That unprotected LM: To STENT or NOT to STENT

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Georgetown University
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I have no relevant financial relationships
Patients are complicated

Active Problems

- Abdominal aortic aneurysm without rupture (Sct 75878002)
- Abnormal weight loss (Sct 267024001)
- Atypical chest pain (Sct 102589003)
- Benign prostatic hypertrophy without outflow obstruction (Sct 254902007)
- Carotid Occl/Stenosis (Icd-9-cm 433.10)
- Cerebrovascular accident (Sct 230690007)
- Gastrostomy present (Sct 302109006)
- Generalized anxiety disorder (Sct 21897009)
- Hypercholesterolemia (Sct 13644009)
- Hypertension (Sct 38341003)
- Hypothyroidism (Sct 40930008)
- Knee pain (Sct 30989003)
- Malignant tumor of tonsil (Sct 36339007)
- Murmur (Sct 414786004)
- Oral phase dysphagia (Sct 429970007)
- Oropharyngeal dysphagia (Sct 71457002)
- Postoperative heterotopic calcification (Sct 80116000)
- Pseudophakia (Sct 95217000)
- Pulmonary aspiration (Sct 68052005)
- Senile cataract (Sct 39450006)
- Xerostomia (Sct 87715008)

Active Medication

<table>
<thead>
<tr>
<th>Drug/Problems</th>
<th>Expires</th>
<th>Status</th>
<th>Last Filled</th>
</tr>
</thead>
<tbody>
<tr>
<td>METOPROLOL SUSTAINED RELEASE CAPSULE</td>
<td>11/29/16</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>USP SOPHIA 5 MG TAB</td>
<td>11/29/16</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>BIOTINE MOUTHWASH</td>
<td>11/29/16</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>PENTOCIDE 100 MG ORAL SOUL</td>
<td>11/29/16</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>ATENIVAS 5 MG TAB</td>
<td>11/29/16</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>NUTRITION SUPPLEMENT STRAWBERRY WIS</td>
<td>01/10/17</td>
<td>Active</td>
<td>Dec 18, 17</td>
</tr>
<tr>
<td>*DICLOFENAC 50 MG/ML TOPICAL GEL</td>
<td>01/10/17</td>
<td>Active</td>
<td>Feb 10, 17</td>
</tr>
<tr>
<td>ARTIFICIAL SALIVA BALANCE CENTER GEL</td>
<td>12/11/17</td>
<td>Active</td>
<td>Dec 18, 17</td>
</tr>
<tr>
<td>ASPIRIN 325 MG TAB</td>
<td>05/20/17</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>ATORVASTATIN CALCIUM 20 MG TAB</td>
<td>09/08/17</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>DOXACINIC 800 MG TAB</td>
<td>06/17/17</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
<tr>
<td>MITRAMINE HCL 30 MG TAB</td>
<td>09/25/17</td>
<td>Active</td>
<td>Nov/28/17</td>
</tr>
</tbody>
</table>

High risk patients with multivessel disease
Patient is an 80 YO AA with PMHx of tonsilar cancer

- s/p radiation 2004
- post-xrt fibrosis and
- Pharyngeal dysphagia s/p,
- PEG 2014,
- AAA (3.9x4.4cm may 2017),

- Carotid artery stenosis

- s/p L carotid artery stent placement 2014,
- hypothyroidism,
- CVA, RMCA,
- HTN, HLD, BPH,
- mood disorder, COPD

- CAD, fixed perfusion defect of RCA.
- moderate MR and HFREF (EF-45%).

- Developed SOB, seen by PCP, diagnosed aspiration pneumonia and started on antibiotics.

- Presented to ER with 3 days of worsening chest pressure and SOB.
- In the ER still on antibiotics, BPs in the 90s/50s, POC tr.0.33,cardiology consulted.
- During hospital stay, pt remained hypotensive, neck veins distended, serum Cr increased gradually from 1.4 to 3.2, trops peaked at 2.4, patient Deeping into cardiogenic shock, EF by echo 20%

- CCU attending concerned, but reluctant to cath. Talked to family, agreed on Hospice

- Interventional cardiology intervened!
STT CHANGES
MULTIVESSEL DISEASE
WHAT TO DO?
ALL LESIONS FIXED
ECG NORMALIZED
PATIENT DID WELL

Good Things Are Happening with PCI !!!!

