The Influence of Systemic Inflammatory Response Syndrome on Prognosis after Transcatheter Aortic Valve Implantation

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Potential conflicts of interest

Speaker’s name: Jan-Malte Sinning, MD

☐ 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)

☑️ I do not have any potential conflict of interest
Background

Transcatheter aortic valve implantation (TAVI)

- Established treatment option for high-risk & inoperable patients with severe aortic stenosis
- > 40,000 implantations worldwide
- PARTNER trial demonstrated similar outcome compared to surgical valve replacement for high-risk patients
- Leukocyte count associated with adverse outcome after TAVI
Hypothesis

Hypotension and suboptimal organ perfusion leads to systemic inflammatory response syndrome (SIRS) which impacts outcome.

Adapted from Bone RC. Chest 1992;101:1644-1655.
Objectives

- **Aim of our study** was to
  
  (1) Characterize the inflammatory response after TAVI
  
  (2) Assess the impact of SIRS on outcome in TAVI patients.

- **Primary endpoint:**
  All-cause mortality at 30 days and 1 year

- **Secondary endpoints:**
  Clinical outcomes defined according to VARC criteria
Methods

• Inclusion of 152 percutaneous TAVI patients

• SIRS was defined as ≥2 of the following criteria:
  • Temperature <36.0°C or >38.0°C
  • Heart rate >90 beats/min
  • Respiratory rate >20/min or PaCO₂ <32 mmHg
  • Leukocyte count >12 or <4 (10⁹/L)

• Blood samples were obtained before and at 1h, 4h, 24h, 48h, 72h, and 7 days after TAVI.

• Hemodynamic monitoring by PiCCO for 24 hours
SIRS Parameters after TAVI

61/152 pts. (40.1%) suffered from post-procedural SIRS

- Temperature: <36.0°C or >38.0°C
- Heart rate: >90 bpm
- Respiratory rate: >20 /min
- Leukocyte count: >12 or <4 \((10^{9}/L)\)

Significance levels: p<0.001
## Baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>All Patients (n = 152)</th>
<th>No SIRS (n = 91)</th>
<th>SIRS (n = 61)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>80.5 ± 6.5</td>
<td>80.8 ± 6.1</td>
<td>80.1 ± 7.2</td>
<td>0.51</td>
</tr>
<tr>
<td>Male gender, n (%)</td>
<td>75 (49.3)</td>
<td>45 (49.5)</td>
<td>30 (49.2)</td>
<td>0.97</td>
</tr>
<tr>
<td>Logistic EuroSCORE (%)</td>
<td>30.4 ± 18.1</td>
<td>29.1 ± 18.2</td>
<td>32.4 ± 17.9</td>
<td>0.28</td>
</tr>
<tr>
<td><strong>STS score: mortality (%)</strong></td>
<td><strong>8.0 (5.0/11.9)</strong></td>
<td><strong>7.1 (4.5/10.9)</strong></td>
<td><strong>9.4 (6.5/13.1)</strong></td>
<td><strong>0.011</strong></td>
</tr>
<tr>
<td>Left ventricular EF (%)</td>
<td>44.2 ± 14.5</td>
<td>45.6 ± 13.7</td>
<td>42.2 ± 15.6</td>
<td>0.17</td>
</tr>
<tr>
<td>Peripheral artery disease, n (%)</td>
<td>59 (38.8)</td>
<td>32 (35.2)</td>
<td>27 (44.3)</td>
<td>0.28</td>
</tr>
<tr>
<td>Chronic renal failure, n (%)</td>
<td>87 (57.2)</td>
<td>51 (56.0)</td>
<td>36 (59.0)</td>
<td>0.63</td>
</tr>
<tr>
<td>COPD, n (%)</td>
<td>43 (28.3)</td>
<td>22 (24.2)</td>
<td>21 (34.4)</td>
<td>0.17</td>
</tr>
<tr>
<td>Pulmonary hypertension, n (%)</td>
<td>55 (36.2)</td>
<td>29 (31.9)</td>
<td>26 (42.6)</td>
<td>0.18</td>
</tr>
</tbody>
</table>

