Age, Glomerular filtration rate, Ejection Fraction, and the AGEF score predict contrast-induced nephropathy in patients with STEMI undergoing primary PCI

Giuseppe Andò, Gaetano Morabito, Cesare de Gregorio, Olimpia Trio, Francesco Saporito, Giuseppe Oreto

University of Messina - Italy
Potential conflicts of interest

Speaker’s name: Giuseppe Andò

☐ I have the following potential conflicts of interest to report:

☐ Research contracts
☐ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

X I do not have any potential conflict of interest
Background

- In patients undergoing primary PCI for STEMI, the occurrence of contrast-induced nephropathy (CIN) has a pronounced impact both on morbidity and mortality.

- Several scores for risk stratification have been developed in candidates to percutaneous or surgical myocardial revascularization. These scores have been validated even in different settings than the ones where they were originally developed.

- To date, none of these scores has been implemented at baseline in patients presenting with STEMI for the prediction of CIN development.

*Mehran, JACC 2004; McCullough, JACC 2008; Nashef, Eur J Cardiothorac Surg 1999; Ranucci, Circulation 2009*
Aims of the study

• To investigate the variables associated with the occurrence of CIN in patients with STEMI undergoing primary PCI.
• To evaluate the predictive value of a 3-variable clinical risk score (the AGEF score) based on (pre-procedural) Age, eGFR and LVEF.
• To compare the AGEF score with other established clinical risk scores (ACEF score, EuroSCORE and Mehran risk score, MRS).
Definitions

Contrast Induced Nephropathy (CIN)
• Absolute increase in serum creatinine ≥0.5 mg/dL or
• Increase in serum creatinine ≥25% from baseline within 72 hours after the administration of contrast medium.

Thomsen HS, Morcos SK. Eur Radiol 2006

Chronic Kidney Disease (CKD)
• eGFR <60 mL/min per 1.73 m²

Study population

• 481 consecutive patients prospectively enrolled (01/2008-06/2011)

• Exclusion criteria:
  – 2 pts with CKD on hemodialysis
  – 10 pts undergoing emergency cardiac surgery for coronary revascularization or STEMI-related mechanical complications
  – 7 pts dead within 12 hours after the procedure
  – 7 pts with incomplete dataset
Clinical and procedural data

• Age 62±12 years, 73% male, 30% diabetes
• EF 48±11 % (assessed in ED or in pre-cath room)
• eGFR 92±33 mL/min per 1.73 m²
• 15% CKD
• 10 pts in cardiogenic shock
• All pts received saline 1 mL/kg/h for 48 hrs
• 1.23 stent/patient, 30 POBA
• Procedural contrast volume 164±63 mL
• 14 pts (3%) received >300 mL of contrast dye
25 (5.2%) cases of CIN

In-hospital mortality was higher among patients with CIN than those without CIN (16% Vs 1.3%, p=0.001)
# Univariate analysis

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.10</td>
<td>1.05-1.14</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cigarette smoking</td>
<td>0.31</td>
<td>0.12-0.85</td>
<td>0.023</td>
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<tr>
<td>Hypertension</td>
<td>3.80</td>
<td>1.28-11.24</td>
<td>0.016</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2.72</td>
<td>1.21-6.11</td>
<td>0.016</td>
</tr>
<tr>
<td>EF</td>
<td>0.94</td>
<td>0.91-0.97</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>eGFR</td>
<td>0.94</td>
<td>0.91-0.96</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LDL-cholesterol</td>
<td>0.99</td>
<td>0.98-1.00</td>
<td>0.078</td>
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<tr>
<td>Hemoglobin</td>
<td>0.75</td>
<td>0.62-0.91</td>
<td>0.004</td>
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<tr>
<td>Troponin</td>
<td>1.01</td>
<td>1.00-1.02</td>
<td>0.037</td>
</tr>
<tr>
<td>Heart rate</td>
<td>1.02</td>
<td>1.00-1.04</td>
<td>0.067</td>
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<tr>
<td>Killip class</td>
<td>2.18</td>
<td>1.17-4.05</td>
<td>0.013</td>
</tr>
<tr>
<td>Use of IABP</td>
<td>8.75</td>
<td>2.18-36.14</td>
<td>0.0027</td>
</tr>
<tr>
<td>Post-procedural TIMI flow</td>
<td>0.40</td>
<td>0.23-0.70</td>
<td>0.001</td>
</tr>
</tbody>
</table>
## Multivariate analysis

