Introduction to Acute Mechanical Circulatory Support

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ACC/SCAI Interventional Cardiology Overview and Board Preparatory Course
The Field of MCS: Robust with Innovation

2007 - 2017

IVADs
HVAD
Impella CP
TH-RVAD
Impella 5.0
TH + 5.0
BiPellas
No Definitive RCT Data Support Acute MCS Use for HR-PCI or Cardiogenic Shock

- Burkhoff: TH vs IABP
- Thiele: TH vs IABP
- Seyfarth: ISAR-SHOCK (Impella 2.5 vs IABP)

Graph showing trends in mechanical circulatory support procedures and IABP insertions from 2004 to 2011.
Hemodynamic Efficacy Without Clear Clinical Benefit in Small RCTs Comparing Acute MCS Options

<table>
<thead>
<tr>
<th></th>
<th>MCS</th>
<th>IABP</th>
<th>30-day mortality</th>
<th>RR</th>
<th>95%CI</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiele et al.</td>
<td>9</td>
<td>21</td>
<td></td>
<td>0.95</td>
<td>[0.48;1.90]</td>
<td>26.8%</td>
</tr>
<tr>
<td>Burkhoff et al.</td>
<td>9</td>
<td>19</td>
<td></td>
<td>1.33</td>
<td>[0.57;3.10]</td>
<td>17.9%</td>
</tr>
<tr>
<td>ISAR-SHOCK</td>
<td>6</td>
<td>13</td>
<td></td>
<td>1.00</td>
<td>[0.44;2.29]</td>
<td>18.6%</td>
</tr>
<tr>
<td>IMPRESS-IN-SEVERE-SHOCK</td>
<td>11</td>
<td>24</td>
<td></td>
<td>0.92</td>
<td>[0.51;1.66]</td>
<td>36.7%</td>
</tr>
<tr>
<td>Overall</td>
<td>35</td>
<td>77</td>
<td></td>
<td>1.01</td>
<td>[0.70;1.44]</td>
<td>100%</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2=0$, $I^2=0\%$, $p=0.91$
Test for overall effect: $p=0.98$

Cardiac index

PCWP

Mean arterial pressure

Thiele and de Waha et al EHJ 2017
Less Use of IABP in Cardiogenic Shock

- Seyfarth: ISAR-SHOCK
- Burkhoff: TH vs IABP
- Thiele: TH vs IABP
- Patel: CRISP-AMI
- Thiele: IABP-SHOCK II

The graph shows a decrease in the use of IABP per million discharges from 2007 to 2012, with notable events highlighted along the timeline.
Increasing Use of Continuous Flow in Cardiogenic Shock

O’Neill: PROTECT II (HR-PCI)
O’Neill: USPELLA AMI/Shock
Kar: TandemHeart in CGS
Seyfarth: ISAR-SHOCK (Impella 2.5 vs IABP)
Clinical Success with Acute MCS: Less about the tools, More about *how and when* you use them.

Kapur and Davila Eur H J 2017
Indications for Acute Mechanical Circulatory Support

High Risk Intervention

- Revascularization in Heart Failure: Class I
- Revascularization strategy based on degree, severity, & extent of CAD; cardiac lesions; extent of LV dysfunction; prior revascularization. PVADS: Large amount of ischemic territory/poor LV function

2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention. JACC
- High risk patients: Class IIb
- CLASS III: HARM without Hemodynamic support; for PCI at hospitals without on-site cardiac surgery

Cardiogenic Shock*

2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention. JACC
- PCI and Cardiogenic Shock: Class I

- Acutely decompensated heart failure patients: Class IIa

2013 Int’l Society for Heart & Lung Transplantation Guidelines for Mechanical Circulatory Support. Jnl of Heart & Lung Transplantation
- Temporary mechanical support for patients with multi-organ failure: Class I

2013 ACCF/AHA Guideline for the Management of Heart Failure, JACC
- “Bridge to Recovery” or “Bridge to Decision” for acute, profound hemodynamic compromise: Class IIa

- STEMI and Cardiogenic Shock: Class IIb
- STEMI and urgent CABG: Class IIa

*Impella is the only FDA-approved AMCS device for CGS
Pre-Session Question 1

Which of the following pumps employs a centrifugal flow rotary device?

1. Impella CP
2. Intra-aortic balloon pump
3. Veno-arterial extracorporeal membrane oxygenation
4. Heartmate Percutaneous Heart Pump (PHP)
Pre-Session Question 2

Which of the following 2 MCS devices reduce LV preload?

1. Impella CP
2. Intra-aortic balloon pump
3. Veno-arterial extracorporeal membrane oxygenation
4. TandemHeart left sided MCS device
Pre-Session Question 3

True or false. VA-ECMO can increase RV afterload?

1. True
2. False
Pre-Session Question 4

Which of the following devices can be used in the setting of acute aortic regurgitation?

1. Impella CP
2. Intra-aortic balloon pump
3. Veno-arterial extracorporeal membrane oxygenation
4. TandemHeart left sided MCS device
Pre-Session Question 5

Which of the following hemodynamic formulas has NOT been reported to identify severe RV failure in AMI?

1. Right atrial pressure
2. Right atrial:Pulmonary capillary wedge pressure ratio
3. Pulmonary pulse pressure/right atrial pressure
4. Pulmonary artery compliance
Pre-Session Question 6

Which one of the following components of the LV pressure volume loop consume the most energy?

1. Isovolumic contraction
2. Isovolumic relaxation
3. Early diastolic filling
4. Systolic ejection
Pre-Session Question 7

Which one of the following is LEAST likely to improve North-South Syndrome with VA-ECMO?

1. Optimizing lung oxygenation and ventilation
2. VVA-ECMO
3. VAV-ECMO
4. VA-ECMO + Impella CP (ECPELLA)
Pre-Session Question 8

Which of the following configurations can be used for biventricular failure and shock in the setting of an LV thrombus?

1. Biventricular Impellas
2. VA-ECMO + Impella CP
3. VA-ECMO alone
4. VA-ECMO + LA venting