

ORIGINAL ARTICLE

Premature Coronary-Artery Atherosclerosis in Systemic Lupus Erythematosus

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ABSTRACT

BACKGROUND

Premature coronary artery disease is a major cause of illness and death in patients with systemic lupus erythematosus, but little is known about the prevalence, extent, and causes of coronary-artery atherosclerosis.

METHODS

We used electron-beam computed tomography to screen for the presence of coronary-artery calcification in 65 patients with systemic lupus erythematosus (mean [\pm SD] age, 40.3 \pm 11.6 years) and 69 control subjects (mean age, 42.7 \pm 12.6 years) with no history of coronary artery disease. When calcification was detected, the extent was measured by means of the Agatston score. The frequency of risk factors for coronary artery disease was compared in patients and controls, and the relation between the patients' clinical characteristics and the presence or absence of coronary-artery calcification was examined.

RESULTS

The two groups were similar with respect to age, race, and sex. Coronary-artery calcification was more frequent in patients with lupus (20 of 65 patients) than in control subjects (6 of 69 subjects) ($P=0.002$). The mean calcification score was 68.9 \pm 244.2 in the patients and 8.8 \pm 41.8 ($P<0.001$) in controls. Levels of total, high-density lipoprotein, and low-density lipoprotein cholesterol were not elevated in patients with lupus, but levels of triglycerides ($P=0.02$) and homocysteine ($P<0.001$) were. Among patients with lupus, measures of disease activity were similar in those with and those without coronary-artery calcification, but those with calcification were more likely to be older ($P<0.001$) and male ($P=0.008$).

CONCLUSIONS

In patients with systemic lupus erythematosus, the prevalence of coronary-artery atherosclerosis is elevated and the age at onset is reduced. Early detection of atherosclerosis may provide an opportunity for therapeutic intervention.

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SYSTEMIC LUPUS ERYTHEMATOSUS IS A chronic inflammatory, autoimmune disease that affects mainly young women, a group usually free of atherosclerosis. Treatment for lupus has improved, and long-term survival has increased; however, it has become clear that patients with lupus have substantially increased morbidity and mortality from cardiovascular disease.¹⁻³ The incidence of myocardial infarction is 5 times as high in patients with lupus as in the general population, and in young women the age-specific incidence is increased by a factor of as much as 50.⁴ The reasons for these differences are poorly understood. Traditional coronary risk factors such as hypercholesterolemia, smoking, and hypertension have been implicated⁵ but do not account for the increase in atherosclerotic disease.⁶ This finding has raised the question whether chronic inflammation or the drugs used to treat it, such as corticosteroids, or other risk factors have a role. The possibility that inflammation associated with lupus could promote atherosclerosis is of particular interest, since the pathogenesis of atherosclerosis is thought to be, in part, mediated by inflammation.⁷

A surrogate measure of coronary atherosclerosis, the presence of carotid-artery plaque, was found to be increased in patients with lupus in an uncontrolled study⁸; however, the prevalence and extent of coronary-artery atherosclerosis remain poorly characterized. Coronary-artery atherosclerosis can be detected noninvasively with the use of electron-beam computed tomography (CT).^{9,10} The extent of coronary-artery calcification correlates with findings on coronary angiography and with the extent of atherosclerosis in pathological specimens and is predictive of future cardiac events.^{9,11-15}

We examined the hypothesis that the prevalence and extent of coronary-artery calcification are increased in patients with lupus, as compared with a control group matched for age, race, and sex, and are related to the patients' clinical characteristics.

METHODS

SUBJECTS

Between January 2000 and October 2002, we studied 65 patients with lupus and 69 control subjects who were frequency-matched for age, race, and sex. Consecutive eligible patients older than 18 years of age who met the classification criteria for systemic lupus erythematosus¹⁶ and who had had the disease longer than one year were enrolled. Controls did not

meet the classification criteria for lupus. Patients and controls with a history of cardiovascular disease (previous stroke, myocardial infarction, or angina) were excluded. Patients were recruited from the practices of local rheumatologists, through a Lupus Foundation newsletter, and by advertisements. Control subjects were recruited from the patients' acquaintances, by advertisement, and from a data base of volunteers maintained by the General Clinical Research Center at Vanderbilt University School of Medicine. The study was approved by the institutional review board of Vanderbilt University Hospital, and all subjects gave written informed consent.

