

ARTICLE

The Role of Carotid Arterial Intima-Media Thickness in Predicting Clinical Coronary Events

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Background: Carotid arterial intima-media thickness is used as a noninvasive surrogate end point to measure progression of atherosclerosis, but its relation to coronary events has not been fully explored.

Objective: To determine whether carotid arterial intima-media thickness predicts coronary events.

Design: Long-term follow-up (average, 8.8 years) of a previously assembled cohort of persons who completed the 2-year Cholesterol Lowering Atherosclerosis Study, a randomized arterial imaging trial designed to study the effects of lipid lowering on progression of atherosclerosis.

Setting: University-based ultrasonography laboratory.

Patients: 146 men 40 to 59 years of age who had previously had coronary artery bypass graft surgery.

Measurements: Preinvasive atherosclerosis in the common carotid artery was evaluated every 6 months with B-mode ultrasonography, and invasive atherosclerosis in the coronary arteries was evaluated at baseline and at 2 years with quantitative coronary angiography. After the trial, the incidences of coronary events (nonfatal acute myocardial infarction, coronary death, and coronary artery revascularization) were documented.

Results: For each 0.03-mm increase per year in carotid arterial intima-media thickness, the relative risk for non-fatal myocardial infarction or coronary death was 2.2 (95% CI, 1.4 to 3.6) and the relative risk for any coronary event was 3.1 (CI, 2.1 to 4.5) ($P < 0.001$). Absolute intima-media thickness was also related to risk for clinical coronary events ($P < 0.02$). Absolute thickness and progression in thickness predicted risk for coronary events beyond that predicted by coronary arterial measures of atherosclerosis and lipid measurements ($P < 0.001$).

Conclusion: Noninvasive B-mode ultrasonographic measurement of progression of intima-media thickness in the distal common carotid artery is a useful surrogate end point for clinical coronary events.

Carotid arterial intima-media thickness measured with B-mode ultrasonography is used as a noninvasive end point (that is, an outcome) in epidemiologic studies and clinical trials to gauge progression and regression of atherosclerosis [1-3]. As such, carotid arterial intima-media thickness, expressed as a single measurement (in millimeters) or a rate of change (in millimeters per year), is used as a surrogate end point for atherosclerosis of the coronary artery. However, its relation to coronary events has not been fully explored.

Article

- ▶ Table of Contents
- ▶ Abstract of this article
- ▶ Figures/Tables List
- ▶ Articles citing this article

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It is well established that progression of atherosclerosis of the coronary artery determined by sequential coronary angiography is predictive of coronary events [4-6]. A close histologic relation between carotid and coronary atherosclerosis has been seen in autopsy studies [7], and the two arterial beds share many risk factors that contribute to the progression of atherosclerosis [8, 9]. Furthermore, carotid arterial intima-media thickness has been a good indicator of the presence and extent of coronary artery disease in observational studies [10, 11].

The Cholesterol Lowering Atherosclerosis Study [12] was a clinical arterial imaging trial designed to study the effects of colestipol-niacin therapy on progression of atherosclerosis in the coronary, femoral, and carotid arteries. We have reported that treatment is beneficial for all three arterial beds [3, 13-16]. In addition, long-term follow-up of the study cohort indicated that progression of coronary artery disease was predictive of coronary events [4].

The objectives of this long-term follow-up of the Cholesterol Lowering Atherosclerosis Study cohort are 1) to determine whether carotid arterial intima-media thickness [expressed as a single measurement or as a rate of change] predicts coronary events, 2) to compare the relative prognostic utility of the two carotid arterial intima-media thickness measures; and 3) to compare the relative prognostic contribution of the two carotid arterial intima-media thickness measures with an angiographic measure of coronary artery disease progression and lipid levels.

Methods

Study Design

In the Cholesterol Lowering Atherosclerosis Study, 188 nonsmoking men 40 to 59 years of age who had previously had coronary artery bypass graft surgery were randomly assigned to receive colestipol-niacin therapy plus dietary therapy (target diet, <125 mg of cholesterol per day and 22% of energy as fat, 10% as polyunsaturated fat, and 4% as saturated fat) or placebo plus dietary therapy (target diet, <250 mg of cholesterol per day and 26% of energy as fat, 10% as polyunsaturated fat, and 5% as saturated fat) [12]. In addition to the primary end point provided by coronary angiograms at baseline and after 2 years of treatment, B-mode ultrasonography of the carotid artery was done at baseline and every 6 months during the 2-year treatment period. The cohort for this study consisted of patients who had completed the 2-year treatment period and had evaluable coronary and carotid arterial end points.

Baseline and 2-year coronary artery films were processed by quantitative coronary angiography in tandem; frames were matched for orientation and degree of contrast filling [17]. For each evaluable arterial segment, three sequential frames were processed in end diastole. For each coronary lesion, percent diameter stenosis was obtained as the average over the three sequential frames. For each patient, the change in percent diameter stenosis over 2 years was averaged for all evaluable coronary artery lesions.

B-mode ultrasonographic images of the carotid artery were obtained with a Dasonics CV400 system with a 7.5-MHz probe (Dasonics, Milpetas, California). Longitudinal views of the far wall of the right distal common carotid artery were recorded with the minimum gain necessary for clear visualization of structures. Common carotid arterial intima-media thickness was measured with an automated computerized edge-detection algorithm [18]. The distance between the echoes arising from the blood-intima interface and the media-adventitia interface was taken as the measure of intima-media thickness. Distal common carotid arterial intima-media thickness was the average of approximately 80 intima-media thickness measurements made over 1 cm. Measurements were made by persons blinded to treatment assignment and the occurrence of clinical coronary events.

Follow-up for Coronary Events

- ▲ Top
- Methods
- ▼ Results
- ▼ Discussion
- ▼ Author & Article Info
- ▼ References

After completion of the 2-year treatment period, the occurrence of major medical events and information on all medications (including lipid-lowering agents) was determined for all patients by a clinic visit (59% of all follow-ups) or a mailed questionnaire (41%) at annual follow-up points through 30 June 1994. No ascertainment bias was associated with method of follow-up.

Coronary events were nonfatal acute myocardial infarction, coronary death, and need for coronary artery revascularization [percutaneous transluminal coronary angioplasty or coronary artery bypass graft surgery] because of recurrence or worsening of angina pectoris. For all patient-reported events, hospital records were obtained for confirmation, and all causes of death were confirmed by hospital records and death certificates. Myocardial infarction was diagnosed by a cardiologist who was blinded to treatment assignment and ultrasonographic and angiographic end point measures. Myocardial infarction was confirmed if two of the following three criteria were substantiated: typical chest pain, positive creatine phosphokinase-MB, and a new Q wave on electrocardiogram. In order to include only events that were clearly related to clinical symptoms, we did not count 1) coronary artery revascularizations that were related to the reading of the 2-year coronary angiogram or 2) silent myocardial infarctions noted on electrocardiograms at annual follow-up examinations as clinical coronary events.

Statistical Analysis

The two dependent variables were time from completion of the trial to nonfatal myocardial infarction or coronary death and time from completion of the trial to the first coronary event (nonfatal myocardial infarction, coronary death, or coronary artery revascularization). The two independent variables were the absolute carotid arterial intima-media thickness (in millimeters), measured at the end of the 2-year trial, and the annual rate of change in carotid arterial intima-media thickness (in millimeters per year), evaluated over the 2-year trial. The intima-media thickness change rate was computed for each patient by fitting a least-squares regression line relating intima-media thickness measurements to time in the study. The average number of ultrasonographic examinations per patient was 2.8 ± 0.4 . The absolute carotid arterial intima-media thickness is a cumulative measure of carotid atherosclerosis, whereas the intima-media thickness change rate represents the speed with which atherosclerosis of the carotid artery is changing.

Univariate and multivariate proportional hazards models were used to test for relations (overall and within each treatment group) between the intima-media thickness variables and coronary event rates. Covariates included the baseline value for intima-media thickness (for analyses of intima-media thickness change rates) and treatment group (for analyses of the total sample). Because patients had the option to continue their randomized, blinded treatment in a 2-year extension of the Cholesterol Lowering Atherosclerosis Study, an additional covariate indexed whether a given patient was treated in the 2-year extension period. Likelihood ratio tests for trend in coronary event rates used each intima-media thickness variable as continuous data. Hazard ratios (as estimators of relative risks) and 95% CIs were expressed per SD (0.03 mm/year for the carotid arterial intima-media thickness change rate and 0.13 mm for the absolute carotid arterial intima-media thickness). Absolute carotid arterial intima-media thickness values were categorized by quartiles based on the distribution of the baseline intima-media thickness for all patients; carotid arterial intima-media thickness change rates were categorized by quartiles based on the distribution of changes in the placebo group. Hazard ratios were then computed for each of the upper quartiles relative to the first.

