Cardiogenic Shock and Initiatives to Reduce Mortality

Tanveer Rab, MD, FACC
William O’Neill, MD, FACC
Perwaiz Meraj, MD, FACC
Alex Truesdell, MD, FACC
The Golden “Hours”?

- 50% dead within 10 hours
- Overall mortality 86%
- Need: right treatment, right place, right time

Killip et al. Am J Cardiol 1967
Incidence of Cardiogenic Shock Growing

Cardiogenic Shock in STEMI Increasing

Studies have shown an increasing incidence of cardiogenic shock in STEMI patients. The graph illustrates the trend from 2003 to 2010, with a notable rise in the percentage of patients experiencing cardiogenic shock. The data indicates a significant increase in the number of cases from 2010 to 2014, with a 53% increase in the Medicare age group, excluding non-Medicare patients.

References:
1. Dhaval Kolte et al. J Am Heart Assoc 2014
2. Centers for Medicare and Medicaid database, MEDPAR FY14
Nationwide Inpatient Sample Databases

A
Total numbers of discharges
ICD-9-CM 785.51, Cardiogenic Shock

B
In-hospital mortality
ICD-9-CM 785.51, Cardiogenic Shock

50 %
PCI Mortality with Cardiogenic Shock Remains a Clinical Challenge

In-Hospital Mortality AMI Cardiogenic Shock with PCI

N = 32,598

2005-2006: 28% (11%)
2011-2013: 31% (p<0.0001)

AMI Cardiogenic Shock with PCI only; Overall mortality >50%
Wayangankar, et al. JACC Int 2016 CATH-PCI Registry
Q10min delay after 90 min
$\rightarrow$ 3.31xdeath/100 PCI tx
CS pts w/o OHCA
FITT-STEMI TRIAL

Scholz KH et al. EHJ 2018
Deaths from Cardiogenic Shock Complicating STEMI are Increasing

EDITORIAL COMMENT

Disappointing Results, But We Must Carry On*

Tanveer Rab, MD

- Lack of early Mechanical Circulatory Support
- Use of IABP
NCDR 2017: Low use of LV support (< 3 %)

IABP used predominantly

Frederick A. Masoudi et al. JACC 2017;69:1427-1450
Right Heart Cath is important with two important derived hemodynamic calculations:

1. Cardiac Power Output (CPO) = MAP x CO
   - Normal > 0.6 Watts

2. Pulmonary Artery Pulsatility Index (PAPI) = sPAP – dPAP / RA
   - Normal > 1.0
Cardiac power is the strongest hemodynamic correlate of mortality in cardiogenic shock.

**SHOCK** trial registry

Unadjusted estimated in-hospital mortality by cardiac power output (n = 189) with pointwise 95% confidence bands.

CPO (Watts) = MAP \times \frac{CO}{451}

Normal > 0.6 Watts
Right sided involvement in 50% of shock patients

![Bar chart showing percentage of RV Failure, RV Dysfunction, and No RV Dysfunction in SHOCK Trial and Registry.]

- **Defining RV Failure**
  - A. CVP > 16
  - B. RA:PCWP > 0.6 or > 0.8
  - C. PAPi (PAPP/CVP) < 1.0

4. Lala, Burkhoff and Kapur et al (Submitted)
Haemodynamics

The Pressure-Volume Loop

- AoV closes
- AoV opens
- LV Systolic Pressure
- Isovolumic Contraction
- Isovolumic Relaxation
- MV opens
- MV closes
- LVEDP
Haemodynamics

Ea - Effective Arterial Elastance – a component of afterload

Emax – load-independent LV contractility = maximal slope of ESPVR

LV Systolic Pressure

LVEDP

Stroke Work
Myocardial Infarction
Cardiogenic Shock
Effects of Mechanical Support

**IABP**
- Reduces peak systolic and diastolic pressures
- Increases LV stroke volume

**pLVAD**
- Reduces LV pressures, LV volumes and LV stroke volume
  - *Reduced cardiac workload*

**V-A ECMO (no vent)**
- Increases LV systolic and diastolic pressures
- Reduces LV stroke volume
  - *Increased slope of arterial elastance (Ea₂)*
AMI Shock Often Treated in Community Hospitals

AMI Cardiogenic Shock with PCI
N = 56,497

90% Private/Community
10% Academic/Gov't

<table>
<thead>
<tr>
<th></th>
<th>2005-06</th>
<th>2011-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;500 PCI</td>
<td>69%</td>
<td>52%</td>
</tr>
<tr>
<td>&lt;500 PCI</td>
<td>31%</td>
<td>48%</td>
</tr>
</tbody>
</table>

Wayangankar et al. JACC Interventions 2016 CATH-PCI REGISTRY
The arguments are:
I only have the balloon pump in my lab

TCTMD Poll June 2016
Which support devices do you have in your cath lab?

