Chronic Total Occlusion: a case for coronary artery bypass grafting

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Disclosure

• Research cooperation with Medistim
• President, Norwegian Association for Cardiothoracic Surgery
Chronic Total Occlusion (CTO)

- Occlusion (TIMI 0) of any length of a native coronary artery >3 months duration
Introduction

• CTO incidence
  – Up to 1/3 of patients undergoing diagnostic coronary angiography
  – 22 % in SYNTAX trial

• CTO treatment
  – remains a strong referral indication for CABG
  – medication is a valid alternative in CTO
  – after left main stem disease CTO is called the “final frontier” of PCI

• PCI of CTO characteristics
  – a great challenge for the interventionalist, lower procedural success rates, higher incidence of procedural complications and increased rate of restenosis
Why should CTO be treated with Coronary Artery Bypass Grafting?

CABG has proven excellent results since the 1. operation in 1964. On- & Off-pump CABG have both convincing short- & long-term results.
Heart operations in Norway
30-day mortality (%)
Mammary artery vs. Vein graft

Loop et al. *NEJM* 1986;314:1
Randomized studies before SYNTAX
CABG vs. PCI-DES in multivessel disease

<table>
<thead>
<tr>
<th>Study</th>
<th>Mortality &amp; MI</th>
<th>Angina relief</th>
<th>Repeat revascularization</th>
<th>Stroke</th>
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<tr>
<td>SoS</td>
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<td>MAIN-COMPARE</td>
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<td>No difference</td>
<td>CABG</td>
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</tr>
</tbody>
</table>

**Superior treatment modality**

**CABG**
- No difference
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- CABG
For patients with intermediate (23-32) or high SYNTAX Scores (≥33), MACCE was increased at 4 years in patients treated with PCI.
## SYNTAX trial

### Reasons for allocation to CABG registry

- Complex anatomy (70.9%)
- CTO (22.0%)
- Unable to take anti-platelet medications (0.9%)
- Patient refused PCI (0.5%)
- Other (5.7%)
For the SYNTAX registry cohort MACCE after 4 years are comparable with the randomized CABG arm and better than PCI.
Scientific evidence
CABG-CTO

• Observational studies* (Level C)
  Median sternotomy = Minimally invasive approach
  On-pump = Off-pump
  Procedure success rate 70-99 %

Vicol et al. Heart Surgery Forum 2003
• CTO (n=420) or stenotic lesions (n=1380)
• Angiographic LIMA-LAD patency 1 yr: 98%
• Conclusion:
  – Occluded LAD is not an additional risk factor for CABG as it is for PCI

Ann Thorac Surg 2010;89:1496-501
### ESC-EACTS Guidelines 2010

**Stable angina**

<table>
<thead>
<tr>
<th>Subset of CAD by anatomy</th>
<th>Favours CABG</th>
<th>Favours PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1VD or 2VD - non-proximal LAD</td>
<td>IIb C</td>
<td>I C</td>
</tr>
<tr>
<td>1VD or 2VD - proximal LAD</td>
<td>IA</td>
<td>IIa B</td>
</tr>
<tr>
<td>3VD simple lesions, full functional revascularisation achievable with PCI, SYNTAX score ≤ 22</td>
<td>IA</td>
<td>IIa B</td>
</tr>
<tr>
<td>3VD complex lesions, incomplete revascularisation achievable with PCI, SYNTAX score &gt; 22</td>
<td>IA</td>
<td>IIIa A</td>
</tr>
<tr>
<td>Left main (isolated or 1VD, ostium/shaft)</td>
<td>IA</td>
<td>IIa B</td>
</tr>
<tr>
<td>Left main (isolated or 1VD, distal bifurcation)</td>
<td>IA</td>
<td>IIb B</td>
</tr>
<tr>
<td>Left main + 2VD or 3VD, SYNTAX score ≤ 32</td>
<td>IA</td>
<td>IIb B</td>
</tr>
<tr>
<td>Left main + 2VD or 3VD, SYNTAX score ≥ 33</td>
<td>IA</td>
<td>III B</td>
</tr>
</tbody>
</table>

- In the most severe patterns of CAD, CABG appears to offer a survival advantage as well as a marked reduction in the need for repeat revascularisation.
ESC-EACTS Guidelines

Comments on CTO treatment

• Negative results of 2 RTCs of PCI early post-MI has confused the indication for PCI-CTO
  (Steg et al. Eur Heart J 2004; Hochman et al. NEJM 2006)

• Incomplete revascularisation by PCI-CTO increases 3-year mortality
  (Hannan et al. Circulation 2006)

• Potential long-term side-effects of radiation

• Success is strongly dependent on operator skills

• Experience with proper management of coronary perforation and cardiac tamponade is required
Concerns of PCI-CTO

- Patient and operator related barriers
  - PCI-CTO attempts are low; USA < 15 %
  - Dependent on high (>200) PCI-volume, improved CTO-crossing technology and proctoring
- Increased risk of contrast nephropathy
- Risk of radiation injury (> 3 Gy)
- Increased in-hospital mortality, MI and CABG
- Labor-intensive, time-consuming and costly
- Increased risk of dissection, perforation and cardiac tamponade (1 % vs. 0.2 %)

Grantham et al. JACC Cardiovasc Interventions 2009
Perforation and cardiac tamponade during PCI
Scientific evidence

PCI-CTO

• Procedural success rates are lower in CTO vs. subtotal/non-occlusive stenosis
  – Same (70 %) BMS and DES  (Prasad et al. JACC 2007)

• Symptom relief:
  – 86 % PCI-success/70 % PCI-failure (TOAST-GISE, JACC 2003)

• LV function improvement after PCI-success*

• Survival advantage after PCI-success*

• Observational studies, registries, meta-analysis (Level C)

* Several studies
Metaanalysis PCI-CTO

- **Objective**
  - Systematic review and meta-analysis of published studies comparing CTO recanalization to medical management

- **Results**
  - No randomized controlled trials; 13 observational studies

- **Conclusions**
  - Successful CTO recanalization appear to be associated with an improvement in mortality and reduction for the need of CABG
  - Randomized clinical trials are needed to confirm these findings

*Joyal et al. Am Heart J 2010*
European Registry of CTO

• **Objective**
  First in-hospital outcomes data of PCI-CTO from the European Registry of Chronic Total Occlusion

• **Results**
  - 16 centres across Europe, 2008-2010, n = 1,914
  - Antegrade procedures obtained higher procedural success of retrograde ones (83.2 % vs. 64.5 %)
  - Coronary perforation occurred more frequently in patients who underwent retrograde approach (4.7 % vs. 2.1 %)

• **Conclusions**
  Retrograde procedures were associated with extended fluoroscopy exposure and procedural time, increased contrast load administration as well as a higher incidence of coronary perforations

*Galassi et al (EuroCTO club). Eurointervention 2011*
Conclusions

• CABG is still the golden standard for chronic total occlusions both in single- and multivessel coronary disease

• PCI technology is still immature for safe performance of chronic total coronary occlusions

• In patients with CTO there is a higher risk of incomplete revascularisation with PCI as compared to coronary surgery

• The Heart Team concept is important for optimal patient selection in CTO treatment

• Randomized control trials are required for further evaluation of PCI in chronic total coronary occlusions