Prevalence and Distribution of Sub-Clinical Atherosclerosis by Screening Vascular Ultrasound in Low and Intermediate Risk Adults: The New York Physicians Study

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Background: Many persons experiencing cardiovascular disease (CVD) events are not at high calculated CVD risk by Framingham risk score. The identification of carotid and femoral plaque has been associated with CVD events. In this study, the prevalence of plaques in adults at low and intermediate risk was examined.

Methods: Asymptomatic patients without CVD (n = 715; 43% women) were screened for carotid and femoral plaque using B-mode ultrasound.

Results: Significant predictors of plaque were male gender and age and, among women, dyslipidemia. Overall plaque prevalence was 32.8% among women and 40.5% among men aged 50 to 64 years. Among subjects with plaque in this age group, 56% of women and 31% of men had plaque exclusively in the femoral artery and would have been missed if only carotid ultrasound had been performed.

Conclusion: Ultrasound screening of the carotid and femoral arteries in a population with low and intermediate Framingham risk scores can identify potentially high risk subjects for whom intensive CVD risk factor modification may be appropriate. (J Am Soc Echocardiogr 2009;22:1145-51.)

Keywords: Ultrasound, Carotid, Femoral, Subclinical atherosclerosis

Cardiovascular disease (CVD) is the leading cause of death in the United States and in other developed countries. In the United States, there are 770,000 annual cases of myocardial infarction and acute coronary syndromes, with a 38% fatality rate within the year of occurrence.[1] Traditional risk factors can identify approximately half of these patients but fail to identify the other half and have lacked adequate specificity and sensitivity for identifying subclinical CVD.[2,3]

Noninvasive imaging of the cardiovascular system is able to identify subclinical atherosclerosis, which may help in the diagnosis of CVD before it becomes apparent through a serious event.[4,5] For example, coronary calcium screening can increase the sensitivity of diagnosis in subjects at low or intermediate risk for coronary heart disease (CHD).[6-10] However, this technology is associated with significant costs, radiation exposure, and equipment needs, thus limiting its use as an effective screening modality.

Ultrasound scanning of the peripheral vasculature is a noninvasive, high-resolution technique that is both mobile and free of radiation. A large outcome study (CAFES-CAVE) followed 10,000 low-risk patients for 10 years and demonstrated a close relation between ultrasonic abnormalities of the carotid and femoral arteries and future risk for myocardial infarction and stroke.[11] This study demonstrated that among low-risk subjects with nonstenosing plaques of the femoral or carotid artery, there was a 39% 10-year CVD event rate.

In this study, we examined the use of carotid and peripheral ultrasound screening in asymptomatic patients at low or intermediate risk for CHD by Framingham risk score (FRS).[12] Specifically, we examined gender-related and age-related associations with carotid and femoral plaque with the goal of determining whether this ultrasound examination might be appropriate in expanded populations.

METHODS

Study Population

The population consisted of 715 asymptomatic adults aged 23 to 85 years (43% women) within a multispecialty university-based group medical practice, self-referred for screening vascular ultrasound evaluation at their annual preventive physical examinations between July 2007 and April 2009. Lipid-lowering treatment was an exclusion so that subjects' FRS could be accurately calculated. Other study exclusions included previous evidence of CVD as demonstrated by a history

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Table 1 Demographics of the total population

