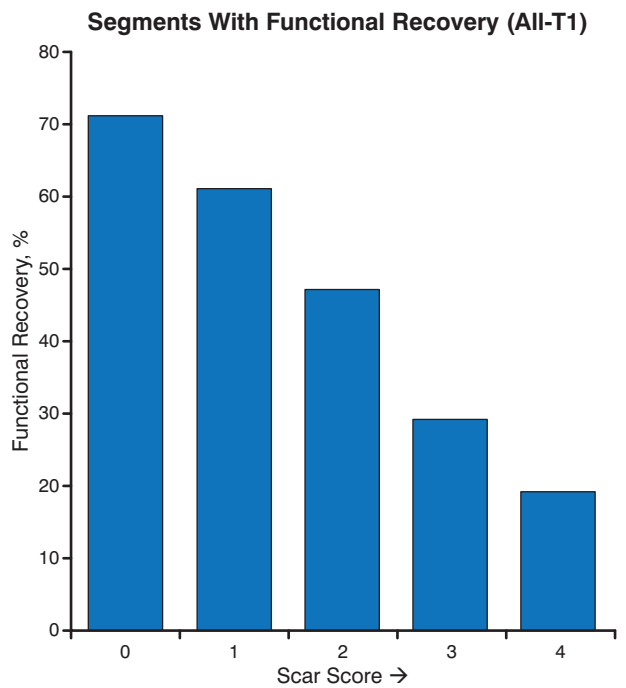
Figure 4. Inverse Relationship Between Extent of Scar and Functional Recovery



Adapted from Lenge VV et al. 124 Delayed-enhancement MRI as a predictor of functional recovery after revascularization: results from an International Multicenter Viability Trial. *J Cardiovasc Mag Res*. 2008;10:A25. With permission from Lenge VV et al and BioMed Central.

infarction, the presence and extent of myocardial scarring as detected by cardiovascular magnetic resonance was a strong predictor of major adverse cardiac events and cardiac death [Kwong RY et al. *Circulation*. 2006].

Factors inversely related to recovery of function after revascularization include baseline EF, magnitude of myocardial scarring, degree of LV remodeling, and time to revascularization. Among the techniques used to detect myocardial viability, nuclear techniques are the most sensitive, while dobutamine echo cardiography has the highest specificity. MRI can detect scar tissue, but it does not provide any information on nonscar tissue. Prof Fathala concluded that from a practical point of view, clinicians should proceed with revascularization once viable myocardium is detected.

CTCA and MPI Improve CAD Detection

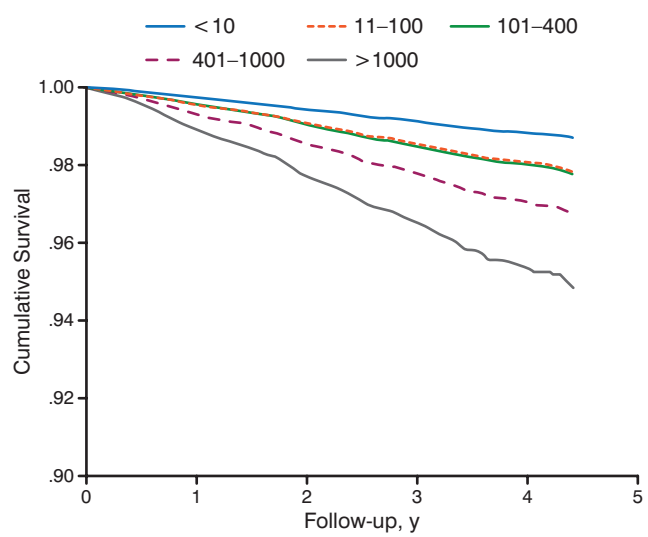
Written by Maria Vinall

Many patients with normal myocardial perfusion assessed by positron emission tomography (PET)/computed tomography (CT) imaging have undetected coronary artery disease (CAD). Combining myocardial perfusion imaging (MPI) with coronary artery calcium scoring (CACS) improves the detection of CAD. Randall C. Thompson, MD, University of Missouri, Kansas City, Missouri, USA, discussed how the use of multimodality imaging often leads to the reclassification of a patient's risk for CAD and alters the course of treatment.

