IABP, Impella, Tandem Heart, ECMO: Compare & Contrast

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Disclosure

- Abiomed – advisory board
• Access
• Sheath size
• Flow
• Hemodynamic effects
• Oxygenation
IABP
# IABP

<table>
<thead>
<tr>
<th>Percutaneous Access</th>
<th>Femoral or axillary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical Access</td>
<td>Axillary or aortic</td>
</tr>
<tr>
<td>Sheath size</td>
<td>7.5Fr*</td>
</tr>
<tr>
<td>Flow</td>
<td>~0.75L*</td>
</tr>
<tr>
<td>Hemodynamic Effects</td>
<td></td>
</tr>
<tr>
<td>Preload</td>
<td>↓</td>
</tr>
<tr>
<td>Afterload</td>
<td>↓</td>
</tr>
<tr>
<td>Coronary flow</td>
<td>↑</td>
</tr>
</tbody>
</table>
Impella 2.5, CP, 5.0
Impella RP

Catheter diameter: 11Fr
Flow rate: greater than 4.0 L/min

Blood Inlet Area

Blood Outlet Area

22FR Pump Motor
# Impella Devices

<table>
<thead>
<tr>
<th></th>
<th>Impella 2.5</th>
<th>Impella CP</th>
<th>Impella 5.0</th>
<th>RP</th>
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<tbody>
<tr>
<td>Percutaneous Access Site</td>
<td>Axillary or Femoral</td>
<td>Axillary or Femoral</td>
<td>NA*</td>
<td>Femoral</td>
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<tr>
<td>Surgical Access Site</td>
<td>Axillary or Femoral</td>
<td>Axillary or Femoral</td>
<td>Axillary or Femoral</td>
<td>XXX</td>
</tr>
<tr>
<td>Sheath size</td>
<td>13Fr/9Fr</td>
<td>14Fr/9Fr</td>
<td>21Fr</td>
<td>22Fr/11Fr</td>
</tr>
<tr>
<td>Flow (L/min)</td>
<td>2.5</td>
<td>3.5*</td>
<td>5.0</td>
<td>&gt; 4.0</td>
</tr>
<tr>
<td>Hemodynamics</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Preload</td>
<td>↓</td>
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<td>Afterload</td>
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<td>↑</td>
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</tbody>
</table>
Impella Case

- 24 y/o woman h/o post-partum CM s/p AICD
- 2 weeks post-partum after 2\textsuperscript{nd} child
- Transferred with cardiogenic shock

- CO = 1.8L/min
- PCWP = 35 mmHg
- Dobutamine 5mcg/kg/min
- Epi 0.04 mcg/kg/min
Impella CP Placement

CO = 3.5
PCWP = 18
CVP = 10
UOP ↑

6 hours later...
UOP ↓
CVP=20
PAPi = 0.75
Pulmonary Artery Pulsitility Index (PAPi)

- $\text{PAPi} = \frac{\text{PA systolic} - \text{PA diastolic}}{\text{CVP}}$

- $\text{PAPi} < 0.9$ \(^1\) AMI $< 1.85$ \(^2\) surgical LVAD
  - Severe RV dysfunction
  - Potential benefit for percutaneous RV support

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Impella Case

- Impella RP placed
- Improved hemodynamics and UOP
- 36 hours – lactate wnl
- 72 hours – creatinine wnl
- Day 5 extubated
- Day 6 listed status 1a
- Day 12 OHT
Tandem Heart: Left sided
Protek Duo Cannula & Tandem Pump
# Tandem Heart

