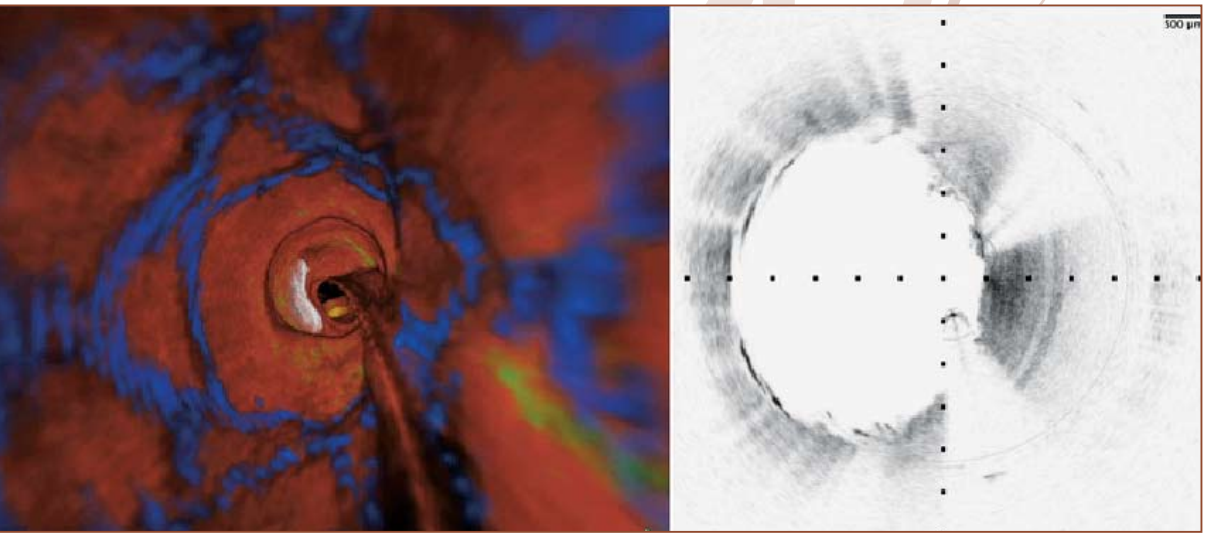
NOVEL IMAGING

May Help Prevent Heart Attacks



Pictured at left:

Optical frequency domain image of the left anterior descending coronary artery of a patient. The color image is a computer reconstructed view of the inside of an artery. The blue lines represent a stent that has been deployed. The long line is the guidewire inside of the artery. The white area in the distance corresponds to a calcified plaque, whereas the yellow area is a fatty plaque. The green dotted areas correspond to clusters of inflammatory cells.

The black-and-white image shows the raw data that corresponds to a cross section of the artery inside of the stented area. The white circular area in the middle is the inside of the artery; the darker circumference is the wall of the vessel. The dark thin lines correspond to struts of the stent against the wall of the vessel.

Imagine taking the same technology that NASA uses to examine the surface of Mars but using it to examine the plaque inside our arteries. It may sound like science fiction, but that's exactly what Lahey cardiologists did when they led the first phase of *SPECTACL*, a groundbreaking clinical trial to test a device designed to identify "fatty" plaques, some of which may be "vulnerable plaques" that put patients at higher risk of heart attack.

The LipiScan Coronary Imaging System, developed by InfraReDx, Inc., in Burlington, Mass., uses near-infrared spectroscopy to identify lipid core containing plaques of interest in the coronary arteries of patients undergoing cardiac catheterization. Such fatty plaques, which cannot be detected by common tests such as a treadmill exam and even coronary angiography, are suspected to be the cause of most sudden cardiac deaths and nonfatal heart attacks.