Because earlier analyses of the study cohort showed a significant relation between progression of coronary artery disease (assessed by the change in percent diameter stenosis using quantitative coronary angiography) and coronary events [4], we also evaluated the relative prognostic contributions of this angiographic measure of coronary artery disease progression and the ultrasonographic measure of carotid arterial intima-media thickness progression. For the change in percent diameter stenosis, hazard ratios and 95% CIs were expressed per 10% change in percent diameter stenosis. The cutoff of 10% change is double the measurement error for percent diameter stenosis on short-term repeated angiography. The joint prognostic contribution of the carotid artery and coronary artery measures of atherosclerosis with lipid levels that were found to be significantly different between patients with and without coronary events was also evaluated.

Values given are the mean \pm SD unless otherwise indicated.

Role of the Funding Source

The authors were responsible for data collection, data management, statistical analyses, and data interpretation. Research was supported by the National Heart, Lung, and Blood Institute through investigator-initiated grants to Dr. Hodis (RO1-HL-49885) and Dr. Mack (RO3-HL-54532). The funding source had no role in deciding whether the study would be submitted for publication.

Results

Characteristics of the Cohort at Baseline and after Treatment

- ▲ Top
- ▲ Methods
- Results
- ▼ Discussion
- ▼ Author & Article Info
- ▼ References

Of the 188 patients randomly assigned to treatment, 42 (22%) were excluded from the study: Eleven did not have a baseline ultrasonogram, 13 had no ultrasonographic follow-up, and 18 had no ultrasonogram evaluable for intima-media thickness. No differences were seen in baseline characteristics or changes on coronary angiography at 2 years between these 42 patients and the remaining 146 patients (78%) who had sufficient data to allow us to compute a carotid arterial intima-media thickness change rate. At baseline, the age of the study cohort was 54.2 ± 4.5 years; the systolic blood pressure was 121.5 ± 13.0 mm Hg; the diastolic blood pressure was 79.3 ± 8.7 mm Hg; the total cholesterol level was 6.30 ± 0.87 mmol/L; the low-density lipoprotein (LDL) cholesterol level was 4.38 ± 0.78 mmol/L; the high-density lipoprotein (HDL) cholesterol level was 1.14 ± 0.24 mmol/L; the triglyceride level was 1.70 ± 0.97 mmol/L; the carotid arterial intima-media thickness was 0.66 ± 0.14 mm; and the coronary artery percent diameter stenosis was 36.0 ± 7.2 . Sixty-nine percent of patients were former smokers. Of the 146 patients, 73 were assigned to drug treatment and 73 were assigned to placebo.

During the 2-year treatment period, the drug produced significant benefit for all lipid levels ($P < 0.01$) and blood pressure ($P < 0.05$). The average outcomes at 2 years for the drug group and the placebo group were 0.64 ± 0.13 mm and 0.68 ± 0.13 mm, respectively, for the common carotid arterial intima-media thickness ($P = 0.06$); -0.024 ± 0.031 mm per year and 0.021 ± 0.021 mm per year, respectively, for the common carotid arterial intima-media thickness change rate ($P < 0.001$); and 0.47 ± 6.10 and 2.83 ± 5.79 , respectively, for the change in percent diameter stenosis ($P = 0.02$). Sixty-three patients in the drug group (86%) and 54 patients in the placebo group (74%) continued into the optional 2-year extension.

Coronary Events

During an average of 8.8 years of follow-up (range, 0.7 to 12.3 years) after angiography at 2 years, 68 of 146 patients (47%) (27 in the drug group and 41 in the placebo group) had at least one coronary event. The first coronary event was percutaneous transluminal coronary angioplasty in 6 patients in the drug group and 9 patients in the placebo group, coronary artery bypass graft surgery in 12 patients in the drug group and 9 patients in the placebo group, nonfatal myocardial infarction in 8 patients in the drug group and 20 patients in the placebo group, and coronary death in 1 patient in the drug group and 3 patients in the placebo group. The rate of total coronary events was 6.3 per 100 person-years (4.7 per 100 person-years in the drug group and 8.0 per 100 person-years in the placebo group; $P = 0.05$). Of these 68 patients, 38 (12 in the drug group and 26 in the placebo group) ultimately had a nonfatal myocardial infarction (9 in the drug group and 22 in the placebo group) or died of coronary disease (3 in the drug group and 4 in the placebo group). The rate of myocardial infarction and coronary death was 3.1 per 100 person-years (1.9 per 100 person-years in the drug group and 4.5 per 100 person-years in the placebo group; $P = 0.03$).

[Table 1](#) shows the clinical characteristics, at baseline and during the trial, of patients with and without coronary events.

Patients with coronary events were more likely to have been assigned to placebo, had lower HDL cholesterol levels during treatment, had greater absolute common carotid arterial intima-media thicknesses, and had more common carotid arterial intima-media thickness progression and coronary artery disease progression. The correlations between the change in

percent diameter stenosis and the two measures of carotid arterial intima-media thickness were 0.21 for absolute carotid arterial intima-media thickness ($P = 0.03$) and 0.28 for carotid arterial intima-media thickness change rate ($P = 0.02$). The correlation between the two carotid arterial intima-media thickness measures was 0.15 ($P = 0.11$).

View this table: [\[in this window\]](#) [\[in a new window\]](#) **Table 1. Clinical Characteristics of the Study Cohort ($n = 146$) at Baseline and during the Trial, Stratified by Occurrence of Clinical Coronary Events***

Common Carotid Arterial Intima-Media Thickness Change Rate and Risk for Coronary Events

Carotid arterial intima-media thickness progression was significantly related to risk for subsequent myocardial infarction or coronary death ([Table 2](#)) (relative risk, 2.2 per 0.03 mm/year; $P < 0.001$). The relative risk for myocardial infarction or coronary death in the highest quartile of intima-media thickness change rate (≥ 0.034 mm/year) was 2.8 relative to the lowest quartile (<0.011 mm/year). In analysis by treatment group, relative risks of similar magnitude were found in the placebo group (relative risk, 2.1 per 0.03 mm/year; $P = 0.02$) and the drug group (relative risk, 2.4 per 0.03 mm/year; $P = 0.007$). Analyses of the relation between the carotid arterial intima-media thickness change rate and subsequent risk for any coronary event yielded results similar to those for myocardial infarction and coronary death ([Table 2](#)).

View this table: [\[in this window\]](#) [\[in a new window\]](#) **Table 2. Common Carotid Arterial Intima-Media Thickness Change Rate and Risk for Clinical Coronary Events***

Absolute Common Carotid Arterial Intima-Media Thickness and Risk for Coronary Events

The absolute carotid arterial intima-media thickness was significantly related to risk for myocardial infarction or coronary death ([Table 3](#)) (relative risk, 1.4 per 0.13 mm; $P = 0.02$). The relative risk for myocardial infarction or coronary death in the highest quartile of absolute intima-media thickness (≥ 0.733 mm) relative to the lowest quartile (<0.566 mm) was 7.7. In analysis by treatment group, absolute common carotid arterial intima-media thickness was significantly related to risk for myocardial infarction or coronary death in the drug group (relative risk, 1.9 per 0.13 mm; $P = 0.009$) but not in the placebo group. Analyses of the relations between absolute carotid arterial intima-media thickness and subsequent risk for any coronary event yielded results similar to those of myocardial infarction or coronary death ([Table 3](#)). Although absolute carotid arterial intima-media thicknesses in the placebo group were not significantly related to coronary events, the relative risks in the upper quartiles were elevated (≥ 3.8).

View this table: [\[in this window\]](#) [\[in a new window\]](#) **Table 3. Absolute Common Carotid Arterial Intima-Media Thickness and Risk for Clinical Coronary Events***

Coronary Angiography, Carotid Arterial Intima-Media Thickness Progression, Lipids, and Risk for Coronary Events: Multivariate Analyses

In evaluations of both measures of common carotid arterial intima-media thickness ([Table 4](#), model 1), both the intima-media thickness change rate and the absolute intima-media thickness were independent predictors of coronary events ($P < 0.05$). In models evaluating measures of carotid and coronary atherosclerosis ([Table 4](#), models 2 and 3), each carotid arterial intima-media thickness measure contributed significantly to prediction of the event risk beyond that provided by the coronary measure of change in percent diameter stenosis ($P < 0.05$). All three measures contributed significantly to the prediction of any coronary event ([Table 4](#), model 4).

