Management of Massive Coronary Thrombi

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Influence of coronary thrombus on outcome of percutaneous coronary angioplasty in the current era (the Mayo Clinic experience).


- 3 times higher MACE – ischemic complications
- Lower procedural success.
- Higher distal embolization leading to slow/no flow
- High mortality
- Longer hospital stays
Distal embolisation and mortality

## TIMI Grading for Thrombus

<table>
<thead>
<tr>
<th>Thrombus Grade</th>
<th>Definition</th>
</tr>
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<tr>
<td>Thrombus grade 0 (G0)</td>
<td>No angiographic characteristics of thrombus are present</td>
</tr>
</tbody>
</table>
| Thrombus grade 1 (G1) | Possible thrombus is present, with such angiography characteristics as  
- Reduced contrast density, haziness, irregular lesion contour,  
- Or a smooth convex meniscus at the site of total occlusion suggestive but not diagnostic of thrombus; in thrombus |
| Thrombus grade 2 (G2) | There is definite thrombus, with greatest dimensions $< 1/2$ the vessel diameter |
| Thrombus grade 3 (G3) | There is definite thrombus but with greatest linear dimension $> 1/2$ but $< 2$ vessel diameters |
| Thrombus grade 4 (G4) | There is definite thrombus with greatest linear dimension $> 2$ vessel diameters |
| Thrombus grade 5 (G5) | There is total occlusion (unable to assess thrombus burden due to total vessel occlusion). |
Yip criteria

**Yip’s Criteria for High Thrombus Burden:**

- 1. Large infarct-related artery (visually estimated reference vessel diameter ≥ 4 mm)
- 2. Angiographic thrombus with the greatest linear dimension > 3 times the reference vessel diameter;
- 3. “Cutoff pattern” (lesion morphology with an abrupt cutoff without taper before the occlusion);
- 4. Accumulated thrombus (> 5 mm of linear dimension) proximal to the occlusion;
- 5. Floating thrombus proximal to the occlusion;
- 6. Persistent dye stasis distal to the obstruction.

> 2 ABOVE = VERY HIGH THROMBUS BURDEN
What means to we have?
Pharmacological means

Mechanical means

None of the above ??
Pharmacological means
Role of GP IIb/IIIa Inhibitors
Intracoronary drug delivery.

- Though this approach has been used empirically in the past and still continues to be used in cardiac catheterization laboratories around the world, it has never been evaluated in a large-scale randomized study.

- The rationale for this approach is the ability to achieve a very high concentration of the drugs at the site of the thrombus without significantly increasing the risk of bleeding.
INFUSE-AMI Trial

452 pts with anterior STEMI
Anticipated Sx to PCI <5 hrs, TIMI 0-2 flow in prox or mid LAD
Primary PCI with bivalirudin anticoagulation

Pre-loaded with aspirin and clopidogrel 600 mg or prasugrel 60 mg
Stratified by symptoms to angio <3 vs ≥3 hrs, and prox vs mid LAD occlusion

R 1:1

Manual aspiration
No aspiration

R 1:1

IC Abcx
No Abcx
IC Abcx
No Abcx

Primary endpoint: Infarct size at 30 days (cMRI)
2° endpoints: TIMI flow, blush, ST-resolution, MACE (30d, 1 yr)
INFUSE-AMI
- Primary powered endpoint -

Aspiration vs. No aspiration

**Infarct size, %LV**

- **Aspiration**
  - N=229
  - Median [IQR]: 17.0% [9.0, 22.8]
  - P=0.51

- **No aspiration**
  - N=223
  - Median [IQR]: 17.3% [7.1, 25.5]

N=452
All anterior MI
Sx-hosp <4 hrs
TIMI 0-2

Stone GW et al. JAMA 2012;307:1817-26
INFUSE-AMI

- Patients randomized to intracoronary abciximab had a significant reduction in the primary end point compared with patients who did not receive abciximab.

- Infarct size measured as a percentage of total left ventricular mass was 15.2% in the abciximab-treated patients compared with 17.5% in those who did not receive abciximab, a significant 2.3% absolute difference in infarct size.

- Regarding the thrombus aspiration arm, the investigators reported no difference in infarct size between patients undergoing manual aspiration thrombectomy and those who didn't receive thrombectomy.
Intracoronary vs intravenous trial
Did not improve myocardial reperfusion as assessed by ST-segment resolution but did improve myocardial reperfusion as assessed by myocardial blush grade and a smaller enzymatic infarct size in STEMI patients undergoing primary PCI.
In conclusion, compared to IV administration, IC administration of GPIs has favorable effects on TIMI flow, TVR, and short-term mortality after PCI, with no difference in rates of bleeding.
2065 pts with STEMI <12 hrs rand to Pri PCI with IC vs IV bolus abciximab.

