14,759 asymptomatic patients were referred by their primary care physicians for CAC screening using electron beam tomography (EBT). All patients had at least 1 cardiac risk factor, but no prior history of coronary artery disease. At the time of scanning, subjects were queried as to the presence of typical cardiac risk factors, including total cholesterol as well as ethnicity. As detailed in prior reports from this registry (10), risk factor status was defined according to definitions from the National Cholesterol Education Program guidelines including age (men age >45 years, women age >55 years), current cigarette smoking, diabetes, history of premature coronary heart disease in first-degree relatives, hypertension, and hyperlipidemia (11). Total cholesterol values were available in 11,275 patients, including measurements <200, 201 to 240, 241 to 260, and >260 mg/dl, respectively.

EBT procedures and interpretation. The study was approved by the Institutional Review Board of Harbor-UCLA Medical Center. All subjects underwent EBT using an Imatron C-150XL ultrafast computed tomography scanner (GE-Imatron, South San Francisco, California). Tomographic imaging was electrocardiographically gated, and image acquisition occurred at a predetermined time in diastole (between 50% and 80% of the R-to-R cycle depending on heart rate). The coronary arteries were visualized without contrast medium, and 30 to 40 consecutive images were obtained at 3-mm intervals, from the bronchial carina caudally to include the entire coronary tree. A CT threshold of 3 pixels and 130 HU was utilized for identification of calcified coronary artery lesions. Specifically, a calcified lesion was defined as a minimum of 3 contiguous pixels ($0.56 \times 0.56 \times 3 = 1$ mm^3 voxel) with a minimum attenuation of 130 HU. The number of calcified lesions was then totaled for each coronary artery.

Each calcified lesion exceeding the minimum criterion was scored using the algorithm developed by Min et al. (4), calculated by multiplying the lesion area by a density factor derived from the maximal HU within this area. The density factor was assigned as follows: 1 for lesions with maximal density of 130 to 199 HU, 2 for lesions 200 to 299 HU, 3 for lesions 300 to 399 HU, and 4 for lesions >400 HU. Moreover, the total CAC score was determined by summing individual lesion scores from each of 4 anatomic sites (left main, left anterior descending, circumflex, and right coronary arteries) (4).

Follow-up methods. All patients provided informed consent for the follow-up portion of this study. All procedures for follow-up were approved by our Investigational Review Board. The occurrence of death from all causes was verified using the National Death Index (12). The searching of this death index was performed by trained researchers blinded to the patient's risk factor data and calcium score results. The length of follow-up was, on average, 6.8 years (standard error of the mean 0.019) or a median of 5.8 years (interquartile range 4.7 to 8.9 years). No patients were lost to follow-up.

Statistical methods. All statistical analyses were performed using SPSS (version 15.0, SPSS Inc., Cary, North Carolina). Categorical variables were compared using chi-square statistics. Continuous mea-

Table 1. Clinical Characteristics of the Study Cohort by the Number of Total CAC Lesions (n = 14,759)

	Total Number of Calcified Lesions					
	0	1–2	3–5	6–10	11–20	>20
n	5,136	2,466	2,202	1,905	1,879	1,171
Age (yrs)	51.3 ± 10	54.9 ± 10	57.1 ± 11	59.9 ± 10	62.7 ± 10	65.2 ± 11
Female (%)	48	47	47	45	44	42
Family history of premature CHD (%)	37	40	38	39	43	46
Current smoker (%)	5	7	6	7	9	8
Diabetic (%)	2	4	5	7	11	16
Ethnicity (%)						
African American	4	4	3	4	3	4
Hispanic	10	8	7	7	6	8
Asian	9	7	6	5	6	6
Caucasian	74	79	80	81	82	80
Other	3	2	4	3	3	2
Hypertension (%)	12	17	22	26	32	39
Hyperlipidemia (%)						
Untreated	14	15	16	12	15	13
Treated	26	38	46	49	52	57
Total cholesterol (%)						
<200 mg/dl	27	26	24	23	29	34
201–240 mg/dl	45	47	46	50	47	47
241–260 mg/dl	15	17	19	16	13	13
>260 mg/dl	13	11	10	10	11	6
Number of risk factors	1.1 ± 0.9	1.3 ± 0.9	1.4 ± 1	1.5 ± 1	1.6 ± 1	1.8 ± 1.1
CAC scores						
Total	0 ± 0	19.9 ± 41	62.7 ± 98	163.3 ± 232	490.5 ± 558	1,227.6 ± 1,107
LAD	0 ± 0	16.2 ± 37	44.1 ± 81	96.4 ± 139	232.4 ± 254	500.9 ± 462
LM	0 ± 0	39.9 ± 58	103.2 ± 143	463.0 ± 511	—	—
RCA	0 ± 0	1.9 ± 15	11.1 ± 38	39.6 ± 113	168.5 ± 293	501.0 ± 651
LCx	0 ± 0	1.3 ± 8	5.9 ± 20	22.8 ± 60	81.3 ± 146	230.6 ± 320