View this table: [Table 4. Multivariate Associations of Lipid Levels and Coronary Arterial and Common Carotid Arterial Measures of Atherosclerosis with Risk for Clinical Coronary Events*](#)
[\[in this window\]](#)
[\[in a new window\]](#)

Because HDL cholesterol levels during treatment were related to any coronary event ([Table 1](#)) and because HDL cholesterol was the only lipid significantly related to risk for coronary events in Cox regression analyses (data not shown), the predictive contribution of this variable was also evaluated. Each carotid arterial intima-media thickness measure contributed significantly to prediction of the event risk beyond that provided by measurements of HDL cholesterol levels alone ([Table 4](#)), models 5 and 6; $P < 0.05$), and all measures of carotid or coronary atherosclerosis contributed significantly to prediction of the event risk beyond that provided by HDL cholesterol levels alone ([Table 4](#)), model 7; $P < 0.05$).

Because of the demonstrated prognostic utility of the two carotid arterial intima-media thickness measurements and the apparent correlation of the change rate with treatment, we evaluated the independent contribution of treatment group to the prediction of the definitive clinical outcome of nonfatal myocardial infarction or coronary death. Considered univariately, assignment to the drug group decreased the relative risk for nonfatal myocardial infarction or coronary death by 0.41 (95% CI, 0.20 to 0.80) ($P = 0.01$). After adjustment for the absolute intima-media thickness, the relative risk was unchanged: 0.45 (CI, 0.23 to 0.90) ($P = 0.02$). In contrast, after adjustment for the intima-media thickness change rate, the treatment effect on nonfatal myocardial infarction or coronary death was no longer apparent (relative risk, 1.1 [CI, 0.4 to 2.6]; $P > 0.2$).

Discussion

The rate of change of preinvasive carotid atherosclerosis determined by measurement of the intima-media thickness of the distal common carotid arterial far wall was predictive of coronary events. For each 0.03-mm increase per year in common carotid arterial intima-media thickness, the relative risk for nonfatal myocardial infarction or coronary death was 2.2 and the relative risk for nonfatal myocardial infarction, coronary death, or a revascularization procedure was 3.1 ([Table 2](#)). This relation with coronary events was similar in the placebo group and the drug group ([Table 2](#)).

In addition, the absolute measurement of the intima-media thickness of the distal common carotid arterial far wall was predictive of coronary events. For each 0.13-mm increment in common carotid arterial intima-media thickness, the risk for coronary events increased (relative risk, 1.4 for myocardial infarction or coronary death and for any coronary event) ([Table 3](#)). Patients in the highest quartile had a very elevated risk for coronary events ([Table 3](#)). In analysis by treatment group,

- ▲ [Top](#)
- ▲ [Methods](#)
- ▲ [Results](#)
- [Discussion](#)
- ▼ [Author & Article Info](#)
- ▼ [References](#)

absolute carotid arterial intima-media thickness was significantly related to risk for myocardial infarction or coronary death or any coronary event in the drug group but not in the placebo group ([Table 3](#)). These findings show an overall gain in the prediction of coronary events in an untreated group of patients by using multiple measurements of intima-media thickness rather than a single determination. In addition, after adjustment for the intima-media thickness change rate, the effect of treatment on nonfatal myocardial infarction or coronary death was no longer apparent. This finding indicates that the effect of treatment on coronary events was mediated through the measurement of the intima-media thickness change rate.

Although previous studies have examined the relation between a single measure of carotid artery atherosclerosis and coronary events, none have examined the relation of progression of common carotid arterial intima-media thickness and coronary events. On the basis of a categorical system describing carotid artery structural changes (including intrusive lesions), Salonen and Salonen [\[19\]](#) reported that a one-time measurement of the maximal common carotid arterial intima-media thickness greater than 1.0 mm was predictive of acute myocardial infarction over a 1-month to 3-year period (relative risk, 2.2 [CI, 0.7 to 6.7]). Using a categorical system describing the severity of atherosclerosis at the carotid and femoral artery bifurcations, Belcaro and colleagues [\[20\]](#) also reported that a one-time intima-media thickness measurement greater than 1.0 mm in asymptomatic patients was predictive of a cardiovascular event over a 6-year period. In both studies, early preintrusive atherosclerosis intima-media thickness values less than 1.0 mm were considered the "normal" referent category. Despite differences in end point definitions, our risk relationships of coronary events and absolute intima-media thickness are consistent with findings from these previous studies.

Our results indicate that measures of atherosclerotic progression from two arterial beds are independent predictors of coronary events ([Table 4](#), models 2 to 4). The relation between common carotid arterial intima-media thickness and angiographic presence and extent of coronary artery disease has been reported elsewhere [\[10, 11\]](#), and many risk factors that contribute to the progression of atherosclerosis are shared by the two arterial beds [\[8, 9, 13, 16, 21-24\]](#). In addition, we have shown that treatment with LDL-cholesterol-lowering drugs significantly reduces common carotid arterial intima-media thickness [\[3, 16, 22\]](#). The independence of these two measures is probably due to the fact that each assesses different phases of the atherosclerotic process: Carotid arterial intima-media thickness assesses early atherosclerosis still limited to the arterial wall, whereas quantitative coronary angiography assesses advanced atherosclerosis when intrusive lesions are present. It is generally acknowledged that the magnitude of reduction in coronary events is out of proportion to the magnitude of reduction in coronary stenosis, thereby supporting plaque stabilization as an underlying mechanism. Our data indicate that carotid arterial intima-media thickness incorporates additional, independent information on prediction of coronary events beyond the angiographic measurement of luminal narrowing.

The association of advanced coronary atherosclerotic lesions with risk factors and risk for coronary events has been determined by serial coronary angiography [\[4-623, 24\]](#). However, progression of the early preintrusive phases of atherosclerosis cannot be determined by angiography because this method allows visualization of the arterial lumen only. Screening and treatment strategies that use angiography are not feasible. On the other hand, measurement of carotid arterial intima-media thickness is noninvasive and can easily be deployed as a low-cost surrogate end point for the progression of coronary artery atherosclerosis. The demonstration that progression of carotid arterial intima-media thickness is predictive of coronary events has important implications for clinical research as well as for clinical assessment and treatment of risk factors for atherosclerosis.

Because almost all persons in affluent societies develop atherosclerosis but not all develop clinical symptoms [\[25\]](#), screening and treatment strategies that use clinical risk factor assessment to identify persons at high risk for the development of symptoms have been recommended. However, guidelines that attempt to apply risk assessment determined from population studies to preventive interventions of an individual person are limited because the causes of atherosclerosis are multifactorial [\[26\]](#). Although risk factors are etiologically important for atherosclerosis, they are not ideal for screening a population at high risk for coronary events [\[27\]](#). Traditional lipid and nonlipid clinical markers of risk for atherosclerosis do not necessarily reflect the atherosclerotic process at the level of the arterial wall.

Measurement of carotid arterial intima-media thickness progression, the result of each individual person's response to his or

her own risk factor burden, removes inferences about the atherosclerotic process derived from traditional risk factor assessment by providing direct information about the progression of atherosclerosis at the level of the arterial wall. A screening strategy based on the rate of intima-media thickness progression is a more rational approach to prevention of coronary artery disease [2] that may improve our ability to decide who should receive antiatherosclerotic therapy to reduce risk for development of clinical symptoms. As we have shown, each carotid arterial intima-media thickness measure contributed significantly to the prediction of coronary events beyond that predicted by HDL cholesterol alone (Table 4, models 5 and 6). To the extent that common carotid arterial intima-media thickness progression is associated with risk for coronary events, a potentially enormous clinical significance is linked to the noninvasive assessment of the progression of early preintrusive atherosclerosis.

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- ▲ [Top](#)
- ▲ [Methods](#)
- ▲ [Results](#)
- ▲ [Discussion](#)
- [Author & Article Info](#)
- ▼ [References](#)

References

1. **Blankenhorn DH, Hodis HN.** George Lyman Duff Memorial Lecture. Arterial imaging and atherosclerosis reversal. *Arterioscler Thromb.* 1994; 14:177-92.

2. **Hodis HN, Mack WJ.** Risk factor assessment, treatment strategy and prevention of coronary artery disease: the need for a more rational approach [Editorial]. *J Intern Med.* 1994; 236:111-3.

3. **Mack WJ, Selzer RH, Hodis HN, Erickson JK, Liu CR, Liu CH, et al.** One-year reduction and longitudinal analysis of carotid intima-media thickness associated with colestipol/niacin therapy. *Stroke.* 1993; 24:1779-83.

4. **Azen SP, Mack WJ, Cashin-Hemphill L, LaBree L, Shircore AM, Selzer RH, et al.** Progression of coronary artery disease predicts clinical coronary events. Long-term follow-up from the Cholesterol Lowering Atherosclerosis Study (CLAS). *Circulation.* 1996; 93:34-41.

5. **Buchwald H, Matts JP, Fitch LL, Campos CT, Sanmarco ME, Amplatz K, et al.** Changes in sequential coronary arteriograms and subsequent coronary events. Surgical Control of the Hyperlipidemias (POSCH) Group. *JAMA.* 1992; 268:1429-33.

