



# The Cardiac MRI Newsletter

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## Viability Imaging

### CMR Today is the Gold Standard for the Assessment of Viability of Infarcted Myocardium

The concept of myocardial viability is based on the fact that even severely dysfunctional myocardium in patients with coronary artery disease may show functional improvement after revascularization. Reversal of myocardial dysfunction is particularly relevant in patients with depressed ventricular function because revascularization improves long-term survival.

There are many methods available to assess viability, including

1. Low-dose dobutamine stress echocardiography
2. Thallium-SPECT
3. FDG-PET
4. CMR - cardiac MRI

All recent studies [1] have shown that CMR is superior to low-dose dobutamine echocardiography and thallium-SPECT for viability imaging. CMR is as good as FDG-PET [2] for picking up the infarcts with the added advantage of better spatial resolution, which allows evaluation of the exact transmural involvement of the myocardium.

The whole concept of viability on CMR is based on the fact that all infarcts enhance vividly 10-15 minutes after intravenous contrast administration. This phenomenon of delayed hyperenhancement has been proven to correlate with the actual extent of the infarct, in numerous animal and human studies [3]. CMR shows the transmural extent of the infarct very reliably. In infarct imaging, on contrast-enhanced CMR, it is now said that "white is dead".

In areas of hypokinesia, if there is a rim of "black" or non-infarcted myocardium that is not contracting well, it indicates the presence of hibernating myocardium, which is likely to improve after revascularization of the artery supplying that particular territory. Viability imaging reliably allows identification of areas of hibernation and viable and non-viable myocardium.

#### REFERENCES

- 1) Wagner A, Mahrholdt H, Holly TA et al. Contrast-enhanced MRI and routine SPECT perfusion imaging for detection of subendocardial infarcts: an imaging study. *Lancet* 2003; 361: 359-360
- 2) Kuhl HP, Beek AM, van der Weerd AP et al. Myocardial viability in chronic ischemic heart disease: comparison of contrast-enhanced magnetic resonance imaging with (18) FDG PET. *JACC* 2003; 16: 1341-1348.
- 3) Kim RJ, Wu E, Rafael A et al. The use of contrast-enhanced magnetic resonance imaging to identify reversible myocardial dysfunction. *NEJM* 2000; 343: 1488-1490.

## Case Reports:

### Case 1:

A 64-years old man presented with cardiac failure and an ejection fraction of 20% on echocardiography. Coronary angiography (Fig. 1A) showed high-grade stenoses in the LAD and LCX.

A cardiac MRI was performed for assessing viability.



The cine images show marked hypokinesia and thinning of the antero-septal and infero-lateral walls of the myocardium, areas supplied by the LAD and LCX, respectively. Full-thickness delayed hyperenhancement is seen in both these areas, suggesting scar tissue.

In view of the full-thickness, transmural involvement, and absence of any viable myocardium, a decision was taken not to revascularize the lesions in this patient.

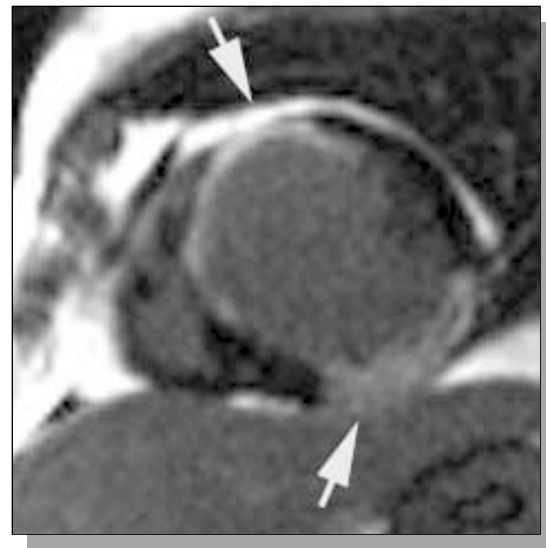


Fig. 1 (A,B). Viability study. The angiogram (A) shows high-grade stenoses of the LAD (arrow) and circumflex (arrowhead) arteries. A diastolic frame from a mid-cavitary short axis cine study (B) shows thinning of the antero-septal (arrow) and infero-lateral (arrowhead) regions - marked hypokinesia was seen on the cine images. The corresponding areas on the contrast-enhanced viability study (C) show full-thickness, transmural infarcts (arrows).

## Case 2:

A 53-years old lady presented with an LAD occlusion and a stenotic lesion in the OM1 (Fig. 2A). Ejection fraction was 24%. A decision had to be made about further treatment.

A cardiac MRI was performed for assessing viability.



The CMR study shows thinning and hypokinesia of the anterior wall of the myocardium on the short axis image, with approximately 50% delayed hyperenhancement of an LAD territory infarct. There is at least 50% viable myocardium in the infarct region. In the apical region seen best in the vertical long axis (VLA) view, marked wall thinning is seen with hypokinesia noted on the cine images.

Most of the anterior wall shows sub-endocardial enhancement of approximately 50% of the myocardial thickness with full-thickness, transmural enhancement at the apex itself. Except at the apex, the rest of the anterior wall shows viable (black) myocardium of at least 50% thickness. As a result, a decision to revascularize the patient was taken.