Variable	Total	FRS		Age (y)			Plaque			
		≤10	10-20	<50	50-64	≥65	None	Any	Carotid only	Femoral only
n	715	582	133	244	352	119	461	254	85	102
Body mass index (kg/m^2)	25.6	25.1†	27.2	26.5†	25.2	24.6	25.7	25.2	24.7	25.7
Waist circumference (in)	33.1	32.7†	35.1	33.7*	33	32.5	33.1	33.2	32.7	33.3
Blood pressure (mm Hg)										
Systolic	122.8	119.8†	135.9	120.5†	122.5	128.4	121.9*	124.4	122.4	125.1
Diastolic	75.4	74.3†	80.3	75.5	75.4	75.2	75.4	75.4	76.1	75.4
Lipids (mg/dL)										
Total cholesterol	217.4	216.6	220.7	214	219.7	217.6	215.8	220.3	223.6	216.6
HDL cholesterol	63.4	65.6†	53.7	56.9†	67.4	64.8	64.7*	61.1	62.9	60.5
LDL cholesterol	132.1	130.5†	139.3	132.6	132	131.6	129.5†	136.9	137.9	135.1
Triglycerides	107.3	99.6†	141.4	117.9*	102.1	101.4	105.8	110.1	104	108.8
Carotid IMT (mm)										
Average	0.737	0.72†	0.809	0.667†	0.744	0.859	0.702†	0.801	0.803*	0.766
Maximum	0.888	0.869†	0.969	0.814†	0.894	1.02	0.85†	0.956	0.964*	0.916
Smoking										
Never	69% (493)	69.6% (405)	66.2% (88)	73% (178)	67.9% (239)	63.9% (76)	73.8% (340)†	60.2% (153)	62.4% (53)	63.7% (65)
Previous	25.9% (185)	26% (151)	25.6% (34)	19.7% (48)†	27.3% (96)	34.5% (41)	21.7% (100)†	33.5% (85)	30.6% (26)	32.4% (33)
Current	5.2% (37)	4.5% (26)	8.3% (11)	7.4% (18)	4.8% (17)	1.7% (2)	4.6% (21)	6.3% (16)	7.1% (6)	3.9% (4)
Hypertension medication	10.4% (74)	6.9% (40)†	25.6% (34)	3.3% (8)†	12.2% (43)	19.3% (23)	10% (46)	11% (28)	9.4% (8)	10.8% (11)
Hypertension	26% (186)	17.9% (104)†	61.7% (82)	18.9% (46)†	26.1% (92)	40.3% (48)	24.3% (112)	29.1% (74)	23.5% (20)	27.5% (28)
Diabetes mellitus	2.1% (15)	1.4% (8)†	5.3% (7)	1.6% (4)	2.3% (8)	2.5% (3)	1.7% (8)	2.8% (7)	2.4% (2)	2.9% (3)
Dyslipidemia	37.8% (270)	35.7% (208)*	46.6% (62)	39.3% (96)	37.8% (133)	34.5% (41)	36.2% (167)	40.6% (103)	41.2% (35)	38.2% (39)

*$P < .05$.
†$P < .01$ compared across gender, FRS group, age group, plaque status, or carotid plaque only versus femoral plaque only.

of known myocardial infarction, angina pectoris, stroke, transient ischemic attack, or claudication or a calculated FRS >20% for CHD.

Risk Factor Evaluation

Systolic and diastolic blood pressure were obtained by cuff sphygmomanometry at the time of the ultrasound examination. A fasting lipid profile was performed by a commercial laboratory, either LabCorp (New York, NY) or Quest (New York, NY). Current smoking was defined as smoking > 20 cigarettes during the week preceding examination. Dyslipidemia was defined as one or more of the following: total cholesterol > 240 mg/dL, high-density lipoprotein (HDL) cholesterol < 40 mg/dL, triglycerides > 200 mg/dL, or the use of lipid-lowering medication. Hypertension was defined as blood pressure > 140/90 mmHg or the use of blood pressure–lowering medication. Diabetes mellitus was defined as fasting glucose ≥ 126 mg/dL, glycosylated hemoglobin > 7.0%, or the use of hypoglycemic medication. The FRS was determined by age, gender, smoking history, blood pressure, presence or absence of diabetes mellitus, and total and HDL cholesterol levels. Low risk was defined as <10% CHD risk over 10 years and intermediate risk as 10% to 20% 10-year risk.[12]

Ultrasound Evaluation

Carotid and femoral ultrasound examinations were carried out using a 7.5-MHz linear-array transducer and a SonoSite MicroMaxx (SonoSite, Inc, Bothell, WA) ultrasound machine by a single technician using the same equipment. The carotid and femoral arteries were interrogated in transverse and longitudinal planes. Carotid artery examina-

Table 2a Comparison of demographics by gender

Variable	Men	Women
n	404	311
Body mass index (kg/m^2)	26.7†	24.0
Waist circumference (in)	35.3†	30.4
Blood pressure (mm Hg)		
Systolic	125.1†	119.8
Diastolic	76.7†	73.8
Lipids (mg/dL)		
Total cholesterol	210.7†	226.0
HDL cholesterol	56.6†	72.3
LDL cholesterol	130.2	134.6
Triglycerides	116.7†	95.1
Carotid IMT (mm)		
Average	0.738	0.736
Maximum	0.891	0.883
Smoking		
Never	71.5% (289)	65.6% (204)
Previous	22.3% (90)*	30.6% (95)
Current	6.2% (25)	3.9% (12)
Hypertension medication	10.4% (42)	10.3% (32)
Hypertension	29.2% (118)*	21.9% (68)
Diabetes mellitus	2% (8)	2.3% (7)
Dyslipidemia	35.4% (143)	40.8% (127)

*$P < .05$.
†$P < .01$ compared across gender.