All $p < 0.0001$, except total cholesterol $p = 0.001$. Age, number of risk factors, and CAC scores are mean ± standard deviation.
CAC = coronary artery calcium; CHD = coronary heart disease; LAD = left anterior descending; LCx = left circumflex; LM = left main; RCA = right coronary artery.

sures were compared using analysis of variance techniques. A probability value <0.05 was considered statistically significant.

Our primary end point was death from all causes. Univariable and multivariable Cox proportional hazards models were calculated to estimate mortality. Hazard ratios and 95% confidence intervals (CIs) for included variables were calculated. We initially evaluated univariable models that included the total number of calcified lesions used either as continuous or categorical measurement. We also examined the number of calcified lesions in each coronary artery. A risk-adjusted or multivariable model was then calculated that included the following covariates: age, gender, smoking, diabetes, and hyperlipidemia. From the multivariable models, predicted mortality was calculated. Predicted mortality was divided by each patient follow-up (in years) to estimate annual mortality. A similar analysis was performed to examine the predictive accuracy of the site of CAC lesions.

A receiver-operating characteristic (ROC) curve was calculated to compare death classification for the total score and the total number of calcified lesions. A concordance index and 95% confidence interval [CI] was generated from the ROC curve.

RESULTS

Characteristics of the study cohort. Characteristics are shown in Table 1. Patients with a greater number of calcified lesions were generally older, less likely to be female, and more likely to have cardiac risk factors including diabetes, a family history of premature coronary heart disease, and hypertension (all $p < 0.0001$). Moreover, patients with a greater number of calcified lesions more often had higher CAC scores. For example, the average CAC score

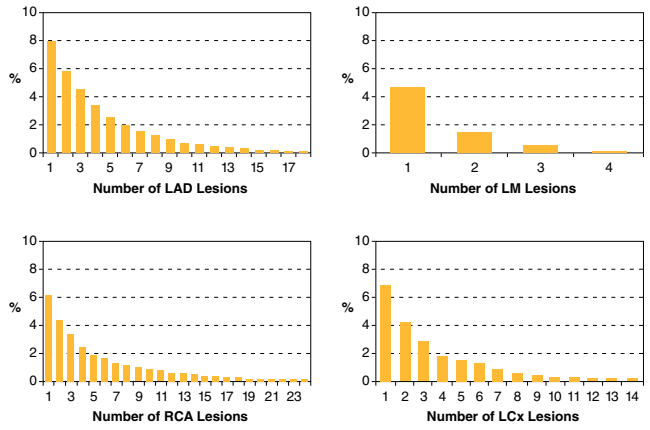

Figure 1. The Frequency of Calcified Lesions by Coronary Artery

This figure plots the percent of patients with the total number of calcified lesions for the left anterior descending (LAD), left main (LM), right coronary (RCA), and left circumflex (LCx) coronary arteries. The total number of lesions varies by the epicardial coronary artery but ranges from 1 to 23 lesions. Any lesion was more frequent in the LAD but also common in the RCA and LCx coronary arteries. Only 0.6% of patients had 3 or more lesions in the LM coronary artery.

for patients with 11 to 20 calcified lesions was 490.5 ± 558, with the majority of this score located in the left anterior descending or right coronary arteries.