- IABP: 89%
- Impella: 31%
- ECMO/VAD: 22%
ACC/AHA 2013 and ESC 2017 Guidelines for LV support in Cardiogenic Shock

- **IABP**
  Disagreement:
  Class IIb (ACC/AHA)
  Class III (ESC)
- **MCS**
  Agreement:
  Class IIb in refractory cardiogenic shock
<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Pneumatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Configuration</td>
<td>Descending aorta via femoral artery</td>
</tr>
<tr>
<td>Maximal Support</td>
<td>0.5 – 1 LPM</td>
</tr>
<tr>
<td>LV Unloading</td>
<td>+</td>
</tr>
<tr>
<td>Implant time, complexity</td>
<td>+</td>
</tr>
<tr>
<td>Management Complexity</td>
<td>+</td>
</tr>
<tr>
<td>Limb Ischemia Risk</td>
<td>+</td>
</tr>
<tr>
<td>Hemolysis Risk</td>
<td>0</td>
</tr>
<tr>
<td>Hemorrhage Risk</td>
<td>+</td>
</tr>
<tr>
<td>Contraindications</td>
<td>AI, severe PAD, Aortic disease</td>
</tr>
</tbody>
</table>

IABP in AMI Cardiogenic Shock: No Hemodynamic or Survival Benefit

IABP SHOCK I
Randomized Controlled Trial
N = 40

IABP SHOCK II
Randomized Controlled Trial
N = 600

CPO = MAP x Cardiac Output x 0.0022

IABP Increased hazard risk of stroke, downgraded to Class III (harm), Level of Evidence A, ESC STEMI Guidelines 2014

2. Thiele H et al. NEJM 2012
Cardiogenic Shock in Acute MI

- 7 randomized trials, n 790 (75% from SHOCK II)
- 4 IABP vs no MCS
- 3 IABP vs other MCS
- No significant difference in survival

Evidence: Intra-Aortic Balloon Pump

Unverzagt et al. Cochrane Database Syst Rev. 2015 Mar 27;(3)
Conclusion: IABP and inotropes increase mortality in Cardiogenic Shock

- IABP increase cardiac work
- Inotropes increase myocardial oxygen consumption and impair microcirculation

Balloon Pump
- Reduces systolic aortic pressure
- Increases Stroke volume

Effect on Cardiac Work

<table>
<thead>
<tr>
<th>Dose</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Inotrope</td>
<td>2%</td>
</tr>
<tr>
<td>Low Dose</td>
<td>3%</td>
</tr>
<tr>
<td>Moderate Dose</td>
<td>7.5%</td>
</tr>
<tr>
<td>One High Dose</td>
<td>21%</td>
</tr>
<tr>
<td>Two High Dose</td>
<td>42%</td>
</tr>
<tr>
<td>Three High Dose</td>
<td>80%</td>
</tr>
</tbody>
</table>

Samuels LE et al, J Card Surg. 1999
# VA ECMO

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Centrifugal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Configuration</td>
<td>Inflow: Femoral vein/IVC</td>
</tr>
<tr>
<td></td>
<td>Outflow: Femoral artery</td>
</tr>
<tr>
<td></td>
<td>Pump: Extracorporeal</td>
</tr>
<tr>
<td>Maximal Support</td>
<td>&gt;5 LPM</td>
</tr>
<tr>
<td>LV Unloading</td>
<td>0</td>
</tr>
<tr>
<td>Implant time, complexity</td>
<td>++</td>
</tr>
<tr>
<td>Management Complexity</td>
<td>+++</td>
</tr>
<tr>
<td>Limb Ischemia Risk</td>
<td>+++</td>
</tr>
<tr>
<td>Hemolysis Risk</td>
<td>++</td>
</tr>
<tr>
<td>Hemorrhage Risk</td>
<td>++++</td>
</tr>
<tr>
<td>Contraindications</td>
<td>AI, severe PAD, contraindication to AC</td>
</tr>
</tbody>
</table>