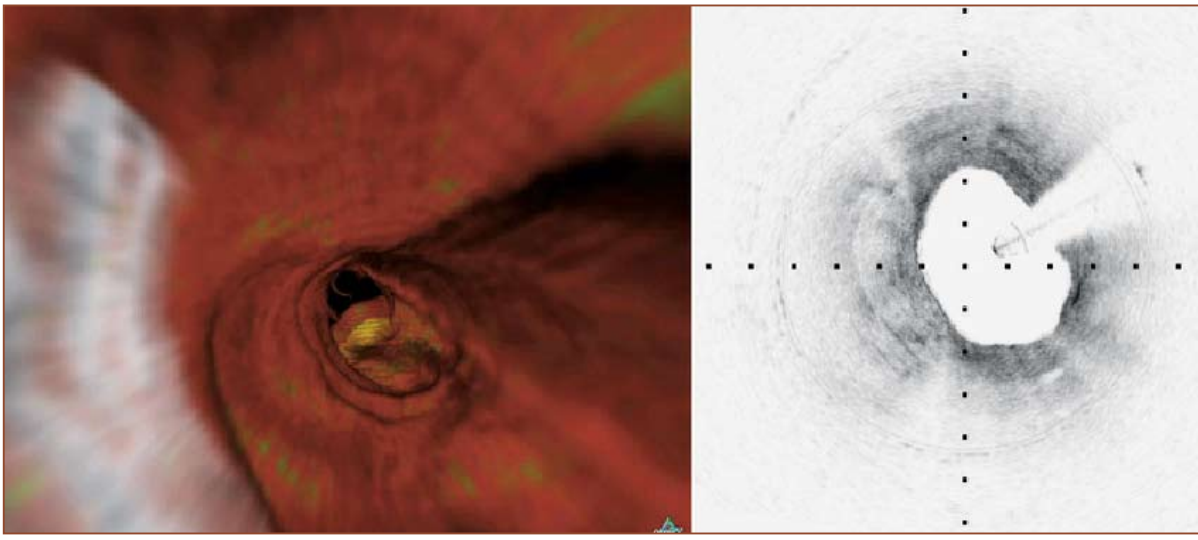
"The principle of spectroscopy," explains Sergio Waxman, MD, director of interventional cardiology research, "is that substances reflect and absorb light differently. These patterns of absorption and reflection can be used to determine the chemical composition of matter, in this case, of a plaque in the wall of an artery."

Thanks to this study, earlier this year the Food and Drug Administration cleared the LipiScan Coronary Imaging System for use by physicians who are evaluating patients with symptoms of coronary heart disease during cardiac angiography, to help in the detection of plaques that have lipid (fatty) cores.

"The FDA's approval is an exciting development," says Waxman. "The next step is to use this system to learn whether knowledge of the presence of these fatty plaques can be used to the benefit of patients, for example, by guiding doctors during angioplasty to decide the best type and length of stents. Eventually, the real question is whether finding and then addressing these plaques with more aggressive drug treatments or stent placement could save lives by preventing heart attacks."

In another, similar study sponsored by the National Heart, Lung, and Blood Institute, Waxman and others are exploring the use of laser light to take pictures inside arteries and look for the presence of dangerous plaques. (See images left and below.)

Pictured at right:
OFDI image of the left anterior descending coronary artery of the same patient. The white area in the color image is the calcified plaque that had been seen in the prior image. The yellow fatty plaque is closer.
The black-and-white image shows the raw data that corresponds to a cross section of the artery just before the calcified plaque. The darkest areas may correspond to areas of inflammation.



During angioplasty, the most commonly used imaging device is an intravascular ultrasound (IVUS) catheter, which is threaded through the blood vessels and uses sound waves to take pictures. In the *Natural History of Vulnerable Coronary Plaques* study, a new type of catheter using optical frequency domain imaging (OFDI) is also used to take more detailed pictures of blood vessel walls and plaques.

"The advantage of OFDI is that it takes incredibly detailed images," says Waxman. "This additional level of detail may result in detection of vulnerable plaques, which may help doctors identify individuals who are at high risk of a heart attack. This new technology may also be used to visualize coronary stents after they have been implanted to determine the risk of clotting inside of a stent or the need to continue aspirin and a second blood thinner to prevent clotting."

Massachusetts General Hospital developed the technology, and Lahey was the first in the world to use it to do coronary studies in patients.

For more information about cardiac research at Lahey, visit our Web site: www.lahey.org.