Coronary Flow Reserve & Index of Microvascular Resistance in Acute STEMI survivors

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Coronary vs myocardial reperfusion

Acute STEMI

Angiography

Primary PCI stent
Successful PCI but **failed** myocardial reperfusion ....
Microvascular obstruction often passes undetected as CMR not usually done

**In-vivo MRI**
- Early Gad
- MVO

**Post-mortem MRI**
- T2*
- Haemorrhage
- T2*
- Cardiac rupture

Rationale for diagnostic wire to assess reperfusion injury

IMR=54
Hypotheses

1) Guidewire based assessment of microvascular function during routine care would be feasible. 
   
   *Compared to either diagnostic test alone*

2) The combination of CFR and IMR might be more closely associated with infarct pathologies.

3) The combination of a reduced CFR and increased IMR would have incremental prognostic and clinical significance.
METHODS: coronary microvascular function assessed with thermodilution

Saline, 18 °C
Intra-coronary injection
3 ml

Coronary flow reserve, CFR
= Tmn rest / Tmn hyperaemia

Index of microvascular resistance, IMR
= Distal coronary pressure (Pd) x mean transit time (Tmn) hyperaemia
Study design

288 acute STEMI patients

ClinicalTrials.gov
BHF MR-MI study
NCT02072850

Enrollment May 2011 – Nov 2012
Follow-up to July 2014 (min 18 months)
A study of bleeding hearts after heart attack

288 STEMI patients

Coronary Physiology
IMR and CFR

PressureWire Sensor in the coronary artery
A study of bleeding hearts after heart attack

288 STEMI patients

Coronary Physiology
IMR and CFR

Cardiac MRI 1.5T

Study design

PressureWire Sensor in the artery

LGE T2*
Acute STEMI, n = 288
Primary PCI with coronary physiology

Day 2 MRI

CMR at 6-months
n = 264 (93%)

Health outcome
n = 288 (100%)

Carrick et al, BHF MR-MI study
Acute STEMI, $n = 288$
Primary PCI with coronary physiology

Day 2 MRI

**IMR and CFR**
Operator only acquired hyperaemic thermodilution measurements ($n=5$)
$n = 283$

CMR at 6-months
$n = 264 (93\%)$

Health outcome
$n = 288 (100\%)$

*ClinicalTrials.gov*
Carrick et al, BHF MR-MI study
Acute STEMI, n = 288
Primary PCI with coronary physiology

Day 2 MRI

IMR and CFR
Operator only acquired hyperaemic thermodilution measurements (n=5)
n = 283

Analysis

CMR with evaluable T2* map
Intolerance of scan, Cardio-resp motion artefact
n = 219

CMR at 6-months
n = 264 (93%)

Health outcome
n = 288 (100%)

ClinicalTrials.gov
Carrick et al, BHF MR-MI study
Results

STEMI
n = 219

Myocardial haemorrhage
Compared with CFR, IMR was more strongly associated with severe vascular damage.

**STEMI**

n = 219

**Myocardial haemorrhage**

IMR 27 vs. haemorrhage

AUC = 0.73 (0.66, 0.79)

CFR 1.5 vs. haemorrhage

AUC = 0.37 (0.30, 0.45)
Compared with IMR, CFR was discriminative of MVO in patients with less severe vasc damage.

**STEMI**
- n = 219

**No Haemorrhage**
- n = 128

**MVO**
- n = 85

**No MVO**
- n = 43
The combination of reduced CFR (<2) & increased IMR (>40): MV associate all cause death/ HF

HR 4.29 (1.83, 10.08); p<0.001
All cause death or heart failure
...however, this composite did not add incremental prognostic value to IMR>40 alone

HR 4.29 (1.83, 10.08); p<0.001
All cause death or heart failure

HR 4.36 (2.10, 9.06); P<0.001
All cause death or heart failure
Microvascular dysfunction (CFR<2, IMR>40) and subsequent LV outcomes

MV analysis CFR<2, IMR>40:
- Change in EF (-3.16 (-5.25, -1.07); p=0.003)
- Change in LVEDV (6.88 (-1.16, 14.92); p=0.093)
Conclusions

- CFR & IMR were associated with change in LVEF
- IMR is more strongly associated with severe vascular damage (IMH) and has stronger prognostic significance
- IMR<27 is a rule-out test for IMH
- IMR>40 has prognostic value
- Routine measurement of IMR is feasible and has potential for immediate risk stratification
Acknowledge British Heart Foundation

Patients

Hospital staff