The ATI Score
(Age-Thrombotic Burden-Index of Microcirculatory Resistance) in STEMI: A cardiac magnetic resonance study

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NO CONFLICT OF INTEREST TO DECLARE
The Question(s)

- Why should we predict the outcome in STEMI?

- How can we predict the outcome in STEMI?

- When can we predict the outcome in STEMI?
Why should we predict the outcome in STEMI?

Primary PCI is the recommended reperfusion therapy over fibrinolysis if performed by an experienced team in a timely fashion.

Incidence: up to 30 - 40% (varying according to diagnostic technique adopted)
“To improve the outcome of STEMI patients and to deal successfully with no reflow we need to understand who are the patients really requiring an additional or alternative approach to conventional stenting strategy”

“Right tool for the right job”
How can we predict the outcome in STEMI?

- **ST resolution**
- **MBG, cTFC**
- **QuBE**
- **Thermodilution (IMR, CFR)**
- **Flow wire (HMR, CVFR)**
- **Echo-contrast**
- **CMR**
When can we predict the outcome in STEMI?

**In the Cathlab**
- Stenting
- CMR
- QuBE
- MBG, cTFC
- ST resolution

**Outside the Cath-lab**
- Echo-contrast
- Flow wire (HMR, CVFR)
- Thermodilution (IMR, CFR)

**Accuracy - Complexity**
- Time
Pre-stenting IMR measurement in STEMI is feasible and can be used to predict final reperfusion.
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Summarising

1. IMR measurement before stenting is feasible in STEMI
2. Pre-stenting IMR is not affected by thrombotic burden and other morphological features of the culprit lesion
3. Pre-stenting IMR > 40 combined with thrombotic burden can predict an unfavourable post-procedure IMR value > 40

Can we think of a Score to predict final reperfusion outcome and to early identify STEMI patients at higher risk requiring alternative or additional therapeutic strategies before stenting?
The ATI score

A tool for predicting the outcome of reperfusion in ST-elevation myocardial infarction using age, thrombotic burden and index of microcirculatory resistance (ATI score)

Table 2. The ATI score.

<table>
<thead>
<tr>
<th></th>
<th>Strata</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>≥50</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Thrombus score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1-2-3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Pre-stenting IMR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤40</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>&gt;40 and &lt;100</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≥100</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
“Risk of a self-predicting prophecy”...?

<table>
<thead>
<tr>
<th>ATI score</th>
<th>Patients</th>
<th>% risk of final IMR &gt;40</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7 (3.8%)</td>
<td>0.0%</td>
</tr>
<tr>
<td>1</td>
<td>29 (15.6%)</td>
<td>0.0%</td>
</tr>
<tr>
<td>2</td>
<td>62 (33.3%)</td>
<td>22.6%</td>
</tr>
<tr>
<td>3</td>
<td>47 (25.3%)</td>
<td>42.6%</td>
</tr>
<tr>
<td>4</td>
<td>19 (10.2%)</td>
<td>89.5%</td>
</tr>
<tr>
<td>5</td>
<td>16 (8.6%)</td>
<td>100%</td>
</tr>
<tr>
<td>6</td>
<td>6 (3.2%)</td>
<td>100%</td>
</tr>
</tbody>
</table>

ATI score (age-thrombus score-IMR)
AUC: 0.87
95% CI: 0.82–0.92
p<0.001

AT score (age-thrombus score)
AUC: 0.78
95% CI: 0.72–0.86
p<0.001
To validate ATI score against cardiac magnetic resonance imaging (cMRI)

1. Admission with STEMI for PPCI
2. Angio-Thrombus Score measured after guidewire passage
3. IMR measured pre-stenting (after thrombus aspiration and/or predilation)
4. ATI score calculation
5. Stenting and PPCI completion
6. Post-stenting IMR measured
7. 24-48 hours cMRI
8. 6 months cMRI
**IMR**

\[
\text{IMR} = P_d(\text{hyperemia}) \times \text{Mean Transit Time}(\text{hyperemia})
\]

Hyperemia induced with i.v. adenosine at 140 mg/kg/min

**cMRI**

**24-48 hours Scan**
- Area at Risk
- Infarct Size
- Microvascular Obstruction
- Myocardial Salvage Index

**6 months Scan**
- Infarct Size
- Infarct size shrinkage
- LV remodeling
164 STEMI patients
referred for pPCI and enrolled in OxAMI study
Between January 2011 and September 2011
and May 2015 and September 2016

- 26 patients coronary physiology assessment post-stenting only
- 7 patients consent withdraw
- 10 patients technical difficulties
- 6 patients unstable haemodynamic status
- 5 patients left main disease
- 6 patients intolerance to adenosine
- 5 patients plain old balloon angioplasty

99 patients
Underwent pPCI with coronary physiology assessment before and after stenting thus with ATI score assessment

- 8 patients declined cMRI
- 5 patients contraindication to cMRI
- 3 patients cMRI not completed
- 3 patients low quality MRI pictures

80 patients
Underwent cMRI within 48 hours
(20 enrolled from January 2011 and September 2011)
(60 enrolled from and May 2015 and September 2016)