<table>
<thead>
<tr>
<th></th>
<th>Left (Traditional)</th>
<th>Right (Protek Duo)</th>
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</thead>
<tbody>
<tr>
<td><strong>Percutaneous Access</strong></td>
<td>Femoral</td>
<td>Internal Jugular Vein</td>
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<td><strong>Surgical Access</strong></td>
<td>NA</td>
<td>NA</td>
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<tr>
<td><strong>Sheath size</strong></td>
<td>21 Fr transeptal LA cannula 29Fr or 31 Fr</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17 Fr CFA cannula</td>
<td></td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td>5 L/min</td>
<td></td>
</tr>
<tr>
<td><strong>Hemodynamic Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Preload</strong></td>
<td>$\downarrow$</td>
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</tr>
<tr>
<td><strong>Afterload</strong></td>
<td>$\uparrow\uparrow\uparrow\uparrow\uparrow$</td>
<td></td>
</tr>
<tr>
<td><strong>Coronary flow</strong></td>
<td>$\uparrow$</td>
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Tandem Heart Case

- 23 y/o woman h/o mitral stenosis
- Bioprosthetic MVR 2 years ago at outside hospital
- 2 weeks post-partum
- Transferred from rural hospital with cardiogenic shock
- Bi-ventricular failure
- Severe MS & moderate MR of bioprosthetic mitral valve
Epi 2mcg/kg/min
Dobutamine 5mcg/kg/min

MVO2 sat = 38%
Lactate >12
Creatinine 2.8
Hemodynamics

- PCWP = 40 mmHg
- LVEDP = 22 mmHg
- PA = 60/40 mmHg
- Mean RA = 25
- PAPi = 0.8
MCS Support Plan

• Bi-ventricular support

• Bridge to Transplant
Left CFA
Iliac Arteries
Antegrad Access

Micro-puncture, ultrasound guided access

6Fr Sheath antegrade direction

Connect to Tandem 17Fr arterial cannula side-port using perfusion connector
Transeptal Crossing
Left Atrial Angiogram
Final Set-up
Tandem Heart Case

• 48 hours – lactate wnl
• 96 hours – creatinine wnl
• Day 7 extubated
• Day 8 listed status 1a
• Day 14 OHT
Tandem Heart – RV Failure s/p LVAD

- 59 y/o man h/o ICM
- s/p Heartmate 2 placement
- Intra-op: RV dilated, poor flow on LVAD
- Increasing dobutamine and epi → minimal increase in LVAD flow
59 y/o s/p LVAD with RV failure
ECMO

- Venous–venous
- Venous - pulmonary artery (with left sided MCS)
- Venous – arterial

- Pump type
  - Roller
  - Centrifugal

- Oxygenator type
  - Polymethylpentene

- Vascular cannula size
  - Determine flow

ECMO
ECMO Systems

• Maquet
• Medos
• Sorin
• Thoratec (Abbott)
• TandemLife
## ECMO

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<table>
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<tr>
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<tbody>
<tr>
<td><strong>Percutaneous Access</strong></td>
<td><strong>CFA/ CFV</strong></td>
</tr>
<tr>
<td><strong>Surgical Access</strong></td>
<td><strong>Open chest</strong></td>
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<tr>
<td><strong>Sheath size</strong></td>
<td><strong>17Fr/21Fr</strong></td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td><strong>≥ 5L/min</strong></td>
</tr>
<tr>
<td><strong>Hemodynamic Effects</strong></td>
<td></td>
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ECMO Case

- 49 y/o woman with non-ischemic cardiomyopathy
- Diagnosed 10 years ago
- Being evaluated for OHT
- Presented to ED with worsening CHF ➔ rapidly deteriorated into cardiogenic shock
- Intubated for hypoxic respiratory failure
- Hypotensive
- ↓ UOP, ↑ Cr, ↑ T bili, ↑ Lactate on
  - dobutamine 5mcg/kg/min
  - epi 0.08 mcg/kg/min
Arterial 29 Fr Access
Venous 32 Fr Access
ECMO Case

- 1 hour - UOP 200cc/hr
- 24 hours – lactate normal
- 48 hours – creatinine normal
- 96 hours – T bili normal
- 5 days - extubated

- Listed 1a for OHT
- 10 days after admission - transplant
EC-Pella

- LV venting with Impella during V-A ECMO
  - Decrease LVEDP
  - Decrease afterload
Summary

• Understand patient needs
• Know device options and limitations
• Select appropriate device
• Growing number of case reports
• Need for more good data
  • Pilot studies
  • Clinical trials