Patients with persistent symptoms and normal myocardial perfusion or mild ischemia on MPI are good candidates for CACS or cardiac computed tomography angiography (CCTA). CCTA can provide information about the amount of calcium in the walls of the coronary arteries and can help predict the risk of heart attack and cardiac death. The Agatston score, a measure of coronary calcification, is based on the area and density of calcified plaques and has been shown to be an independent predictor of mortality ($P < .001$; Figure 1) [Shaw LJ et al. *Radiology*. 2003].

In one study, 200 patients without known CAD were referred for CACS after normal MPI. Based on a CAC score > 100, 17.5% were identified as having CAD. Patients who were reclassified by CACS were not easily identifiable by traditional risk factors, although the patient's age and Framingham risk score did predict the presence of CAC [Thompson RC et al. *J Nucl Cardiol*. 2005]. Another study of 760 patients with no CAD history, a normal PET/CT stress perfusion study, and a same-setting CAC

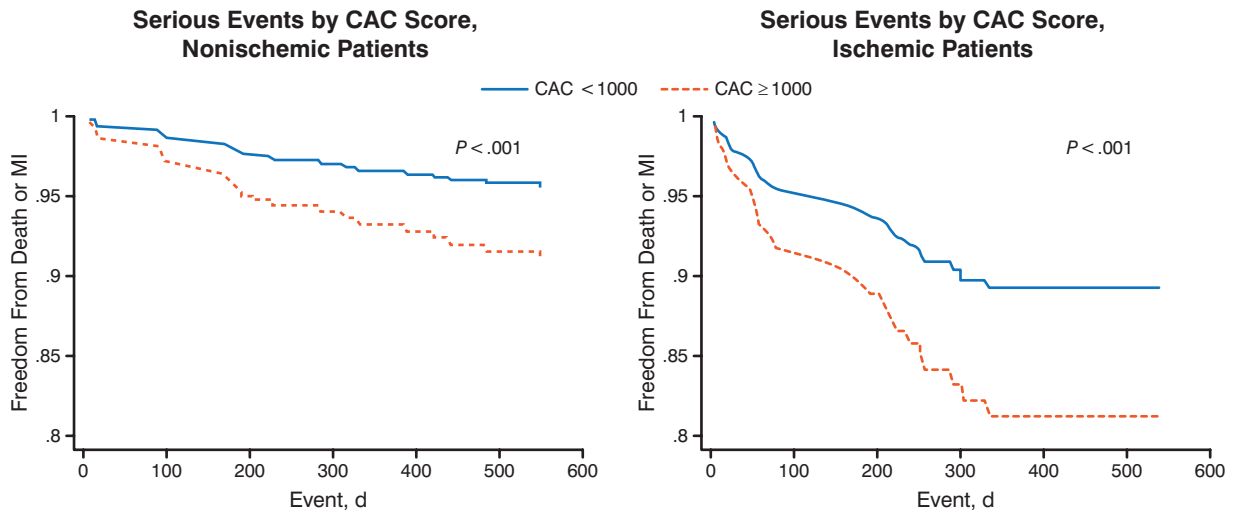
Figure 1. Coronary Calcium Score Independent Predictor of All-Cause Mortality



Graph shows risk-adjusted all-cause survival estimates according to calcium score subsets. Even after adjustment, survival rate is proportionally worse as the baseline calcium score increases.

Adapted from Shaw LJ et al. Graph shows risk-adjusted all-cause survival estimates according to calcium score subsets. Even after adjustment, survival rate is proportionally worse as the baseline calcium score increases. Radiology, 2003;228:826-833. With permission from RSNA.

Figure 2. High CAC Score Better Predictor of Poor Outcome Than Presence of Ischemia



CAC, coronary artery calcium; MI, myocardial ischemia.