Yes!!! Patient signed permission to show his picture

Second day, out of bed

A week later, Going to the OPERA!!!!
It supplies approximately two-thirds of the blood to the heart and 100% of the blood flow to the left ventricle.

- Acute occlusion can be lethal.
- Technical issues, STENT thrombosis can be lethal
- Anatomically lesions can be at:
  - the ostium,
  - mid-shaft,
  - the distal LM and/or, bifurcation
- 70% of significant LMCA involve the distal and bifurcation.
- Carina is usually free of disease, allows single-stent strategy to be successful. There are many unresolved issues to optimally treat bifurcation lesions
Ostial and mid-shaft lesions can be STENTed like any other artery (with caution)
Distal/bifurcation lesions are complex
  - Should be done only by experienced operators in expert centers
Techniques have evolved and perfected
Can be done safely, with high success rate
Yet most patients with LM are referred for CABG
Often interventionalists are faced with the dilemma:

To STENT or NOT to STENT
TECHNIQUES FOR BIFURCATION STENTING
PROVISIONAL STENTING
CULOTTE STENTING
BIFURCATION TWO STENT TECHNIQUES

Mini-Crash Technique

Double-kissing Technique
V STENT TECHNIQUE

Should we be doing more restenting of LM?
Let’s Look at the Evidence
OSTEAL, SHAFT AND BIFURCATION LESIONS
LM found in 5-10% of patients undergoing coronary angiography, 70% bifurcation lesions

Compared with medical treatment, coronary artery bypass grafting (CABG) of LMCA lesion has shown significant benefit

CABG has been the gold standard therapy for LMCA disease until recently.

The interventional cardiologists felt emboldened to use PCI for LMCA mainly due to improved techniques and stent technologies.

Available data comparing efficacy and safety of PCIs and CABG show pretty comparable results.

Still management can be challenging, especially in high risk anatomic subsets involving LMCA bifurcation lesions.

An integrated approach should be reinforced to improve clinical outcomes.

To STENT or NOT to STENT
WHY PCI OF LM DISEASE

- Single center studies and registries confirmed **high success** rates for LM PCI and **amazing safety** even in bifurcation lesions.
- Large body of data from observational registries and clinical trials supports the feasibility, efficacy and safety of stenting as compared to CABG for unprotected LMCA disease.
- Several observational studies show that:
  - **Early clinical events** of LMCA stenting were similar or superior to those of CABG.
  - **Late Mortality** between 30 days and 3 years was **similar** in both the groups.
- Recent data indicate that rates of death, and the combined rates of death, MI, and stroke **were not significantly higher** with use of stenting compared with CABG with f/u to 5,10 years.
- Risk of target vessel revascularization (TVR) was higher with PCI than CABG.
- Randomized data?
REVASCULARIZATION IN LEFT MAIN AND MULTIVESSEL CAD IN STABLE PATIENTS

Department of Cardiovascular Medicine, Mayo Clinic
Many times unstable
High risk for surgery
High risk for PCI
Evidence based medicine
Data supportive but Guidelines??
To stent or not to stent
PCI vs CABG for Left Main Disease
Pooled analysis of SYNTAX LM and PRECOMBAT (N=1,305)

