Molecular imaging 'sees' inside coronary arteries to measure disease

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Patients with cardiovascular disease will now benefit from a powerful new molecular imaging tool to detect disease in the main arteries supplying oxygen to the heart, say researchers presenting studies at the Society of Nuclear Medicine's 2012 Annual Meeting.

When an active heart needs more oxygen, blood vessels have a natural ability to open more so that greater amounts of blood can flow. The maximum dilation possible is the coronary flow reserve or CFR. This is an important reference, because it is one of the earliest signs of coronary artery disease, which is caused by atherosclerosis, a narrowing or hardening of these arteries due to a build-up of cholesterol and scar tissue. Diseased coronary arteries are unable to dilate as fully as healthy blood vessels, potentially limiting oxygen supply to the heart muscle.

The World Health Organization considers cardiovascular disease the number one cause of death and disability across the globe. Coronary artery disease is just one of a range of these diseases that can cause serious problems, including heart attack, if left untreated.

In two studies presented at the meeting, investigators examined quantitative imaging data to determine the true extent of coronary artery disease. In one study, researchers tested a molecular imaging method called myocardial perfusion imaging, also known as a stress test, conducted with positron emission tomography (PET). They then measured the CFR and calculated the precise dilation of blood vessels at rest and under stress. The objective of the study was to compare this

technique's ability to predict arterial disease to a more conventional imaging method called angiography. In the other study, researchers used a PET stress test and measured CFR to determine whether age is always a risk factor for arterial disease.

"The quantification of CFR with molecular imaging provides a substantial advantage for unmasking coronary artery disease, even in patients who would otherwise be considered healthy with normal myocardial perfusion imaging," says Michael Fiechter, M.D., lead investigator of one study in cardiac imaging at the department of radiology for University Hospital Zurich, Zurich, Switzerland.

Measuring CFR goes beyond traditional myocardial perfusion imaging, which is based on visual interpretation of the differences between blood flow at rest and under stress, and instead actually quantifies coronary artery disease using imaging data acquired during scanning. The molecular imaging technique is made possible with PET, which uses injected imaging probes that emit signals picked up by a specialized scanner. Coronary artery disease is often evaluated using angiography, an X-ray procedure that involves catheterization and the injection of a dye into the coronary arteries in order to image blood flow and structure of the vessels, and echocardiography, which uses sound waves to image the heart.

"Although different studies revealed a prognostic value of CFR, this study is the first that systematically assessed the diagnostic value of CFR against invasive coronary angiography as a standard of reference for detection of coronary artery disease," says Philipp Kaufmann, M.D., a lead author of one of the studies in the department of radiology and cardiac imaging at University Hospital Zurich, Zurich, Switzerland.

In the two presented studies, a total of 777 elderly participants underwent myocardial perfusion imaging with PET and either Rb-82 or

N-13-ammonia as an imaging biomarker to evaluate quantitative CFR as an indicator for coronary artery disease. One study of 73 participants concluded significant improvements across five different reference points including sensitivity, positive predictive value, and accuracy of myocardial perfusion imaging compared to imaging studies without CFR measurements.

In a separate study of 704 patients over the age of 75, researchers using similar methods discovered that age was not necessarily a risk factor for developing coronary artery disease, as was once thought.

"This is the first large study of the effects of aging on coronary vascular function in patients," says Venkatesh Murthy, M.D., Ph.D., cardiovascular medicine and imaging fellow at Brigham and Women's Hospital and Harvard Medical School in Boston, Mass. "Aging has been previously shown in small studies to affect vascular performance, but these have generally used less accurate methodologies. We demonstrate that many older adults have preserved coronary vascular function and that this group has an extremely favorable prognosis. They are much less likely to die from cardiac causes compared to those with abnormal coronary vascular function. This work suggests that loss of vascular function may not be an inevitable consequence of aging."

Results of the research revealed that myocardial perfusion imaging with PET and either Rb-82 or N-13-ammonia with added quantitative CFR measurements significantly improved sensitivity and diagnostic value of stress testing over myocardial perfusion imaging alone. The evidence also shows that this molecular imaging technique is extremely accurate and may provide more information for identifying coronary vascular disease and for exploring why some people develop the disease and others do not.

"The primary message of our study is that aging does not always imply

decline in vascular function and that the many people with preserved vascular function have far better prognosis— about half the risk of dying from heart disease," says Murthy.

Provided by Society of Nuclear Medicine