6. **Waters D, Craven TE, Lesperance J.** Prognostic significance of progression of coronary atherosclerosis. *Circulation.* 1993; 87:1067-75.

- ▲ [Top](#)
- ▲ [Methods](#)
- ▲ [Results](#)
- ▲ [Discussion](#)
- ▲ [Author & Article Info](#)
- [References](#)

7. **Mitchell JR, Schwartz CJ.** Relationship between arterial disease at different sites. *Br Med J.* 1962; 1:1293-301.
8. **Persson J, Formgren J, Israelsson B, Berglund G.** Ultrasound-determined intima-media thickness and atherosclerosis. Direct and indirect validation. *Arterioscler Thromb.* 1994; 14:261-4.
9. **Geroulakos G, O'Gorman D, Nicolaides A, Sheridan D, Elkeles R, Shaper AG.** Carotid intima-media thickness: correlation with the British Regional Heart Study risk score. *J Intern Med.* 1994; 235:431-3.
10. **Geroulakos G, O'Gorman DJ, Kalodiki E, Sheridan DJ, Nicolaides AN.** The carotid intima-media thickness as a marker of the presence of severe symptomatic coronary artery disease. *Eur Heart J.* 1994; 15:781-5.
11. **Crouse JR 3d, Craven TE, Hagaman AP, Bond MG.** Association of coronary disease with segment-specific intimal-medial thickening of the extracranial carotid artery. *Circulation.* 1995; 92:1141-7. [[Abstract/Free Full Text](#)]
12. **Blankenhorn DH, Johnson RL, Nessim SA, Azen SP, Sanmarco ME, Selzer RH.** The Cholesterol Lowering Atherosclerosis Study (CLAS): design, methods, and baseline results. *Controlled Clin Trials.* 1987; 8:354-87.
13. **Blankenhorn DH, Nessim SA, Johnson RL, Sanmarco ME, Azen SP, Cashin-Hemphill L.** Beneficial effects of combined colestipol-niacin therapy on coronary atherosclerosis and coronary venous bypass grafts. *JAMA.* 1987; 257:3233-40.
14. **Cashin-Hemphill L, Mack WJ, Pogoda JM, Sanmarco ME, Azen SP, Blankenhorn DH.** Beneficial effects of colestipol-niacin on coronary atherosclerosis. A 4-year follow-up. *JAMA.* 1990; 264:3013-7.
15. **Blankenhorn DH, Azen SP, Crawford DW, Nessim SA, Sanmarco ME, Selzer RH, et al.** Effects of colestipol-niacin therapy on human femoral atherosclerosis. *Circulation.* 1991; 83:438-47.
16. **Blankenhorn DH, Selzer RH, Crawford DW, Barth JD, Liu CR, Liu CH, et al.** Beneficial effects of colestipol-niacin therapy on the common carotid artery. Two- and four-year reduction of intima-media thickness measured by ultrasound. *Circulation.* 1993; 88:20-8.
17. **Selzer RH, Hagerty C, Azen SP, Siebes M, Lee P, Shircore A, et al.** Precision and reproducibility of quantitative coronary angiography with applications to controlled clinical trials. A sampling study. *J Clin Invest.* 1989; 83:520-6.
18. **Selzer RH, Hodis HN, Kwong-Fu H, Mack WJ, Lee PL, Liu CR, et al.** Evaluation of computerized edge tracking for quantifying intima-media thickness of the common carotid artery from B-mode ultrasound images. *Atherosclerosis.* 1994; 111:1-11.
19. **Salonen JT, Salonen R.** Ultrasonographically assessed carotid morphology and the risk of coronary heart disease. *Arterioscler Thromb.* 1991; 11:1245-9.
20. **Belcaro G, Nicolaides AN, Laurora G, Cesarone MR, De Sanctis M, Incandela L, et al.** Ultrasound morphology classification of the arterial wall and cardiovascular events in a 6-year follow up study. *Arterioscler Thromb Vasc Biol.* 1996; 16:851-6.
21. **Blankenhorn DH, Alaupovic P, Wickham E, Chin HP, Azen SP.** Prediction of angiographic change in native human coronary arteries and aortocoronary bypass grafts. Lipid and nonlipid factors. *Circulation.* 1990; 81:470-6.
22. **Hodis HN, Mack WJ, LaBree L, Selzer RH, Liu C, Liu C, et al.** Reduction in carotid arterial wall thickness using lovastatin and dietary therapy: a randomized controlled clinical trial. *Ann Intern Med.* 1996; 124:548-56.
23. **Blankenhorn DH, Azen SP, Krams DM, Mack WJ, Cashin-Hemphill L, Hodis HN, et al.** Coronary angiographic

changes with lovastatin therapy. The Monitored Atherosclerosis Regression Study (MARS). The MARS Research Group. Ann Intern Med. 1993; 119:969-76.

24. Hodis HN, Mack WJ, Azen SP, Alaupovic P, Pogoda JM, LaBree L, et al. Triglyceride- and cholesterol-rich lipoproteins have a differential effect on mild/moderate and severe lesion progression as assessed by quantitative coronary angiography in a controlled trial of lovastatin. Circulation. 1994; 90:42-9.

25. Natural history of aortic and coronary atherosclerotic lesions in youth. Findings from the PDAY Study. Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Research Group. Arterioscler Thromb. 1993; 13:1291-8.

26. Mcisaac WJ, Naylor CD, Basinski A. Mismatch of coronary risk and treatment intensity under the National Cholesterol Education Program guidelines. J Gen Intern Med. 1991; 6:518-23.

27. Castelli WP. The fact and fiction of lowering cholesterol concentrations in the primary prevention of coronary heart disease. Br Heart J. 1993; 69:S70-3.

This article has been cited by other articles:



European Heart Journal Supplements

▶ HOME

A. J. Taylor

Evidence to support aggressive management of HDL-cholesterol: implications of recent trials

Eur. Heart J. Suppl., October 1, 2006; 8(suppl_F): F74 - F80.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Vascular Medicine

▶ HOME

P. Poredos

Intima-media thickness: indicator of cardiovascular risk and measure of the extent of atherosclerosis

Vascular Medicine, February 1, 2004; 9(1): 46 - 54.

[\[Abstract\]](#) [\[PDF\]](#)



Stroke

▶ HOME

H. Yokoyama, N. Katakami, and Y. Yamasaki

Recent Advances of Intervention to Inhibit Progression of Carotid Intima-Media Thickness in Patients With Type 2 Diabetes Mellitus

Stroke, September 1, 2006; 37(9): 2420 - 2427.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



European Heart Journal

▶ HOME

J. M. Dijk, Y. van der Graaf, M. L. Bots, D. E. Grobbee, A. Algra, and on behalf of the SMART study group

Carotid intima-media thickness and the risk of new vascular events in patients with manifest atherosclerotic disease: the SMART study

Eur. Heart J., August 2, 2006; 27(16): 1971 - 1978.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



American Journal of EPIDEMIOLOGY

▶ HOME

K. A. Volcik, R. A. Barkley, R. G. Hutchinson, T. H. Mosley, G. Heiss, A. R. Sharrett, C. M. Ballantyne, and E. Boerwinkle

Apolipoprotein E Polymorphisms Predict Low Density Lipoprotein Cholesterol Levels and Carotid Artery Wall Thickness but Not Incident Coronary Heart Disease in 12,491 ARIC Study Participants

Am. J. Epidemiol., August 15, 2006; 164(4): 342 - 348.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



JOURNAL OF LIPID RESEARCH

▶ HOME

J. R. Crouse III

Thematic review series: Patient-Oriented Research. Imaging atherosclerosis: state of the art

J. Lipid Res., August 1, 2006; 47(8): 1677 - 1699.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



PSYCHOSOMATIC MEDICINE

▶ HOME

L. Keltikangas-Jarvinen, L. Pulkki-Raback, S. Puttonen, J. Viikari, and O. T. Raitakari

Childhood Hyperactivity as a Predictor of Carotid Artery Intima Media Thickness Over a Period of 21 Years: The Cardiovascular Risk in Young Finns Study

Psychosom Med, July 1, 2006; 68(4): 509 - 516.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

G. Tsvigoulis, K. Vemmos, C. Papamichael, K. Spengos, E. Manios, K. Stamatelopoulos, D. Vassilopoulos, and N. Zakopoulos

Common Carotid Artery Intima-Media Thickness and the Risk of Stroke Recurrence

Stroke, July 1, 2006; 37(7): 1913 - 1916.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Vascular Medicine

▶ HOME

J. E Macioch, C D. Katsamakis, J. Robin, P. R Liebson, P. M Meyer, C. Geohas, J. S Raichlen, M. H Davidson, and S. B Feinstein

Effect of contrast enhancement on measurement of carotid artery intimal medial thickness

Vascular Medicine, February 1, 2004; 9(1): 7 - 12.

