Intravascular Ultrasonography: Can It Now Document Plaque and Artery Morphology or Virtual Histology?

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Intravascular ultrasonography (IVUS) images the vessel wall from within the lumen. It is a catheter-based technology, increasingly used in peripheral interventions where it assesses the severity of disease and the completeness of treatment. Although IVUS was originally developed to assist coronary artery interventions, it is now used in a wide variety of peripheral endovascular procedures. In recent years, technologic improvements have transformed IVUS into a much more practical guidance system for the interventionalist. Both three-dimensional reconstruction of the images and colorflow IVUS have made it much easier to understand different plaque characteristics and plaque morphology. For example, IVUS easily identifies ulcerated plaque, calcification, and thrombus on the vessel wall. IVUS is a sensitive and useful tool that currently tends to be underused because of perceived expense.

Recent attention to the nature and composition of arteriosclerotic plaque has been possible because of the development of virtual histology (VH) IVUS. The frequency spectrum of ultrasound reflected from different plaque types is collated by computer software and assigned different colors (fibrous, dark green; fibrofatty, light green; calcified, white; and necrotic lipid core, red). This provides a color-coded map that is superimposed on the original IVUS image and provides great detail of the plaque morphology. VH IVUS has been validated against true histologic sections of the arterial wall with extremely close correlation.

VH IVUS has highlighted the concept of "vulnerable" plaque, and it color codes it red. Although this development is especially likely to influence coronary interventions (where vulnerable plaque is associated with plaque rupture and sudden death), the role of VH IVUS is also likely to impact peripheral cases, particularly carotid artery interventions. This is because it would be extremely helpful for the interventionalist to be able to anticipate how the plaque will behave at the moment of treatment. Will the plaque embolize? Will it resist complete stent deployment? Carotid angioplasty and stenting procedures could thus be tailored around the plaque type. A worldwide registry to identify the clinical role for VH IVUS is commencing.