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>eGFR</td>
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<td>0.93-0.98</td>
<td>0.001</td>
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<tr>
<td>EF</td>
<td>0.94</td>
<td>0.90-0.98</td>
<td>0.007</td>
<td>0.69</td>
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<tr>
<td>Age</td>
<td>1.06</td>
<td>1.00-1.12</td>
<td>0.042</td>
<td>0.78</td>
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<tr>
<td>Post-procedural</td>
<td>0.43</td>
<td>0.19-0.98</td>
<td>0.045</td>
<td>0.57</td>
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<tr>
<td>TIMI flow</td>
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</tbody>
</table>
AGEF score calculation

• AGEF score was calculated by adding 1 point to the Age/EF(%) ratio if the eGFR was <60 mL/min per 1.73 m$^2$ (MDRD-4 formula).

Modified from Ranucci et al. Circulation 2009

\[ \text{AGEF} = \frac{\text{Age}}{\text{EF}(\%)} + 1 \ (\text{if CKD}) \]
Risk scores as predictors of CIN

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
<th>AUC</th>
<th>p*</th>
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</thead>
<tbody>
<tr>
<td>Mehran</td>
<td>1.27</td>
<td>1.17-1.39</td>
<td>&lt;0.001</td>
<td>0.80</td>
<td>0.15</td>
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<tr>
<td>EuroSCORE</td>
<td>1.61</td>
<td>1.36-1.91</td>
<td>&lt;0.001</td>
<td>0.82</td>
<td>0.14</td>
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<tr>
<td>ACEF</td>
<td>4.06</td>
<td>2.43-6.81</td>
<td>&lt;0.001</td>
<td>0.82</td>
<td>0.029</td>
</tr>
<tr>
<td>AGEF</td>
<td>5.19</td>
<td>3.13-8.62</td>
<td>&lt;0.001</td>
<td>0.88</td>
<td></td>
</tr>
</tbody>
</table>

*p Vs AGEF

Risk = \( \frac{e^{\text{AGEF score} \times 1.65 - 6.26}}{1 + e^{\text{AGEF score} \times 1.65 - 6.26}} \)
AGEF cutoff: 1.5

- 100% Sensitivity
- Hosmer-Lemeshow $\chi^2 = 10.25$, $p = 0.25$
- All CIN patients in the highest tertile
ROC curves and cutoff values

- **Mehran risk score cutoff:** 5
  - 72% sensitivity
  - Coincides with the upper boundary of the lowest risk category in the original Mehran study.

- **EuroSCORE cutoff:** 6
  - 92% sensitivity
  - Coincides with the lower boundary of the high risk category.

*Mehran, JACC 2004; Nashef, Eur J Cardiothorac Surg 1999*
Study limitations

• Small population from a single center.
• Incidence of CIN likely underestimated:
  – In patients excluded from the study the prevalence of either chronic or cardiogenic shock-related renal dysfunction is higher;
  – in the subgroup of patients with CKD (15%) the incidence of CIN was 24% (Vs 2%), p<0.001.
• eGFR calculation may not reflect patients’ true baseline condition at the time of pPCI.
Conclusions

• Advanced age, depressed LVEF and reduced eGFR are independent predictors of CIN development after primary PCI for STEMI.

• A linear risk score based on age, EF and eGFR can predict the risk of CIN at least as accurately as more complex non-linear risk scores and is well fitted to the acute setting.

• Complex risk models may be over fitted, at least in populations with a low rate of events.