[\[Abstract\]](#) [\[PDF\]](#)



Journal of the American College of Cardiology

▶ HOME

V. R.S. Fernandes, J. F. Polak, T. Edvardsen, B. Carvalho, A. Gomes, D. A. Bluemke, K. Nasir, D. H. O'Leary, and J. A.C. Lima

Subclinical Atherosclerosis and Incipient Regional Myocardial Dysfunction in Asymptomatic Individuals: The Multi-Ethnic Study of Atherosclerosis (MESA)

J. Am. Coll. Cardiol., June 20, 2006; 47(12): 2420 - 2428.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

R. S. Vasan

Biomarkers of Cardiovascular Disease: Molecular Basis and Practical Considerations

Circulation, May 16, 2006; 113(19): 2335 - 2362.

[\[Full Text\]](#) [\[PDF\]](#)



THE JOURNAL OF CLINICAL ENDOCRINOLOGY & METABOLISM

▶ HOME

J. Lo, S. E. Dolan, J. R. Kanter, L. C. Hemphill, J. M. Connelly, R. S. Lees, and S. K. Grinspoon

Effects of Obesity, Body Composition, and Adiponectin on Carotid Intima-Media Thickness in Healthy Women

J. Clin. Endocrinol. Metab., May 1, 2006; 91(5): 1677 - 1682.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



THE JOURNAL OF CLINICAL ENDOCRINOLOGY & METABOLISM

▶ HOME

M. E. Molitch, D. R. Clemmons, S. Malozowski, G. R. Merriam, S. M. Shalet, M. L. Vance, and for The Endocrine Society's Clinical Guidelines Su

Evaluation and Treatment of Adult Growth Hormone Deficiency: An Endocrine Society Clinical Practice Guideline

J. Clin. Endocrinol. Metab., May 1, 2006; 91(5): 1621 - 1634.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Angiology

▶ HOME

D. A. Stakos, D. P. Schuster, E. A. Sparks, C. F. Wooley, K. Osei, and H. Boudoulas

Cardiovascular Effects of Type 1 Diabetes Mellitus in Children

Angiology, May 1, 2005; 56(3): 311 - 317.

[\[Abstract\]](#) [\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

H. Watanabe, S. Soderlund, A. Soro-Paavonen, A. Hiukka, E. Leinonen, C. Alagona, R. Salonen, T.-P. Tuomainen, C. Ehnholm, M. Jauhiainen, and M.-R. Taskinen

Decreased High-Density Lipoprotein (HDL) Particle Size, Pre β -, and Large HDL Subspecies Concentration in Finnish Low-HDL Families: Relationship With Intima-Media Thickness

Arterioscler. Thromb. Vasc. Biol., April 1, 2006; 26(4): 897 - 902.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



European Heart Journal

▶ HOME

M. L. Bots, G. W. Evans, W. Riley, K. H. McBride, E. D. Paskett, F. A. Helmond, D. E. Grobbee, and for the OPAL Investigators

The effect of tibolone and continuous combined conjugated equine oestrogens plus medroxyprogesterone acetate on progression of carotid intima-media thickness: the Osteoporosis Prevention and Arterial effects of tiboLone (OPAL) study

Eur. Heart J., March 2, 2006; 27(6): 746 - 755.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

D. Staub, A. Meyerhans, B. Bundi, H. P. Schmid, and B. Frauchiger

Prediction of Cardiovascular Morbidity and Mortality: Comparison of the Internal Carotid Artery Resistive Index With the Common Carotid Artery Intima-Media Thickness

Stroke, March 1, 2006; 37(3): 800 - 805.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



The Journal of Nuclear Medicine

▶ HOME

D. S. Berman, R. Hachamovitch, L. J. Shaw, J. D. Friedman, S. W. Hayes, L. E.J. Thomson, D. S. Fieno, G. Germano, P. Slomka, N. D. Wong, X. Kang, and A. Rozanski

Roles of Nuclear Cardiology, Cardiac Computed Tomography, and Cardiac Magnetic Resonance: Assessment of Patients with Suspected Coronary Artery Disease

J. Nucl. Med., January 1, 2006; 47(1): 74 - 82.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

R. A. Hegele, K. Z. Al-Shali, A. A. House, A. J.G. Hanley, S. B. Harris, M. Mamakeesick, A. Fenster, B. Zinman, H. Cao, and J. D. Spence

Disparate Associations of a Functional Promoter Polymorphism in PCK1 With Carotid Wall Ultrasound Traits

Stroke, December 1, 2005; 36(12): 2566 - 2570.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

K. C.M.C. Koeijvoets, J. Rodenburg, B. A. Hutten, A. Wiegman, J. J.P. Kastelein, and E. J.G. Sijbrands

Low-Density Lipoprotein Receptor Genotype and Response to Pravastatin in Children With Familial Hypercholesterolemia: Substudy of an Intima-Media Thickness Trial

Circulation, November 15, 2005; 112(20): 3168 - 3173.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Diabetes Care

▶ HOME

P. Raggi, A. Bellasi, and C. Ratti

Ischemia Imaging and Plaque Imaging in Diabetes: Complementary tools to improve cardiovascular risk management

Diabetes Care, November 1, 2005; 28(11): 2787 - 2794.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



PSYCHOSOMATIC MEDICINE

▶ HOME

M. Hintsanen, M. Kivimaki, M. Elovainio, L. Pulkki-Raback, P. Keskivaara, M. Juonala, O. T. Raitakari, and L. Keltikangas-Jarvinen

Job Strain and Early Atherosclerosis: The Cardiovascular Risk in Young Finns Study

Psychosom Med, September 1, 2005; 67(5): 740 - 747.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



EUROPEAN JOURNAL OF CARDIO-THORACIC SURGERY

▶ HOME

V. Aboyans, J. Guilloux, P. Lacroix, C. Yildiz, A. Postil, and M. Laskar
Common carotid intima-media thickness measurement is not a pertinent predictor for secondary cardiovascular events after coronary bypass surgery. A prospective study

Eur. J. Cardiothorac. Surg., September 1, 2005; 28(3): 415 - 419.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



AMERICAN JOURNAL OF Respiratory and Critical Care Medicine

▶ HOME

K. Minoguchi, T. Yokoe, T. Tazaki, H. Minoguchi, A. Tanaka, N. Oda, S. Okada, S. Ohta, H. Naito, and M. Adachi

Increased Carotid Intima-Media Thickness and Serum Inflammatory Markers in Obstructive Sleep Apnea

Am. J. Respir. Crit. Care Med., September 1, 2005; 172(5): 625 - 630.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

P.-J. Touboul, J. Labreuche, E. Vicaut, P. Amarenco, and on behalf of the GENIC Investigators

Carotid Intima-Media Thickness, Plaques, and Framingham Risk Score as Independent Determinants of Stroke Risk

Stroke, August 1, 2005; 36(8): 1741 - 1745.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Journal of the American College of Cardiology

▶ HOME

J. Makinen, M. J. Jarvisalo, P. Pollanen, A. Perheentupa, K. Irjala, M. Koskenvuo, J. Makinen, I. Huhtaniemi, and O. T. Raitakari

Increased Carotid Atherosclerosis in Andropausal Middle-Aged Men

J. Am. Coll. Cardiol., May 17, 2005; 45(10): 1603 - 1608.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Journal of the American College of Cardiology

▶ HOME

R. P. Wildman, L. L. Schott, S. Brockwell, L. H. Kuller, and K. Sutton-Tyrrell
A dietary and exercise intervention slows menopause-associated progression of subclinical atherosclerosis as measured by intima-media thickness of the carotid arteries

J. Am. Coll. Cardiol., August 4, 2004; 44(3): 579 - 585.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Diabetes Care

▶ HOME

S. Bernard, A. Serusclat, F. Targe, S. Charriere, O. Roth, J. Beaune, F. Berthezene, and P. Moulin

Incremental Predictive Value of Carotid Ultrasonography in the Assessment of Coronary Risk in a Cohort of Asymptomatic Type 2 Diabetic Subjects

Diabetes Care, May 1, 2005; 28(5): 1158 - 1162.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



THE JOURNAL OF CLINICAL ENDOCRINOLOGY & METABOLISM

▶ HOME

A. H. Xiang, R. K. Peters, S. L. Kjos, C. Ochoa, A. Marroquin, J. Goico, S. Tan, C. Wang, S. P. Azen, C.-r. Liu, C.-h. Liu, H. N. Hodis, and T. A. Buchanan

Effect of Thiazolidinedione Treatment on Progression of Subclinical Atherosclerosis in Premenopausal Women at High Risk for Type 2 Diabetes

