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EDITORIAL COMMENT

Can Carotid Plaque Predict Coronary Plaque?*

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Atherothrombotic occlusive vascular disease is a leading cause of acute cardiovascular events (acute coronary syndromes, sudden death, and ischemic stroke). Therapeutic lifestyle modification, medical therapy to control risk factors, and, in selected cases, revascularization by percutaneous coronary intervention and/or coronary bypass surgery significantly reduce atherothrombotic cardiovascular events. However, identifying individuals at risk of near-term acute cardiovascular events to aggressively target them for preventive interventions remains a challenge, especially because nearly one-half of acute cardiovascular events occur as the very first

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manifestation of occult atherosclerotic vascular disease. Framingham risk score and other epidemiologically derived risk scores, although useful in characterizing risk in groups of subjects, leave considerable uncertainty, especially in those in the low- to intermediate-risk range and in individual subjects (1–3). Imaging to detect subclinical atherosclerosis, the pathoanatomic basis for atherothrombosis, has been recommended as an adjunct to the Framingham risk score to more accurately characterize risk in individual patients and in particular among those with intermediate-risk status based on the Framingham risk score (1,2).The 2 vascular beds that are the basis for most of the serious occlusive cardiovascular events are the coronary arterial bed and the extracranial carotid arterial bed. Subclinical atherosclerosis in each of these vascular beds can be detected fairly reliably using ultrasound to image carotid vasculature and computed tomography (CT) without contrast to visualize calcified atherosclerotic lesions (coronary calcium scan) or CT with intravenous contrast injection (CT angiography) to visualize calcified and noncalcified coronary plaque and resulting alterations in vessel size and lumen area (1). The obvious methodological advantages of ultrasound include its totally noninvasive nature, lack of any risk, ease of use, and suitability for repeated imaging. The obvious drawbacks of CT include radiation exposure (higher with CT angiography than with coronary calcium scan), missing the rare patients who only have noncalcified plaque detectable by CT angiography but not by coronary calcium scan, and the need for injection of iodinated contrast in the case of CT angiography. Because atherosclerosis is believed to be a diffuse disease with focal areas of accentuation at various vascular sites, it is logical to ask whether detection of atherosclerosis in 1 important vascular bed can reliably predict its presence in another important vascular bed. Because extracranial carotid arteries can be easily and safely imaged with ultrasound, it is logical to ask whether the presence or absence of carotid plaque predicts the presence or absence of coronary plaque.

In this issue of the *iJACC*, Cohen et al. (4) attempted to answer these very questions by imaging the carotid arteries of 150 subjects referred for coronary CT angiography with ultrasound in close temporal proximity to CT angiography; the authors also obtained a CT coronary calcium score on noncontrast images. The authors measured carotid intima-media thickness (IMT) as well as carotid plaque from the ultrasound images and correlated these findings with coronary CT findings.

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Table 1. Carotid Ultrasound Versus Coronary Calcium Scan (n = 150)

	Coronary Calcium Present	Coronary Calcium Absent
Carotid plaque present	77	30
Carotid plaque absent	10	33

Table 2. Carotid Ultrasound Versus Coronary CT Angiogram (n = 147)

	Coronary Plaque Present	Coronary Plaque Absent
Carotid plaque present	72	33
Carotid plaque absent	12	30

The authors show that carotid plaque was present in 107 of 150 subjects (71.3%); of these 107 subjects, 28% had no coronary plaque on calcium scan (Table 1). Coronary plaque was present in 87 of 150 subjects (58%) on calcium scan, and of these 87 subjects, carotid plaque was present in 77 (87.5%) (Table 1). CT angiography data were only available for 147 subjects: carotid plaque was present in 105 of 147 subjects (71%); of these 105 subjects, 31% had no coronary plaque on CT angiography (Table 2). Coronary plaque by CT angiography was present in 84 of 147 subjects (57%), and of these 84 subjects, carotid plaque was present in 85% (Table 2) (4). The presence of a carotid plaque predicted the presence of any calcified coronary plaque (calcium score >0) with an odds ratio of 5.4 ($p < 0.0001$); similarly, carotid plaque predicted the presence of any coronary plaque on CT angiography with an odds ratio of 2.8 ($p = 0.03$). Carotid IMT, whether using >1.5 mm or averaged mean IMT was also related to the presence of coronary plaque, but the association was weaker (4). These findings are generally comparable to those of previously published studies comparing carotid ultrasound with invasive coronary angiography or coronary calcium scanning (5–10).