The frequency of calcified lesions varied by coronary artery (Fig. 1). Calcified lesions more often occurred in the left anterior descending coronary artery, followed by the right, circumflex, and left main coronary arteries, respectively.

We recorded 281 deaths among the 14,759 patients included. Overall age-adjusted and gender-adjusted Cox survival was 99.2% at 5 years and 98.3% at 10 years.

Table 2. Risk-Adjusted Model, Controlling for Cardiac Risk Factors, by the Total Number of Calcified Lesions Using a Continuous Measure of the Number of Calcified Lesions as Well as its Categorical Subsets

	Hazard Ratio	95% CI	p Value
Risk-adjusted model 1: chi-square = 459, p < 0.0001			
Continuous measure	1.03	1.02–1.04	<0.0001
Risk-adjusted model 2: chi-square = 366, p < 0.0001			
Categorical measure (chi-square = 22, p = 0.001)			
Total number of lesions			
1–2	1.52	0.79–2.94	0.21
3–5	1.78	0.97–3.29	0.064
6–10	1.85	0.99–3.45	0.052
11–20	2.44	1.38–4.32	0.002
>20	3.60	2.01–6.44	<0.0001

Risk-adjusted models include age, gender, smoking, diabetes, hypertension, and hyperlipidemia.
CI = confidence interval.

Relationship between the number of calcified lesions and all-cause mortality. Using either a continuous or categorical measure of the total number of calcified lesions, the univariable models were significantly associated with all-cause mortality ($p < 0.0001$ for both) (Table 2). The hazard ratios were elevated 4.2- and 9.0-fold for patients with 10 to 19 and 20 or more calcified lesions ($p < 0.0001$ for both). In Cox proportional hazards models that controlled for cardiac risk factors (including age, gender, diabetes, smoking, and hyperlipidemia), the total number of lesions remained a significant predictor of all-cause mortality (Table 2).

The risk-adjusted annual mortality by the total number of calcified lesions is presented in Figure 2. As the total number of calcified lesions increases, average annual mortality increases proportionally ($p < 0.0001$). Annual mortality was 0.19% (95% CI 0.18% to 0.21%) per year for patients without any calcified lesions. For patients with 10 or more lesions, the annual mortality exceeded 1% per year. Similarly, for those with 20 or more lesions, the annual mortality exceeded 2% per year.

Figure 3 plots the risk-adjusted annual mortality, revealing the highest relative risk ratios in the left anterior descending and left main coronary arteries. However, mortality rates were significantly higher for the left main as compared with other coronary arteries ($p < 0.0001$). For the left main artery, annual mortality rates were 1.3%, 2.1%, 9.2%, and 13.6% for 1 to 2, 3 to 5, and ≥6 lesions, respectively ($p < 0.0001$). When totaling the number of calcified lesions from a combination of the left main and left anterior descending coronary artery, relative risk ratios were 1.9- to 5.7-fold higher for 10 to ≥20 lesions when compared with other arteries ($p < 0.0001$).

Figure 4 shows the cumulative risk-adjusted survival for patients with only 1 lesion ($p < 0.0001$). Only 1 patient died, during follow-up, among the 1,675 patients with only 1 lesion and a CAC score total ≤10. However, cumulative survival ranged from 98% to 96% for 1 calcified lesion with total CAC scores from 11 to 100 and 400 to 999. For patients with 1 calcified lesion with a CAC score of ≥1,000, cumulative survival was 90.5% ($p < 0.0001$).

Vascular territory CAC scores. When adding all 4 of the CAC scores to a risk-adjusted model (controlling for cardiac risk factors), only the left main (p <

0.0001) and left anterior descending coronary ($p < 0.0001$) arteries were statistically significant. From this model, the risk-adjusted annual mortality rates for left main and left anterior descending coronary arteries were calculated (Table 3). These results revealed that annual mortality was 0.33%, 0.81%, 1.73%, and 7.71% for left main CAC scores of 0 to 10, 11 to 100, 101 to 399, and 400 to 999, respectively ($p < 0.0001$). All 4 patients with a CAC score of ≥1,000 in the left main coronary artery died during follow-up. Moreover, annual mortality was 0.23%, 0.37%, 0.56%, 1.01%, and 2.94% for left anterior descending CAC scores of 0 to 10, 11 to 100, 101 to 399, 400 to 999, and ≥1,000, respectively ($p < 0.0001$).

