Table 1. Factors That Predict Late Outcomes After Percutaneous Mitral Commissurotomy

Factor	Adjusted HR (95% CI)	*P* Value	Points for Score (of 13 Total Points)
Age, y, and final MVA, cm^2			
< 50 and MVA ≥ 2.00	1		0
< 50 and MVA 1.50–2.00, or 50–70 and MVA > 1.75	2.1 (1.6 to 2.9)	< .0001	2
50–70 and MVA 1.50–1.75, or ≥ 70 and MVA ≥ 1.50	5.1 (3.5 to 7.5)	< .0001	5
Valve anatomy and sex			
No valve calcification	1		0
Valve calcifi cation			
Female	1.2 (0.9 to 1.6)	.18	0
Male	2.3 (1.6 to 3.2)	< .0001	3
Rhythm and NYHA class			
Sinus rhythm or atrial fibrillation and NYHA class I to II	1		0
Atrial fibrillation and NYHA class III to IV	1.8 (1.4 to 2.3)	< .0001	2
Final mean mitral gradient, mm Hg			
≤3	1		0
3–6	1.1 (1.0 to 1.8)	.05	1
≥6	2.5 (1.8 to 3.5)	< .0001	3

MVA, mitral valve area.

Adapted from Bouleti C et al. Late results of percutaneous mitral commissurotomy up to 20 years: development and validation of a risk score predicting late functional results from a series of 912 patients. *Circulation* 2012;125:2119–2127. With permission from American Heart Association, Inc.

surgery, and was 2.37 cm^2 on Doppler ECHO at the mean 8.5-year follow-up. An MVA > 2.0 cm^2 was found in 81% of patients at follow-up. Importantly, this study showed that a postintervention MVA between 1.3 and 1.5 cm^2 should not be considered a success, stated Prof Smit.

Valvuloplasty is ideal for complex disease, which includes all valves with pathology extending beyond the leaflet and valvular structural disease, as defined by the scoring systems. Such valves likely require either valvuloplasty or valve repair for the first attempt at valve salvage, stated Prof Smit.

The selection of a percutaneous or surgical procedure is determined by the available expertise, infrastructure, and cost. If both options are available, Prof Smit recommends BMV as the first choice, or CMC, if the patient is an ideal candidate according to the scoring systems. OMC should be performed for all other patients. An irreparable valve should be replaced because the possibility of another surgery may not be available in developing countries. A diagnostic program for early detection should be established.

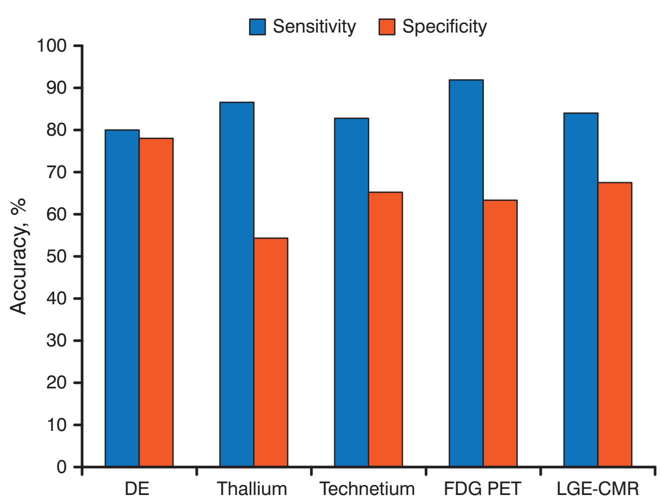
Imaging Solutions to Determining Myocardial Viability Before Revascularization

Written by Maria Vinall

Up to 61% of patients with left ventricular (LV) dysfunction still have some viable myocardium. Ahmad Fathala, MD, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia, believes that revascularization should continue even in the face of jeopardized—but still viable—myocardium.

Surgical revascularization may improve heart failure (HF) symptoms, LV ejection fraction (EF), and long-term prognosis in patients with coronary artery disease (CAD) who have a substantial amount of viable myocardium. A variety of methods can be used to identify patients with viable myocardium and to predict patient outcomes, but the sensitivity and specificity vary among the techniques (Figure 1) [Schinkel AF et al. *Curr Probl Cardiol.* 2007].