![Diagram of VA ECMO setup](Image)
VA-ECMO

Nationwide Inpatient Sample databases

4 fold increase in use

Mortality unchanged at 50 %

Circ Cardiovasc Interv. 2017;10:e004337
# Outcomes in Cardiac Arrest with VA ECMO

<table>
<thead>
<tr>
<th>Study</th>
<th>Type</th>
<th>Cardiac Arrest</th>
<th>Cardiac Disease</th>
<th>Comparison</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nichol et al. (54)</td>
<td>CS and/or cardiac arrest</td>
<td>1,494 studies</td>
<td>75% cardiac</td>
<td>VA-ECMO 91%</td>
<td>50% survival to hospital discharge</td>
</tr>
<tr>
<td>ELSO registry (39)</td>
<td>Cardiac arrest</td>
<td>2,633: 295 ECPR</td>
<td>VA-ECMO 91%</td>
<td></td>
<td>27% survival to hospital discharge</td>
</tr>
<tr>
<td>Takyama et al. (53)</td>
<td>Refractory CS, 23% active CPR</td>
<td>90</td>
<td>SBP &lt; 90 mm Hg, CI &lt; 2.0 l/min/m², evidence of end-organ failure despite inotropes/vasopressors or IABP</td>
<td>VA-ECMO</td>
<td>49% survival to hospital discharge</td>
</tr>
</tbody>
</table>

- Vascular injury, bleeding and stroke: 33%
- Neurologic complications: 26% and 18%
- Bleeding and stroke: 26% and 18%
- LV distention and pulmonary edema
# Tandem Heart

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Centrifugal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Configuration</td>
<td>Inflow: LA via transeptal Outflow: Femoral artery Pump: Paracorporeal</td>
</tr>
<tr>
<td>Maximal Support</td>
<td>Up to 5 LPM</td>
</tr>
<tr>
<td>LV Unloading</td>
<td>++</td>
</tr>
<tr>
<td>Implant time, complexity</td>
<td>+++</td>
</tr>
<tr>
<td>Management Complexity</td>
<td>+++</td>
</tr>
<tr>
<td>Limb Ischemia Risk</td>
<td>+++</td>
</tr>
<tr>
<td>Hemolysis Risk</td>
<td>++</td>
</tr>
<tr>
<td>Hemorrhage Risk</td>
<td>+++</td>
</tr>
<tr>
<td>Contraindications</td>
<td>AI, severe PAD, contraindication to AC, LA thrombus</td>
</tr>
</tbody>
</table>
Improved haemodynamic parameters
Increase in bleeding, limb ischaemia, and sepsis

Thiele EHJ 2005;26:1276. Burkhoff AHJ 2006;152:e1
### IMPELLA

**Device Configuration**
- Inflow: LV
- Outflow: Aorta
- Pump: Transaortic

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Axial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal Support</td>
<td>1-5 LPM <em>(Impella 2.5, Impella CP, Impella 5)</em></td>
</tr>
<tr>
<td>LV Unloading</td>
<td>++ - +++</td>
</tr>
<tr>
<td>Implant time, complexity</td>
<td>++ - +++</td>
</tr>
<tr>
<td>Management Complexity</td>
<td>++</td>
</tr>
<tr>
<td>Limb Ischemia Risk</td>
<td>++</td>
</tr>
<tr>
<td>Hemolysis Risk</td>
<td>++</td>
</tr>
<tr>
<td>Hemorrhage Risk</td>
<td>++</td>
</tr>
<tr>
<td>Contraindications</td>
<td>LV thrombus, mechanical aortic valve, severe AS/AI, contraindication to AC</td>
</tr>
</tbody>
</table>

Received FDA Approval for Cardiogenic Shock after MI or OHS due to LV failure - 2016
**Door to “Unloading”?**

- **Do as Surgeons do** (*bypass first [unload LV/RV], reperfuse last*)
- **Increasing clinical evidence that implantation of an Impella device prior to PCI STEMI and shock may improve survival**