Adapted from Schenker MP et al. Interrelation of coronary calcification, myocardial ischemia, and outcomes in patients with intermediate likelihood of coronary artery disease: a combined positron emission tomography/computed tomography study. *Circulation*. 2008;117(13):1693–1700. With permission from American Heart Association.

scan found that 64.1% had subclinical CAD based on an abnormal CACS. Changes in medical therapy appeared to be related to whether the patient had received multimodal therapy (PET/CT) or dedicated PET [Bybee KA et al. *J Nucl Cardiol*. 2010].

Although there was some residual risk of CAD in those with low CAC scores, higher CAC scores generally predicted a higher likelihood of ischemia. Annualized event rates in patients with normal PET MPI and no CAC were substantially lower than in patients with a CAC score ≥1000 (2.6% vs 12.3%). Rates were also lower among patients with ischemia on PET MPI and no CAC compared with those patients with a CAC score ≥1000 (8.2% vs 22.1%; Figure 2). These data suggest that incremental risk stratification can be achieved by incorporating information on the extent of CAD as measured by CACS, along with the physiological information gleaned from MPI [Schenker MP et al. *Circulation*. 2008].

MPI scans and computerized tomography coronary angiograms (CTCAs) have an internal link that provides good diagnostic performance for CAD [Li JM et al. *Int J Mol Imaging*. 2012]. They provide different and complementary information for detection of ischemia (MPI) versus detection of atherosclerosis (CTCA). There is concern, however, about the possibility of both false-positive and false-negative findings.

In patients with a negative MPI, 84.7% had a negative CTCA and 15.3% had a positive CTCA, whereas in patients with a positive MPI, 32.8% had a negative CTCA and 67.2% had a positive CTCA. In contrast, in patients with a negative CTCA, the proportion with a negative and positive MPI were 94.4% and 5.6%, respectively, whereas in patients with a positive CTCA, these proportions were 59.8% and 40.2%, respectively.

Multiple studies have noted that the frequency of ischemia in vessels with ≥50% stenosis (detected by CTA) had a negative predictive value of 91% to 100% and positive predictive value of 29% to 44%. Dr Thompson advises using MPI to confirm ischemia when stenosis is identified on a coronary CTA. MPI improves the detection of CAD in vessels <2 mm, whereas CTA contributes to the assessment of multivessel CAD. One advantage of MPI with a hybrid CT device is the ability to obtain same-setting measurement of the CACS, which makes it possible to detect obstructive atherosclerosis causing myocardial ischemia. Both techniques contribute to the management of coronary stenosis.

In best practice, the routine addition of CACS to MPI improves the detection of disease in patients who merit medical CAD management and prevention strategies. Patients who have normal or mildly ischemic MPI and persistent symptoms are good candidates for CACS or CCTA. Patients with indeterminate, or even severe, lesions on CCTA frequently merit additional testing with MPI, CT angiography with fractional flow reserve for detecting ischemia, and CT MPI.

An anatomy-based testing strategy with CT coronary angiography and a physiology-based testing strategy

with MPI may be clinically useful for the evaluation of known or suspected CAD in symptomatic patients. In selected patient cohorts, imaging approaches integrating structure and function may provide improved assessments of risk, thereby allowing a more personalized approach to management.