Information was obtained through a structured interview, physical examination, laboratory tests, and electron-beam CT, and in the case of patients, review of medical records. Current and cumulative use of medications was determined by combining the information provided by patients and medical records. The medical record was reviewed to confirm the medical history and to obtain the results of tests for antinuclear antibody, anti-double-stranded DNA, anticardiolipin antibodies, and lupus anticoagulant. Patients were considered to have antiphospholipid antibodies if they had a positive test for anticardiolipin antibodies (more than 23 IgG phospholipid units or more than 11 IgM phospholipid units) or lupus anticoagulant (defined by a prolonged partial-thromboplastin time or Russell's viper-venom time).¹⁷

A family history of coronary artery disease was defined as a first-degree relative who had had a myocardial infarction or stroke before the age of 55 years in males or before the age of 65 years in females.¹⁸ Height and weight were measured, and the body-mass index was calculated as the weight in kilograms divided by the square of the height in meters. Blood pressure was determined as the average of two measurements obtained 5 minutes apart after subjects had rested quietly in the supine position for 10 minutes. Subjects were considered to have hypertension if they were taking antihypertensive agents or if they had a systolic blood pressure of at least 140 mm Hg or a diastolic pressure of at least 90 mm Hg. Disease activity and accumulated organ damage were measured in patients with lupus with the use of the Systemic Lupus Erythematosus Disease Activity Index and the Systemic Lupus International Collaborating Clinics damage index, respectively.^{19,20}

Blood was collected after an overnight fast for the measurement of a complete blood count and

levels of creatinine, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides, Lp(a) lipoprotein by cholesterol content, and homocysteine. In patients with lupus, C-reactive protein levels, the Westergren erythrocyte sedimentation rate, and the total hemolytic complement were also determined.

IMAGING PROCEDURES

All subjects underwent imaging with an Imatron C-150 scanner (Imatron). Imaging was performed with a 100-msec scanning time and a single-slice thickness of 3 mm. A total of 40 slices were obtained during single breath-holding periods. Tomographic imaging was electrocardiographically triggered at 60 percent of the interval between R waves. All areas of calcification within the borders of a coronary artery with a minimal attenuation of 130 Hounsfield units were computed. A calcified coronary plaque was considered present if at least three consecutive pixels were measured (voxel size, 1.03 mm³). The acquired images were reviewed at the core electron-beam CT laboratory on a NetraMD workstation (ScImage). Subjects were included in this study only if complete data were available from their scans, without misregistration of slices owing to artifacts of motion, respiration, or asynchronous electrocardiographic triggering. To ensure the continuity and consistency of the interpretation of scores, a single expert investigator who was unaware of the subjects' clinical status read all the scans.

CALCULATION OF CALCIUM SCORES

The degree of coronary-artery calcification was calculated as described by Agatston et al.²¹ The sum of the scores for all arterial lesions provides an overall score for each subject.²¹ The correlation between this score and other variables, such as coronary risk factors, inflammatory markers, and lupus disease activity, was determined.

STATISTICAL ANALYSIS

Assuming the frequency of coronary-artery calcification is 15 percent among asymptomatic 40-year-old women,²² the study required 65 patients and 65 controls to have 85 percent power to detect a minimal frequency of coronary-artery calcification of 35 percent among patients with lupus. Statistical analyses were performed in two phases. First, the prevalence of coronary-artery calcification and coronary risk factors was compared in patients with lupus and control subjects. The distribution of coronary risk

factors was assessed with the use of exact Mann-Whitney U tests for continuous variables and Fisher's exact tests for categorical variables. The exact Mann-Whitney U test was used to compare the distribution of coronary calcium scores between patients and controls. Because of the skewed distribution of calcium scores, an association between coronary-artery calcification and disease was further assessed according to the presence or absence of any coronary calcification.

Adjusted odds ratios were obtained with the use of a logistic-regression model to determine independent associations between the presence of coronary-artery calcium and disease status after controlling for covariates. Covariates were identified if the P value was less than 0.05 on the basis of the univariate analyses. Age and sex were also included in the multivariable logistic-regression model. We performed a similar analysis using logistic regression to evaluate the association between disease status and three levels of coronary calcification (none, low, and high). The difference in the rates of increase in the prevalence of coronary-artery calcification according to age between patients and controls was assessed with the use of logistic regression with an interaction term.