---

**FIGURE 1** Forest Plot Comparing In-Hospital/30-Day Mortality in “Early” vs. “Late” Impella

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Risk Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Risk Ratio (IV, Fixed, 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oweneel et al, 2017</td>
<td>-1.4697</td>
<td>1.2461</td>
<td>47.7%</td>
<td>0.23 [0.02, 2.64]</td>
</tr>
<tr>
<td>Basir et al, 2016</td>
<td>-0.7236</td>
<td>0.3589</td>
<td>56.4%</td>
<td>0.49 [0.24, 0.98]</td>
</tr>
<tr>
<td>Schroeter et al, 2016</td>
<td>-0.462</td>
<td>0.4323</td>
<td>38.9%</td>
<td>0.63 [0.27, 1.47]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>100.0%</strong> [0.52, 0.88]</td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 0.66, df = 2 (P = 0.72); I² = 0%
Test for overall effect: Z = 2.44 (P = 0.01)

CI = confidence interval.
Timing of Support Impacts Outcomes

30 Day Survival

cVAD Registry*
N=154

Impella Pre - PCI

IABP/Inotropes Pre-PCI

Log-Rank, p=0.004

Survival Rate

Days from initiation of Impella

O’Neill, et. al, J Interven Cardiol, 2014
### Randomization in AMI CS is Challenging

Prospective Impella Trials In Emergent Settings

<table>
<thead>
<tr>
<th>Study</th>
<th>Trial ID</th>
<th>Condition</th>
<th>Pts Required (n)</th>
<th>Pts Enrolled (n)</th>
<th>Duration (months)</th>
<th>Status</th>
<th>Reason for Discontinuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRENCH TRIAL (2006)</td>
<td>NCT00314847</td>
<td>AMI CS</td>
<td>200</td>
<td>19</td>
<td>52</td>
<td>Discontinued</td>
<td>Low Enrollment</td>
</tr>
<tr>
<td>ISAR-SHOCK (2006)</td>
<td>NCT00417378</td>
<td>AMI CS</td>
<td>26</td>
<td>26</td>
<td>19</td>
<td>Completed</td>
<td>N/A</td>
</tr>
<tr>
<td>IMPRESS (2007)</td>
<td>NTR1079 trialregister.nl</td>
<td>STEMI Pre-CS</td>
<td>130</td>
<td>18</td>
<td>22</td>
<td>Discontinued</td>
<td>Low Enrollment</td>
</tr>
<tr>
<td>RECOVER I FDA (2008)</td>
<td>NCT00596726</td>
<td>PCSs</td>
<td>Up to 20</td>
<td>17</td>
<td>28</td>
<td>Completed</td>
<td>N/A</td>
</tr>
<tr>
<td>RECOVER II FDA (2009)</td>
<td>NCT00972270</td>
<td>AMI CS</td>
<td>384</td>
<td>1</td>
<td>18</td>
<td>Discontinued</td>
<td>Low Enrollment</td>
</tr>
<tr>
<td>RELIEF I (2010)</td>
<td>NCT01185691</td>
<td>ADHF</td>
<td>20</td>
<td>1</td>
<td>33</td>
<td>Discontinued</td>
<td>Low Enrollment</td>
</tr>
<tr>
<td>DANSHOCK (2012)</td>
<td>NCT01633502</td>
<td>AMI CS</td>
<td>360</td>
<td>~50</td>
<td>40</td>
<td>Enrolling</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Problem: Low Enrollment
IMPRESS TRIAL

- 48 patients (underpowered)
- Majority in cardiogenic shock after cardiac arrest
- 100% mechanical ventilation
- 35% not salvageable – anoxic brain injury and refractory CGS
- Enrollment not completed
- No difference in outcomes

 Majority had device placement 

AFTER PCI

Impella vs Intra-Aortic Balloon Pump

CENTRAL ILLUSTRATION: Impella CP Versus IABP in Cardiogenic Shock

C. All-cause Mortality, ≤6 Months

Initiatives to Reduce Mortality
**QUALITY MEASURES**
- Impella Pre-PCI
- Door to Support Time < 90 minutes
- Establish TIMI III Flow
- Right Heart Cath
- Wean Off Vasopressors & Inotropes
- Maintain CPO >0.6 Watts
- Improve survival to discharge to >80%

**EXCLUSION CRITERIA**
- Evidence of acute MI (ACS) in the absence of shock
- Unresuscitated out-of-hospital cardiac arrest or any cardiac arrest in which ROSC is not achieved in 10 minutes
- Advanced age (≥ 70 years)
- Septic, sepsis, septic shock, and metastatic cause of shock
- Risk factor (e.g., history of stroke, pulmonary embolism, decompensated chronic heart failure)
- Active bleeding
- Inadequate peripheral vascular access
- Mechanical complications of dial
- Fractured femoral neck
- Patients who did not receive revascularization
- Cardiac tamponade in presence of pericardiocentesis
- Mechanical aortic valve