The Future of Percutaneous MV Therapy

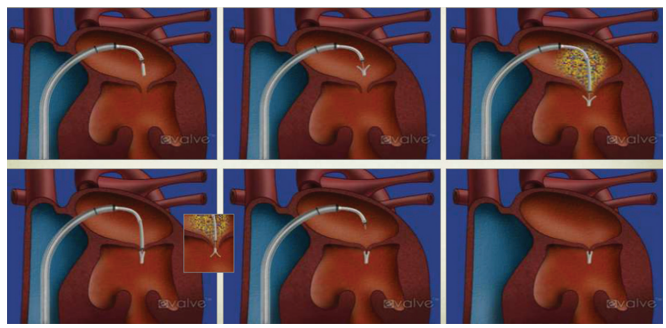
Written by Maria Vinall

Ramesh Daggubati, MD, East Carolina Heart Institute, Greenville, North Carolina, USA, described some of the percutaneous technologies on the horizon for treating mitral regurgitation (MR) and stenosis. He began with the case of an 86-year-old man with a history of diabetes, hypertension, NYHA class III congestive heart failure, and pulmonary hypertension, who had undergone coronary artery bypass surgery in 1994 and received an implantable cardioverter defibrillator in 2007. The patient developed severe MR but was not considered a candidate for mitral valve (MV) surgery. Instead, he was treated in the catheterization laboratory using 2 MV leaflet clips (Figure 1). The patient was transferred to the general ward on day 1 and discharged 4 days later. At 9 months, the patient had only mild residual MR and there had been reductions in left ventricular (LV) volume. The patient's symptoms improved and he continues to do well 4 years after implantation of the mitral clip.

The Endovalve-Herrmann prosthesis is a novel device that is currently being developed for MV replacement. The implant consists of a foldable nitinol structure with specially designed grippers that are repositionable before release. A minithoracotomy is performed on the beating heart and the device is implanted from the left atrial side. Because of the difficulty of keeping the valve in place, another device is being developed that is delivered transseptally and locks onto the inferior and superior surfaces of the mitral annulus. This device has a self-expanding, bi-level nitinol frame and 2 sets of opposing anchors (Figure 2).

EVEREST II [NCT00209274] was the first pivotal US trial for leaflet repair with a clip device. In this study, 279 patients with moderate-to-severe MR (grade 3+ or 4+) were randomly assigned (2:1 ratio) to either percutaneous MV repair with the MitraClip System or to conventional surgical repair/replacement. At 12 months, grade 3+ or 4+ MR was 21% in the percutaneous-repair group and 20% in the surgery group (Figure 3). Both groups had improved LV size, NYHA functional class, and quality-of-life measures compared with baseline [Feldman T et al. *N Engl J Med*. 2011].

Figure 1. Deployment and Placement of Mitral Valve Leaflet Clip



Reproduced with permission from R Daggubati, MD.

Figure 2. Mitral Valve Self-Expanding Replacement Device (CardiAQ)

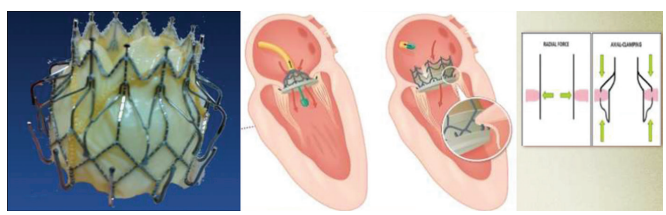


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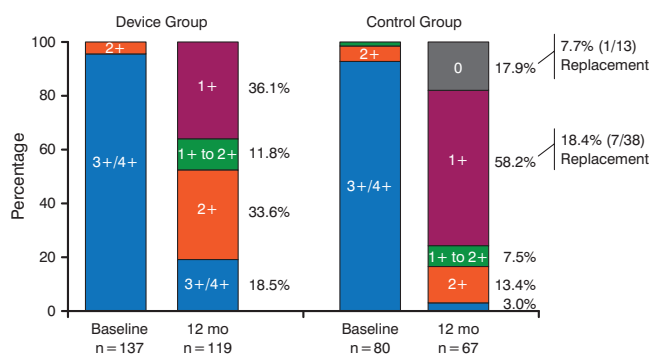
Figure 3. Reduction in Mitral Regurgitation After MitraClip Placement or Surgical Repair



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The COAPT trial [NCT01626079] is currently enrolling participants and is randomizing high-risk patients with functional MR (≥3+)to treatment with either the MitraClip or standard medical care. This trial and its European counterpart, RESHAPE, are expected to evaluate whether there is a role for the MitraClip in patients with functional MR.