J. Clin. Endocrinol. Metab., April 1, 2005; 90(4): 1986 - 1991.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

M. L. Bots, D. E. Grobbee, A. Hofman, and J. C.M. Witteman

Common Carotid Intima-Media Thickness and Risk of Acute Myocardial Infarction: The Role of Lumen Diameter

Stroke, April 1, 2005; 36(4): 762 - 767.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



T. Ogata, M. Yasaka, M. Yamagishi, O. Seguchi, K. Nagatsuka, and K. Minematsu

Atherosclerosis Found on Carotid Ultrasonography Is Associated With Atherosclerosis on Coronary Intravascular Ultrasonography

J. Ultrasound Med., April 1, 2005; 24(4): 469 - 474.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



D. Wang, H. Yang, M. J. Quinones, I. Bulnes-Enriquez, X. Jimenez, R. D. L. Rosa, T. Modilevsky, K. Yu, Y. Li, K. D. Taylor, W. A. Hsueh, H. N. Hodis, and J. I. Rotter

A Genome-Wide Scan for Carotid Artery Intima-Media Thickness: The Mexican-American Coronary Artery Disease Family Study

Stroke, March 1, 2005; 36(3): 540 - 545.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



M. Desvarieux, R. T. Demmer, T. Rundek, B. Boden-Albala, D. R. Jacobs Jr, R. L. Sacco, and P. N. Papapanou

Periodontal Microbiota and Carotid Intima-Media Thickness: The Oral Infections and Vascular Disease Epidemiology Study (INVEST)

Circulation, February 8, 2005; 111(5): 576 - 582.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



P. W. F. Wilson, S. C. Smith Jr, R. S. Blumenthal, G. L. Burke, and N. D. Wong

Task force #4--how do we select patients for atherosclerosis imaging?

J. Am. Coll. Cardiol., June 4, 2003; 41(11): 1898 - 1906.

[\[Full Text\]](#) [\[PDF\]](#)



A. J. Taylor, L. E. Sullenberger, H. J. Lee, J. K. Lee, and K. A. Grace

Arterial Biology for the Investigation of the Treatment Effects of Reducing Cholesterol (ARBITER) 2: A Double-Blind, Placebo-Controlled Study of Extended-Release Niacin on Atherosclerosis Progression in Secondary Prevention Patients Treated With Statins

Circulation, December 7, 2004; 110(23): 3512 - 3517.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



European Heart Journal

▶ HOME

J. K. Olijhoek, Y. van der Graaf, J.-D. Banga, A. Algra, T. J. Rabelink, F. L. J. Visseren, and for the SMART Study Group

The Metabolic Syndrome is associated with advanced vascular damage in patients with coronary heart disease, stroke, peripheral arterial disease or abdominal aortic aneurysm

Eur. Heart J., February 2, 2004; 25(4): 342 - 348.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



QJM

▶ HOME

M.L. Eigenbrodt, Z. Bursac, E.P. Eigenbrodt, D.J. Couper, R.E. Tracy, and J. L. Mehta

Mathematical estimation of the potential effect of vascular remodelling/dilatation on B-mode ultrasound intima-medial thickness

QJM, November 1, 2004; 97(11): 729 - 737.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Journal of the American College of Cardiology

▶ HOME

R. F. Redberg, R. A. Vogel, M. H. Criqui, D. M. Herrington, J. A. C. Lima, and M. J. Roman

Task force #3--what is the spectrum of current and emerging techniques for the noninvasive measurement of atherosclerosis?

J. Am. Coll. Cardiol., June 4, 2003; 41(11): 1886 - 1898.

[\[Full Text\]](#) [\[PDF\]](#)



European Heart Journal

▶ HOME

P.M. Rothwell

The Interrelation between carotid, femoral and coronary artery disease

Eur. Heart J., January 1, 2001; 22(1): 11 - 14.

[\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

L. L. Schott, R. P. Wildman, S. Brockwell, L. R. Simkin-Silverman, L. H. Kuller, and K. Sutton-Tyrrell

Segment-Specific Effects of Cardiovascular Risk Factors on Carotid Artery Intima-Medial Thickness in Women at Midlife

Arterioscler. Thromb. Vasc. Biol., October 1, 2004; 24(10): 1951 - 1956.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

S.-H. H. Juo, H.-F. Lin, T. Rundek, E. A. Sabala, B. Boden-Albala, N. Park, M.-Y. Lan, and R. L. Sacco

Genetic and Environmental Contributions to Carotid Intima-Media Thickness and Obesity Phenotypes in the Northern Manhattan Family Study

Stroke, October 1, 2004; 35(10): 2243 - 2247.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



European Heart Journal

▶ HOME

C. M.L. Chapman, J. P. Beilby, S. E. Humphries, L. J. Palmer, P. L. Thompson, and J. Hung

Association of an allelic variant of interleukin-6 with subclinical carotid atherosclerosis in an Australian community population

Eur. Heart J., August 2, 2003; 24(16): 1494 - 1499.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

T. A. Manolio, E. Boerwinkle, C. J. O'Donnell, and A. F. Wilson

Genetics of Ultrasonographic Carotid Atherosclerosis

Arterioscler. Thromb. Vasc. Biol., September 1, 2004; 24(9): 1567 - 1577.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

A. D. Mackinnon, P. Jerrard-Dunne, M. Sitzer, A. Buehler, S. von Kegler, and H. S. Markus

Rates and Determinants of Site-Specific Progression of Carotid Artery Intima-Media Thickness: The Carotid Atherosclerosis Progression Study

Stroke, September 1, 2004; 35(9): 2150 - 2154.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



American Journal of EPIDEMIOLOGY

▶ HOME

C. M. Hutter, M. A. Austin, and S. E. Humphries

Familial Hypercholesterolemia, Peripheral Arterial Disease, and Stroke: A HuGE Minireview

Am. J. Epidemiol., September 1, 2004; 160(5): 430 - 435.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



JAMA

▶ HOME

A. Wiegman, B. A. Hutten, E. de Groot, J. Rodenburg, H. D. Bakker, H. R. Buller, E. J. G. Sijbrands, and J. J. P. Kastelein

Efficacy and Safety of Statin Therapy in Children With Familial Hypercholesterolemia: A Randomized Controlled Trial

JAMA, July 21, 2004; 292(3): 331 - 337.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

S. Stork, A. W. van den Beld, C. von Schacky, C. E. Angermann, S. W.J. Lamberts, D. E. Grobbee, and M. L. Bots

Carotid Artery Plaque Burden, Stiffness, and Mortality Risk in Elderly Men: A Prospective, Population-Based Cohort Study

Circulation, July 20, 2004; 110(3): 344 - 348.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



THE JOURNAL OF CLINICAL ENDOCRINOLOGY & METABOLISM

▶ HOME

A. H. Slyper

What Vascular Ultrasound Testing Has Revealed about Pediatric Atherogenesis, and a Potential Clinical Role for Ultrasound in Pediatric Risk Assessment

J. Clin. Endocrinol. Metab., July 1, 2004; 89(7): 3089 - 3095.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

G. B. J. Mancini, B. Dahlof, and J. Diez

Surrogate Markers for Cardiovascular Disease: Structural Markers

Circulation, June 29, 2004; 109(25_suppl_1): IV-22 - IV-30.

[\[Full Text\]](#) [\[PDF\]](#)



Annals of Internal Medicine

▶ HOME

R. Rauramaa, P. Halonen, S. B. Vaisanen, T. A. Lakka, A. Schmidt-Trucksass, A. Berg, I. M. Penttila, T. Rankinen, and C. Bouchard

Effects of Aerobic Physical Exercise on Inflammation and Atherosclerosis in Men: The DNASCO Study: A Six-Year Randomized, Controlled Trial

Ann Intern Med, June 15, 2004; 140(12): 1007 - 1014.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

R. C. Pasternak, M. H. Criqui, E. J. Benjamin, F. G. R. Fowkes, E. M. Isselbacher, P. A. McCullough, P. A. Wolf, and Z.-J. Zheng

Atherosclerotic Vascular Disease Conference: Writing Group I: Epidemiology

Circulation, June 1, 2004; 109(21): 2605 - 2612.

