CMR imaging assessing viability in patients with chronic ventricular dysfunction due to coronary artery disease: a meta-analysis of prospective trials

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CRD summary
This review concluded that contrast delayed enhancement plus low-dose dobutamine should increase the accuracy of magnetic resonance imaging for patients with chronic left ventricular dysfunction. The potential for missed studies and the overestimation of accuracy in half of the included studies, means that the results should be treated with caution.

Authors’ objectives
To compare the diagnostic accuracy of three cardiac magnetic resonance imaging (MRI) methods for assessing myocardial viability, in patients with chronic left ventricular dysfunction, due to coronary artery disease. The methods were end-diastolic wall thickness, low-dose dobutamine and contrast delayed enhancement.

Searching
PubMed, EMBASE and Cochrane Central Register of Controlled Trials (CENTRAL) were searched, without language restrictions, for peer-reviewed publications from 1966 to June 2011; the search strategy was reported. Reference lists of included studies were screened, and abstracts without full articles were excluded.

Study selection
Prospective studies that evaluated end-diastolic wall thickness, low-dose dobutamine, or contrast delayed enhancement, during cardiac MRI assessment of myocardial viability, were eligible for inclusion. Studies had to recruit adults (over 19 years old), with chronic stable left ventricular dysfunction, at least two weeks after a myocardial infarction, who were being assessed for percutaneous coronary intervention or coronary artery bypass grafting. Studies had to report sufficient data to produce 2x2 tables of test performance, for standardised cut-off values, for each test. A standard evaluation technique had to be used to assess improvement after revascularisation, in terms of left ventricular or global function or both.

In the included studies, where reported, the mean age ranged from 57 to 69 years, the percentage of men ranged from 48 to 95, and the baseline left ventricular ejection fraction ranged from 28% to 62%. The dose of dobutamine was five to 10 micrograms per kg per minute. The delay after gadolinium administration ranged from six to 25 minutes, in the contrast delayed enhancement studies. The cut-off for viability was less than 50% in the contrast delayed enhancement studies, over 2mm in the low-dose dobutamine studies, and over 5.5mm or over 6mm in the end-diastolic wall thickness studies.

The authors did not state how many reviewers selected studies for the review.

Assessment of study quality
Study quality was assessed, by two independent reviewers, using the 14-point Quality Assessment of Diagnostic Accuracy Studies (QUADAS) tool; disagreements were resolved by discussion.

Data extraction
Two reviewers extracted the data to construct 2x2 tables of test performance for MRI before revascularisation. The left ventricular function after revascularisation was the reference standard. Sensitivity, specificity, and positive and negative predictive values were calculated. Study authors were contacted for missing information. Disagreements were resolved by discussion.

Methods of synthesis
Summary estimates of sensitivity and specificity, with 95% confidence intervals, were calculated using a bivariate random-effects model, and summary receiver operating characteristic curves were produced. Similar models were used to produce the summary positive and negative predictive value estimates, but the details of the model were not provided.
Heterogeneity was assessed by visual inspection of the summary receiver operating characteristic curves. Logistic regression was used to investigate the impact on sensitivity of the duration of follow-up, proportion of males, cut-off thresholds, and age. Publication bias was investigated using the Egger, Macaskill, and Deeks methods.

**Results of the review**

Nineteen studies, with 24 sets of data, met the inclusion criteria (698 patients; range 10 to 52). Twelve of the 14 criteria on QUADAS were met by all studies; half of the data sets (11 studies) did report blinding interpreters of the reference standard; and two data sets (one study) did not explain withdrawals. Where reported, the follow-up assessments were conducted between six and 88 weeks after the procedures; most were conducted within 36 weeks.

For contrast delayed enhancement (11 studies), sensitivity was 95% (95% CI 93 to 97), specificity was 51% (95% CI 40 to 62), overall accuracy was 70% (95% CI 69 to 71), the positive predictive value was 69% (95% CI 56 to 80) and the negative predictive value was 90% (95% CI 85 to 93).

For low-dose dobutamine (9 studies), sensitivity was 81% (95% CI 73 to 86), specificity was 91% (95% CI 84 to 95), overall accuracy was 84% (95% CI 82 to 86), the positive predictive value was 93% (95% CI 87 to 97) and the negative predictive value was 75% (95% CI 65 to 83).

For end-diastolic wall thickness (four studies), sensitivity was 96% (95% CI 91 to 98), specificity was 38% (95% CI 23 to 57), overall accuracy was 68% (95% CI 66 to 70), the positive predictive value was 71% (95% CI 49 to 86) and the negative predictive value was 85% (95% CI 70 to 93).

Contrast delayed enhancement and end-diastolic wall thickness had significantly higher sensitivities, and lower specificities, than low-dose dobutamine. The results of the sensitivity analyses were reported. There was some evidence of publication bias.

**Authors’ conclusions**

Contrast delayed enhancement MRI had the best sensitivity and negative predictive value, while low-dose dobutamine had the best specificity and positive predictive value; combining these two methods should increase the accuracy for patients with chronic left ventricular dysfunction.

**CRD commentary**

The review addressed a clear research question, supported by reproducible inclusion criteria. Relevant sources were searched, but only peer-reviewed articles were included and there was some evidence of publication bias. The search did not include diagnostic filters, which avoided missing further studies. Data extraction and quality assessment were conducted in duplicate; it was unclear whether similar methods to reduce error and bias were used for study selection.

Study quality was assessed, using appropriate criteria, and the results were reported in full. About half of the included studies met all of the QUADAS criteria, but half did not report blinding of the interpreters of the reference standard, which could mean that accuracy was overestimated. When examining the forest plots, accuracy did seem to be overestimated in these studies. The authors stated that the studies included 698 patients; some studies examined more than one test, and if they were used on the same patients, the total sample size should have been 546 patients. Appropriate methods of synthesis were used.

Although the conclusions reflected the evidence presented, the potential for missed studies and the overestimation of accuracy in half of the included studies, means that the results should be treated with caution.

**Implications of the review for practice and research**

**Practice:** The authors stated that the extent of wall scar tissue should be assessed with contrast delayed enhancement, and the contractile reserve should be assessed with low-dose dobutamine, for the best possible diagnostic and prognostic information.

**Research:** The authors stated that more reliable tests should be investigated, for the evaluation of patients with chronic left ventricular dysfunction, before revascularisation.

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