Temporary Mechanical Circulatory Support in the Cath Lab: Time for an Algorithm?

Advanced Cardiopulmonary Support of the Critically Ill Adult Conference 2019

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Disclosures

None

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YES !!

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Do We Need an Algorithm or Protocol for Everything?

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What Come into Our Cath Lab?

- Level One MI
- COOL IT
- Cardiogenic shock/arrest
- Complex PCI
- Protected high risk PCI
- Respiratory failure
- Complex structural procedures
- Potential complex ablations

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Understanding the Problem: Cardiogenic Shock (CS)

- **Systemic tissue hypo-perfusion secondary to inadequate cardiac output despite adequate circulatory volume and LV**
  - **It is all about the hemodynamics**
    - **Cardiac Index <1.8 L/min/m2 without hemodynamic support or <2.2 L/min/m2 with support**
    - **PCWP>15mmHg**
  - Signs of impaired organ perfusion with at least one of the following criteria
    - altered mental status
    - cold, clammy skin
    - oliguria
    - increased serum-lactate

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Cardiovascular Research Foundation

SCAI SHOCK:
A Team-Based Course on Cardiogenic Shock
October 12–13
Boston

Cardiogenic Shock Protocol

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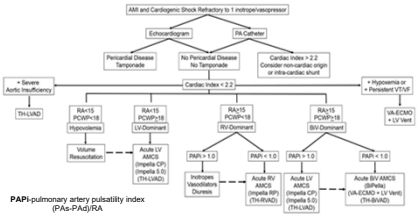
The Tufts Cardiogenic Shock Algorithm



PAPi-pulmonary artery pulsatility index (PAs-PAd)/RA

Kapur, Tufts Acute Mechanical Circulatory Support Program

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Protected High Risk PCI Algorithm

LVEF <50%: Evaluate Algorithm

LVEF <40%: Recommend RHC prior to PCI

+2 Cardiac Index < 2.0 or PA sat < 55%
+1 Syntax score >22
+1 EF < 25%
+1 Systolic < 100mmHg at baseline
+1 ACS presentation
+1 Planned Revascularization >2 territories
+1 Likely Prolonged Ischemia
- **Retrograde CTO**
- **Atherectomy**

+1 Severe mitral regurgitation
+1 Decompensated state
- **LVEDP >20**
- **Significant new orthopnea**

-1 High risk vascular injury / significant bleeding
-1 Hemoglobin < 8

0-2 → **Unlikely to Need Support**
3 → **Consider Support**
>4 → **Strongly Consider Support**

McCabe, James: TCT Nov. 2017

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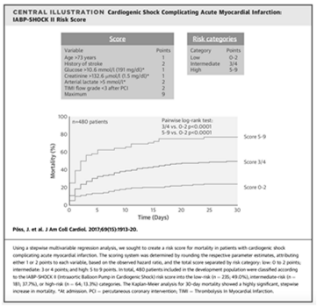
IABP-SHOCK II Risk Score



Pöss, J . JACC 2017:69(15):1913-20

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Elements of a MCS/Shock Algorithm

- **Indications/hemodynamics**: Mechanism of shock, prognosis/co-morbidities, advanced directives.
  - Decisions which often have to be made quickly
- **Early** initiation of mechanical support when indicated
  - "Door to support or unloading" concept
- Choice of **device(s)** based on the hemodynamics
  - Often dependent on operator preference, availability.
- **Flexiblity** in response to **hemodynamic changes**
  - LV venting, RV support.
- **Outcomes** oriented
  - Institutional, ELSO registry, national, NCDR.
  - Research initiatives
- **Provides consistency** within and between institutions
- Other considerations: specialists, staffing, equipment, hospital goals and economics.

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Your Algorithm

Depends on your institution, goals and available resources

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Ingredient for Success

- **Dedicated MCS Team**
  - Clear leader(s) of the team ("hemodynamicist")
  - Trained interventionalists
  - AHF specialists
  - CT surgery
  - Intensivists
  - Well trained nursing staff
  - Perfusionists
  - Vascular surgery
  - Pharmacists
  - Hospital and system support
  - Ability to transition to chronic MCS, destination therapy, transplantation.
  - EMTs, transport, referring hospitals, emergency departments.
  - Neuropyschology, PMR, social services
  - Device representatives

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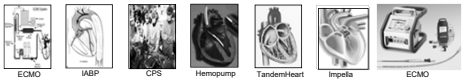
Evolution of MCS



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Indications for MCS Broadening