Models integrating both calcified lesion count and Agatston score. In general, patients with more frequent calcified lesions also had higher CAC scores. Specifically, 81.3% and 95.2% of patients with 11 to 20 and >20 calcified lesions also had a CAC score ≥100. Figure 5 presents the risk-adjusted annual mortality of both the Agatston score and the total number of calcified lesions. Annual mortality increased with higher CAC scores, yet did not vary greatly with the number of lesions. With exception, for patients with 1 to 2 lesions and a total CAC score ≥400, annual mortality was 1.44%. Furthermore, all patients with Agatston scores ≥1,000 had high annual mortality rates of 1% or higher. However, the annual mortality was dramatically higher, at 4.5% and 3.0% for those with 1 to 2 and 3 to 5 calcified lesions as compared with 1.1% to 2.0% for those with 6 to >20 lesions, respectively ($p < 0.0001$).

Comparative predictive accuracy of lesion count versus total Agatston score. The results from an ROC analysis comparing the classification of deaths by the total number of calcified lesions as compared with the total Agatston score are presented in Figure 6. The area under the curve was 0.74 (95% CI 0.71 to 0.77, $p < 0.0001$) for the Agatston score and was not improved by the addition of the total number of calcified lesions (area = 0.71, 95% CI 0.68 to 0.74, $p < 0.0001$). These results reveal that by including the number of calcified lesions, only 1.7% of patients were reclassified as to their risk of death. That is, if one considers patients who only have ≥20 calcified lesions or a CAC score ≥400, their relative hazard for death was elevated 9.8-fold (95% CI 8.1- to 1.20-fold), and in the latter, the risk was not increased by lesion frequency.

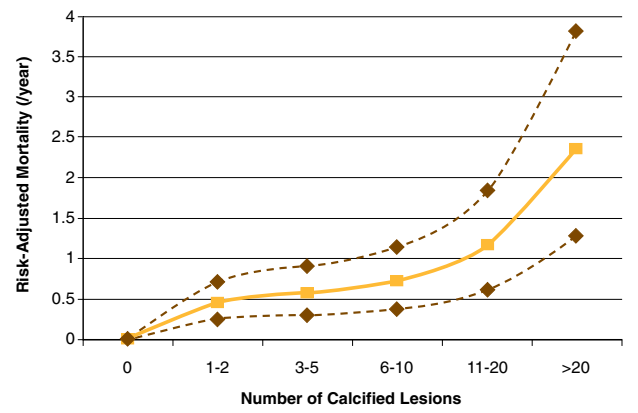

Figure 2. Risk-Adjusted Annual Mortality (95% Confidence Intervals) by the Number of Calcified Lesions

This figure plots predicted or risk-adjusted annual mortality rates, including 95% confidence intervals, by the number of calcified lesions. These results are based on data from a Cox proportional hazards multivariable model that included the number of calcified lesions plus cardiac risk factors. There is a directly proportional relationship between mortality risk and the number of calcified lesions such that mortality rates increase in patients with more frequent calcified lesions.

DISCUSSION

Coronary artery calcification is a subcomponent of atheroma, and its detection in asymptomatic individuals with cardiac risk factors is associated with an increased risk of major cardiovascular events (1). Numerous reports have examined the predictive accuracy of the total Agatston score, consistently

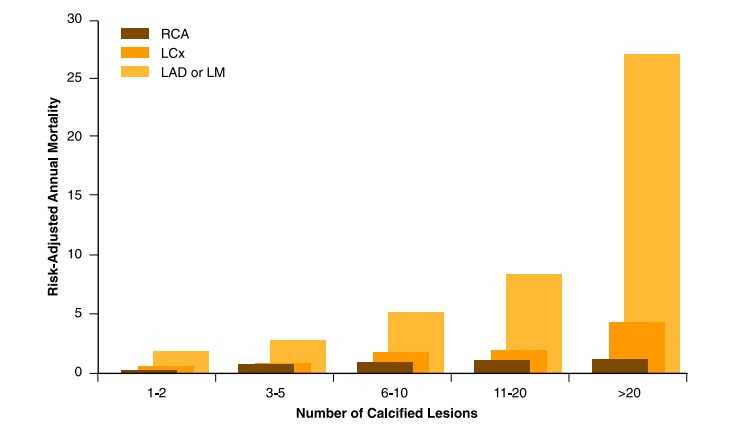

Figure 3. Risk-Adjusted Annual Mortality for CAC Score Subsets by the Number of Calcified Lesions CAC ≥100

