When is Hemodynamic Support needed during Left Main PCI?

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Most commonly used hemodynamic support devices in the cath lab

LM subsets requiring hemodynamic support

- Severely depressed LV systolic dysfunction
- Occluded/Non-dominant RCA
- Severe aortic stenosis
- Cardiogenic shock
- Ventricular arrhythmias
- Complex/calcified coronary anatomy, requiring atherectomy, multiple balloon dilatations and aggressive lesion prep
84 y/o female with h/o severe AS s/p TAVR with 23mm Edwards-SAPIEN 2 years ago p/w SOB on exertion. LVEF Normal

Baseline coronary angiogram via trans-radial approach

Although FFR LM → LAD 0.81, but IVUS MLA of LM 4.6 mm²
DES 3.5 x 18 mm to LM to LAD by Trans-radial approach, No hemodynamic support
1799 patients with unprotected left main coronary artery stenosis presenting with ACS in the GRACE Registry

Balloon pump used in 20% of patients with undergoing PCI of ULMCA for ACS

Use and Effectiveness of IABP during high-risk PCI: NCDR Registry

Background—Intra-aortic balloon pumps (IABP) frequently are used to provide hemodynamic support during high risk percutaneous coronary intervention (PCI), but clinical evidence to support their use is mixed. We examined hospital variation in IABP use among high risk PCI patients, and determined the association of IABP use on mortality in this population.

Methods and Results—We analyzed data submitted to the CathPCI Registry between January 2005 and December 2007.

IABP used in 28.1% of ULMCA PCI in the United States

Hospitals were categorized into quartiles by their proportional use of IABP. We examined differences in in-hospital mortality across hospital quartiles using a hierarchical logistic regression model to adjust for differences in patient and hospital characteristics across hospital quartiles of IABP use. IABPs were used in 18,990 (10.5%) of 181,599 high risk PCIs. Proportional use of IABP varied significantly across hospital quartiles: Q1, 0.0 to 6.5%; Q2, 6.6 to 9.2%; Q3, 9.3 to 14.1%; Q4, 14.2 to 40.0%. In multivariable analysis, after adjustment for differences in patient and hospital characteristics, in-hospital mortality was comparable across quartiles of hospital IABP usage (Q1, Ref; Q2, odds ratio 1.11, 95% CI 0.99–1.24; Q3, OR 1.03, 95% CI 0.92–1.15; Q4, OR 1.06, 95% CI 0.94–1.18).

Conclusions—IABP use varied significantly across hospitals for high risk PCI. However, this variation in IABP use was not associated with differences in in-hospital mortality. (Circ Cardiovasc Qual Outcomes. 2012;5:21-30.)
47 y old executive with history of hodgkin’s disease and radiation to chest. Presents with exertional angina. Vital capacity 40% of normal, MRI possible constriction. CT Surgical consultation is obtained.
Post Procedure, Procedure time 1 hour, Discharged <24 hrs
BCIS-1 Study: Randomized trial of elective IABP versus no IABP in high-risk PCI

IABP (n=150, 27% LM); no IABP (n=151, 29% LM)

Primary end-point: MACCE at 28 days (Death/MI/Stroke/Revascularization)

No difference in primary end point at 28 days
Trend towards improved mortality at 6 months

BCIS-1 Study: Randomized trial of elective IABP versus no IABP in high-risk PCI

IABP (n=150, 27% LM); no IABP (n=151, 29% LM)

Significantly improved long-term mortality with IABP in high-risk PCI

31% relative reduction in long-term mortality with IABP

28% vs. 38.4%

Elective versus provisional intraaortic balloon pumping in unprotected left main stenting

Elective IABP (n=69); Conservative group (n=150)
Elective IABP used in 31% of patients undergoing LM PCI

Milan criteria for elective IABP before ULMCA PCI
- LM bifurcation lesion
- EF < 40%
- Atherectomy
- Unstable angina
- RCA critical stenosis

15% (12/150) patients in the conservative group required insertion of IABP due to hemodynamic instability

Elective versus provisional intraaortic balloon pumping in unprotected left main stenting

Elective IABP (n=69); Conservative group (n=150)

Predictors of outcomes during LM PCI

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Odds ratio</th>
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<tbody>
<tr>
<td>Elective IABP</td>
<td>0.08 (0.01-0.69)</td>
</tr>
<tr>
<td>Euroscore &gt; 6 plus distal LM</td>
<td>5.49 (1.47-20.51)</td>
</tr>
<tr>
<td>SBP &lt; 100mmHg</td>
<td>3.52 (0.50-24.73)</td>
</tr>
</tbody>
</table>

Intraprocedural events are higher with conservative approach

1.4% vs. 9.5%

87 y/o male presenting with NSTEMI

Severely depressed cardiac function (EF 15%)