**ACCESS & HEMODYNAMIC SUPPORT**
- Obtain femoral arterial access for direct visualization with use of ultrasound and fluoro
- Obtain venous access (Femoral or Internal Jugular)
- Obtain either Fish or extended cardiac index or LVEDP
- If LVEDP > 15 or Cardiac Index < 2.5 AND anatomy suitable, place Impella

**Coronary Angiography & PCI**
- Attempt to provide TEP II above all major epicardial vessels other than CT
- If unable to obtain TIMI 3 flow, consider administration of time-critical vasodilators

**Perform Post-PCI Hemodynamic Calculations**
1. Cardiac Power Output (CPO): MAP x CO
2. Pulmonary Artery Pulsatility Index (PAPI): (aPAP – dPAP) / RA

**Wean OFF Vasopressors and Inotropes**
CPO should be >0.6 and eitherFish or extended cardiac index or LVEDP should be considered or in the Cath Lab or left in place with monitor to ICU.

**Resuscitation of Support**
- EPO results of correlations should consider the following options:
  - PAPI to consider right heart hemodynamic support
  - PAPI ≥ 0.6 consideration for additional local hemodynamic support
  - Placement of an appropriate MCS device
  - Impedance THA/thoracic cavity
- ECMO should be used and PAPI should provide right heart hemodynamic support if difficult transition for RV failure/bi-ventricular failure

**Vascular Assessment**
- Prior to discharge from the Cath Lab, a detailed vascular exam should be performed including femoral engagement and length measurement of the affected limb.
- Hematoma, external bruises should be documented.

**ICU Care**
- Daily hemodynamic measurements should be performed, including detailed vascular exam.
- Monitor for signs of hemodynamic and adjust Impella parameters as needed

**Discharge**
- Impella should only be considered for explantation once the following criteria are met:
  - Weaning off of all inotropes and vasopressors
  - CPO >0.6 and PAPI > 1.0

**Relate to Decision**
- Patients who do not meet favorable recovery within 3-5 days as clinically inferred, should be transferred to an LVAD/Transplant center. If patients are not candidates, palliative care options should be considered.

NATIONAL CARDIOGENIC SHOCK INITIATIVE
NationalCSI@hfhs.org
www.henryford.com/cardiogenicshock

American College of Cardiology
American College of Nursing
RAPID Identification of Cardiogenic Shock

Cath Lab Activation

Obtain Femoral Access

LVEDP

< 15 mmHg

Consider Other Causes of Shock

≥ 15 mmHg

IMPELLA

Door To Support Time

Target < 90 minutes
**CARDIAC POWER OUTPUT**

\[ \text{CPO} = \frac{\text{MAP} \times \text{CO}}{451} \]

**PULMONARY ARTERY PULSATILITY INDEX**

\[ \text{PAPI} = sPA - dPA / RA \]

**Impella Support**

\[ \downarrow \]

**PCI**

\[ \downarrow \]

**Right Heart Cath**

\[ \downarrow \]

**CPO < 0.6**

- **PAPI < 0.9**
  - **Possible RV Failure**
  - **Consider RV Support**

- **PAPI > 0.9**
  - **RV Normal**
  - **Consider ↑ of LV Support or Transfer to LVAD Center**

**CPO ≥ 0.6 and PAPI > 0.9**

- **Continue to Titrate**
  - **↓ Pressors/Inotropes**
The National Cardiogenic Shock Initiative

88 Patients

Excluded

- 23 patients
  - 4 unwitnessed arrest w/ delay CPR
  - 2 Septic Shock
  - 1 Aortic Stenosis
  - 1 massive PE
  - 5 patients without evidence of shock
    - Procedural complication
    - Decompensated Heart Failure (2)
    - Hypertensive Emergency
  - 9 patients with IABP prior to MCS

65 AMICS w/ Early MCS Support

Out of Hospital Cardiac Arrest – 10/65 (15%)
In Hospital Cardiac Arrest – 17/65 (31%)

Pre-PCI Impella 48/65 (74%)
IP/Post Impella 17/65 (26%)

