Is there a role of hybrid coronary revascularization?

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No conflicts of interest
Conventional CABG since 80’s:

- LIMA-LAD
- Skeletonized SVG to the remaining target vessels
- ECC
Major drawbacks of CABG

• Poor SVG longevity
  Patency at 1-yr ~ 80%, at 15 yrs ~ 30%
• ~ 2% stroke
• ~ 2% deep sternal wound infection
• ~ 20% leg wound complications
• Delayed recovery
Guidelines on myocardial revascularization

Recommendations CABG vs. PCI

Low predicted mortality

Recommendation for the type of revascularization in patients with stable coronary artery disease with suitable coronary anatomy for both procedures and low predicted surgical mortality

Recommendations according to extent of CAD

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>CABG</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One-vessel CAD</strong></td>
<td></td>
<td></td>
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<tr>
<td>Without proximal LAD stenosis.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>With proximal LAD stenosis, (^{66,101,139–144})</td>
<td>I</td>
<td>A</td>
</tr>
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<td></td>
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<tr>
<td>Without proximal LAD stenosis.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>With proximal LAD stenosis, (^{68,70,73})</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td><strong>Left main CAD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left main disease with low SYNTAX score (0–22), (^{69,121,122,124,145–148})</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Left main disease with intermediate SYNTAX score (23–32), (^{69,121,122,124,145–148})</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Left main disease with high SYNTAX score (&gt;33), (^{69,121,122,124,146–148})</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td><strong>Three-vessel CAD without diabetes mellitus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three-vessel disease with low SYNTAX score (0–22), (^{102,103,121,123,124,133,149})</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Three-vessel disease with intermediate or high SYNTAX score (&gt;22), (^{102,103,121,123,124,133,149})</td>
<td>I</td>
<td>A</td>
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<td><strong>Three-vessel CAD with diabetes mellitus</strong></td>
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</table>

Patient Population

• older
• more comorbidities
• more advanced CAD
• 2/3 of patients excluded from RCT comparing CABG/PCI

Guidelines on myocardial revascularization
Hybrid coronary revascularization

Recommendations on procedural aspects of coronary artery bypass grafting

<table>
<thead>
<tr>
<th>Minimally invasive techniques</th>
<th>I</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-pump CABG and preferably no-touch techniques on the ascending aorta, by experienced operators, are recommended in patients with significant atherosclerotic aortic disease. 508,509,544,557–559</td>
<td></td>
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</tr>
<tr>
<td>Off-pump CABG should be considered for subgroups of high-risk patients by experienced off-pump teams. 525,557–560</td>
<td>IIA</td>
<td>B</td>
</tr>
<tr>
<td>Where expertise exists, minimally invasive CABG in general, can be considered in patients with isolated LAD lesions or in specific subsets of patients at experienced centres</td>
<td>IIA</td>
<td>B</td>
</tr>
<tr>
<td>Hybrid procedures, defined as the combination of PCI and CABG, may be considered in specific patient subsets at experienced centres</td>
<td>IIb</td>
<td>B</td>
</tr>
</tbody>
</table>

... may be considered in specific patients at experienced centres

Hybrid coronary revascularization

Planned combination of minimal invasive off-pump LIMA to LAD with PCI of non-LAD target vessels

MIDCAB  TECAB  JOPCAB
Rationale for hybrid revascularization

• Survival benefit of a LIMA-to-LAD graft
  10-year patency rate ~ 98%
  Tatoulis J et al. Patencies of 2127 arterial to coronary conduits over 15 years. 
  *Ann Thorac Surg* 2004;77:93–101

• Significant angiographic vein graft
  stenosis/occlusion > in-stent restenosis/-thrombosis
...however

- ischemia-driven revascularization rates considerably higher in PCI vs. CABG patients with treated multivessel CAD
  Mohr FW al. 5-year follow-up of the randomised, clinical SYNTAX trial. *Lancet* 2013;381:629–38

- stent thrombosis more frequently associated with MACCE than graft occlusion
  Farooq V et al. Short-term and long-term clinical impact of stent thrombosis and graft occlusion in the SYNTAX Trial at 5 years *J Am Coll Cardiol* 2013;62:2360–9
HCR vs. CABG: short-term clinical outcome

- MACCE comparable to CABG
- Reduced morbidity (Transfusion, renal failure, LOS, Afib)

Small numbers, mostly retrospective
- Minority characterized by EuroSCORE, SYNTAX score
- Mainly compared to OPCAB
HCR vs. CABG: mid-term clinical outcome

- All-cause mortality comparable
- Increased rate of repeat revascularization after HCR

Evidence direct comparison
HCR vs. CABG vs. PCI

- 1 PS-matched study
- n= 141 each group
- 3-year follow-up

3-year outcome of HCR versus conventional CABG and multivessel PCI in Aarhus/DK
A matched-group comparison

• 103 HCR patients (Coronary Hybrid Revascularisation Feasibility Study) compared with CABG and multivessel PCI

• Data from Western Denmark Heart Registry (VDHR)
• Linked by CPR number to:
  – Danish National Patient Registry (LPR)
  – Clinical laboratory information system (LABKA)

Modrau et al. 31st EACTS Annual Meeting Vienna, Austria 2017
3-year outcome of HMR versus CABG and PCI