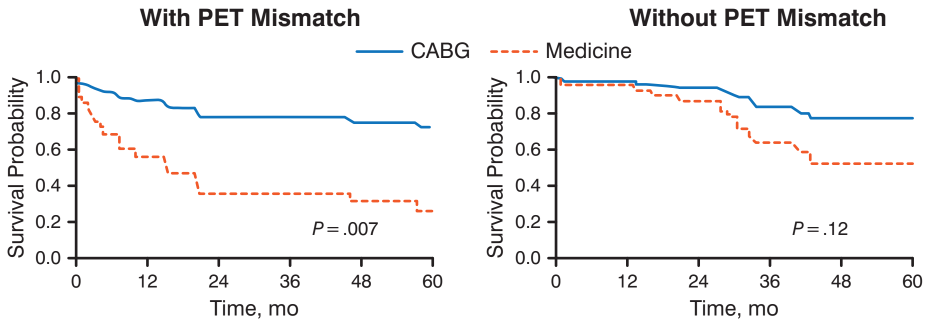
Figure 1. Sensitivity and Specificity of Various Imaging Methods for Identifying Myocardial Viability



DE, dobutamine echocardiography; FDG PET, F-18 fluorodeoxyglucose positron-emission tomography; LGE-CMR, late gadolinium enhancement cardiovascular magnetic resonance.

Source: Schinkel AF et al. *Curr Probl Cardiol*. 2007. Reproduced with permission from A Fathala, MD.

Figure 2. Prognosis of Patients With LV Dysfunction by PET Pattern of Viability and Mode of Treatment



CABG, coronary artery bypass grafting; LV, left ventricular; PET, positron-emission tomography.

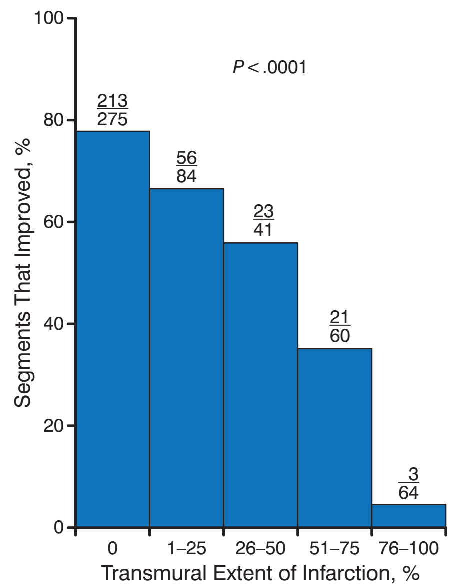
Adapted from the *Journal of Thoracic and Cardiovascular Surgery*, 116, Di Carli MF et al, Long-term survival of patients with coronary artery disease and left ventricular dysfunction: Implications for the role of myocardial viability assessment in management decisions, 997–1004, Copyright (1998), with permission from Mosby, Inc.

In 1998, a study was conducted to assess the long-term benefit of myocardial viability assessment for stratifying risk and selecting patients with low EF for coronary artery bypass grafting (CABG). It found that patients with severe CAD, low EF (median, 25%), and evidence of viable myocardium on positron-emission tomography (PET) had significantly improved 4-year survival (75% vs 30%; $P = .007$; Figure 2). After CABG, patients also had significant improvement in angina and HF symptoms compared with those receiving medical therapy.

An important question is whether patient management based on results of a myocardium viability assessment makes a difference in outcome. Beanlands and colleagues attempted to answer this question in a study that assessed myocardial viability through F-18 fluorodeoxyglucose (FDG) PET. The results showed no difference in the primary outcome—a composite of cardiac death, myocardial infarction, or recurrent hospital stay for cardiac cause, within 1 year—for patients assigned to management based on FDG PET versus standard care. Actual compliance with the PET-recommended treatment was poor (25% of patients with PET-indicated revascularization did not have it done). When the data were reanalyzed to include only patients receiving PET-adherent treatment, a significant survival benefit was seen ($P = .019$) [Beanlands RS et al. *J Am Coll Cardiol.* 2007]. This survival benefit associated with FDG PET management was recently confirmed [Abraham A et al. *J Nucl Med.* 2010].