5-Year Outcomes

Low to Intermediate (0-32) SYNTAX Scores

High (≥33) SYNTAX Scores

Cavalcante R, et al. JACC 2016;68:999-1009
# RANDOMIZED STUDIES

## EXCEL and NOBLE – Study Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>EXCEL</th>
<th>NOBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomized pts, centers, countries, geographies</td>
<td>1,905 pts at 126 sites in 17 countries (US, EU)</td>
<td>1,201 pts at 36 sites in 9 countries (EU)</td>
</tr>
<tr>
<td>Recruitment period</td>
<td>2010-2014</td>
<td>2008-2015</td>
</tr>
<tr>
<td>Age*</td>
<td>66 years (mean)</td>
<td>66 years (mean)</td>
</tr>
<tr>
<td>Diabetes mellitus*</td>
<td>30%</td>
<td>15%</td>
</tr>
<tr>
<td>LVEF*</td>
<td>57% (mean)</td>
<td>60% (mean)</td>
</tr>
<tr>
<td>Acute coronary syndrome*</td>
<td>24%</td>
<td>18%</td>
</tr>
<tr>
<td>SYNTAX score* (Core-lab)</td>
<td>27 (mean)</td>
<td>23 (mean)</td>
</tr>
<tr>
<td>Distal location*</td>
<td>82%</td>
<td>81%</td>
</tr>
<tr>
<td>IVUS use*</td>
<td>77%</td>
<td>74%</td>
</tr>
<tr>
<td>Off-Pump CABG</td>
<td>29%</td>
<td>16%</td>
</tr>
<tr>
<td>Arterial conduits used</td>
<td>99%</td>
<td>95%</td>
</tr>
<tr>
<td>Only arterial conduits used</td>
<td>25%</td>
<td>14%</td>
</tr>
</tbody>
</table>

*Data are shown for the PCI cohort

# PCI VS CABG: NOBLE STUDY RESULTS

## NOBLE: Study Results

<table>
<thead>
<tr>
<th>Event</th>
<th>PCI* (n=592)</th>
<th>CABG* (n=592)</th>
<th>HR [95%CI]</th>
<th>P_{Sup}</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACCE</td>
<td>29%</td>
<td>19%</td>
<td>1.48 (1.11-1.96)</td>
<td>0.007</td>
</tr>
<tr>
<td>Death</td>
<td>12%</td>
<td>9%</td>
<td>1.07 (0.67-1.72)</td>
<td>0.77</td>
</tr>
<tr>
<td>Non-procedural MI</td>
<td>7%</td>
<td>2%</td>
<td>2.88 (1.40-5.90)</td>
<td>0.004</td>
</tr>
<tr>
<td>Stroke</td>
<td>5%</td>
<td>2%</td>
<td>2.25 (0.93-5.48)</td>
<td>0.07</td>
</tr>
<tr>
<td>Repeat revascularization</td>
<td>16%</td>
<td>10%</td>
<td>1.50 (1.04-2.17)</td>
<td>0.032</td>
</tr>
</tbody>
</table>

*Data are shown as 5-year K-M estimates

Outcomes according to intention to treat

MACCE
MYOCARDIAL INFARCTIONS

Results

Non-procedural myocardial infarction

![Graph showing the comparison between CABG and PCI]

HR 2.88 (1.40–5.90); p=0.004

<table>
<thead>
<tr>
<th>Number at risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCI</td>
</tr>
<tr>
<td>CABG</td>
</tr>
<tr>
<td>592</td>
</tr>
<tr>
<td>536</td>
</tr>
<tr>
<td>442</td>
</tr>
<tr>
<td>313</td>
</tr>
<tr>
<td>227</td>
</tr>
<tr>
<td>127</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analysis time (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

- PCI: 6.9%
- CABG: 1.9%
Results
Total repeat revascularization

<table>
<thead>
<tr>
<th>Analysis Time (years)</th>
<th>CABG</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>592</td>
<td>592</td>
</tr>
<tr>
<td>1</td>
<td>536</td>
<td>539</td>
</tr>
<tr>
<td>2</td>
<td>440</td>
<td>442</td>
</tr>
<tr>
<td>3</td>
<td>319</td>
<td>313</td>
</tr>
<tr>
<td>4</td>
<td>219</td>
<td>227</td>
</tr>
<tr>
<td>5</td>
<td>129</td>
<td>227</td>
</tr>
</tbody>
</table>

HR 1.50 (1.04–2.17); p=0.03

16.2% for PCI
10.4% for CABG
Results

STROKE

HR 2.25 (0.92–5.48); p=0.07

Number at risk
PCI 592 539 442 313 227 127
CABG 592 536 440 319 219 129

4.9% 1.7%
The EXCEL study
PCI vs CABG for LM: Time-to-Event Curves

The NOBLE study: primary endpoint of major adverse cardiac and cerebrovascular events (MACCE) was 29% for PCI versus 19% for CABG, even though the all-cause mortality was similar.