[\[Full Text\]](#) [\[PDF\]](#)



American Journal of Roentgenology

▶ HOME

A. E. Li, I. Kamel, F. Rando, M. Anderson, B. Kumbasar, J. A. C. Lima, and D. A. Bluemke

Using MRI to Assess Aortic Wall Thickness in the Multiethnic Study of Atherosclerosis: Distribution by Race, Sex, and Age

Am. J. Roentgenol., March 1, 2004; 182(3): 593 - 597.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



OBESITY RESEARCH

▶ HOME

R. A.F. Hegazi, K. Sutton-Tyrrell, R. W. Evans, L. H. Kuller, S. Belle, M. Yamamoto, D. Edmundowicz, and D. E. Kelley

Relationship of Adiposity to Subclinical Atherosclerosis in Obese Patients with Type 2 Diabetes

Obesity, December 1, 2003; 11(12): 1597 - 1605.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



THE ANNALS OF PHARMACOTHERAPY

▶ HOME

J. M McKenney

Potential Nontraditional Applications of Statins

Ann. Pharmacother., July 1, 2003; 37(7): 1063 - 1071.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



European Heart Journal

▶ HOME

A. Iglesias del Sol, M.L. Bots, D.E. Grobbee, A. Hofman, and J.C.M. Witteman

Carotid intima-media thickness at different sites: relation to incident myocardial infarction. The Rotterdam Study

Eur. Heart J., June 2, 2002; 23(12): 934 - 940.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

M. L. Bots, G. W. Evans, W. A. Riley, and D. E. Grobbee

Carotid Intima-Media Thickness Measurements in Intervention Studies: Design Options, Progression Rates, and Sample Size Considerations: A Point of View

Stroke, December 1, 2003; 34(12): 2985 - 2994.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



JAMA

▶ HOME

O. T. Raitakari, M. Juonala, M. Kahonen, L. Taittonen, T. Laitinen, N. Maki-Torkko, M. J. Jarvisalo, M. Uhari, E. Jokinen, T. Ronnema, H. K. Akerblom, and J. S. A. Viikari

Cardiovascular Risk Factors in Childhood and Carotid Artery Intima-Media Thickness in Adulthood: The Cardiovascular Risk in Young Finns Study

JAMA, November 5, 2003; 290(17): 2277 - 2283.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



JAMA

▶ HOME

S. Li, W. Chen, S. R. Srinivasan, M. G. Bond, R. Tang, E. M. Urbina, and G. S. Berenson

Childhood Cardiovascular Risk Factors and Carotid Vascular Changes in Adulthood: The Bogalusa Heart Study

JAMA, November 5, 2003; 290(17): 2271 - 2276.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



ASIAN CARDIOVASCULAR & THORACIC ANNALS

▶ HOME

G. Hansa, K. Bhargava, M. Bansal, S. Tandon, and R. R Kasliwal
Carotid Intima-Media Thickness and Coronary Artery Disease: an Indian Perspective

Asian Cardiovasc Thorac Ann, September 1, 2003; 11(3): 217 - 221.

[\[Abstract\]](#) [\[Full Text\]](#)



Diabetes Care

▶ HOME

Y. Aso, K.-i. Okumura, K. Takebayashi, S. Wakabayashi, and T. Inukai
Relationships of Plasma Interleukin-18 Concentrations to Hyperhomocysteinemia and Carotid Intimal-Media Wall Thickness in Patients With Type 2 Diabetes

Diabetes Care, September 1, 2003; 26(9): 2622 - 2627.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



ARCHIVES OF INTERNAL MEDICINE

▶ HOME

P. R. W. de Sauvage Nolting, E. de Groot, A. H. Zwinderman, R. J. A. Buirma, M. D. Trip, and J. J. P. Kastelein
Regression of Carotid and Femoral Artery Intima-Media Thickness in Familial Hypercholesterolemia: Treatment With Simvastatin

Archives of Internal Medicine, August 11, 2003; 163(15): 1837 - 1841.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Annals of Internal Medicine

▶ HOME

H. N. Hodis, W. J. Mack, R. A. Lobo, D. Shoupe, A. Sevanian, P. R. Mahrer, R. H. Selzer, C.-r. Liu, C.-h. Liu, S. P. Azen, and for the Estrogen in the Prevention of Atherosclerosis

Estrogen in the Prevention of Atherosclerosis: A Randomized, Double-Blind, Placebo-Controlled Trial

Ann Intern Med, December 4, 2001; 135(11): 939 - 953.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Journal of the American College of Cardiology

▶ HOME

A. G. Semb, S. van Wissen, T. Ueland, T. Smilde, T. Waehre, M. D. Tripp, S. S. Froland, J. J. P. Kastelein, L. Gullestad, T. R. Pedersen, P.a. Aukrust, and A. F. H. Stalenhoef

Raised serum levels of soluble CD40 ligand in patients with familial hypercholesterolemia: downregulatory effect of statin therapy

J. Am. Coll. Cardiol., January 15, 2003; 41(2): 275 - 279.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

L. E. Wagenknecht, D. Zaccaro, M. A. Espeland, A. J. Karter, D. H. O'Leary, and S. M. Haffner

Diabetes and Progression of Carotid Atherosclerosis: The Insulin Resistance Atherosclerosis Study

Arterioscler. Thromb. Vasc. Biol., June 1, 2003; 23(6): 1035 - 1041.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



The NEW ENGLAND JOURNAL of MEDICINE

▶ HOME

The Diabetes Control and Complications Trial/Epide Intensive Diabetes Therapy and Carotid Intima-Media Thickness in Type 1 Diabetes Mellitus

N. Engl. J. Med., June 5, 2003; 348(23): 2294 - 2303.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



ARCHIVES OF INTERNAL MEDICINE

▶ HOME

S. M. Grundy, J. I. Cleeman, B. M. Rifkind, L. H. Kuller, and for the Coordinating Committee of the National Cho

Cholesterol Lowering in the Elderly Population

Archives of Internal Medicine, August 9, 1999; 159(15): 1670 - 1678.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



ARCHIVES OF INTERNAL MEDICINE

▶ HOME

T. Mannami, S. Baba, and J. Ogata

Strong and Significant Relationships Between Aggregation of Major Coronary Risk Factors and the Acceleration of Carotid Atherosclerosis in the General Population of a Japanese City: The Suita Study

Archives of Internal Medicine, August 14, 2000; 160(15): 2297 - 2303.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



PSYCHOSOMATIC MEDICINE

▶ HOME

F. A. Treiber, T. Kamarck, N. Schneiderman, D. Sheffield, G. Kapuku, and T. Taylor

Cardiovascular Reactivity and Development of Preclinical and Clinical Disease States

Psychosom Med, January 1, 2003; 65(1): 46 - 62.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

References

Circulation, December 17, 2002; 106(25): 3373 - 3421.

[\[Full Text\]](#)



Circulation

▶ HOME

T. Simon, P. Boutouyrie, J.M. Simon, B. Laloux, C. Tournigand, A.I. Tropeano, S. Laurent, and P. Jaillon

Influence of Tamoxifen on Carotid Intima-Media Thickness in Postmenopausal Women

Circulation, December 3, 2002; 106(23): 2925 - 2929.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

A. Zanchetti, M. G. Bond, M. Hennig, A. Neiss, G. Mancia, C. Dal Palu, L. Hansson, B. Magnani, K.-H. Rahn, J. L. Reid, J. Rodicio, M. Safar, L. Eckes, P. Rizzini, and on behalf of the ELSA investigators

Calcium Antagonist Lacidipine Slows Down Progression of Asymptomatic Carotid Atherosclerosis: Principal Results of the European Lacidipine Study on Atherosclerosis (ELSA), a Randomized, Double-Blind, Long-Term Trial

Circulation, November 5, 2002; 106(19): 2422 - 2427.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Hypertension

▶ HOME

P. J. Gianaros, M. E. Bleil, M. F. Muldoon, J.R. Jennings, K. Sutton-Tyrrell, J. M. McCaffery, and S. B. Manuck

Is Cardiovascular Reactivity Associated With Atherosclerosis Among Hypertensives?

Hypertension, November 1, 2002; 40(5): 742 - 747.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

J. R. Crouse III, R. Tang, M. A. Espeland, J. G. Terry, T. Morgan, and M. Mercuri

Associations of Extracranial Carotid Atherosclerosis Progression With Coronary Status and Risk Factors in Patients With and Without Coronary Artery Disease

Circulation, October 15, 2002; 106(16): 2061 - 2066.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



diabetes

▶ HOME

S. H. Golden, A. R. Folsom, J. Coresh, A. R. Sharrett, M. Szklo, and F. Brancati

Risk Factor Groupings Related to Insulin Resistance and Their Synergistic Effects on Subclinical Atherosclerosis: The Atherosclerosis Risk in Communities Study

Diabetes, October 1, 2002; 51(10): 3069 - 3076.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Diabetes Care

▶ HOME

R. Hayaishi-Okano, Y. Yamasaki, N. Katakami, K. Ohtoshi, S.-I. Gorogawa, A. Kuroda, M. Matsuhisa, K. Kosugi, N. Nishikawa, Y. Kajimoto, and M. Hori
Elevated C-Reactive Protein Associates With Early-Stage Carotid Atherosclerosis in Young Subjects With Type 1 Diabetes

Diabetes Care, August 1, 2002; 25(8): 1432 - 1438.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Diabetes Care

▶ HOME

N. Mitsuhashi, T. Onuma, S. Kubo, N. Takayanagi, M. Honda, and R. Kawamori

Coronary Artery Disease and Carotid Artery Intima-Media Thickness in Japanese Type 2 Diabetic Patients

Diabetes Care, August 1, 2002; 25(8): 1308 - 1312.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

A. H. Xiang, S. P. Azen, T. A. Buchanan, L. J. Raffel, S. Tan, L.S.-C. Cheng, J. Diaz, E. Toscano, M. Quinonnes, C.R. Liu, C.H. Liu, L. W. Castellani, W. A. Hsueh, J. I. Rotter, and H. N. Hodis

Heritability of Subclinical Atherosclerosis in Latino Families Ascertained Through a Hypertensive Parent

Arterioscler. Thromb. Vasc. Biol., May 1, 2002; 22(5): 843 - 848.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

R. F. Redberg, P. Greenland, V. Fuster, K. Pyorala, S. N. Blair, A. R. Folsom, A. B. Newman, D. H. O'Leary, T. J. Orchard, B. Psaty, J. S. Schwartz, R. Starke, and P. W.F. Wilson

Prevention Conference VI: Diabetes and Cardiovascular Disease: Writing Group III: Risk Assessment in Persons With Diabetes

Circulation, May 7, 2002; 105(18): e144 - 152.