**STS score** = Society of Thoracic Surgeons score for the risk of mortality
Leukocyte Count and SIRS

Leukocyte count (10^9/L) over time after TAVI for SIRS and no SIRS conditions. The graph shows significant differences at 4 hours (p<0.001), 24 hours (p<0.001), 48 hours (p<0.001), and 72 hours (p<0.001) post-TAVI, with p-values of 0.015 at 4 hours for no SIRS conditions and 0.12 for no SIRS conditions at 0 hours post-TAVI.
Biomarker increase after TAVI

Interleukin 6

Interleukin 8

C-reactive protein

Procalcitonin

Cut-off value for bacterial infection ≥0.5 µg/L

# p<0.05    * p<0.01
Hemodynamic performance

**Lactate**
- SIRS
- No SIRS

**NT-proBNP**

**Cardiac index**

**Systemic vascular resistance index**

# p<0.05
* p<0.01
Clinical Outcomes

- 30-day mortality: p<0.001
- 1-year mortality: p<0.001
- Stroke: p=0.003
- Myocardial infarction: p=0.042
- Major vasc. complications: p=0.011
- Major bleeding: p<0.001
- RBC transfusion: p<0.001
- Acute kidney injury: p=0.035
- Pacemaker implantation:
1-year Outcome

p (log rank-test) < 0.001

HR (95% CI) = 7.4 (3.5–15.6)

<table>
<thead>
<tr>
<th></th>
<th>No SIRS</th>
<th>SIRS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. at risk</td>
<td>91</td>
<td>61</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>51</td>
<td>141</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>22</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>55</td>
</tr>
</tbody>
</table>
Subanalysis 1-year Outcome

Exclusion of patients with
- Major vascular complications
- Major bleeding

n = 134

Exclusion of patients with
- Major vascular complications
- Major bleeding
- Acute kidney injury

n = 107

Cumulative survival

Follow-up (days)

p (log rank–test) < 0.001
HR (95% CI) = 8.3 (3.5–19.4)

Follow-up (days)

p (log rank–test) = 0.004
HR (95% CI) = 4.7 (1.5–14.9)
# 1-year Mortality Risk - Regression Analysis

<table>
<thead>
<tr>
<th>Condition</th>
<th>Univariate HR (95% CI)</th>
<th>p-Value</th>
<th>Multivariate HR (95% CI)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute kidney injury</td>
<td>7.0 (3.8-13.2)</td>
<td>&lt;0.001</td>
<td>3.3 (1.7-6.6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td>2.8 (1.5-5.3)</td>
<td>0.001</td>
<td>1.8 (0.9-3.6)</td>
<td>0.11</td>
</tr>
<tr>
<td>Moderate/severe periAR</td>
<td>4.0 (2.1-7.5)</td>
<td>&lt;0.001</td>
<td>3.7 (1.9-7.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SIRS</td>
<td>7.4 (3.5-15.6)</td>
<td>&lt;0.001</td>
<td>4.4 (1.9-10.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>2.6 (1.3-5.5)</td>
<td>0.01</td>
<td>1.5 (0.7-8.6)</td>
<td>0.32</td>
</tr>
<tr>
<td>COPD</td>
<td>1.7 (0.9-3.2)</td>
<td>0.11</td>
<td>1.2 (0.6-2.5)</td>
<td>0.62</td>
</tr>
<tr>
<td>Chronic renal failure</td>
<td>2.1 (1.0-4.2)</td>
<td>0.039</td>
<td>0.7 (0.3-1.6)</td>
<td>0.40</td>
</tr>
<tr>
<td>Logistic EuroSCORE</td>
<td>1.0 (1.0-1.0)</td>
<td>&lt;0.001</td>
<td>1.0 (1.0-1.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>STS score mortality</td>
<td>1.1 (1.0-1.1)</td>
<td>&lt;0.001</td>
<td>1.0 (1.0-1.1)</td>
<td>0.26</td>
</tr>
</tbody>
</table>
Summary

Aortic stenosis
- Anesthesia
- Rapid pacing
- Balloon vavuloplasty
- Valve deployment
- Vascular complications
- RBC transfusion

Valve replacement

TAVI procedure

Suboptimal organ perfusion

Hypotension

Ischemia-reperfusion injury

Cytokine release

SIRS

Outcome