CARDIOVASCULAR MEDICINE

# Microvascular perfusion 1 week and 6 months after myocardial infarction by first-pass perfusion cardiovascular magnetic resonance imaging

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**Objective:** To characterise the evolution of myocardial perfusion during the first 6 months after myocardial infarction by first-pass perfusion cardiovascular magnetic resonance imaging (CMR) and determine its significance.
**Design:** Prospective cohort design.
**Setting:** Single-centre study in a teaching hospital in Spain.
**Patients:** 40 patients with a first ST-elevation myocardial infarction, single-vessel disease and thrombolysis in myocardial infarction (TIMI) grade 3 flow (stent in 33 patients) underwent rest and low-dose dobutamine CMR 7 (SD 1) and 184 (SD 11) days after infarction. Microvascular perfusion was assessed at rest by visual assessment and quantitative analysis of first-pass perfusion CMR. Of the 640 segments, 290 segments subtended by the infarct-related artery (IRA) were focused on.
**Results:** Both 1 week and 6 months after infarction, segments with normal perfusion showed more wall thickening, contractile reserve and wall thickness, and less transmural necrosis, $p < 0.05$ in all cases. Of 76 hypoperfused segments at the first week, 47 (62%) normalised perfusion at the sixth month. However, 42 segments (14% of the whole group) showed chronic abnormal perfusion; these segments showed worse CMR indices in the late phase ($p < 0.05$ in all cases).
**Conclusions:** In patients with an open IRA, more than half of the segments with abnormal perfusion at the first week are normally perfused after six months. First-pass perfusion CMR shows that in a small percentage of segments, abnormal perfusion may become a chronic phenomenon—these areas have a more severe deterioration of systolic function, wall thickness, contractile reserve and the transmural extent of necrosis.

The primary objective of treatment after myocardial infarction is to restore tissue perfusion.[1] In patients with an open infarct-related artery (IRA), a lack of perfusion at the microvascular level is related to worse outcome.[1–5] The extent of abnormal perfusion may change in the months after myocardial infarction.[5 6]

Cardiovascular magnetic resonance imaging (CMR) allows state-of-the-art analysis of the heart in different clinical scenarios.[7] Basically, two methods have been described for evaluating perfusion using CMR: first-pass perfusion imaging (which analyses myocardial enhancement immediately after contrast injection)[7–11] and late-enhancement imaging (which evaluates the presence of microvascular obstruction in the middle of the necrotic area several minutes after contrast administration).[4 12 13 14] Several authors[13 14] have shown (using late-enhancement imaging) that microvascular obstruction after myocardial infarction is always a transient phenomenon.

Little is known about the evolution of microvascular perfusion after myocardial infarction analysed with first-pass perfusion CMR. We conducted this study to evaluate by means of this technique the evolution of microvascular perfusion as well as its influence on systolic function, wall thickness, contractile reserve (evaluated with stress dobutamine CMR) and the extent of necrosis (analysed with late-enhancement imaging) in the first 6 months after myocardial infarction in patients with an open IRA.

## PATIENTS AND METHODS

### Study group

We prospectively included 60 consecutive patients with a first ST-elevation myocardial infarction treated with thrombolytic therapy (time to reperfusion 229 (standard deviation (SD) 115) min) within the first 6 h after onset of chest pain. To avoid several confusing factors that could alter the interpretation of the microvasculature (occlusion or severe stenosis in the IRA, previous necrosis, multivessel disease, reinfarction, restenosis, etc), the inclusion criteria were as follows:

a. Stable clinical course without complications during the first 6 months
b. Single-vessel disease and a patent (thrombolysis in myocardial infarction grade (TIMI) 3 flow and residual stenosis <50%) IRA at the end of pre-discharge cardiac catheterisation and at the sixth month
c. No contraindications to CMR.

We excluded 20 patients who had multivessel disease (n = 10), TIMI flow <3 (n = 2), restenosis (n = 5), claustrophobia (n = 2) and reinfarction (n = 1). Therefore, the final study group comprised 40 patients (fig 1).

The local ethics committee approved the research protocol. Informed consent was obtained from all patients.

### Cardiac catheterisation

Cardiac catheterisation was carried out 4 (SD 1) days after myocardial infarction. TIMI grade 3 flow was observed in 20 (50%) patients; a stent was placed in 33 (82%) patients in

**Abbreviations:** CMR, cardiovascular magnetic resonance imaging; IRA, infarct-related artery; TIMI, thrombolysis in myocardial infarction; True FISP, true fast imaging in steady-state precession