Effect of Thrombus Aspiration in Patients With Myocardial Infarction Presenting Late After Symptom Onset

**Steffen Desch, MD**

Thomas Stiermaier, MD; Suzanne de Waha, MD; Philipp Lurz, MD, PhD; Matthias Gutberlet, MD; Marcus Sandri, MD; Norman Mangner, MD; Enno Boudriot, MD; Michael Woinke, MD; Sandra Erbs, MD; Gerhard Schuler, MD; Georg Fuernau, MD; Ingo Eitel, MD; Holger Thiele, MD
**Disclosure Statement of Financial Interest**

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

<table>
<thead>
<tr>
<th>Affiliation/Financial Relationship</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Grant/Research Support</td>
<td>• Medtronic</td>
</tr>
<tr>
<td>• Consulting Fees/Honoraria</td>
<td>• None related to the study</td>
</tr>
<tr>
<td>• Major Stock Shareholder/Equity</td>
<td>• None related to the study</td>
</tr>
<tr>
<td>• Royalty Income</td>
<td>• None related to the study</td>
</tr>
<tr>
<td>• Ownership/Founder</td>
<td>• None related to the study</td>
</tr>
<tr>
<td>• Intellectual Property Rights</td>
<td>• None related to the study</td>
</tr>
<tr>
<td>• Other Financial Benefit</td>
<td>• None related to the study</td>
</tr>
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</table>
Recent trials on thrombus aspiration in STEMI reported disappointing results with no reduction in mortality and possibly an increase in stroke.

Background

**Hypothesis**

- Routine thrombus aspiration reduces microvascular obstruction (MVO) assessed by cardiac magnetic resonance imaging (CMR) in patients with subacute STEMI presenting between 12 and 48 hours after symptom onset.

**Design**

- Prospective, randomized, controlled, single-blind
- Single-center
Methods

**Main Inclusion Criteria**

- STEMI ≥12 and ≤48 hours after symptom onset
- Age ≥18 and ≤90 years

**Main Exclusion Criteria**

- Prior thrombolysis
- Contraindications for CMR
- Life expectancy <6 months
Methods

**Primary Endpoint**

- Extent of MVO on late gadolinium enhancement CMR at day 1 - 4
Methods

Secondary Endpoints

- **CMR**
  - Infarct size
  - Myocardial salvage
  - LV volumes and ejection fraction
- **Angiography**
  - TIMI flow post-PCI
  - Myocardial blush grade post-PCI
- **Enzymatic infarct size**
  - High-sensitivity troponin T after 24 and 48 hours
- **Clinical outcome**
  - 30-day follow-up
  - All-cause and cardiovascular death, myocardial reinfarction, TLR, TVR, stent thrombosis, stroke
Methods

Percutaneous Coronary Intervention

• Thrombus aspiration:
  - Before first balloon inflation
  - Manual aspiration catheter
    (Export® AP, 6 French, Medtronic Inc.)
  - Minimum of 2 passages recommended

• Additional procedural strategies:
  - According to current best practice
    (e.g. heparin/bivalirudin ± GP IIb/IIIa-inhibitor)
Methods

Cardiac Magnetic Resonance Imaging

- Standard protocol / day 1 - 4

- CMR core laboratory
  - University Heart Center Lübeck, Germany
  - Assessment by fully blinded operators

Function 2Ch/4Ch | T2 SA | Function SA | LGE 2Ch/4Ch/SA

Area at risk | LV-EF, LVEDV, LVESV | MVO, infarct size
Methods

Sample Size Calculation

Mean difference 2.0 %LV
Standard deviation 3.5 %LV
Power 90%
Alpha 0.05
Drop-out 15%

Sample size, n: 152
2 x 76
152 patients with subacute STEMI ≥12 and ≤48 hours after symptom onset

1:1 randomization

Final diagnosis other than STEMI (n=8)

Thrombus aspiration (n=70)

Received allocated treatment (n=70)

No CMR (n=14)

Intention-to-treat (n=56)

Standard PCI Only (n=74)

Received allocated treatment (n=69)

No CMR (n=19)

Intention-to-treat (n=55)

Primary endpoint: Microvascular obstruction
# Results

## Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Thrombus aspiration n = 70</th>
<th>Standard PCI n = 74</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>66 ± 12</td>
<td>66 ± 15</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>55/70 (79)</td>
<td>48/74 (65)</td>
</tr>
<tr>
<td>Hyperlipoproteinemia, n (%)</td>
<td>11/70 (16)</td>
<td>17/74 (23)</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>22/70 (31)</td>
<td>25/74 (34)</td>
</tr>
<tr>
<td>Ongoing signs of ischemia, n (%)</td>
<td>28/57 (49)</td>
<td>34/62 (55)</td>
</tr>
<tr>
<td>Symptom-onset-to-balloon, hours</td>
<td>26 ± 13</td>
<td>29 ± 12</td>
</tr>
<tr>
<td>TIMI flow pre-PCI 0, n (%)</td>
<td>44/70 (63)</td>
<td>46/74 (62)</td>
</tr>
<tr>
<td>GP IIb/IIIa-inhibitor, n (%)</td>
<td>18/70 (25)</td>
<td>21/74 (28)</td>
</tr>
</tbody>
</table>
Results