Although the authors conclude that their findings support the diffuse/generalized nature of atherosclerosis, it should be pointed out that these results were obtained from a relatively small cohort of subjects who were not all asymptomatic individuals undergoing routine screening; in fact, nearly 40% had cardiac symptoms and or known coronary artery disease. Thus, the data are derived from a somewhat biased referral population, which may explain, in part, the high prevalence of disease noted in this study (nearly 80% had carotid and/or coronary plaque), and these results may need to be verified in a larger cohort of truly asymptomatic subjects. Furthermore, significant discrepancies remain between the prevalence of carotid plaque and coronary plaque in this study. For example, 23% to 28% of subjects without a carotid plaque on ultrasound had coronary plaque on CT imaging (abnormal calcium scan or CT angiogram), and 47% to 52% of subjects without coronary plaque on CT imaging (normal calcium scan or CT angiogram) had carotid plaque. These discrepancies certainly suggest that, in addition to systemic factors, local factors also influence susceptibility of vasculature to atherosclerosis. Assuming the results reported by Cohen et al. (4) can be replicated in a larger cohort of asymptomatic subjects, then what are the potential implications of these findings for screening for subclinical atherosclerosis? If the goal of screening is to simply identify subclinical atherosclerotic disease in 1 of 2 important vascular beds, then it would seem reasonable to start with carotid ultrasound first (because it is simple and safe with no radiation

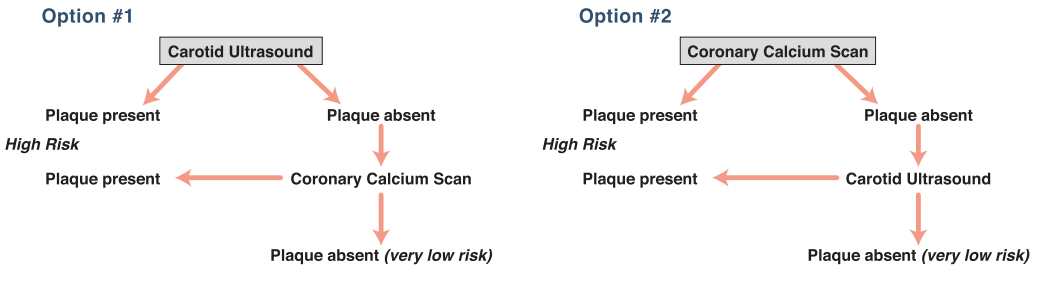

Figure 1. Approaches to Detection of Subclinical Atherosclerosis

exposure and can be repeated at intervals to track changes in plaque with time and therapy), and if the study shows carotid plaque, then no additional screening may be needed. However, if the carotid study is negative, then it would seem prudent to proceed to imaging the coronary vasculature with a CT calcium scan as a preferred modality (Fig. 1). However, this recommendation needs to be tempered in light of the fact that several studies have shown that a coronary calcium scan is a better predictor of cardiovascular events than carotid IMT (11–13), and the current study provides no data on outcomes. An alternative strategy would start with CT coronary calcium scanning and stop if the scan is positive but followed by carotid plaque imaging if coronary calcium score is 0; this strategy may be favored in view of the known strong prognostic value of a CT coronary calcium scan compared with carotid ultrasound (Fig. 1). The inferior prognostic value of carotid ultrasound compared with coronary calcium scan may be due to the use of IMT as a surrogate for carotid atherosclerosis but may not be so if ultrasound is used to detect and measure actual carotid plaque and plaque burden using plaque area/plaque volume measurements (5,14–18). The actual relative merits of these 2 strategies remain to be defined and require additional prospective and comparative studies. Although detecting subclinical atherosclerosis is valuable in risk stratification, we must acknowledge that direct proof that such detection translates into a better outcome is lacking, although several reports suggest that the frequency of use of risk-modifying interventions is increased when subclinical atherosclerosis is detected (19–21).

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