The second exploratory part of the analysis included only patients with lupus. The patients' characteristics were compared with the use of exact Mann-Whitney U tests and Fisher's exact tests. Logistic regression was used to obtain age- and sex-adjusted odds ratios for the presence of coronary calcium.

All analyses used a two-sided significance level of 5 percent and were performed with the use of SAS software (version 8.02, SAS Institute) and ProcLogExact (version 4, Cytel Software).

RESULTS

CHARACTERISTICS OF PATIENTS AND CONTROLS

The demographic characteristics and cardiovascular risk factors for the 65 patients with lupus and the 69 control subjects are shown in Table 1. Patients and controls were successfully matched for age, sex, and race. The subjects were predominantly well educated, with 97 percent having 12 or more years of education, and young, with an average age of approximately 40 years, and predominantly female (approximately 85 percent) and white (approximately 75 percent). The mean (\pm SD) duration of disease from the time of the diagnosis of systemic

Table 1. Clinical Characteristics of Patients with Lupus and Control Subjects.*

Characteristic	Patients (N=65)	Controls (N=69)	P Value†‡
Age (yr)	40.3±11.6	42.7±12.6	0.26
Female sex (%)	91	84	0.30‡
White race (%)	72	75	0.96‡
Duration of disease (yr)	9.9±8.7	NA	NA
Current smoking (%)	35	16	0.02‡
Blood pressure (mm Hg)			
Systolic	121.8±19.5	121.3±16.0	0.63
Diastolic	77.3±14.97	73.4±10.1	0.19
Hypertension (%)	48	25	0.007‡
Family history of coronary heart disease (%)	20	13	0.35‡
Body-mass index	28.2±6.1	27.0±5.3	0.28
Postmenopausal (%)	35	26	0.26
Creatinine (mg/dl)	0.9±0.3	0.8±0.2	0.47
Albumin (g/dl)	3.7±0.5	3.7±0.3	0.69
Cholesterol (mg/dl)			
Total	172.8±51.4	178.8±45.4	0.20
High-density lipoprotein	47.3±16.5	48.9±16.2	0.60
Low-density lipoprotein	101.8±40.9	109.7±37.8	0.06
Lp(a) lipoprotein	29.5±30.8	30.7±37.6	0.91
Triglycerides (mg/dl)	118.7±56.4	99.9±62.2	0.02
Homocysteine (μmol/liter)	9.8±3.9	7.9±2.2	<0.001

* Plus-minus values are means ±SD. To convert values for creatinine to micromoles per liter, multiply by 88.4. To convert values for cholesterol to millimoles per liter, multiply by 0.02586. To convert values for triglycerides to millimoles per liter, multiply by 0.01129. NA denotes not applicable.

† Unless otherwise noted, Mann-Whitney U tests were used for comparisons between groups.

‡ Fisher's two-tailed exact test was used.

lupus erythematosus by a physician was 9.9±8.7 years.

Hypertension was more common among the patients than the controls (48 percent vs. 25 percent, $P=0.007$). Thirty percent of controls and 50 percent of patients had ever smoked. More patients than controls currently smoked (35 percent vs. 16 percent, $P=0.02$) (Table 1). Two patients with lupus had undergone renal transplantation, and one was receiving long-term hemodialysis.

Levels of total, high-density lipoprotein, and low-density lipoprotein cholesterol and Lp(a) lipoprotein were similar in the two groups, but levels of triglycerides ($P=0.02$) and homocysteine ($P<0.001$) were significantly higher among the patients (Table 1).

CORONARY-ARTERY CALCIFICATION

Coronary-artery calcium scores averaged 68.9±244.2 (range, 0 to 1526) in the patients and 8.8±41.8 (range, 0 to 243.4) in controls ($P<0.001$). The frequency of a calcification score of zero and of values above or below 64 is shown in Table 2. Coronary-artery calcification was more prevalent in patients with lupus than controls. Calcification was present in 20 of 65 patients (31 percent) and in 6 of 69 control subjects (9 percent, $P=0.002$), and the unadjusted odds ratio was 4.7 (95 percent confidence interval, 1.7 to 12.6). After we controlled for age, sex, total pack-years of smoking, presence or absence of hypertension, triglyceride levels, and homocysteine levels, the adjusted odds ratios for the presence of coronary-artery calcification in patients with lupus was 9.8 ($P=0.001$), as compared with controls. Low and high levels of coronary-artery calcification were defined with the use of a calcium score above or below the median calcium score of patients with calcification (64 Agatston units). The odds ratios for having low and high levels of coronary calcification (with the absence of calcification used as the reference level) were 4.6 for both levels, and the adjusted odds ratios were 10.0 and 9.6, respectively. Coronary-artery calcium was present in one of two patients who had undergone renal transplantation and was not present in the patient who was receiving hemodialysis.

