A better sign of blood vessel narrowing and early coronary artery disease

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Cardiologists and heart imaging specialists at 15 medical centers in eight countries, and led by researchers at Johns Hopkins, have enrolled the first dozen patients in a year-long investigation to learn whether the subtle squeezing of blood flow through the inner layers of the heart is better than traditional SPECT nuclear imaging tests and other diagnostic radiology procedures for accurately tracking the earliest signs of coronary artery clogs.

Each year, nearly 800,000 American men and women with coronary artery disease suffer a heart attack, resulting in more than 150,000 deaths.

The latest international study of so-called CT perfusion imaging will involve the participation of some 400 men and women identified as being at higher risk of coronary artery disease because they have had symptoms of the illness, such as shortness of breath, chest pain or fatigue. All qualify for a more detailed inspection of their heart's blood vessels by cardiac catheterization, an invasive procedure in which a thin plastic tube is directly inserted into the heart's blood vessels to detect blockages and help widen each artery as needed.

"Our study goal is to figure out how well various imaging tests measure the degree of blockage or narrowing in any particular artery and therefore which is more useful in predicting patients who need catheterization or angioplasty, or bypass surgery," says cardiologist and senior study investigator João Lima, M.D. "Some patients would do just

as well or better with drug therapy to maintain a healthy blood flow to the heart, but we need to better sort out who they are with more accuracy."

Lima says that as many as one-fifth of the 1.3 million cardiac catheterizations performed each year nationwide show no blockages.

In addition to having a standard SPECT imaging test, in which radioactive chemicals are injected into the body to produce 3-D images of the blood vessels, all study participants will undergo before catheterization another test to map out the blood vessels and any potential blockages, a CT angiogram (CTA), plus a CT perfusion (CTP) imaging test to gauge any changes in the volume of blood flow.

Key to performing both CTA and CTP is use of the 320 computed tomography scanner, the most advanced technology available to image the heart and its surrounding blood vessels. The device was first installed in North America at Johns Hopkins in 2007 and can produce three-D images of blood vessels no bigger than the average width of a toothpick (1.5 millimeters). Results from both 320-CT tests will be compared to those from SPECT and what is found by cardiac catheterization.

"Perfusion imaging is a simple and easy test for patients to undergo," says Lima, who adds that the whole procedure usually takes less than 20 minutes to set up and perform. Cardiac catheterization, which also checks for heart vessel blockages, takes longer, between 30 minutes and 45 minutes to perform, and requires several hours for recovery. Potential complications from the invasive procedure, although rare, include heart attack, stroke and death.

"If we can more easily examine patients, then we can reduce the amount of time needed in hospital and, we hope, reduce the number of invasive procedures, which are more inconvenient and open to greater risk to

patients from complications," says Lima, a professor of medicine and radiology at the Johns Hopkins University School of Medicine and its Heart and Vascular Institute.

More than a quarter-million Americans undergo coronary bypass surgery each year, and another 1.2 million people undergo angioplasty, a procedure much like catheterization that forcibly opens narrowed arteries.

Lead study investigator and cardiologist Richard George, M.D., part of the Johns Hopkins team that developed special computer software to accurately measure the speed of blood flowing through the heart's arteries and muscle, says the 320-CT is fast and exposes patients to far less radiation.

George, an assistant professor at Hopkins where he also serves as director of its CT Perfusion Laboratory, says a CTP takes three seconds or less of actual scanning and, if done correctly, involves an average radiation exposure of about 8 millisieverts. A SPECT test, he says, averages between 10 millisieverts and 26 millisieverts, and cardiac catheterization ranges between 2 millisieverts and 10 millisieverts. The 320-CT scanning device has at least five times the speed and power of the 64-CT scanners in widespread use elsewhere.

The scanner's software compares ratios of brightly dyed blood flows between the innermost and outermost layers of heart muscle, where the effects of arterial narrowing first appear.

As part of CTP imaging, each patient is injected with a chemical dye containing iodine, known to light up on screen when struck by the scanner's X-rays. Lower concentrations of iodine will show up as darker regions, indicating constrained and reduced blood flow, the underlying cause of chest pain, than brighter regions where blood flow is more

uniform and free flowing.

To enhance the image, blood flow to the heart is sped up through chemical injections of adenosine, which causes the blood-pumping organ to beat faster.

Previous research by the team among 60 patients with suspected coronary artery disease showed that using dual testing with CTA and CTP had almost the same statistical predictive values as SPECT, prompting the team's latest investigation to see if the dual tests were as clinically useful as SPECT.

George cautions that CT scans are not a substitute for catheterization, but are "an alternative diagnostic tool" physicians can use to "get a real picture" of the extent of coronary blockages and their effects on blood flow, especially when physicians need both sets of information to make treatment decisions.

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