Magnetic resonance imaging (MRI) is also useful in assessing myocardial viability. Contrast-enhanced MRI with late gadolinium enhancement can identify reversible or stunning myocardial dysfunction and determine if regions of abnormal ventricular contraction will improve after revascularization in patients with CAD (Figure 3) [Kim RJ et al. *N Engl J Med.* 2000].

Figure 3. LGE Identifies Reversible Myocardial Dysfunction Prior to Revascularization

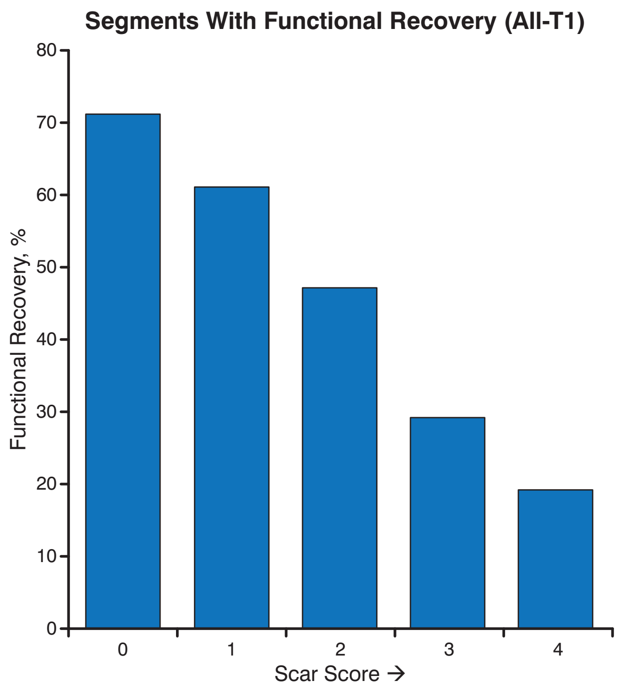


LGE, late gadolinium enhancement.

Source: Kim RJ et al. *N Engl J Med*. 2000. Reproduced with permission from A Fathala, MD.

Delayed-enhancement MRI is a robust predictor of functional recovery after revascularization. Results of a prospective international multicenter trial showed an inverse relationship between the extent of myocardial scarring, as determined by contrast MRI, and functional recovery. The higher the scar score, the fewer myocardial segments that recovered after revascularization (Figure 4) [Lenge VV et al. *J Cardiovasc Mag Res.* 2008]. In another trial that assessed the prognostic significance of unrecognized myocardial scarring in patients with no history of myocardial

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

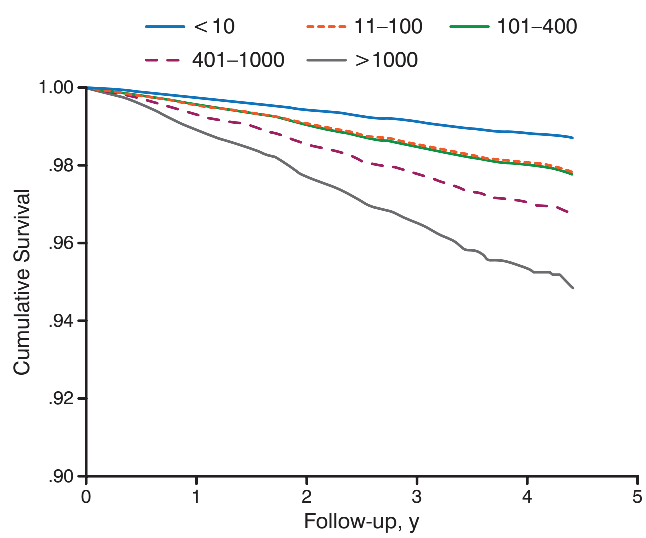
Written by Maria Vinall

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.