New method effective in detecting dangerous coronary plaque

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A significant number of patients who suffer a heart attack never have any warning signs. For many of these individuals, the source of the problem is noncalcified plaque, a buildup of soft deposits embedded deep within the walls of the heart's arteries, undetectable by angiography or cardiac stress tests – and prone to rupture without warning.

Now a new noninvasive method has shown success in detecting and measuring noncalcified plaque. In a pilot clinical study led by investigators at Beth Israel Deaconess Medical Center (BIDMC), the technique -- voxel analysis used in conjunction with MDCTA (multi-detector computed tomography angiography) – was shown to be equally as effective as catheter coronary angiography in identifying patients at risk for heart disease. Reported in the June 2008 issue of the American Journal of Roentgenology (AJR), the new findings may help doctors monitor the effects of medical treatment to reduce patients' risk of atherosclerosis and heart disease.

"The importance of quantifying plaque is critical because total plaque burden is considered the most important predictor of coronary events," explains the study's senior author Melvin Clouse, MD, PhD, Emeritus Chairman of the Department of Radiology and Director of Radiology Research at BIDMC and Deaconess Professor of Radiology at Harvard Medical School. "Furthermore, the rupture of soft noncalcified plaque has been implicated as the cause of heart attack."

Exercise stress testing and coronary angiography, the standard methods

for diagnosing atherosclerosis and heart attack risk, both work by visualizing the lumen, the channel through which blood flows.

However, because the lumen also increases in size as plaque progresses, coronary artery disease may go undetected until late in the disease process. And, adds Clouse, "Because soft plaque buildup may not significantly narrow the lumen, conventional angiography and stress tests fail to provide a complete picture of plaque accumulation."

The investigators set out to evaluate a new method of plaque assessment using multidetector computed tomography angiography (MDCTA). Unlike coronary angiography, in which a catheter is threaded through the femoral artery and up into the heart, MDCTA is not invasive. The CT scanning method, comprised of 64 separate scans, provides a detailed cross-sectional view of the blood vessel wall based on the amount and volume of blockage present.

Its ability to differentiate plaque density makes it particularly useful in distinguishing between stable plaque and unstable plaque.

"The latest MDCT scanners have made it possible to detect noncalcified plaque," explains Clouse. "However, due to a number of technical and physiologic factors, accurate and reproducible measurements of this plaque was difficult and time-consuming. We, therefore, developed a new technique that would overcome these obstacles."

The researchers analyzed 41 normal and eight abnormal arterial cross sections with noncalcified plaque selected from 10 patients undergoing MDCTA for percentage of stenosis and plaque volume using a voxel analysis technique, in which density values are measured to identify the boundaries between epicardial fat and the outer arterial wall and between the inner wall and the lumen.

"Voxel analysis estimates the volume of plaque in a blood vessel based on a range of volumetric densities," explains Clouse. Within the selected volume, the number of voxels having a density within the range of plaque is established, from which the volume of plaque is then estimated. (In CT scans, voxel values are Hounsfield units, which give the opacity of material to X-rays.) The detailed measurements – nearly 2,300 in total – provided physicians with a detailed picture of the coronary arteries and surrounding areas.

"By plotting a voxel histogram across the arterial wall, we were able to measure the amount of plaque, as well as the narrowing of the artery," explains Clouse. Importantly, he notes, the technique additionally defines the outer boundary of the adventitia, the connective tissue surrounding the artery. Though considered extraneous to the artery, the adventitia appears to play a critical role in the disease process.

"Using this new method, we hope to be able to be able to better assess the effects of medication treatment and lifestyle interventions in treating atherosclerosis," says Clouse, who as a member of a team of clinical investigators will study the effects of lifestyle intervention (diet, exercise and omega-3 fatty acid supplement) or salsalate medication compared to placebo on coronary artery calcification as assessed by MDCTA.

Source: Beth Israel Deaconess Medical Center