Fatty arteries to 'go green' with new screening technique

May 26 2011

An FDA-approved green imaging dye can detect small amounts of fatty buildup along the walls of arteries , which can lead to heart attacks, shows a new study in rabbits.

The findings point to the dye--known as indocyanine green--as promising new tool for screening tool for this buildup, also known as atherosclerosis. Detecting tiny, high-risk plaques early on is the main challenge in preventing atherosclerosis-related complications.

Now, Farouc Jaffer and colleagues show that indocyanine green, currently used by ophthalmologists to view leaky blood vessels in the eye, can also shine the spotlight on cholesterol-rich and inflamed plaques in atherosclerosis.

In the study, researchers fed a large group of rabbits cholesterol heavy meals to mimic the disease. Eight weeks later, the team injected indocyanine green into the animals and probed their coronary arteries with an imaging guidewire.

The researchers analyzed the rabbits with near-infrared fluorescence imaging, which detected infra-red signals in abdominal and pelvic arteries—areas the researchers knew were littered with fatty, inflamed plaques. As expected, few infra-red signals were seen in healthy control animals. Next, the authors applied the green imaging technique to live animals.

Using the guidewire, they were able to detect fatty plaques in the coronary arteries of five rabbits within 20 minutes after dye injection. Traditional imaging methods like X-ray angiography and intravascular ultrasound confirmed the location of the fatty plaques in the live rabbits.

Indocyanine green is quickly absorbed by cholesterol-rich molecules and accumulates specifically in inflamed areas, making it particularly effective for highlighting high-risk plaques, the team found.

The results support the potential application of indocyanine green as a powerful, green screening tool for human coronary atherosclerosis.

More information: Indocyanine Green Enables Near-Infrared Fluorescence Imaging of Lipid-Rich, Inflamed Atherosclerotic Plaques, *Sci Transl Med* 25 May 2011: Vol. 3, Issue 84, p. 84ra45 DOI: 10.1126/scitranslmed.3001577

ABSTRACT
New high-resolution molecular and structural imaging strategies are needed to visualize high-risk plaques that are likely to cause acute myocardial infarction, because current diagnostic methods do not reliably identify at-risk subjects. Although molecular imaging agents are available for low-resolution detection of atherosclerosis in large arteries, a lack of imaging agents coupled to high-resolution modalities has limited molecular imaging of atherosclerosis in the smaller coronary arteries. Here, we have demonstrated that indocyanine green (ICG), a Food and Drug Administration–approved near-infrared fluorescence (NIRF)–emitting compound, targets atheromas within 20 min of injection and provides sufficient signal enhancement for in vivo detection of lipid-rich, inflamed, coronary-sized plaques in atherosclerotic rabbits. In vivo NIRF sensing was achieved with an intravascular wire in the aorta, a vessel of comparable caliber to human coronary arteries. Ex vivo fluorescence reflectance imaging showed high

plaque target-to-background ratios in atheroma-bearing rabbits injected with ICG compared to atheroma-bearing rabbits injected with saline. In vitro studies using human macrophages established that ICG preferentially targets lipid-loaded macrophages. In an early clinical study of human atheroma specimens from four patients, we found that ICG colocalized with plaque macrophages and lipids. The atheroma-targeting capability of ICG has the potential to accelerate the clinical development of NIRF molecular imaging of high-risk plaques in humans.

Provided by AAAS