The frequency of calcification scores indicative of coronary-artery atherosclerosis of varying severity in patients with lupus and controls is shown in Figure 1. A calcium score of zero represents the absence of detectable calcium, whereas a score of greater than 400 indicates the presence of extensive coronary-artery calcification. None of the control subjects had a calcium score greater than 400, whereas three patients with lupus did.

The prevalence and extent of coronary-artery calcification in the general population increase with age.²³ Therefore, the prevalence of coronary-artery calcification in patients and controls in different age groups was compared (Fig. 2). Coronary-artery calcification occurred at a younger age in patients with lupus than controls, and the prevalence increased with increasing age. The absence of coronary calcium in the elderly control group is most likely due to the small number of subjects in this subgroup (seven). However, this absence does not materially affect the interpretation of the data, since when we performed an analysis excluding the subgroup of patients older than 60 years of age, coronary-artery

Table 2. Prevalence of Coronary-Artery Calcification and Calcification Scores in Patients with Lupus and Control Subjects.*

Variable	Patients (N=65)	Controls (N=69)	Unadjusted		Adjusted	
			Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
	<i>percent (number)</i>					
Coronary-artery calcification	31 (20)	9 (6)	4.7 (1.7–12.6)	0.002	9.8 (2.5–39.0)	0.001
Calcification score†						
1 to 63	15 (10)	4 (3)	4.6 (1.2–17.9)	0.02	10.0 (2.0–50.0)	0.005
≥64	15 (10)	4 (3)	4.6 (1.2–17.9)	0.02	9.6 (1.4–65.4)	0.02

* Logistic regression was used for unadjusted odds ratios. For adjusted odds ratios, logistic regression was used after adjustment for age, sex, pack-years of smoking, presence or absence of hypertension, triglyceride levels, and homocysteine levels. CI denotes confidence interval.

† A calcification score of 0 is used as the reference level in the logistic-regression analyses. Higher scores indicate more extensive calcification.