Stone, et al., note that “the results of [the trial] suggest that PCI is an acceptable or perhaps preferred alternative to CABG.
**EXCEL: PRIMARY END POINT**

**Primary Endpoint**
Death, Stroke or MI at 3 Years

![Graph showing survival rates for CABG and PCI over 3 years.](image)

- CABG (n=957): 15.4%
- PCI (n=948): 14.7%

HR [95% CI] = 1.00 [95% CI: 0.79, 1.26]

*P = 0.98*

<table>
<thead>
<tr>
<th>Months</th>
<th>No. at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCI</td>
<td>948 896 875 850 784 445</td>
</tr>
<tr>
<td>CABG</td>
<td>957 868 836 817 763 458</td>
</tr>
</tbody>
</table>
# PERI-PROCEDURAL EVENTS

## EXCEL: Periprocedural Events

<table>
<thead>
<tr>
<th>Event</th>
<th>PCI (n=948)</th>
<th>CABG (n=957)</th>
<th>RR [95% CI]</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>30-Day peri-procedural MAE, any</strong></td>
<td></td>
<td></td>
<td>0.35 [0.28, 0.45]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Death*</td>
<td>0.9%</td>
<td>1.0%</td>
<td>0.91 [0.39, 2.23]</td>
<td>0.83</td>
</tr>
<tr>
<td>- Stroke*</td>
<td>0.6%</td>
<td>1.3%</td>
<td>0.50 [0.19, 1.34]</td>
<td>0.16</td>
</tr>
<tr>
<td>- Myocardial infarction*</td>
<td>3.9%</td>
<td>6.2%</td>
<td>0.63 [0.42, 0.95]</td>
<td>0.02</td>
</tr>
<tr>
<td>- Ischemia-driven revascularization*</td>
<td>0.6%</td>
<td>1.4%</td>
<td>0.47 [0.18, 1.22]</td>
<td>0.11</td>
</tr>
<tr>
<td>- TIMI major/minor bleeding</td>
<td>3.7%</td>
<td>8.9%</td>
<td>0.42 [0.28, 0.61]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Transfusion ≥2 units</td>
<td>4.0%</td>
<td>17.0%</td>
<td>0.24 [0.17, 0.33]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Major arrhythmia**</td>
<td>2.0%</td>
<td>15.8%</td>
<td>0.13 [0.08, 0.20]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Surgery/radiologic procedure</td>
<td>1.1%</td>
<td>4.0%</td>
<td>0.27 [0.13, 0.53]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Renal failure†</td>
<td>0.5%</td>
<td>2.4%</td>
<td>0.22 [0.08, 0.57]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Sternal wound dehiscence</td>
<td>0.0%</td>
<td>1.9%</td>
<td>0.03 [0.00, 0.45]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Infection requiring antibiotics</td>
<td>2.3%</td>
<td>13.6%</td>
<td>0.17 [0.11, 0.27]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Prolonged intubation (&gt;48 hours)</td>
<td>0.4%</td>
<td>2.9%</td>
<td>0.14 [0.05, 0.41]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Post-pericardiotomy syndrome</td>
<td>0.0%</td>
<td>0.4%</td>
<td>0.11 [0.01, 2.08]</td>
<td>0.12</td>
</tr>
</tbody>
</table>

*Adjudicated events, others are site-reported. **SVT requiring cardioversion, VT or VF requiring treatment, or bradyarrhythmia requiring temporary or permanent pacemaker. †Serum creatinine increased by ≥0.5 mg/dL from baseline or need for dialysis.

Stone GW, et al. NEJM 2016
PRIMARY END POINT
PCI or CABG.

Fig. 2 Meta-analysis of the composite endpoint of death, myocardial infarction (MI) and stroke. Forest plot and summary effect of the difference in the incidence of the composite endpoint of death, myocardial infarction (MI) and stroke, showing no difference between CABG and PCI.

