How to manage No-reflow?

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Conflicts of interest M. Roffi

Research funding
- Abbott vascular
- Biotronik
- Biosensor
- Medtronic
- Boston Scientific

Speaker fees
- Astra Zeneca
Definition

• Inadequate myocardial perfusion through a given segment of coronary circulation without angiographic evidence of mechanical vessel obstruction
Epidemiology

• Variable prevalence after revascularization between 5 to 50%. Niccoli et al, JACC, 2009

• It can occur in up to 10% of cases of primary PCI. Lee et al, J interv Car 2005.
Negative impact on outcome

- Myocardial infarction
- Early post-infarction complications (arrhythmias, heart failure, shock)
- Mortality ↑

Niccoli et al, JACC 2009
Pathophysiology

Diagnosis

In the cath-lab

- Angiography
  - Final TIMI flow ≤2
  - Final TIMI flow 3 with MBG <2

- Doppler wire
  - Systolic retrograde flow
  - Diminished systolic antegrade flow
  - Rapid deceleration of diastolic flow

In the CCU

- Electrocardiogram
  - ST resolution <50 or 70% 60/90 min after PPCI

Pre-discharge

- MCE
  - Lack of intramyocardial contrast opacification

- CE-CMR
  - Lack of gadolinium enhancement during first pass
  - Lack of gadolinium enhancement within a necrotic Region (late gadolinium hyperenhancement)
No-reflow predictors

- **Thrombus burden**
- **Vein graft lesion**
- Ischemia duration
- Ischemia extent
- Neutrophil count
- Diabetes
- Acute hyperglycemia
- Hypercholesterolemia
Femoral (ZH time)
Left radial approach
Note the ECG
Note the ECG
Note the ECG
| Paramètre                                    | Unité | Valeurs Réf./Séuil | 01/06/2016 06:00-00 | 01/06/2016 08:00-00 | 01/06/2016 12:00-00 | 01/06/2016 20:00-00 | 31/05/2016 06:00-00 | 31/05/2016 08:00-00 | 31/05/2016 12:00-00 | 31/05/2016 20:00-00 | 31/05/2016 05:40-00 | 31/05/2016 08:00-00 | 30/05/2016 06:00-00 | 30/05/2016 05:40-00 | 30/05/2016 08:00-00 | 30/05/2016 01:10-00 | 30/05/2016 05:40-00 | 30/05/2016 08:00-00 | 30/05/2016 01:10-00 | 30/05/2016 05:40-00 | 30/05/2016 08:00-00 | 30/05/2016 01:10-00 | 20/05/2016 01:10-00 | 20/05/2016 05:40-00 | 20/05/2016 08:00-00 | 20/05/2016 01:10-00 | 20/05/2016 05:40-00 | 20/05/2016 08:00-00 |
|---------------------------------------------|-------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Glucose                                    | mmol/L| 5.4                 |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Hémoglobine glyquée                       | %     | 5.6                 |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Glucémie moyennée estimée                  | mmol/L| 6.3                 |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Sodium                                     | mmol/L| 141                 | 139                  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Potassium                                  | mmol/L| 4.1                 | 3.9                  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Osmolarité calculée                       | mOsm/kg| 293                |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Urobilin                                   | mmol/L| 6.8                 |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Crétinine                                  | mmol/L| 93                  |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| eGFR (CKD-EPI)                             | ml/min/1.73m²| 71 [A] |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Creatinine kinase totale                   | UI     | 113                 |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Triponine T ultra sensible                 | ng/dL | 14 [B]              |                       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
How to manage the No-reflow

• There is no single, standard treatment of the no-reflow phenomenon.
Reduce thrombus burden and prevent distal embolization

- Reduce thrombus burden
  - Thrombectomy devices (Angiojet)
  - Catheter thrombus aspiration
  - GP IIb/IIIa inhibitors
- Prevent distal embolization
  - Direct stenting
  - Filters
Management of reperfusion-related injury

- Glycoprotein IIb / IIIa antagonists
- Adenosine
- Verapamil
- Nitroprusside
SAFER Study: Distal protection in SVG

30-Day Death/MI/Urgent Revascularization

- **GP IIb/IIIa, n = 389**
  - 16.5%
  - P = 0.18
- **Placebo, n = 216**
  - 12.6%
GP IIb/IIIa in Graft PCI vs. All PCI

Multivariate Analysis for 30-Day Death/MI/UR

Risk Ratio & 95% CI

Graft PCI
N=627

All PCI
N=13,158

p < 0.001

p = 0.14

M. Roffi et al, Circulation. 2002;106:3063-3067
No reflow (Assessment ECG, TMPG)

- Exclude another cause
- Thrombus, Spasm, Dissection, air embolism
  - NTG 100-200 mcg to 4 bolus
  - Distal contrast injections

Check ACT

Hemodynamic stabilisation

- Pressors Agents IABP
- O2 delivery Pacemaker

Target 200-250 s
UFH:UFH + 2b/3a

Delivery system
- Guiding catheter
- Over-the-wire catheter
- Micocatheter
- Aspiration catheter

First line management (each bolus can be given several times)
1. Adenosine up to 60 mcg bolus
2. Verapamil up to 200 mcg bolus or 100 mcg/min up to 1000 mcg total, with temporary pacer on standby
   Never give >200 mcg as bolus
3. Nitroprusside up to 200 mcg bolus, up to 1000 mcg total dose
4. Epinephrine 50-200 ug
5. Nicardipine 200 ug
6. Nicorandil 2 ug
7. Diltiazem 0.5 – 2.5 mg over 1 min up to 5 mcg

Never shown to be effective
1. Nitroglycerin (arteriols > 100 mm)
### 2008 ESC STEMI Guidelines

#### Prevention
- **Thrombus aspiration**
  - Class: Ila
  - Level: B

- **Abciximab 0.25 mg/kg bolus and 0.125 µg/kg/min infusion for 12–24 h**
  - Class: Ila
  - Level: B

#### Treatment
- **Adenosine: 70 µg/kg/min i.v. over 3 h during and after PCI**
  - Class: Ila
  - Level: B

- **Adenosine: intracoronary bolus of 30–60 µg during PCI**
  - Class: Ila
  - Level: C

- **Verapamil: intracoronary bolus of 0.5–1 mg during PCI**
  - Class: Ila
  - Level: C

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**NB** nothing on nitroglycerine

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### 2014 ESC REVASC GL: STEMI

GP IIb/IIIa inhibitors should be considered for bail-out or evidence of no-reflow or a thrombotic complication.

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### 2012 ESC STEMI Guidelines

→ no more recommendation for adenososine, verapamil