This figure plots predicted or risk-adjusted annual mortality rates by the number of calcified lesions in the LAD or LM, RCA, and LCx coronary arteries. These results are based on data from a Cox proportional hazards multivariable model that included the number of calcified lesions plus cardiac risk factors. For all coronary arteries, mortality rates are higher for patients with more frequent calcified lesions. However, mortality rates were highest for patients with calcified lesions in the LAD or LM coronary arteries. CAC = coronary artery calcium; other abbreviations as in Figure 1.

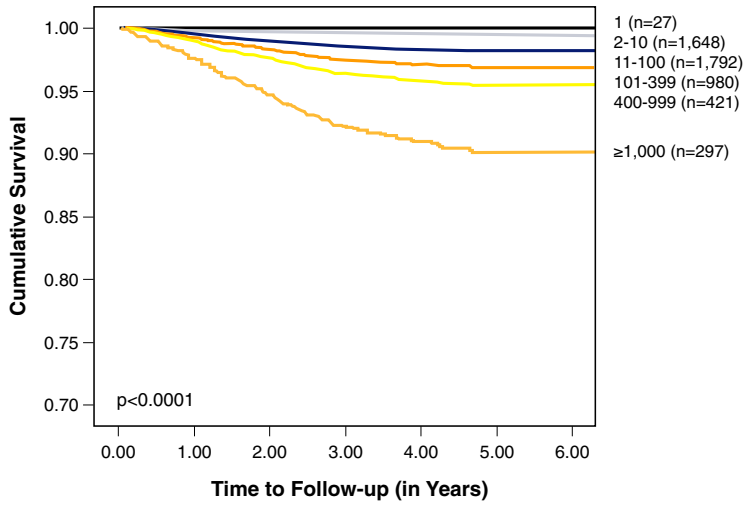

Figure 4. Cumulative Risk-Adjusted Cox Survival for Patients with 1 Calcified Lesion (n = 5,165)

This survival curve is based on a Cox proportional hazards univariable regression model that includes only patients with 1 calcified lesion. These results indicate that patients with large coronary artery calcium scores, in that 1 lesion, had worse cumulative survival ($p < 0.0001$).

reporting its high predictive accuracy for estimation of both all-cause mortality and cardiovascular death or nonfatal myocardial infarction (1,11). Prior reports have not defined how lesion count or location influences prognosis. We report herein that mortality rates increased proportionally with the total and individual vessel's number of calcified lesions. However, when compared against the prognostic performance of the total CAC score, information on lesion count added minimally to the estimation of all-cause mortality. In large part, this was because the vast majority of individuals with numerous calcified lesions also had high CAC scores. Thus, although predictive information is contained in the number of calcified lesions, its added value is minimal.

Table 3. Annualized Risk-Adjusted Mortality by Scores in the Left Anterior Descending and Left Main Coronary Arteries

	Annualized Mortality Rate (%)	95% Confidence Interval	p Value
Total score			<0.0001
0–10 (n = 14,613)	0.06	0.05–0.07	
11–100 (n = 5,033)	0.29	0.28–0.30	
101–399 (n = 3,177)	0.61	0.60–0.62	
400–999 (n = 1,469)	1.26	1.25–1.27	
≥1,000 (n = 965)	2.50	2.48–2.52	
Left anterior descending			<0.0001
0–10 (n = 8,669)	0.23	0.22–0.24	
11–100 (n = 3,026)	0.37	0.35–0.39	
101–399 (n = 2,228)	0.56	0.53–0.59	
400–999 (n = 817)	1.01	0.92–1.10	
≥1,000 (n = 175)	2.94	2.39–3.48	
Left main			
0–10 (n = 13,724)	0.33	0.32–0.34	
11–100 (n = 834)	0.81	0.74–0.89	
101–399 (n = 226)	1.73	1.44–2.01	
400–999 (n = 15)	7.71	3.13–12.30	
≥1,000 (n = 4)	100.0	100.0–100.0	

Scores from the left circumflex ($p = 0.71$) and right coronary ($p = 0.72$) arteries were not statistically significant in a risk-adjusted model.

