Place de la FFR dans le SCA

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No potential conflicts of interest to report
The use of a FFR to guide revascularization strategy is nowadays supported by robust outcome clinical data in patients undergoing elective PCI.

However, doubts remain about interpretation and reliability of FFR measurements to assess culprit and non-culprit arteries and guide revascularization decisions in patients with acute coronary syndrome.
FFR AND MYOCARDIAL MICROVASCULAR FUNCTION

EPICARDIAL = CONDUCTANCE
ARTERIES > 550 µ

MICROVASCULATURE = RESISTANCE
ARTERIES < 550 µ

Muller O, De Bruyne B, Oxford Textbook of Interventional Cardiology
FFR AND MYOCARDIAL MICROVASCULAR FUNCTION

**FOCAL STENOSIS**

**EPICARDIAL = CONDUCTANCE**

**ARTERIES > 550 µ**

**MICROVASCULATURE = RESISTANCE**

**ARTERIES < 550 µ**

\[
FFR = \frac{Q_S^{\text{max}}}{Q_N^{\text{max}}} = \frac{P_d}{P_a}
\]

**MAXIMAL CORONARY HYPEREMIA**

**PRESERVED MICROCIRCULATION**

**VASODILATORY CAPACITY**

Muller O, De Bruiyne B, Oxford Textbook of Interventional Cardiology
FFR AND MYOCARDIAL MICROVASCULAR FUNCTION

**THROMBOSIS**

- **Distal Embolization**
  - **Epicardial Conductance** Arteries > 550 µ
  - **Microvasculature Resistance** Arteries < 550 µ

**MAXIMAL CORONARY HYPEREMIA?**

- Impaired Microvascular Vasodilatory Capacity
- Microvascular Dysfunction

- **Δp₁**
- **Δp₂ ??**

Adapted from: Muller O, De Bruyne B, Oxford Textbook of Interventional Cardiology
13 patients, 1VD after thrombolysis for STEMI, baseline and stress regional myocardial blood flow assessed by PET study in IRA and remote myocardial region at 1 week and 6 months.
MICROCIRCULATION VASODILATORY CAPACITY IN ACS

STEMI vs. NSTEMI

140 PATIENTS WITH 1VD, PCI FOR STABLE ANGINA (N=50), NSTEMI (N=50, 4.2 DAYS) OR STEMI (N=40, 0.1 DAY).
IMR, FFR AND CFR BEFORE PCI IN CULPRIT AND NON-CULPRIT ARTERIES

RESISTANCE RESERVE RATIO (RRR) = BASELINE RESISTANCE INDEX / INDEX OF MICROVASCULAR RESISTANCE (IMR)

MEDIAN RESISTANCE RESERVE RATIO ACROSS PATIENT SUBGROUPS

Layland J, Circ Cardiovasc Interv. 2013
FFR AND ACUTE CORONARY SYNDROME
ACUTE MYOCARDIAL INFARCTION

CULPRIT ARTERY

DS=75%

NECROSIS

ACUTE MICROVASCULAR DYSFUNCTION

NON CULPRIT ARTERY

DS=75%

NORMAL MICROCIRCULATION?

RELIABILITY AND CLINICAL BENEFIT OF FFR MEASUREMENTS IN CULPRIT AND NON CULPRIT ARTERY?
FFR AFTER RECENT MI CULPRIT ARTERY

57 patients

MI → MIBI → FFR > PCI → MIBI

> 6 jours

De Bruyne B, Circulation 2001
**FFR AFTER RECENT MI**

**CULPRIT ARTERY**

- **57 PATIENTS, RECENT MI (≥6 DAYS, MEAN: 20 DAYS, 60% STEMI),**
- **BASELINE SPECT MYOCARDIAL PERFUSION IMAGING AND FFR OF IRA BEFORE AND AFTER PCI**

**RELATIONSHIP BETWEEN FFR AND SPECT IMAGING BEFORE AND AFTER PCI AMONG PATIENTS WITH TRULY POSITIVE AND TRULY NEGATIVE SPECT IMAGING**

<table>
<thead>
<tr>
<th>FFR ≥ 0.75 (n = 45)</th>
<th>MIBI + (n = 40)</th>
<th>MIBI - (n = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>FFR &lt; 0.75 (n = 35)</td>
<td>35</td>
<td>0</td>
</tr>
</tbody>
</table>

Concordance = 94%

κ = 0.87; P < 0.0001

De Bruyne B, Circulation 2001
FFR AFTER RECENT MI
CULPRIT ARTERY

57 PATIENTS, RECENT MI (≥6 DAYS, MEAN: 20 DAYS, 60% STEMI), BASELINE SPECT IMAGING AND FFR OF IRA BEFORE AND AFTER PCI

RELATIONSHIP BETWEEN LVEF, FFR AND DS WITH SPECT IMAGING

FOR A SIMILAR DEGREE OF STENOSIS, THE VALUE OF FFR DEPENDS ON THE MASS OF VIABLE MYOCARDIUM

De Bruyne B, Circulation 2001
FFR IN ACUTE CORONARY SYNDROME
SUBANALYSIS OF THE FAME TRIAL