Primary Endpoint: Microvascular Obstruction

Microvascular obstruction, %LV

<table>
<thead>
<tr>
<th></th>
<th>Thrombus aspiration</th>
<th>Standard PCI only</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 ± 4.0</td>
<td></td>
<td>3.1 ± 4.4</td>
</tr>
</tbody>
</table>

p=0.47
## Results

### MVO in Predefined Subgroups

<table>
<thead>
<tr>
<th>Baseline variable</th>
<th>No. of patients</th>
<th>Mean Difference in MVO %LV (95% CI)</th>
<th>P-value for interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Patients</td>
<td>111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male sex</td>
<td>86/111</td>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td>Female sex</td>
<td>25/111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>32/111</td>
<td></td>
<td>0.29</td>
</tr>
<tr>
<td>No diabetes</td>
<td>79/111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIMI thrombus grade 0-4</td>
<td>38/111</td>
<td></td>
<td>0.82</td>
</tr>
<tr>
<td>TIMI thrombus grade 5</td>
<td>73/111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIMI-flow pre PCI 0-1</td>
<td>77/111</td>
<td></td>
<td>0.53</td>
</tr>
<tr>
<td>TIMI-flow pre PCI 2-3</td>
<td>34/111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP IIb/IIIa-inhibitor</td>
<td>32/111</td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>No GP IIb/IIIa-inhibitor</td>
<td>79/111</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Thrombectomy better**
- **Standard PCI better**
Results

Secondary Endpoints: Infarct Size and Salvage

Infarct size; %LV

Thrombus aspiration: 30±17
Standard PCI only: 27±17

Myocardial salvage index

Thrombus aspiration: 26±21
Standard PCI only: 29±31

p=0.49

p=0.63
Results

Secondary Endpoints: LV Function and Volumes

- **LV ejection fraction, %**
  - Thrombus aspiration: 46±11
  - Standard PCI only: 45±12
  - **p=0.44**

- **LVEDV, ml**
  - Thrombus aspiration: 160±52
  - Standard PCI only: 157±12
  - **p=0.77**

- **LVESV, ml**
  - Thrombus aspiration: 88±38
  - Standard PCI only: 89±34
  - **p=0.89**
Results

Secondary Endpoints: Angiography

$\text{TIMI flow post-PCI, } \%$

- **Thrombus aspiration**
  - 0: 6, 9, 7
  - 1: 8, 8, 15
  - 2: 8, 3, 10
  - 3: 79

- **Standard PCI only**
  - 0: 17, 3, 20
  - 1: 10, 10, 5
  - 2: 70
  - 3: 67

$\text{MBG post-PCI, } \%$

- **Thrombus aspiration**
  - 0: 17, 3, 20
  - 1: 10, 10, 5
  - 2: 70
  - 3: 67

- **Standard PCI only**
  - 0: 17, 3, 20
  - 1: 10, 10, 5
  - 2: 70
  - 3: 67

$p=0.44$

$p=0.83$
Results

Secondary Endpoints: Enzymatic Infarct Size

- **Troponin T at 24 h, ng/l**
  - Thrombus aspiration: 3031 ± 2189
  - Standard PCI only: 2588 ± 1908
  - Significance: p = 0.24

- **Troponin T at 48 h, ng/l**
  - Thrombus aspiration: 2995 ± 2395
  - Standard PCI only: 3150 ± 2140
  - Significance: p = 0.75
# Results

## Secondary Endpoints: Clinical Outcome

<table>
<thead>
<tr>
<th>Event</th>
<th>Thrombus aspiration n = 70</th>
<th>Standard PCI n = 74</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause death, n (%)</td>
<td>2 (3)</td>
<td>4 (5)</td>
<td>0.68</td>
</tr>
<tr>
<td>Cardiovascular death, n (%)</td>
<td>2 (3)</td>
<td>3 (4)</td>
<td>1.0</td>
</tr>
<tr>
<td>Reinfarction, n (%)</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>TVR, n (%)</td>
<td>2 (3)</td>
<td>0</td>
<td>0.24</td>
</tr>
<tr>
<td>TLR, n (%)</td>
<td>2 (3)</td>
<td>0</td>
<td>0.24</td>
</tr>
<tr>
<td>Stent thrombosis, n (%)</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Stroke, n (%)</td>
<td>0</td>
<td>1 (1)</td>
<td>0.24</td>
</tr>
</tbody>
</table>
Conclusion

• In patients with subacute STEMI routine manual thrombus aspiration before PCI failed to show a significant reduction in the primary endpoint of MVO assessed by CMR, as compared to conventional PCI alone.

• The finding is supported by a lack of benefit in angiographic, enzymatic, and clinical secondary endpoints.