Patient on IABP, Impella, ECMO

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Percutaneous Support Devices

- Devices
  - IABP
  - ECMO
    - CardioHelp
  - TandemHeart
  - Impella
- The premise of using support devices
- Data for the device use
- Advantages and disadvantages
IABP
What does Tandem Heart do?

- Oxygenated blood in LA\(\rightarrow\)Femoral Artery
  - Decompress LV
  - Reduce workload on LV
  - Provide excellent end-organ perfusion
- Access:
  - 21F LA Drainage Cannula with 14 side holes (62 or 72 cm)
  - Femoral arterial cannula (15-17F) to the iliac artery (17 cm)
- Centrifugal pump
  - Can adjust output by RPM
  - Percutaneous: up to 5 L/min
  - Surgical: up to 8 L/min
- Requires anticoagulation
Impella
Impella

- Left Ventricle-Aorta flow
- 2.5 – 5.0 L/min flow achieved
- Percutaneous:
  - Impella 2.5: 13F access
    - → 2.5 L/min
  - Impella CP: 14F access
    - CP → 4 L/min
  - Impella 5.0: 21F access
    - → 5.0 L/min
    - Surgical cutdown
- Surgical:
  - Impella LD
  - Impella RP

Impella 2.5 shown
**ECMO**

- **Hardware:**
  - ECMO Cart: Gas blender, RA and oxygen lines, gas tank, Rotaflow console and driver, manual hand crank, temperature unit

- **Cannulae:**
  - Arterial: 16-20F
  - Venous: 18-28F
  - Distal Reperfusion: 5-7F antegrade
Cardiohelp

- Newer device
  - ECMO gone mini
- Provides both circulatory and respiratory support
- Can support 5 – 7 L/min flow
- Cannulae:
  - Arterial 15-23F
  - Venous 19-29F
- Potential for more liberal use
What are the indications?

- Acute myocardial infarction with or without shock
  - Support end-organ perfusion
  - ? Reduce infarct size
  - Acute mitral regurgitation or ventricular septal rupture
- Decompensated heart failure syndromes
  - Including valvular syndromes
- High risk percutaneous coronary intervention (PCI)
  - Alter ischemic threshold
  - Avoid potential complications
- Refractory angina
Other Indications

- Post-cardiotomy/ peri-operative by surgery
- Refractory ventricular arrhythmias
- Prophylaxis during EP procedures
Utilization of Assist Devices

Stretch et al, J Am Coll Cardiol 2014;64:1407–15
Morality with Short Term Support Devices
## Surgical Versus Percutaneous

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Procedures</td>
<td>Surgical</td>
<td>Percutaneous</td>
</tr>
<tr>
<td></td>
<td>1,895 (79.5)</td>
<td>490 (20.5)</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>1,029 (83.3)</td>
<td>207 (16.7)</td>
</tr>
<tr>
<td>Primary diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMI</td>
<td>606 (79.3)</td>
<td>158 (20.7)</td>
</tr>
<tr>
<td>CAD</td>
<td>384 (80.3)</td>
<td>94 (19.7)</td>
</tr>
<tr>
<td>CHF</td>
<td>197 (69.4)</td>
<td>87 (30.6)</td>
</tr>
<tr>
<td>Other</td>
<td>485 (81.2)</td>
<td>112 (18.8)</td>
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</tbody>
</table>

Stretch et al, J Am Coll Cardiol 2014;64:1407–15
Changing Trends

Patient with
Acute myocardial infarction (AMI),
Congestive heart failure (CHF), or
Coronary artery disease and other heart disease (CAD)

PRE-2007

MCS instituted after
circulatory collapse (reactive)

Organ dysfunction has already occurred

Limited or no percutaneous MCS devices available

Most MCS implanted surgically (primarily by cardiac surgeons)

Longer hospital stay post-surgery

Higher mortality

Higher hospital costs

POST-2007

Percutaneous MCS devices more readily available

MCS increasingly implemented without need for surgical consultation

Shorter hospital stay and higher rate of home discharges

Reduced hospital costs

Lower mortality

MCS instituted before
circulatory collapse (anticipatory)