5 randomized studies, 4,499 patients

Rosa ST et al; BMC 2017;17:240
PCI VS CABG FOR LEFT MAIN REVASCULARIZATION

6 RCTs, 4700 patients with LM disease randomized to PCI or CABG

Percutaneous coronary intervention vs. coronary artery bypass grafting for left main revascularization: an updated meta-analysis

Navkaranbir S. Bajaj¹,², Nirav Patel²†, Rajat Kalra³, Peter Marogil⁴, Ashwanikumar Bhardwaj², Garima Arora², and Pankaj Arora²,⁵,†

¹Division of Cardiovascular Medicine, Department of Radiology, Brigham and Women’s Hospital, 75 Francis St, Boston, MA 02115, USA; ²Division of Cardiovascular Diseases, Department of Medicine, University of Alabama at Birmingham, 1900 University Boulevard Birmingham, AL 35233, USA; ³Cardiovascular Division, University of Minnesota, 420 Delaware St SE, Minneapolis, MN 55455, USA; ⁴Department of Internal Medicine, Brookwood Baptist Health, 101 Brookwood Medical Center Drive Birmingham, AL 35209, USA; and ⁵Section of Cardiology, Birmingham Veterans Affairs Medical Center, 700 19th St S, Birmingham, AL 35233, USA

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MACCE: PCI VS CABG FOR LM DISEASE

META ANALYSIS: PCI VS CABG FOR LEFT MAIN

PCI VS CABG FOR LM: OUTCOMES STRATIFIED BY TIME OR SYNTAX SCORE

MACCE AFTER PCI OR CABG

In randomized trials, no difference in the primary end point
No difference in Mortality
Fewer recurrent revascularization after CABG
Current guidelines favor CABG
Of note These studies included mostly patients with stable CAD

- SO!! Are we doing enough PCIs
- Should we do more?
Patient was a 69 yo Hisp male ex-smoker with HTN, alcohol binge, ex-IVDA, HIV,

Presented to ED with new onset chest pain x 24 hrs, cTnI 30,

EKG with inferolateral ST changes. SOB with mild exersion

The day before admission, he developed chest tightness, SOB, diaphoresis with minimal exertion. CP eased with resting but recurred at home prompting the ED visit.

He remained CP free since receiving SL NTG.

Labs: OK, serum cr: 0.6, Troponin I 29.99, 35. 6 and 13.5

Cath
What to do?
- Stent the LM?, STENT the RCA? Both? Stage?
- Send Patient to surgery?
- Treat Medically?

Well!!!
- Intervenlistian scared
- Surgeon Concerned
- Family undecided??
- Patient could not think/make up his mind!

Need to make quick decisions, take action
- Day three decision made to transferred patient to CC center for CABG, but...Patient ....
- Coded on the way and expired!!!>??

INDECISION
SECOND PATIENT

- 76 y/o WM with pm hx of CAD s/p 2 DES to RCA (2002),
- Hx of DM2, HTN, and HLD
- Presents to another VA-ER c/o chest pain and SOB.
- Pt had trouble walking a few steps with no c/p or SOB
- In ER found with troponin I of 3.0, increased to 7.0
- Started on ASA/plavix and c/p resolved.
- Transferred to DCVA for cardiac cath.
- Taken to cath lab
AFTER ADMISSION AND TREATMENT

Taken to cath!!!
SECOND PATIENT
Patient slated for surgery
Taken to CCU in stable condition
Remained on IV heparin, BB, ASA, no Plavix
At 2 AM wake up with c/p, resident gave NTG,
Became tachycardic, then collapsed
Pulmonary edema, CPR, stabilized, intubated and Interventionalist called
Taken to cath (in 45 min !!!)
Patient intubated, but hemodynamically stable
SECOND PATIENT
SECOND PATIENT
BALLOON-STENT LM, LAD
TROPONIN I - SERUM CREATININ
Post PCI patient transferred to CCU, with IABP, intubated on pressors. Echo showed poor LV function BP in the 80s systolic

Improved over the next 2 days, woke up, hemodynamics stabilized, pressors d/ced, IABP D/Ced, extubated

Patient mobilized,
Sat on chair and walked on day 3
- New echo showed EF of 50%
Patient send home, in stable/GREAT condition.

PCI works
Need to do more unprotected LM cases
Patient recovered nicely

Interventions WORK!!!
Great things are happening at the VA
Ostial and/or mid-shaft LMCA disease easy
Isolated LMCA disease easy
LMCA bifurcational disease treatable by single stent Low or intermediate Syntax score (Syntax score <33)
Patients with ACS, NSTEMI
- Hemodynamically unstable
- Unstable lesion
- Patients that cannot wait for surgery
- Surgery is not readily available
- PCI can be done faster than surgery

PCI should be performed by skilled operators, in well equipped labs