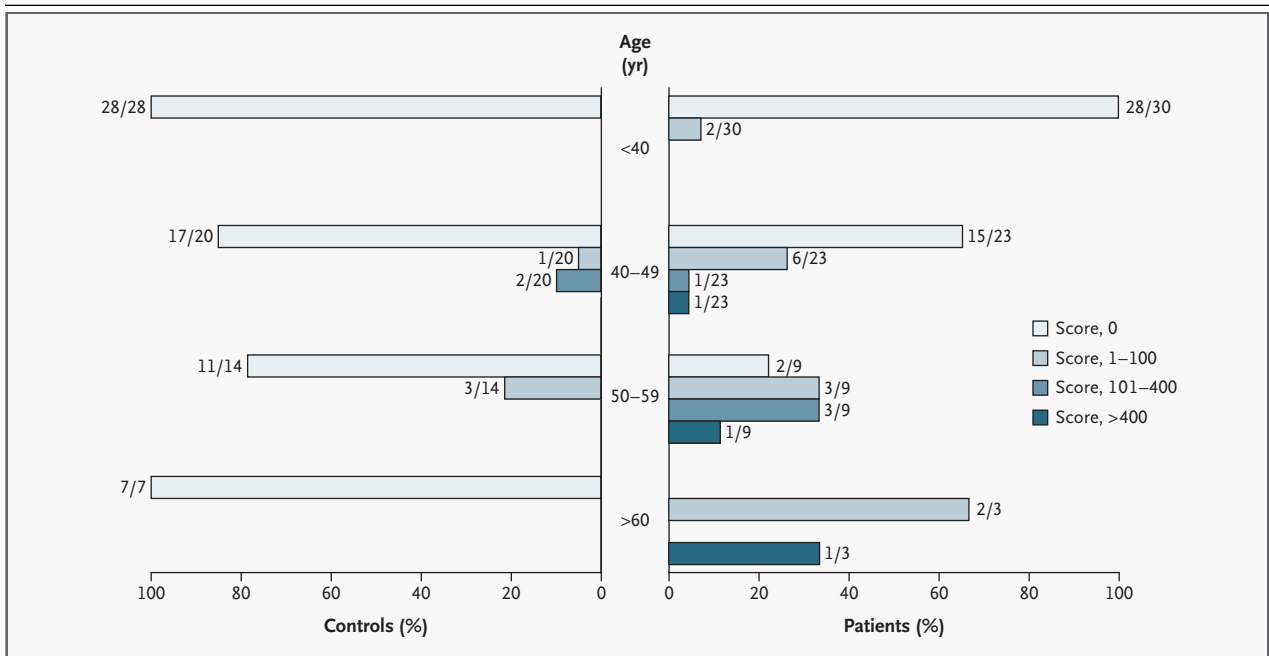
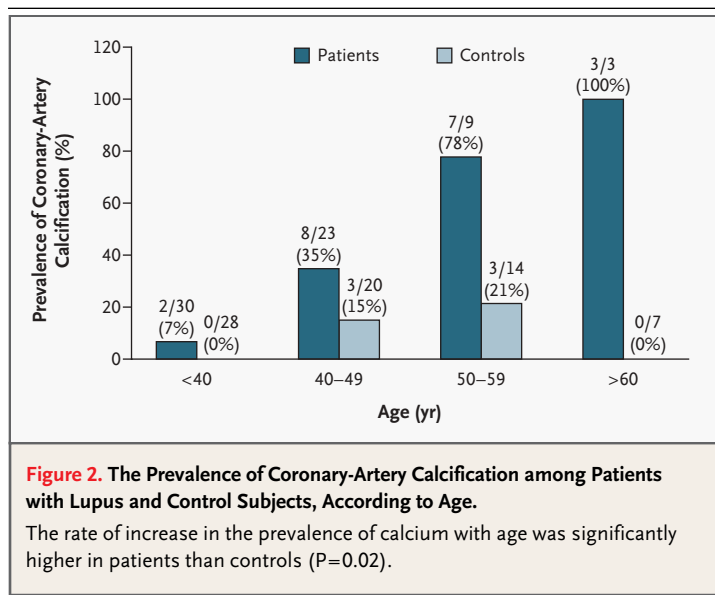


Figure 1. Frequency of Coronary-Artery Calcium Scores among Patients with Lupus and Control Subjects, According to Age. Higher scores indicate more extensive calcification.

calcium was present in 17 of 62 patients with lupus and 6 of 62 controls (P=0.01).

Older age (P<0.001) and male sex (P=0.008) were more common in patients with coronary-artery calcification than in those without calcification, but the groups did not differ significantly with respect to other risk factors for atherosclerosis or markers of inflammation or disease activity (Table 3). The

average creatinine level was slightly higher in patients with calcification (0.9±0.1 mg per deciliter [80±9 μmol per liter]) than in those without calcification (0.8±0.4 mg per deciliter [71±35 μmol per liter], P<0.001), but this difference was not significant after adjustment for age and sex (Table 3). There was no significant relation between the use of corticosteroids and the presence of coronary-artery cal-



cification. The use of hydroxychloroquine in patients with and those without calcification did not differ significantly.

DISCUSSION

Our results indicate that coronary-artery calcification, as detected by electron-beam CT, occurs more frequently and at a younger age in patients with lupus than in control subjects. This study shows that asymptomatic atherosclerosis is frequently present in patients with lupus and cannot be predicted by the presence or absence of other cardiovascular risk factors. Complementary findings are reported elsewhere in this issue of the *Journal*.²⁴

Previous evidence from autopsies and clinical studies has suggested that the prevalence of subclinical atherosclerosis is increased in patients with lupus.²⁵ Manzi et al. used B-mode ultrasonography to measure carotid-artery plaques and intimal-medial thickness in 175 women with lupus, 15 percent of whom had already had a cardiovascular event.⁸ They found that 40 percent of women with lupus had at least one focal carotid-artery plaque, a higher frequency than would have been expected to occur among healthy women. Another study retrospectively compared patients with lupus who had a history of cardiovascular disease and those who had no such history and found that carotid-artery intimal-medial thickness was greater in patients with a history of cardiovascular disease.²⁶

