Device Uses Infrared Light to Assess Plaques

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A new imaging system recently cleared for marketing by the Food and Drug Administration offers cardiologists help in assessing coronary artery plaque content to determine if the deposit is vulnerable to rupture.

Plaques containing large lipid cores have been associated with plaque rupture and thrombosis in patients with coronary artery disease. The ability to assess the makeup of coronary artery plaques and identify those patients at greatest risk of plaque rupture and subsequent heart attack has become something of a holy grail for cardiology.

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The LipiScan near-infrared catheter imaging system (InfraReDx Inc.) "is the first device that can help assess the chemical makeup of coronary artery plaques and help physicians identify those plaques with lipid cores, which may be of particular concern," Dr. Daniel Schultz, director of the FDA's Center for Devices and Radiological Health, said in a press release.

The InfraReDx system relies on near-infrared spectroscopy (NIRS), which utilizes the near-infrared region of the electromagnetic spectrum (roughly 800-2,500 nm) to determine the chemical makeup of a plaque. One advantage is that NIR radiation can typically penetrate much further into a sample than even mid-infrared waves, making the technique useful in probing bulk material with little or no sample preparation.

The technique involves targeting a material with electromagnetic radiation over the NIR range. The amount of energy absorbed by material at different wavelengths results in a spectrum that serves as a unique fingerprint for a specific compound. Human tissues contain a variety of substances whose absorption spectra at NIR wavelengths are well defined.

The device is cleared for use by physicians who are evaluating patients with symptoms of coronary heart disease during coronary angiography.

"It's an excellent technology to identify lipid-rich plaques and vulnerable plaques in the coronary arterial wall," said Dr. George Beller, professor of internal medicine and interim chief of the division of cardiovascular medicine at the University of Virginia, Charlottesville. "Unlike other types of devices, near-infrared light can penetrate through blood to get signals from structures that are actually several millimeters deep relative to the tissue surface."

The technology has the potential to alter patient management. For example, a patient catheterized following acute coronary syndrome who is found to have lipid-laden plaques with thin fibrous caps might be more likely to get more aggressive medical management after stenting of the main lesion.

"The next question is whether it will prove to be a clinically useful tool," Dr. Beller said.

The Spectroscopic Assessment of Coronary Lipid (SPECTACL) study, aimed at demonstrating that spectra obtained in the coronaries of 125 patients with stable and unstable coronary artery disease are similar to postmortem specimens, is still ongoing. The trial's secondary end point is to determine the presence of lipid-rich plaques in the coronary arteries of these patients.

Although NIRS shows promise, research continues on the use of other imaging modalities to identify vulnerable plaques.

"The [NIRS] technique may have advantages over intravascular ultrasound [IVUS] or virtual histology IVUS, but that remains to be seen because that technique is also being evaluated to distinguish between predominantly fibrous plaques and those which have predominantly necrotic cores that are lipid laden," Dr. Beller said.

The search also goes on for noninvasive means of evaluating plaque vulnerability. "This technology doesn't preclude the major goal of identifying plaques noninvasively, with nuclear or MR or CT techniques. That is still a very high priority," he said. ■