80% ostial LM, 90% distal LM, 90% ostial LAD, 80% mid-LAD

100% prox-RCA with bridging collaterals to mid-RCA
Severely depressed systolic function
Ejection Fraction 15%
Patient not a surgical candidate
Final result

s/p Resolute 2.5x22mm, 2.25x14mm, 2.75x12mm and 3.0x26mm stents to the LAD

Patient discharged home 5 days later
71 y/o male with AVA 1.3 cm$^2$, LVEF 60%
Stent Positioning and Deployment

Xience V 3.5 x 18 mm

Xience V 3.0 x 18 mm
Final Angiogram
94 y/o male with LM trifurcation stenosis, severe AS and severely depressed EF (20%) 

Patient turned down by 2 surgeons 

Baseline Coronary Angiogram
Balloon aortic valvuloplasty performed, followed by insertion of Impella 4.0

22 x 5 mm Z-med BAV balloon

Angiogram after Impella insertion
Final Result

Impella removed at the end of the procedure
Transfemoral TAVR performed 1 month later

- 29mm Sapien-XT deployed

- POBA of the LM Stent performed with the 4.0x12 balloon

- Final Result: 4.0 x 12 mm angioplasty balloon positioned in the LAD
Safety and feasibility of Impella 2.5 in patients undergoing high-risk PCI: Europella Registry

144 patients undergoing high-risk PCI

LM PCI performed in 52.8% (76/144) patients

30-day mortality 5.5%; 30-day MI 0%

Sjauw KD. et al. JACC 2009.

<table>
<thead>
<tr>
<th>Qualification for high-risk PCI</th>
<th>Count (Percentage)</th>
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<tbody>
<tr>
<td>Left main coronary artery PCI</td>
<td>76 (52.8)</td>
</tr>
<tr>
<td>Last patent vessel PCI</td>
<td>25 (17.4)</td>
</tr>
<tr>
<td>Multivessel disease</td>
<td>118 (81.9)</td>
</tr>
<tr>
<td>Low LVEF</td>
<td>51 (35.4)</td>
</tr>
<tr>
<td>Other</td>
<td>12 (8.3)</td>
</tr>
<tr>
<td>Refused for CABG</td>
<td>62 (43.1)</td>
</tr>
</tbody>
</table>
PROTECT II Study: Randomized trial of Impella 2.5 versus IABP during high-risk PCI

Unprotected left main/Last Patent Conduit group

90 day Major Adverse Event (Per-Protocol)

Decreased 90-day MAE rates with Impella 2.5 versus IABP

84 y/o male with unstable angina, LVEF 15%

Baseline Coronary Angiogram
Tandem heart placed for hemodynamic support
5 stents later…
High-risk PCI = Left main/Multivessel PCI with low EF

33/54 patients (62%) underwent LM PCI

High-risk LM PCI is feasible with Tandem Heart support

<table>
<thead>
<tr>
<th></th>
<th>Pre-tandem heart</th>
<th>Post-tandem heart</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA pressure</td>
<td>16 mmHg</td>
<td>10 mmHg</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PA pressure</td>
<td>45 mmHg</td>
<td>36 mmHg</td>
<td>0.04</td>
</tr>
<tr>
<td>PCWP</td>
<td>25 mmHg</td>
<td>17 mmHg</td>
<td>0.02</td>
</tr>
<tr>
<td>CO</td>
<td>4.7 L/min</td>
<td>5.7 L/min</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Favorable hemodynamics with Tandem Heart

97% procedural success
10% 30-day mortality

Alli et al. Catheterization and Cardiovascular Interventions 2012.
High-risk PCI = Left main/Multivessel PCI with low EF

33/54 patients (62%) underwent LM PCI

Mayo Clinic Algorithm for hemodynamic support during high-risk PCI

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<th>Simple PCI</th>
<th>Complex PCI</th>
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<tbody>
<tr>
<td>LVEF &gt; 30%</td>
<td>None</td>
<td>IABP</td>
</tr>
<tr>
<td>LVEF &lt; 30%</td>
<td>IABP</td>
<td>Impella or Tandem Heart</td>
</tr>
</tbody>
</table>

Alli et al. Catheterization and Cardiovascular Interventions 2012.
My approach to hemodynamic support in LM PCI

<table>
<thead>
<tr>
<th></th>
<th>Simple anatomy</th>
<th>Complex anatomy</th>
<th>Very complex anatomy</th>
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<tbody>
<tr>
<td></td>
<td>(Ostial, mid-shaft, single stent strategy)</td>
<td>(Bifurcation lesion)</td>
<td></td>
</tr>
<tr>
<td>LVEF &lt; 20%</td>
<td>IABP/Impella</td>
<td>Impella/Tandem Heart</td>
<td>Impella/Tandem Heart</td>
</tr>
<tr>
<td>LVEF 20-35%</td>
<td>IABP</td>
<td>IABP/Impella</td>
<td>Impella</td>
</tr>
<tr>
<td>LVEF &gt; 35%</td>
<td>4 French sheath</td>
<td>IABP</td>
<td>Impella</td>
</tr>
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