- 30 patients lost at follow up

50 patients
Underwent cMRI at 6 months follow up
<table>
<thead>
<tr>
<th></th>
<th>ATI 0 – 1 (19 pts)</th>
<th>ATI 2 – 3 (38 pts)</th>
<th>ATI 4 - 5 - 6 (23 pts)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>56.95 ± 10.52</td>
<td>60.50 ± 9.79</td>
<td>62.00 ± 11.14</td>
<td>0.28</td>
</tr>
<tr>
<td>Male gender</td>
<td>18 (94.7)</td>
<td>31 (81.6)</td>
<td>20 (86.9)</td>
<td>0.39</td>
</tr>
<tr>
<td>Diabetes</td>
<td>6 (31.6)</td>
<td>11 (28.9)</td>
<td>6 (26.1)</td>
<td>0.93</td>
</tr>
<tr>
<td>Hypertension</td>
<td>13 (68.4)</td>
<td>19 (50.0)</td>
<td>9 (39.1)</td>
<td>0.16</td>
</tr>
<tr>
<td>Active smoker</td>
<td>9 (47.4)</td>
<td>22 (57.9)</td>
<td>8 (34.8)</td>
<td>0.21</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>8 (42.1)</td>
<td>12 (31.6)</td>
<td>10 (43.5)</td>
<td>0.58</td>
</tr>
<tr>
<td>Family History of CAD</td>
<td>10 (52.6)</td>
<td>17 (44.7)</td>
<td>9 (39.1)</td>
<td>0.68</td>
</tr>
<tr>
<td>Ischemic Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 3 hours</td>
<td>7 (36.8)</td>
<td>18 (47.4)</td>
<td>10 (43.5)</td>
<td>0.89</td>
</tr>
<tr>
<td>3 – 6 hours</td>
<td>8 (42.1)</td>
<td>13 (34.2)</td>
<td>7 (30.4)</td>
<td></td>
</tr>
<tr>
<td>&gt; 6 hours</td>
<td>4 (21.1)</td>
<td>7 (18.4)</td>
<td>6 (26.1)</td>
<td></td>
</tr>
<tr>
<td>TIMI flow 0 at presentation</td>
<td>12 (63.2)</td>
<td>32 (84.2)</td>
<td>20 (86.9)</td>
<td>0.09</td>
</tr>
<tr>
<td>Culprit Artery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAD</td>
<td>9 (47.4)</td>
<td>16 (42.1)</td>
<td>14 (60.9)</td>
<td>0.22</td>
</tr>
<tr>
<td>LCx</td>
<td>0 (0.0)</td>
<td>3 (7.9)</td>
<td>3 (13.0)</td>
<td></td>
</tr>
<tr>
<td>RCA</td>
<td>10 (52.6)</td>
<td>19 (50.0)</td>
<td>6 (26.1)</td>
<td></td>
</tr>
<tr>
<td>Thrombus-aspiration</td>
<td>11 (57.9)</td>
<td>32 (84.2)</td>
<td>19 (82.6)</td>
<td>0.06</td>
</tr>
<tr>
<td>Stent Length (mm)</td>
<td>28.0 (20.0 – 38.0)</td>
<td>26.0 (20.0 – 32.0)</td>
<td>28.0 (22.0 – 48.0)</td>
<td>0.45</td>
</tr>
<tr>
<td>Stent Diameter (mm)</td>
<td>3.5 (3.0 – 4.0)</td>
<td>3.5 (3.4 – 4.0)</td>
<td>3.5 (3.2 – 4.0)</td>
<td>0.88</td>
</tr>
<tr>
<td>Postdilation</td>
<td>14 (73.7)</td>
<td>27 (71.0)</td>
<td>19 (82.6)</td>
<td>0.59</td>
</tr>
</tbody>
</table>
Conclusions

1. The ATI score showed to be effective in predicting unfavourable IMR > 40
   - Age
   - Pre-stenting IMR
   - Angiographic Thrombus Score

   Early identification of 30-40% of patients having a suboptimal post-stenting myocardial reperfusion

1. ATI score diagnostic efficacy confirmed against cMRI
Future Perspectives

Clinical Implications

• Still need of validation of the ATI score for prediction of clinical endpoints

• ATI score as possible tool to early identify high risk STEMI patients requiring alternative/additional approaches to the conventional treatment with stenting

Academic Implications

• ATI score as possible inclusion criterion in the design of future trials investigating new therapeutic strategies in STEMI
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Special Thanks

Consultants
- Prof Adrian Banning
- Prof Rajesh Kharbanda
- Prof Keith Channon
- Prof Robin Choudhury
- Dr Colin Forfar
- Dr Bernard Prendergast
- Dr Jeremy Langrish
- Dr Andy Lucking

AVIC staff
- Paula Colmenero
- Carole Davey
- Peter Manley
- Alison Fletcher
- Juliet Semple

CCU and Catheterization Laboratory Staff
- Nurses
- Physiologists
- Radiographers

Fellows
- Dr Mathias Wolfrum
- Dr Gregor Fahrni
- Dr Mohammad Alkhalil

Research Nurses
- Lisa Gaughran
- Adina Ilas