**Inclusion:**
- MVD incl. involvement prox. LAD

**Exclusion:**
- Main stem stenosis
  - Complex stentning required
  - Treatment < 24 hours required

**1:1:1 exact-matching on:**
- Age ± 5 years
- Sex
- No. of diseased vessels
- Sum risk score ± 1:
  - EF (<50); recent AMI; eGFR (<50); DM; COLD; PAD
3-year outcome of HMR versus CABG and PCI

Demographics

<table>
<thead>
<tr>
<th>N=</th>
<th>HMR</th>
<th>CABG</th>
<th>PCI</th>
<th>p-value</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax score, mean (CI)</td>
<td>18.4 (17.2-19.7)</td>
<td>18.9 (17.9-19.9)</td>
<td>16.7 (15.4-18.0)</td>
<td>0.06</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Logistic EuroSCORE I, mean (CI)</td>
<td>3.3 (2.5-4.0)</td>
<td>3.8 (3.1-4.4)</td>
<td>3.5 (2.8-4.2)</td>
<td>0.34</td>
<td>0.62</td>
<td>0.63</td>
</tr>
<tr>
<td>Previous AMI, n (%)</td>
<td>14 (14)</td>
<td>26 (25)</td>
<td>22 (21)</td>
<td>0.05</td>
<td>0.20</td>
<td>0.62</td>
</tr>
<tr>
<td>Acute coronary syndrome, n (%)</td>
<td>16 (16)</td>
<td>17 (17)</td>
<td>10 (10)</td>
<td>1.00</td>
<td>0.29</td>
<td>0.21</td>
</tr>
<tr>
<td>Renal failure (eGFR &lt; 30), n (%)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>16 (16)</td>
<td>12 (12)</td>
<td>10 (10)</td>
<td>0.54</td>
<td>0.29</td>
<td>0.82</td>
</tr>
<tr>
<td>Ejection fraction &lt;30%, n (%)</td>
<td>2 (2)</td>
<td>1 (1)</td>
<td>3 (3)</td>
<td>1.00</td>
<td>1.00</td>
<td>0.62</td>
</tr>
<tr>
<td>Peripheral vascular disease, n (%)</td>
<td>2 (2)</td>
<td>3 (3)</td>
<td>4 (4)</td>
<td>1.00</td>
<td>0.68</td>
<td>1.00</td>
</tr>
<tr>
<td>Chronic obstructive lung disease, n (%)</td>
<td>0 (0)</td>
<td>3 (3)</td>
<td>4 (4)</td>
<td>0.25</td>
<td>0.12</td>
<td>1.00</td>
</tr>
<tr>
<td>Current smoker, n (%)</td>
<td>15 (15)</td>
<td>22 (21)</td>
<td>19 (18)</td>
<td>0.28</td>
<td>0.57</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Data presented as mean (CI= Confidence Interval), or n (%)
3-year MACCE
3-year individual MACCE components

- **Death**: Cumulative event rate (%)
  - HMR: 6.8%
  - CABG: 5.8%
  - PCI: 5.8%

- **AMI**: Cumulative event rate (%)
  - CABG: 3.9%
  - PCI: 2.9%
  - HMR: 3.9%

- **Stroke**: Cumulative event rate (%)
  - CABG: 3.9%
  - PCI: 3.9%
  - HMR: 3.9%

- **Repeat Revascularization**: Cumulative event rate (%)
  - HMR: 21.4%
  - PCI: 12.6%
  - CABG: 9.7%

**HCR cohort**: 56% angiographic driven repeat revascularization
### 3-year procedure-associated morbidity

<table>
<thead>
<tr>
<th></th>
<th>HMR</th>
<th>CABG</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>103</td>
<td>103</td>
<td>103</td>
</tr>
<tr>
<td><strong>Transfusion rate, % (CI)</strong></td>
<td>20% (13-29)</td>
<td>30% (21-40)</td>
<td>1% (0-5)</td>
</tr>
<tr>
<td><strong>Acute kidney injury (RIFLE), %</strong></td>
<td>2%</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Length of stay, mean days (CI)</strong></td>
<td>10.1 (9.2-10.9)</td>
<td>11.9 (10.7-13.1)</td>
<td>3.7 (2.9-4.5)</td>
</tr>
<tr>
<td><strong>Deep sternal wound infection, % (CI)</strong></td>
<td>0 (0-3.5)</td>
<td>2.9 (0.6-8.3)</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>Reoperation for haemorrhage, % (CI)</strong></td>
<td>6.8% (2.8-13.5)</td>
<td>6.8% (2.8-13.5)</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>Symptomatic pleural effusion, % (CI)</strong></td>
<td>14.7% (8.5-23.1)</td>
<td>8.7% (4.1-15.9)</td>
<td>1.9% (0.2-6.8)</td>
</tr>
<tr>
<td><strong>Number cardial readmission, % (CI)</strong></td>
<td>63% (53.0-72.4)</td>
<td>28% (19.7-37.9)</td>
<td>45% (34.9-54.8)</td>
</tr>
<tr>
<td><strong>Length of readmission, mean days (CI)</strong></td>
<td>3.1 (2.0-4.1)</td>
<td>10.3 (2.6-18.1)</td>
<td>4.1 (2.6-5.5)</td>
</tr>
</tbody>
</table>
Conclusion

• Optimal treatment tailored by the heart team incl. considering individual patient characteristics, procedure-associated morbidity.

• HCR promising alternative to PCI and CABG in selected patients.
Spin-off hybrid coronary revascularization

• Increase of coronary surgery instead of expected decrease

• JOPCAB - mainly stand alone - constitutes for 30% of coronary surgery

Main benefit.....