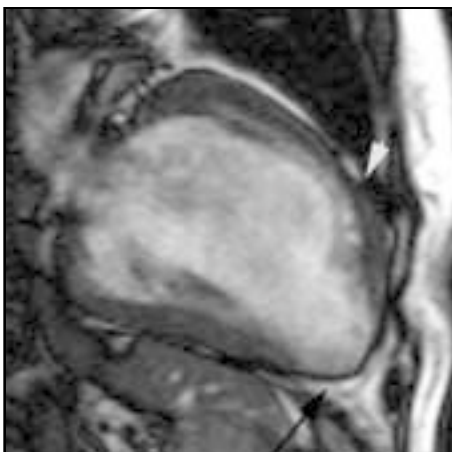
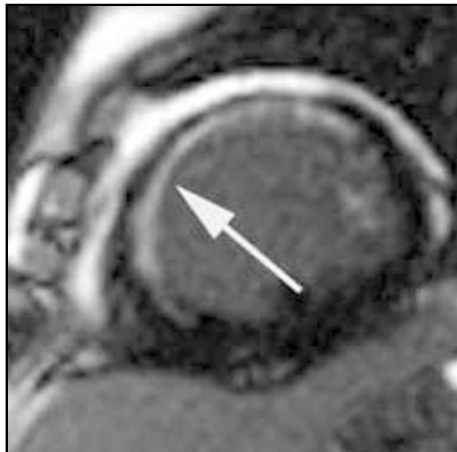
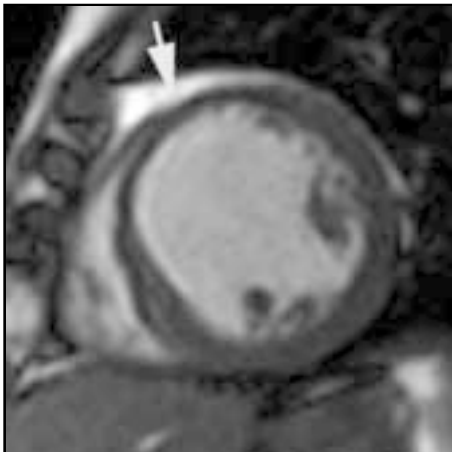


Fig. 2 (A-E): Viability study. The angiogram (A) shows an LAD occlusion (arrow) with a stenotic lesion of the OM1 (arrowhead). A diastolic frame from a mid-cavitary short axis cine study (B) shows thinning of the anterior and antero-septal walls (arrow) with hypokinesia noted on the cine study. The corresponding viability image shows a sub-endocardial infarct (C) involving approximately 50% of the myocardial thickness (arrow). A diastolic frame from a vertical long-axis (VLA) cine study (D) shows marked apical thinning (arrow) with moderate anterior wall thinning (arrowheads) with marked hypokinesia seen at the apex on the cine study. The corresponding viability image (E) shows a transmural infarct (arrow) involving the apex (arrow) with a sub-endocardial infarct involving approximately 50% of the myocardium (arrowhead) in the anterior wall.

# INFARCT IMAGING AND HEART FAILURE

As a corollary, CMR is also very useful in the evaluation of patients with cardiac failure to distinguish between dilated cardiomyopathy (DCM) and chronic LV dysfunction due to coronary artery disease, also called "ischemic cardiomyopathy".

In patients with ischemic cardiomyopathy, CMR shows infarcts, either sub-endocardial or full-thickness and confirms the presence of coronary artery disease. In patients with DCM, CMR either shows no enhancement or in some patients shows mid-myocardial enhancement due to fibrosis. CMR can reliably separate these two entities, thus obviating the need for initial coronary angiography to differentiate between these two conditions, in patients with LV failure.

## REFERENCES

1. McCrohon JA, Moon JCC, Prasad SK et al. Differentiation of heart failure related to dilated cardiomyopathy and coronary artery diseases using gadolinium enhanced cardiovascular magnetic resonance. *Circulation* 2003; 108: 0054-0058.

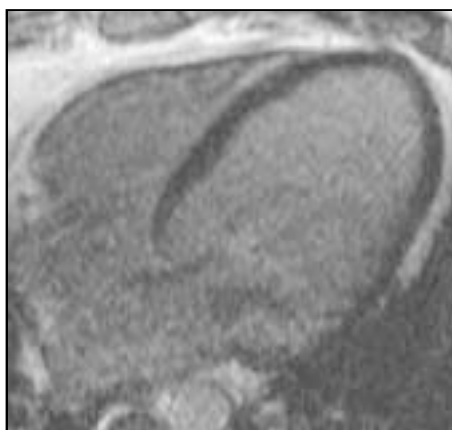


Fig. 3 (A,B): Dilated cardiomyopathy. A diastolic frame from a horizontal long-axis (HLA) cine study shows LV dilatation (A). The corresponding contrast-enhanced image (B) shows no enhancement.

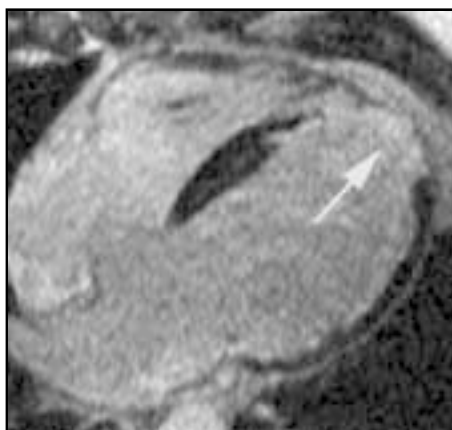


Fig. 4 (A,B): Ischemic cardiomyopathy. A diastolic frame from an HLA cine study (A) shows LV dilatation with thinning of the apex (arrow). The corresponding contrast-enhanced study (B) shows a full-thickness transmural infarct involving the apex (arrow).

Viability imaging takes approximately 30-40 minutes, does not require any preparation and is not a stress study. The cost is equivalent to that of a single MRI examination with contrast

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