Despite its limited independent predictive information, there were several notable findings that have clinical relevance to the interpretation of CT measurements of CAC. First, a high-risk CAC score is defined as ≥400, with ensuing annual mortality rates from 1% to 2% or higher, and a patient's risk is similar regardless of whether this score is defined with 3 or 20 lesions. With exception, patients with frequent lesions in the left main or those with only a few large calcified lesions have a particularly high mortality risk. It is well known that spotty coronary calcium is a marker of vulnerable plaque and is more frequently found in culprit lesions (6–9,13). Our results reveal that a concentrated frequency of calcified lesions (i.e., >20) was associated with an increase in mortality notably for the left main coronary artery (Fig. 3). The strong association with mortality is consistent with pathological reports noting a strong correlation between calcification and sudden cardiac death (8). Moreover, in a small series of 49 patients, Schmermund et al. (6) proposed that spotty calcium may be a

marker for more advanced atherosclerosis. From the current study, frequent calcified lesions in the left main coronary artery were associated with annual mortality rates up to 13.6% for those with ≥6 calcified lesions; a rate significantly higher than for other coronary arteries ($p < 0.0001$). This finding is consistent with prior results noting that frequent yet diffuse CAC has been associated with a greater burden of atherosclerotic plaque in the vessel wall and more often with significant stenosis (14).

Our results further show that the prognostic accuracy of CAC scores varied within each of the coronary arteries. Limited case series (15) have been published on the detection of CAC in each of the coronary arteries. The specificity of a negative CAC score for excluding obstructive coronary artery disease exceeds 95% and is not variable by lesion location (16–18). However, the prognostic variability in the location of CAC has not been published. The current results reveal that of the individual coronary arteries, CAC scores from the left main and left anterior descending coronary arteries have a higher prognostic importance when compared with the left circumflex and right coronary arteries. It is well known from the angiographic literature that left main coronary stenosis is associated with substantial worsening in cardiac and all-cause survival (3). Survival for patients with significant left main obstructive disease is exceedingly low (i.e., approximately 20% at 5 years) (2). Similar results have been noted for patients undergoing coronary CT angiography, in which left main stenosis ≥50% was associated with 15% mortality rate at 1.5 years of follow-up (4). The current results report that ≥6 calcified lesions in the left main coronary artery were associated with annual mortality rates in excess of 13% per year. Furthermore, for patients with a left main CAC score of 400 to 999 or ≥1,000, annual mortality rates ranged from 7.7% to 20.0%.

A second finding was that mortality risk was also significantly elevated for patients with high risk CAC scores (score ≥400) in the left anterior descending coronary artery. Although these results seem to limit the importance of the right or left circumflex coronary arteries, they are consistent with prior data and relate to the larger circumferential area of the left ventricle that the left anterior descending coronary artery supplies. We speculate that the prognostic impact of a single large calcified lesion in the left anterior descending coronary artery may be indicative of severe underlying obstructive disease. However, in the absence of angiographic data this remains a speculation on our part.

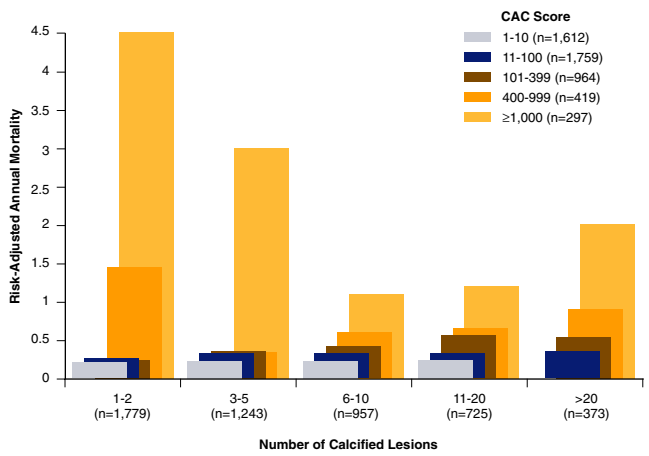

Figure 5. Risk-Adjusted Annual Mortality for CAC Score Subsets by the Number of Calcified Lesions