Door to Balloon (STEMI) 98.3 min
Door to Support 91.5 min

74% Survival (N=48/65)
LACTATE LEVELS ACCORDING TO SURVIVAL

- ADMISSION
  - Non-Survivors: 6.9
  - Survivors: 4.6

- 12 HR
  - Non-Survivors: 7.1
  - Survivors: 2.7

- 24 HR
  - Non-Survivors: 7.8
  - Survivors: 2.3
CARDIAC POWER OUTPUT ACCORDING TO SURVIVAL

Non-Survivors

Survivors

PRE
POST
12 HR
24 HR

0.58
0.67
0.79
0.99
0.68
0.726
0.91
1

0.726
0.91
1
### Predictors of Survival CPO & Lactate at 12-24 hours (N=49/65)

<table>
<thead>
<tr>
<th>Lactate &lt; 3 &amp; CPO &lt; 0.8</th>
<th>Lactate &gt; 3 &amp; CPO &lt; 0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>83% Survival</td>
<td>36% Survival</td>
</tr>
<tr>
<td><strong>Lactate &lt; 3 &amp; CPO &gt; 0.8</strong></td>
<td><strong>Lactate &gt; 3 &amp; CPO &gt; 0.8</strong></td>
</tr>
<tr>
<td>95% Survival</td>
<td>66% Survival</td>
</tr>
</tbody>
</table>

*On Behalf of the National CSI Investigators (Unpublished, March 2018)*
## MCS Options

<table>
<thead>
<tr>
<th>Pulsatile</th>
<th>Axial-Flow</th>
<th>Centrifugal Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>IABP</td>
<td>Impella CP</td>
<td>TandemHeart</td>
</tr>
<tr>
<td>Intracorporeal</td>
<td>PHP *</td>
<td>VA-ECMO</td>
</tr>
</tbody>
</table>

- **Impella CP**: Labor intensive, No LV unloading
- **PHP**: Labor intensive
- **TandemHeart**: No LV unloading

**Continuous Flow Pumps**

**Minimal benefit in clinical trials**

**Labor intensive**

**No LV unloading**

*(Bi-Pella/EC-Pella)*

*Investigational*
A Practical Approach to Mechanical Circulatory Support in Patients Undergoing Percutaneous Coronary Intervention

An Interventional Perspective

Tamara M. Atkinson, MD, a E. Magnus Ohman, MD, b William W. O’Neill, MD, c Tanveer Rab, MD, d Joaquin E. Cigarroa, MD, a on behalf of the Interventional Scientific Council of the American College of Cardiology

(J Am Coll Cardiol Intv 2016;9:871-83)
Call for Organized Statewide Networks for Management of Acute Myocardial Infarction-Related Cardiogenic Shock

- Network of partners (spoke and hub)
- EMS/ER (rapid triage/transport)
  - Access/communications
    - High-volume
- Specialty care (center of excellence)
- Advanced (and integrated) therapies
  - Common set of providers
    - Quality (ongoing QI)
- Data management
- Administration, oversight, leadership...
- Research

Figure. Proposed Statewide Organization of Acute Myocardial Infarction With Cardiogenic Shock (AMICS) Management Similar to Trauma Center Paradigm

- Statewide organized system
- AMICS
  - Level 1: All aspects of definitive care
    - Long-term VAD
    - Right ventricle support
    - Total artificial heart
    - Heart transplant
  - Level 2: Initiation of definitive care
    - Cardiac catheterization laboratory
    - Percutaneous temporary VAD
    - ECMO
  - Level 3: Prompt assessment, resuscitation, stabilization, and emergency interventions
    - Diagnosis
    - Chemical support
    - Invasive monitoring
- ATLS
  - Initial resuscitation in the field by first responder
- ACLS
Shock Team Activation

• “One-call” system
• CCU Critical Care, CCU Cardiology, Cardiac Surgery, Interventional Cardiology, Advanced Heart Failure
  • Rapid, collaborative decision-making
  • “Bedside” or “Virtual” consultation
    • Consensus plan of care
    • Early MCS (as appropriate)
    • Hemodynamic-guidance
    • Formalized process
Conclusions

• There is increasing mortality in cardiogenic shock complicating myocardial infarction
• There is very low use of LV support
• IABP and inotropes increase mortality
• *Mechanical Hemodynamic Support* in Cardiogenic Shock Should be Used in All Patients!

*AND SHOULD BE PLACED BEFORE PCI*
Questions?