[\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

L.M. Cupini, P. Pasqualetti, M. Diomedi, F. Vernieri, M. Silvestrini, B. Rizzato, F. Ferrante, and G. Bernardi

Carotid Artery Intima-Media Thickness and Lacunar Versus Nonlacunar Infarcts

Stroke, March 1, 2002; 33(3): 689 - 694.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



American Journal of EPIDEMIOLOGY

▶ HOME

S. H. Golden, A. Maguire, J. Ding, J. R. Crouse, J. A. Cauley, H. Zacur, and M. Szklo

Endogenous Postmenopausal Hormones and Carotid Atherosclerosis: A Case-Control Study of the Atherosclerosis Risk in Communities Cohort

Am. J. Epidemiol., March 1, 2002; 155(5): 437 - 445.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

D. Baldassarre, M. Amato, L. Pustina, E. Tremoli, C. R. Sirtori, L. Calabresi, and G. Franceschini

Increased Carotid Artery Intima-Media Thickness in Subjects With Primary Hypoalphalipoproteinemia

Arterioscler. Thromb. Vasc. Biol., February 1, 2002; 22(2): 317 - 322.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

O. Wiklund, J. Hulthe, J. Wikstrand, C. Schmidt, S.-O. Olofsson, and G. Bondjers

Effect of Controlled Release/Extended Release Metoprolol on Carotid Intima-Media Thickness in Patients With Hypercholesterolemia: A 3-Year Randomized Study

Stroke, February 1, 2002; 33(2): 572 - 577.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



diabetes

▶ HOME

M. J. Jarvisalo, A. Putto-Laurila, L. Jartti, T. Lehtimaki, T. Solakivi, T. Ronnemaa, and O. T. Raitakari

Carotid Artery Intima-Media Thickness in Children With Type 1 Diabetes

Diabetes, February 1, 2002; 51(2): 493 - 498.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

L. Iuliano, F. Micheletta, F. Violi, L.G. Spagnoli, E. M. Lonn, S. Yusuf, Q. Yi, S. Smith, A. Moore-Cox, J. Bosch, V. Dzavik, C. I. Doris, W. A. Riley, and K. K. Teo

Effect of Ramipril and Vitamin E on Atherosclerosis Response

Circulation, January 15, 2002; 105(2): e5 - 6.

[\[Full Text\]](#) [\[PDF\]](#)



Stroke

▶ HOME

D. Tanne, A. Shotan, U. Goldbourt, M. Haim, V. Boyko, Y. Adler, L. Mandelzweig, and S. Behar

Severity of Angina Pectoris and Risk of Ischemic Stroke

Stroke, January 1, 2002; 33(1): 245 - 250.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

Y. Arad, D. Newstein, F. Cadet, M. Roth, and A. D. Guerci

Association of Multiple Risk Factors and Insulin Resistance With Increased Prevalence of Asymptomatic Coronary Artery Disease by an Electron-Beam Computed Tomographic Study

Arterioscler. Thromb. Vasc. Biol., December 1, 2001; 21(12): 2051 - 2058.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



European Heart Journal

▶ HOME

C. Napoli and W. Palinski

Maternal hypercholesterolemia during pregnancy influences the later development of atherosclerosis: clinical and pathogenic implications

Eur. Heart J., January 1, 2001; 22(1): 4 - 9.

[\[PDF\]](#)



Circulation

▶ HOME

P. Greenland, S. C. Smith Jr, and S. M. Grundy

Improving Coronary Heart Disease Risk Assessment in Asymptomatic People: Role of Traditional Risk Factors and Noninvasive Cardiovascular Tests

Circulation, October 9, 2001; 104(15): 1863 - 1867.

[\[Full Text\]](#) [\[PDF\]](#)



Stroke

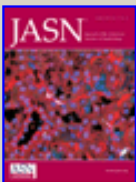
▶ HOME

J. D. Barth, A. Iglesias del Sol, D. E. Grobbee, J. C.M. Witteman, and M. L. Bots

IMT for the Elderly?

Stroke, October 1, 2001; 32(10): 2443 - 2445.

[\[Full Text\]](#) [\[PDF\]](#)



Journal of the American Society of Nephrology

▶ HOME

S. K. GANESH, A. G. STACK, N. W. LEVIN, T. HULBERT-SHEARON, and F. K. PORT

Association of Elevated Serum PO₄, Ca PO₄ Product, and Parathyroid Hormone with Cardiac Mortality Risk in Chronic Hemodialysis Patients

J. Am. Soc. Nephrol., October 1, 2001; 12(10): 2131 - 2138.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Neurology

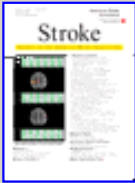
▶ HOME

P. Amarenco

Hypercholesterolemia, lipid-lowering agents, and the risk for brain infarction

Neurology, September 1, 2001; 57(90002): S35 - 44.

[\[Abstract\]](#) [\[Full Text\]](#)



Stroke

▶ HOME

A. I. del Sol, K. G.M. Moons, M. Hollander, A. Hofman, P. J. Koudstaal, D. E. Grobbee, M. M.B. Breteler, J. C.M. Witteman, and M. L. Bots

Is Carotid Intima-Media Thickness Useful in Cardiovascular Disease Risk Assessment? : The Rotterdam Study

Stroke, July 1, 2001; 32(7): 1532 - 1538.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Journal of the American Society of Nephrology

▶ HOME

A. G. STACK and W. E. BLOEMBERGEN

Prevalence and Clinical Correlates of Coronary Artery Disease among New Dialysis Patients in the United States: A Cross-Sectional Study

J. Am. Soc. Nephrol., July 1, 2001; 12(7): 1516 - 1523.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Circulation

▶ HOME

A. Simon, J. Garipey, D. Moyses, and J. Levenson

Differential Effects of Nifedipine and Co-Amilozide on the Progression of Early Carotid Wall Changes

Circulation, June 19, 2001; 103(24): 2949 - 2954.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



The NEW ENGLAND JOURNAL of MEDICINE

▶ HOME

D. H. O'Leary, J. F. Polak, R. A. Kronmal, T. A. Manolio, G. L. Burke, S. K. Wolfson, and The Cardiovascular Health Study Collaborative Rese

Carotid-Artery Intima and Media Thickness as a Risk Factor for Myocardial Infarction and Stroke in Older Adults

N. Engl. J. Med., January 7, 1999; 340(1): 14 - 22.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Arteriosclerosis, Thrombosis, and Vascular Biology

▶ HOME

P. Angerer, S. Stork, W. Kothny, P. Schmitt, and C. von Schacky

Effect of Oral Postmenopausal Hormone Replacement on Progression of Atherosclerosis : A Randomized, Controlled Trial

Arterioscler. Thromb. Vasc. Biol., February 1, 2001; 21(2): 262 - 268.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



G.P. Bernini, M. Sgro', A. Moretti, G.F. Argenio, C.O. Barlascini, R. Cristofani, and A. Salvetti

Endogenous Androgens and Carotid Intimal-Medial Thickness in Women

J. Clin. Endocrinol. Metab., June 1, 1999; 84(6): 2008 - 2012.

[\[Abstract\]](#) [\[Full Text\]](#)



B. Pitt, R. P. Byington, C. D. Furberg, D. B. Hunninghake, G. B. J. Mancini, M. E. Miller, and W. Riley

Effect of Amlodipine on the Progression of Atherosclerosis and the Occurrence of Clinical Events

Circulation, September 26, 2000; 102(13): 1503 - 1510.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

■ Article

- ▶ Table of Contents
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