This figure plots predicted or risk-adjusted annual mortality rates by the number of calcified lesions and coronary artery calcium (CAC) score results. These results are based on data from a Cox proportional hazards multivariable model that included the number of calcified lesions, the CAC score, and cardiac risk factors. Although mortality rates increased for patients with more frequent lesions as well as for those with higher CAC scores, mortality rates were highest for patients with few, very large calcified lesions.

Study limitations. Although our series was sufficiently large to detect differences in all-cause mortality across patient subsets, the analysis of cardiac-

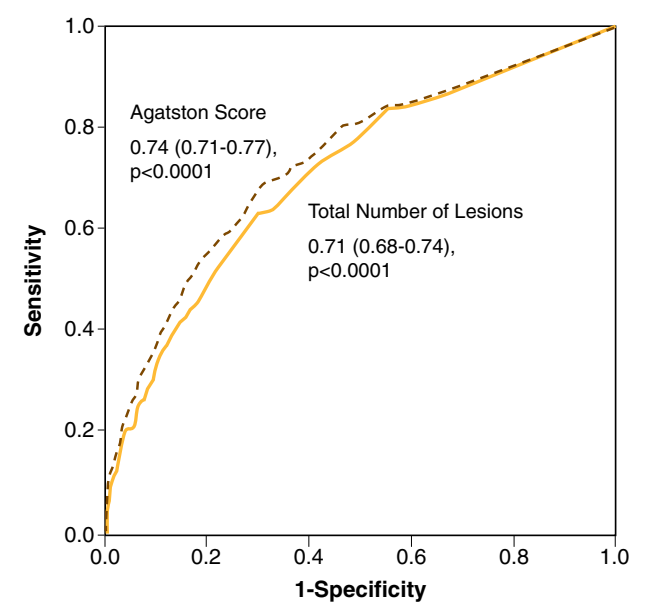

Figure 6. ROC Curves for the Total Number of Calcified Lesions Compared With the Agatston Score

The receiver-operating characteristic (ROC) curve plots the sensitivity (y-axis) by 1 – specificity (or false positive rate, x-axis) for both the total number of lesions and the Agatston or coronary artery calcium score. These results reveal a similar ability to classify mortality risk for both the Agatston score and the number of calcified lesions.

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specific events may have added further to these prognostic findings. Another limitation to this report is that not only would the number of calcified lesions be helpful for risk assessment, but it is likely that knowledge of both the calcified area and plaque attenuation may have further refined our mortality findings. Furthermore, we believe that the location of the calcified lesion (i.e., proximal or distal) would also add to the current results, but was not available in our database. Data on coronary dominance were unavailable, but could have influenced the results presented herein. Finally, it remains possible that because all of our patients were asymptomatic and in stable clinical condition, spotty calcification may not be associated with the same adverse sequelae as reported for patients presenting with acute coronary syndromes (19).

CONCLUSIONS

The current results, from a large consecutive series of asymptomatic adults, show that the commonly used CAC or Agatston score is highly accurate for the estimation of all-cause mortality. The classification of high-risk findings, based on the CAC score, remains accurate regardless of whether there are a few or numerous calcified lesions. The exception is frequent calcified lesions in the left main coronary artery, which pose a particularly high risk for patients. Finally, our results showed that the location of calcified lesions provides additional important prognostic information. Consistent with prior X-ray and CT angiographic literature, evidence of high-risk CAC scores in the left main artery particularly, but also in the left anterior descending coronary artery, were associated with a higher mortality risk than that noted elsewhere within the arterial tree. We believe that the current findings may provide additional insight and guidance for the interpretation of CT measurements of CAC.

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