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CME

Intravascular Frequency-Domain Optical Coherence Tomography Assessment of Carotid Artery Disease in Symptomatic and Asymptomatic Patients

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CME Objective for This Article: At the completion of this article the learner should be able to: 1) identify the plaque characteristics that can be detected by optical coherence tomography (OCT) and are associated with symptomatic carotid disease; 2) compare and contrast the use of angiography and optical coherence tomography (OCT) in evaluating carotid lesions; and 3) define complicated "vulnerable" carotid plaque.

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Intravascular Frequency-Domain Optical Coherence Tomography Assessment of Carotid Artery Disease in Symptomatic and Asymptomatic Patients

Objectives The goal of this study was to investigate carotid plaque characteristics in symptomatic versus asymptomatic patients with the use of nonocclusive optical coherence tomography (OCT).

Background The identification of asymptomatic patients with carotid disease who are at risk of stroke remains a challenge. There is an increasing awareness that plaque characteristics may best risk-stratify this population. We hypothesized that OCT, a new high-resolution (~10 μm) imaging modality, might be useful for the identification of low-risk versus high-risk carotid plaque features and help us to understand the relationship between carotid diameter stenosis and plaque morphology to ischemic stroke.

Methods Fifty-three patients undergoing diagnostic carotid angiography were studied with OCT. Data analysis was carried out by imaging experts who were unaware of the clinical characteristics of the study population.

Results Plaque with American Heart Association type VI complicated features was more common in symptomatic than asymptomatic patients (74.1% vs. 36.4%, $p = 0.02$). This was largely driven by differences in the incidence of thin-cap fibroatheroma with rupture (40.7% vs. 13.6%, $p = 0.056$) and thrombus (67.7% vs. 36.4%, $p = 0.034$). Conversely, non–type VI plaques were more common in asymptomatic than symptomatic patients (63.6% vs. 25.9%, $p = 0.02$). No association between the degree of stenosis and plaque morphology was identified.

Conclusions This retrospective analysis of carotid OCT data supports the hypothesis that the evaluation of carotid plaque characteristics with this high-resolution imaging technique has the potential to alter the understanding and treatment of carotid artery disease. (J Am Coll Cardiol Intv 2014;7:674–84) © 2014 by the American College of Cardiology Foundation

Stroke is the fourth leading cause of death and a leading cause of disability in the United States. Carotid atherosclerosis is implicated as the culprit in many of these cases, and nearly two-thirds of these strokes occur in patients who were previously asymptomatic (1,2). The identification of patients with asymptomatic disease who are at risk of stroke remains challenging as there is an increasing awareness that the degree of carotid stenosis is a poor predictor of stroke risk (3). Although some studies indicate that, with modern medical management, the outlook of asymptomatic carotid artery disease has improved substantially (4) since the publication of the North American (5) and European asymptomatic trials (6), over 370,000 carotid artery revascularization procedures were carried out on asymptomatic patients in the United States between 2005 and 2007 (7). These data point

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out the need for a revised paradigm to dictate indications for revascularization on the basis of a better understanding of stroke risk. Several studies have suggested that this stroke risk may be best predicted by plaque characteristics in these asymptomatic lesions (3,8–11).

Although the potential value of magnetic resonance (MR) (11) and multidetector computed tomography imaging (8), as well as virtual histology intravascular ultrasound (12) to assess these plaque characteristics has been reported in small studies, current consensus guidelines cite only the degree of stenosis as an indication for carotid revascularization (13).

This group recently described a pilot experience with the use of nonocclusive optical coherence tomography (OCT) to assess atherosclerotic plaque in human carotid arteries (14). This newer light-based modality delivers resolution to 10 to 15 μm, giving it the highest imaging resolution of any currently available vascular imaging technique. In fact, a body of data obtained primarily in the coronary vasculature, with extensive histopathological validation, documents the utility of OCT not only in eliminating the angiographic pitfalls of stenosis determination imposed by plaque eccentricity (15,16) but also in the accurate identification of plaque components such as lipid, calcium, and fibrous tissue (17). In addition, OCT makes it possible to directly visualize and quantify thin-cap fibroatheroma (TCFA), intraluminal thrombus, calcified nodules, and vascular inflammation (18–24). These important features of American Heart Association (AHA) type VI complicated, high-risk or vulnerable plaque (25), heretofore largely invisible by other imaging modalities due to their lower resolution, are readily identified and quantified by the micron-scale resolution of OCT.