Avoidance of organ dysfunction

Stretch et al, J Am Coll Cardiol 2014;64:1407–15
Percutaneous Support Devices

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    - CardioHelp
  - TandemHeart
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- The premise of using support devices
- Data for the device use
- Advantages and disadvantages
## Cardiac Support Recommendations (ACC/AHA)

<table>
<thead>
<tr>
<th>Class I</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(STEMI)</td>
<td>Cardiogenic shock (hypotension, low output state) not quickly reversed with pharmacologic therapy (LOE: B)</td>
</tr>
<tr>
<td>(STEMI)</td>
<td>Acute MR or VSD complicating MI</td>
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<tr>
<td>(STEMI)</td>
<td>Recurrent ischemic-type chest discomfort and signs of hemodynamic instability, poor LV function, or a large area of myocardium at risk (LOE: C)</td>
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<td>Recurrent intractable ventricular arrhythmias with hemodynamic instability</td>
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<table>
<thead>
<tr>
<th>Class IIa</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(STEMI)</td>
<td>Management of refractory polymorphic VT (LOE: B)</td>
</tr>
<tr>
<td>(NSTEMI/UA)</td>
<td>Intra-aortic balloon pump counterpulsation for severe ischemia that is continuing or recurs frequently despite intensive medical therapy or for hemodynamic instability in patients before or after coronary angiography (LOE: C)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Class IIb</th>
<th>Recommendation</th>
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<tr>
<td>(STEMI)</td>
<td>Refractory pulmonary congestion (LOE: C)</td>
</tr>
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<td>Elective insertion of an appropriate hemodynamic support device as an adjunct to PCI may be reasonable in carefully selected high-risk patients (LOE: C)</td>
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Cardiohelp

- Newer device
  - ECMO gone mini
- Provides both circulatory and respiratory support
- Can support 5 – 7 L/min flow
- Cannulae:
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  - Venous 19-29F
- Potential for more liberal use
Reperfusion Cannula
Securing System

- Large tegaderm
- Suture reperfusion sheath
- Use biopatch at each site
- Suture both A and V cannulae using 0 silk
- White tie at tubing overlap on both A and V cannulae
- Use stat locks for added stability
ECMO Management

- Target flow = 60 ml/min/kg
- Minimize “chugging” by ensuring that central venous pressure is 12-16 cmH2O
  - “Chugging” is the term used when the venous cannula is intermittently adherent to the SVC wall due to inadequate CVP
- Place right radial arterial line to monitor PaO2 level as this is a way to monitor oxygenation of brain and coronaries (further away from arterial cannula)
- Use IABP and/or Inotropes to ensure that aortic valve is opening and that the ventricle is contracting (maintain pulsatility)
- Heparin gtt per stroke nomogram (no bolus doses)
- Maintain ECMO Gasses PaO2 > 200 mmHg and PaCO2 35-45 mmHg.
- Peripheral ABG Goal: PaO2 >65 mmHg and PaCO2 35-45 mmHg (pH 7.35-7.45). Increase sweep flow/speed if need PCO2 lower
Patient Monitoring

- CBC q12h
- PTT q6h
- Daily CMP, fibrinogen, LDH, and CK
- Doppler pulses in both LE
- Daily CXR
- Swan ganz catheter
- Frequent (daily) echo to assess LV decompression and AV opening/closure
Ventilator Management

- Tidal volumes
- 4-6 ml/kg (ideal body weight)
- FI02 < 50%
- PEEP 5-12 cmH20
- RR < 12 min
- Peak airway pressure < 32 cmH20
- Peak plateau pressure < 30 cmH20
- PaO2 of right radial A-line > 65
Hemodynamic Management

- Maintain MAP > 65 mmHg
- Goal SVO2 > 60%
- Wean inotropes/pressors as much as possible to maintain BP and pulsatility
- Most will have IABP as well
Prophylactic Antibiotics

- One dose of antibiotics covering Gm+ and Gm- pathogens (Vancomycin/Zosyn) at the time of device insertion.
- Other antibiotic therapy as indicated clinically
Support does not come free

- Risk of peripheral complications
  - Limb ischemia or bleeding
- Risk of infection
- Risk of neurologic events
- Added cost of procedures

- Always consider short and long term viability of patient