However, in this study, as in that by Manzi et al.,⁸ carotid-artery intimal-medial thickness — a measure often considered to be associated with coronary atherosclerosis²⁷ — in patients without a previous cardiovascular event did not differ from values in the general population.²⁶

Attempts to address the extent and severity of coronary artery disease in patients with lupus more directly have used single-photon-emission CT dual-isotope myocardial perfusion imaging. Such studies detected abnormalities in 35 percent of patients.²⁸ However, the prevalence of coronary-artery atherosclerosis in patients with lupus has remained unclear because it is difficult to measure noninvasively.

The ability to measure coronary-artery calcification by electron-beam CT has provided a reproducible and quantitative method for the detection of subclinical coronary-artery atherosclerosis that yields information about the risk of cardiovascular events in addition to that provided by other risk factors.²⁹ In the present study we used electron-beam CT to study subjects with no history of cardiovascular disease and found an increased prevalence of coronary-artery calcification, indicating increased coronary atherosclerosis and cardiovascular risk, among patients with lupus, most of whom were relatively young women.

Because the prevalence of myocardial infarction is increased among patients with lupus, several studies have measured cardiovascular risk factors in this group.^{5,8} Age and the presence of hypertension were associated with clinical coronary artery disease.⁶ Elevated levels of homocysteine have been reported in patients with lupus and have been associated with stroke and arterial thrombotic events.³⁰ We found that hypertension occurred more frequently in patients with lupus than in controls and that the patients also had elevated levels of triglycerides and homocysteine. By contrast, the levels of traditional cardiovascular risk factors such as low-density lipoprotein and high-density lipoprotein cholesterol, which are commonly measured as a means of predicting cardiovascular risk in the general population,¹⁸ did not differ significantly between patients and control subjects.

The relation between cardiovascular risk factors and coronary-artery calcium is of particular interest, since a strong relation would allow clinicians to identify patients with undetected coronary-artery atherosclerosis by means of such risk markers. Therefore, we compared patients with coronary-artery calcium and those without it. After ad-

Table 3. Characteristics of Patients with Lupus, According to the Presence or Absence of Coronary-Artery Calcification.*

Characteristic	Calcification (N=20)	No Calcification (N=45)	P Value†	Adjusted for Age and Sex	
				Odds Ratio (95% CI)‡	P Value
Age (yr)	49.9±10.9	36.0±9.2	<0.001	NA	NA
Female sex (%)	75	98	0.008§	NA	NA
White race (%)	70	73	0.88§	2.47 (0.5–11.4)	0.25
Duration of disease (yr)	12.1±10.3	8.9±7.9	0.16	0.96 (0.88–1.06)	0.41
Blood pressure (mm Hg)					
Systolic	127.0±22.0	119.4±18.0	0.12	1.01 (0.98–1.05)	0.58
Diastolic	78.0±15.2	77.0±14.6	0.66	1.00 (0.95–1.05)	0.99
Family history of coronary heart disease (%)	25	18	0.52§	1.80 (0.39–8.42)	0.45
Current smoking (%)	45	31	0.40§	1.19 (0.30–4.76)	0.80
Total pack-yr of smoking	11.5±13.3	5.7±10.3	0.18	1.00 (0.94–1.05)	0.91
Body-mass index	29.5±6.1	27.6±6.1	0.22	1.03 (0.92–1.15)	0.59
Creatinine (mg/dl)	0.9±0.1	0.8±0.4	<0.001	3.96 (0.52–30.4)	0.19
Albumin (g/dl)	3.6±0.4	3.7±0.6	0.49	0.43 (0.09–2.02)	0.28
Cholesterol (mg/dl)					
Total	179.8±48.4	169.6±53.0	0.45	1.00 (0.99–1.01)	0.95
High-density lipoprotein	46.1±18.8	47.8±15.6	0.53	0.98 (0.94–1.02)	0.38
Low-density lipoprotein	108.8±34.2	98.6±43.6	0.12	1.00 (0.99–1.02)	0.67
Lp(a) lipoprotein	40.6±35.1	24.4±27.6	0.09	1.02 (1.00–1.05)	0.07
Triglycerides (mg/dl)	124.6±59.9	116.0±55.3	0.48	1.00 (0.99–1.01)	0.74
Homocysteine (μmol/liter)	10.5±3.0	9.4±4.2	0.09	1.08 (0.88–1.33)	0.47
Erythrocyte sedimentation rate (mm/hr)	22.5±22.4	25.9±28.5	0.78	1.01 (0.98–1.04)	0.68
C-reactive protein (mg/dl)	0.9±1.0	0.8±1.0	0.40	1.29 (0.58–2.91)	0.53
Total hemolytic complement (units)	217.2±65.7	200.0±67.6	0.25	1.00 (0.99–1.01)	0.91
Anti-double-stranded DNA (%)¶	22	49	0.08§	1.00 (0.99–1.01)	0.96
Antiphospholipid antibody (%)	10	39	0.03§	0.21 (0.03–1.66)	0.14
SLEDAI score**	3.2±3.3	3.9±3.6	0.62	0.96 (0.76–1.21)	0.72
SLICC damage index score††	1.2±1.6	1.0±1.4	0.87	1.13 (0.73–1.74)	0.59
Cumulative dose of prednisone (g)	35.0±39.6	35.0±43.0	0.40	1.00 (1.00–1.00)	0.68

