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FACTORS ASSOCIATED WITH FALSE NEGATIVE CARDIOVASCULAR MAGNETIC RESONANCE PERFUSION STUDIES: A CE-MARC SUBSTUDY

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Background Diagnosis of coronary ischaemia by perfusion cardiovascular magnetic resonance (CMR) has high sensitivity and specificity when using X-ray coronary angiography as the reference standard. Potential reasons for false negative perfusion CMR studies include suboptimal image quality, technical reasons, or the potential discrepancy between angiographic stenosis and detectable myocardial hypoperfusion. The rates at which these factors occur have not been specifically studied to date. The CE-MARC study prospectively enrolled 752 patients with suspected coronary artery disease, scheduled to undergo CMR, SPECT and X-ray coronary angiography. We assessed potential reasons for the false negative CMR perfusion studies within CE-MARC.

Methods All patients with significant coronary stenosis ($\geq 70\%$ stenosis of a first order coronary artery ≥ 2 mm diameter, or left main stem stenosis $\geq 50\%$ as measured by quantitative coronary angiography (QCA)), who had a normal or probably normal CMR perfusion analysis from the original, blinded read were selected from the CE-MARC population. Patient and imaging characteristics were analysed. Myocardial perfusion reserve (MPR) was calculated offline (PMI v0.4) from CMR stress and rest perfusion images using the Fermi model, with arterial input defined in LV blood pool, and the whole mid-LV short axis myocardial slice used as tissue response.

Results 36 patients with a false-negative CMR result were identified (table 1). 1 patient had 'unusable' image quality grading, and was excluded from further analysis. 4 (11%) patients had images

Table 1 Patient characteristics for false negative perfusion CMR in CE-MARC.

	False negative patients	CE-MARC whole population
N	35	752
Age (years)	61 \pm 7	60 \pm 10
Male	29 (83%)	471 (63%)
Body-mass index (kg/m ²)	28.3 \pm 4.0	29.2 \pm 4.4
Resting BP (mm Hg)	125/71 \pm 20/10	138/79 \pm 21/11
LAD disease	19 (54%)	183 (25%)
Circumflex disease	16 (46%)	133 (18%)
RCA disease	8 (23%)	110 (15%)
Left main disease	2 (6%)	23 (3%)

Data as n (%) or mean \pm SD.

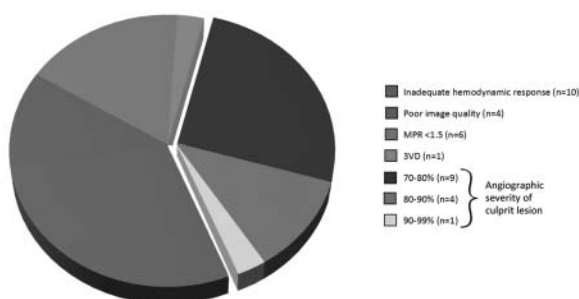


Figure 1 Factors associated with a false negative CMR perfusion scan. One factor is shown per patient (n=35).

graded as 'poor quality.' 10 patients (29%) had inadequate hemodynamic response to adenosine (SBP decrease <10 mm Hg or heart rate increase <10 beats/min). 1 patient (3%) had angiographic 3-vessel disease, supporting balanced ischaemia. A further 6 patients (17%) had an adequate hemodynamic response but MPR <1.5, suggesting possible inadequate vasodilatation (in the absence of triple vessel disease). Of the remaining 14 patients, mean QCA diameter of culprit stenoses was $74\% \pm 12\%$, close to the angiographic cut-off of $\geq 70\%$ for significant disease (figure 1).

Conclusions Of the many potential factors contributing to false negative CMR perfusion studies, over one third of false negative studies may have been related to lack of efficacy of pharmacological stress at the standard adenosine dose of $140 \mu\text{g/kg/min}$. A substantial proportion of patients had coronary stenosis severity close to the angiographic cut-off of 70%, which may represent discordance between anatomical and functional assessment. Non-diagnostic image quality and three-vessel disease made a relatively small contribution to false-negative CMR studies.