328 PATIENTS WITH UA / NSTEMI (POSITIVE TROPONIN, PEAK CREATINE KINASE <1’000 IU) AND MULTIVESSEL CORONARY ARTERY DISEASE

Sels JW, JACC Cardiovasc Interv. 2011
FFR AND ACUTE CORONARY SYNDROME
ACUTE MYOCARDIAL INFARCTION

CULPRIT ARTERY

DS=75%

NECROSIS

ACUTE MICROVASCULAR DYSFUNCTION

NON CULPRIT ARTERY

DS=75%

NORMAL MICROCIRCULATION?
**FFR DURING ACUTE MI**

**NON-CULPRIT ARTERY**

101 patients with ACS (STEMI 74%, NSTEMI 26%), FFR of 112 non-culprit stenoses at day 0 and 35 ± 4

<table>
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<tr>
<th>FFR of non-culprit artery stenoses during acute phase and follow-up</th>
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</table>

| Correlation for FFR and diameter stenosis (%) during acute phase and follow-up |

- **ONLY 2/112 (2%)** stenoses with FFR >0.80 during ACS and <0.75 at follow-up

- **FFR measurements in non-culprit arteries during ACS:**
  - Are **RELIABLE** for evaluating severity of non-culprit stenoses during primary PCI
  - May **IMPROVE RISK STRATIFICATION** and **HASTEN CLINICAL DECISION-MAKING** about the need for additional myocardial revascularization after acute MI

Ntalianis A, JACC Cardiovasc Interv. 2010
FFR DURING ACUTE MI
NON-CULPRIT ARTERY AND OUTCOME

107 PATIENTS WITH ACS (NSTEMI 90%, STEMI 10%), 100% PCI OF IRA, FFR IN ANGIOGRAPHICALLY INTERMEDIATE NON-CULPRIT ARTERY, TREATED (FFR <0.75, 24%) vs. DEFERRED (FFR ≥0.75, 76%) PATIENTS, 1-YEAR FOLLOW-UP

KAPLAN-MEIER SURVIVAL CURVES

Lopez-Palop R, Rev Esp Cardiol 2012
FFR AND ACUTE CORONARY SYNDROME
ACUTE MYOCARDIAL INFARCTION

CULPRIT ARTERY

DS=75%

NECROSIS
ACUTE MICROVASCULAR DYSFUNCTION

NON CULPRIT ARTERY

DS=75%
NORMAL MICROCIRCULATION?
FAMOUS - NSTEMI
COMPARE Acute
<table>
<thead>
<tr>
<th>COMPLETE (NCT 01740479)</th>
<th>PRIMULTI (NCT01980802)</th>
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<tbody>
<tr>
<td>- Primary rescue/convalescent PCI within 72h</td>
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<tr>
<td>- Culprit only vs staged complete</td>
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</tr>
<tr>
<td>- Non-culprit lesions</td>
<td></td>
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<tr>
<td>- 3.5mm</td>
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<tr>
<td>- 75% DS</td>
<td></td>
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<tr>
<td>- 50% DS plus FFR ≤ 0.80</td>
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</tr>
<tr>
<td>- ASA/Ticagrelor</td>
<td></td>
</tr>
<tr>
<td>- Death/MI</td>
<td></td>
</tr>
<tr>
<td>- Started Dec 2012</td>
<td></td>
</tr>
<tr>
<td>- Estimated completion 2018</td>
<td></td>
</tr>
<tr>
<td>- STEMI patients with MVD (n=480)</td>
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</tr>
<tr>
<td>- Randomized 1:1 additional PCI or full revascularization with FFR guidance</td>
<td></td>
</tr>
<tr>
<td>- Only lesions with DS ≥ 50% can be randomized</td>
<td></td>
</tr>
<tr>
<td>- All randomized lesions with DS 50-99% evaluated by FFR</td>
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<tr>
<td>- PCI if FFR &lt; 0.80</td>
<td></td>
</tr>
<tr>
<td>- Lesions with DS &gt;90% are treated without prior FFR</td>
<td></td>
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<tr>
<td>- ALL NON-CULPRITS STAGED DURING INDEX ADMISSION i.e. NOT FRAM STRATEGY</td>
<td></td>
</tr>
<tr>
<td>- Started May 2011</td>
<td></td>
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<tr>
<td>- Estimated Completion for PEP February 2014</td>
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</tbody>
</table>

And others...
The use of FFR remains a valuable tool to guide revascularization strategy in patients with ACS, both in the culprit and non-culprit arteries.

However, FFR may be unreliable and should not be used to assess culprit lesions during STEMI.

After recent MI (>4-6 days), FFR is reliable to assess residual ischemia of culprit lesions, depends on the mass of viable myocardium and may predict LV recovery.

In patients with ACS, FFR is reliable to assess non-culprit lesions, may improve early risk stratification of patients and hasten clinical decision-making about the need for additional myocardial revascularization.
FIN