* Plus-minus values are means ±SD. To convert values for creatinine to micromoles per liter, multiply by 88.4. To convert values for cholesterol to millimoles per liter, multiply by 0.02586. To convert values for cholesterol to millimoles per liter, multiply by 0.01129. CI denotes confidence interval, and NA not applicable.

† Unless otherwise noted, Mann-Whitney U tests were used for comparisons between groups.

‡ Logistic regression was used to obtain age- and sex-adjusted odds ratios for the presence of coronary calcification.

§ Fisher's two-tailed exact test was used.

¶ Results were available for 18 patients with calcification and 41 without calcification.

|| Results were available for 19 patients with calcification and 41 without calcification.

**Higher scores for the Systemic Lupus Erythematosus Disease Activity Index (SLEDAI) indicate greater disease activity.

††Higher scores for the Systemic Lupus International Collaborating Clinics (SLICC) damage index indicate greater disease-related damage.

justment for age and sex, no cardiovascular risk factor, acute-phase reactant, or disease-activity index was significantly associated with the presence of coronary-artery calcium. However, given the wide confidence intervals for some variables, these findings should be regarded as exploratory rather than

definitive. Antiphospholipid antibodies are thought to promote atherosclerosis.³¹ In our study, patients with anti-double-stranded DNA and antiphospholipid antibodies were younger than those without them. Thus, the apparent trend toward a lower frequency of coronary-artery calcification in patients

with these antibodies was no longer present after adjustment for age.

The cause of accelerated atherosclerosis in patients with lupus remains unclear. However, we did not measure many inflammatory mediators, such as cytokines, cellular adhesion molecules, CD40 ligand, and markers of oxidative stress, that have been implicated in the pathogenesis of atherosclerosis.³² Furthermore, a single measurement of an inflammatory marker provides only a cross-sectional measure of inflammation, whereas atherosclerosis is a chronic process.

Our findings suggest that coronary-artery atherosclerosis is more prevalent among patients with lupus than in the general population and cannot be predicted by the measurement of traditional risk factors or markers of disease activity. This supposition is concordant with the results of a retrospective study, which found that, even after accounting for base-line cardiovascular risk factors as defined in the Framingham Study, the risk of adverse cardiovascular outcomes was increased by a factor of 7 to 17 in patients with lupus as compared with the Framingham cohort.⁶ Thus, to identify asymptomatic

patients with lupus who are at high risk for a cardiovascular event, the use of Framingham risk factors alone is inadequate, and the use of novel markers of cardiovascular risk should be explored. Coronary-artery calcification may be such a marker,³³ since high calcium scores are associated with an increased probability of the presence of vulnerable plaque, and although they do not identify specific vulnerable lesions,³⁴ the predictive value of these scores should be explored in patients with lupus.

In conclusion, asymptomatic coronary-artery atherosclerosis, as detected by electron-beam CT, is more common in patients with lupus than in the general population but is not associated with traditional coronary risk factors, lupus disease activity, or corticosteroid therapy. Lupus should be added to the list of conditions that raise cardiovascular risk independent of conventional risk factors.

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