The IC bolus delivered directly through the guiding catheter as well as the IV bolus were followed by an IV infusion of abciximab for 12 h.

Thrombectomy was used in about 20% of patients almost equally in both groups, particularly in lesions with high thrombus burden.

J Am Coll Cardiol. 2013 Apr 2;61(13):1447-54
Intracoronary abciximab does not reduce rates of death or myocardial infarction (MI) compared to standard intravenous (IV) administration of the glycoprotein IIb/IIIa inhibitor in patients with ST-segment elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (PCI).
Role of Thrombolysis
Intracoronary streptokinase after primary percutaneous coronary intervention.

Sezer M, Ofilaz H, Gören T, Okçular I, Umman B, Nişancı Y, Bilge AK, Sanlı Y, Merić M, Umman S.

Abstract

BACKGROUND: Microvascular perfusion is often impaired after primary percutaneous coronary intervention (PCI). We proposed that in situ thrombosis might contribute to poor myocardial perfusion in this setting. To test this hypothesis, we evaluated the effect of low-dose intracoronary streptokinase administered immediately after primary PCI.

METHODS: Forty-one patients undergoing primary PCI were randomly assigned to receive intracoronary streptokinase (250 kU) or no additional therapy. Two days later, cardiac catheterization was repeated, and coronary hemodynamic end points were measured with the use of a guidewire tipped with pressure and temperature sensors. In patients with anterior myocardial infarction, the deceleration time of coronary diastolic flow was measured with transthoracic echocardiography. At 6 months, angiography, echocardiography, and technetium-99m single-photon-emission computed tomography were performed.

RESULTS: Two days after PCI, all measures of microvascular function (means +/-SD) were significantly better in the streptokinase group than in the control group, including coronary flow reserve (2.01 +/- 0.57 vs. 1.39 +/- 0.31), the index of microvascular resistance (16.29 +/- 5.06 U vs. 32.49 +/- 11.04 U), the collateral-flow index (0.08 +/- 0.05 vs. 0.17 +/- 0.07), mean coronary wedge pressure (10.81 +/- 5.46 mm Hg vs. 17.20 +/- 7.93 mm Hg), systolic coronary wedge pressure (18.24 +/- 6.07 mm Hg vs. 33.80 +/- 11.00 mm Hg), and diastolic deceleration time (828 +/- 258 msec vs. 360 +/- 292 msec). The administration of intracoronary streptokinase was also associated with a significantly lower corrected Thrombolysis in Myocardial Infarction frame count (the number of cine frames required for dye to travel from the ostium of a coronary artery to a standardized distal coronary landmark) at 2 days. At 6 months, however, there was no evidence of a difference between the two study groups in left ventricular size or function.

The administration of low-dose intracoronary streptokinase immediately after primary PCI improved myocardial reperfusion but not long-term left ventricular size or function.
Short Communication

Intracoronary tenecteplase in STEMI with massive thrombus

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IC TNK in high thrombus burden

Table 2
TNK - Tenecteplase, VF - Ventricular fibrillation, VT - Ventricular tachycardia, LVD - Left ventricular Dysfunction.

<table>
<thead>
<tr>
<th>TIMI flow grade</th>
<th>Myocardial blush grade</th>
<th>ST Resolution</th>
<th>In Hospital Events</th>
<th>At 1 month follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Post TNK</td>
<td>Yes/No</td>
<td>Adverse Events</td>
<td>Stroke</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>VT/VF - Cardiomyopathy &amp; No</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Yes, from Urethra and later becomes clear</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
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1/5th dose: IC
4/5th dose: IV
Heparin 24 H
CAG at H4
6. Conclusions

Intracoronary thrombolysis is an option in young patients with large thrombus burden and with ectatic coronaries and obviates the need for stenting in these patients.
Mechanical means
Simple vs ‘Complex’

Pronto

Export

Marker

Diver

Wire Lumen

X-Sizer

AngioJet

ThromCat
Thrombosuction devices

- Manual aspiration catheters,
- Power-sourced thrombectomy,
- Ultrasound-induced sonication, and
- Excimer laser.
- Embolic protection.
74 yrs
Smoker
Inferior STEMI seen at H3
Thrombus-aspiration
BUT ...
Procedural aspects of the primary percutaneous coronary intervention strategy

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<th>Class</th>
<th>Level</th>
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<td>III</td>
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<td>IIa</td>
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<td>C</td>
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Effect of Adjunctive Thrombus Aspiration on In-Hospital and 3-Year Outcomes in Patients With ST-Segment Elevation Myocardial Infarction and Large Native Coronary Artery Thrombus Burden

Muhammed Edibe Betül Hakan, MD
Kamer Kaya, MD
Şahin Uğur, MD
Ceylan Alpar, MD
Özgür Sancaktar, MD
Nesin, MD
Duygu Ataş, MD

ysis were also not significantly different between the 2 groups. In conclusion, adjunctive TA during PPCI was not associated with better in-hospital and 3-year all-cause deaths in patients with STEMI and a large coronary artery thrombus. © 2017 Elsevier Inc. All rights reserved. (Am J Cardiol 2017;120:1708–1714)
Other Devices
The Mguard Stent

- The sleeve is designed to expand seamlessly when the stent is deployed, without affecting the structural integrity of the stent, and to prevent plaque detachment during and post procedure.

- The MGuardTM Coronary stent provides long acting embolic protection, without adding complexity in deliverability. The sleeve is designed to diffuse stent pressure on the vessel wall, thereby may reduce injury and lower the likelihood of restenosis.
Prospective, Randomized, Multicenter Evaluation of a Polyethylene Terephthalate Micronet Mesh–Covered Stent (MGuard) in ST-Segment Elevation Myocardial Infarction.

The MASTER Trial

Methods A total of 433 patients with STEMI presenting within 12 h of symptom onset undergoing PCI were randomized at 50 sites in 9 countries to the MGuard (n = 217) or commercially available bare metal or drug-eluting stents (n = 216). The primary endpoint was the rate of complete (≥70%) ST-segment resolution measured 60 to 90 min post-procedure.

Results Baseline characteristics were well matched between the groups. The primary endpoint of post-procedure complete ST-segment resolution was significantly improved in patients randomized to the MGuard stent compared with control patients (57.8% vs. 44.7%; difference: 13.2%; 95% confidence interval: 3.1% to 23.3%; p = 0.008). By core laboratory analysis, the MGuard stent compared with control stents also resulted in superior rates of Thrombolysis In Myocardial Infarction 3 flow (91.7% vs. 82.9%, p = 0.006) with comparable rates of myocardial blush grade 2 or 3 (83.9% vs. 84.7%, p = 0.81). Mortality (0% vs. 1.9%, p = 0.06) and major adverse cardiac events (1.8% vs. 2.3%, p = 0.75) at 30 days were not significantly different between patients randomized to the MGuard stent and control stent, respectively.

Among patients with acute STEMI undergoing emergent PCI, the MGuard micronet mesh–covered stent compared with conventional metal stents resulted in superior rates of epicardial coronary flow and complete ST-segment resolution. A larger randomized trial is warranted to determine whether these benefits result in reduced infarct size and/or improved clinical outcomes.
If MGS implantation is noninferior to a strategy of MT pretreatment followed by BMS deployment, it will lend support to the use of this treatment as another possible option for STEMI patients undergoing PCI.
In the 2010 European Guidelines on Myocardial revascularization, mesh-based protection, is now recommended for use:

“Mesh-based protection may be considered for PCI of highly thrombotic or SVG lesions” (class IIb/c recommendation)
Defer Strategy
### DEFER STEMI – Primary Endpoints

<table>
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<th>Immediate Stenting (n = 49)</th>
<th>Deferred Stenting (n = 52)</th>
<th>P Value</th>
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<tbody>
<tr>
<td>No Reflow/Slow Flow (TIMI &lt; 3)</td>
<td>29%</td>
<td>6%</td>
<td>0.003</td>
</tr>
<tr>
<td>Intra-procedural Thrombotic Events</td>
<td>33%</td>
<td>10%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>No Reflow (TIMI 0/1)</td>
<td>14%</td>
<td>2%</td>
<td>0.03</td>
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BUT ...
## Procedural aspects of the primary percutaneous coronary intervention strategy

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- A 63 years old man
- History of hypertension and smoking
- Admitted for Inferior STEMI with prehospital thrombolysis by TNK at H3.
- At admission: persistent chest pain with regression of ST elevation by 50%
- CAG on arrival
• Decision to wait and see: Defer Strategy
• LVEF by Echo: 58%
• LMWH
• Taken to the cath lab 10 days later: Delay due to busy cath lab activities
CONCLUSION

- Thrombus is our enemy in the cath lab particularly in the setting of STEMI
- We need to use all the tools that we have to resolve it, including:
  - Conventional ones: Thrombus aspiration, IIb IIa Inhibitors, lytics…
CONCLUSION

But also non conventional ones such as multiple wires, careful deep throating of the guiding...

- And Remember as long as the thrombus is there, the patient is loosing myocardium