TABLE 1 Suggested Indications for Percutaneous MCS

Indication	Comments
Complications of AMI	Ischemic mitral regurgitation is particularly well-suited to these devices as the hemodynamic disturbance is usually acute and substantial. Acutely depressed LV function from large AMI during and after primary PCI is an increasing indication for temporary MCS use. Cardiogenic shock from RV infarction can be treated with percutaneous right ventricular support.
Severe heart failure in the setting of nonischemic cardiomyopathy	Examples include severe exacerbations of chronic systolic heart failure as well as acutely reversible cardiomyopathies such as fulminant myocarditis, stress cardiomyopathy, or peripartum cardiomyopathy. In patients presenting in INTERMACS profiles 1 or 2, MCS can be used as a bridge to destination VAD placement or as a bridge to recovery if the ejection fraction rapidly improves (108).
Acute cardiac allograft failure	Primary allograft failure (adult or pediatric) may be due to acute cellular or antibody-mediated rejection, prolonged ischemic time, or inadequate organ preservation.
Post-transplant RV failure	Acute RV failure has several potential causes, including recipient pulmonary hypertension, intraoperative injury/ischemia, and excess volume/blood product resuscitation. MCS support provides time for the donor right ventricle to recover function, often with the assistance of inotropic and pulmonary vasodilator therapy (109).
Patients slow to wean from cardiopulmonary bypass following heart surgery	Although selected patients may be transitioned to a percutaneous system for additional weaning, this is rarely done.
Refractory arrhythmias	Patients can be treated with a percutaneous system that is somewhat independent of the cardiac rhythm. For recurrent, refractory, ventricular arrhythmias, ECMO may be required for biventricular failure.
Prophylactic use for high risk PCI	Particularly in patients with severe LV dysfunction (EF <20% to 30%) and complex coronary artery disease involving a large territory (sole-remaining vessel, left main or three vessel disease) (94,95,98).
High-risk or complex ablation of ventricular tachycardia	Similar to HR-PCI, complex VT ablation can be made feasible with percutaneous support. MCS use allows the patient to remain in VT longer during arrhythmia mapping without as much concern about systemic hypoperfusion.
High-risk percutaneous valve interventions	These evolving procedures may be aided with the use of MCSs.

2015 SCAI/ACC/HFSA/STS Clinical Expert Consensus Statement

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Use of MCS is on the Rise

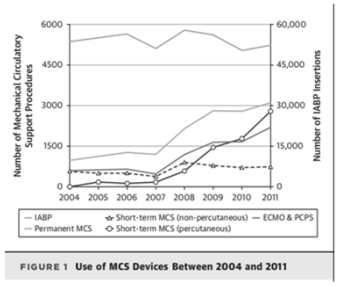

FIGURE 1 Use of MCS Devices Between 2004 and 2011

Stretch R. JACC 2014;64;1407-15

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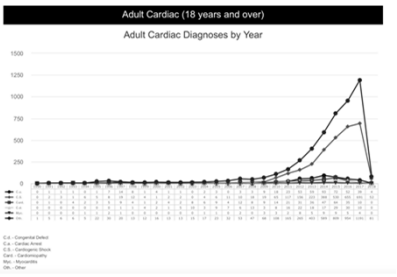
Use of AMCS (ECMO) is on the Rise



ELSO Registry July 2018

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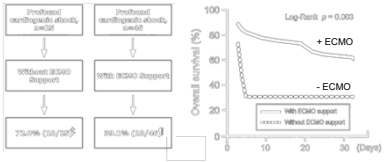
VA ECMO for AMI with Refractory Cardiogenic Shock

Profound Shock
SBP < 75 mmHg + IABP + Dopamine > 60 mcg/kg/min



Crit Care Med 2010; 38:1810 –1817

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Door to Support or Unloading Concept

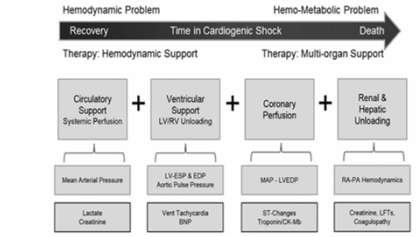

Figure 1. **The hemodynamic support equation.** The Hemodynamic Support Equation encompasses the four major management objectives for patients with cardiogenic shock, which include: circulatory support, ventricular unloading, myocardial perfusion, and decongestive strategies. BNP, brain natriuretic peptide; CK-MB, creatinine kinase and its MB isozyme; EDP, end-diastolic pressure; ESP, end-systolic pressure; LFT, liver function test; LV, left ventricle; MAP, mean arterial pressure; PA, pulmonary artery; RA, right atrium; RV, right ventricle.

Esposito, Kapur. F1000Research 2017, 6(F1000 Faculty Rev):737

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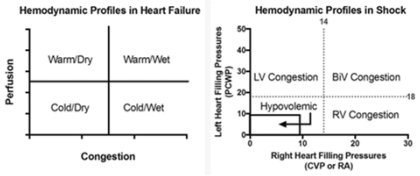
Hemodynamic Stratification Pre-AMCS Implant



Esposito, Kapur. F1000Research 2017, 6(F1000 Faculty Rev):737

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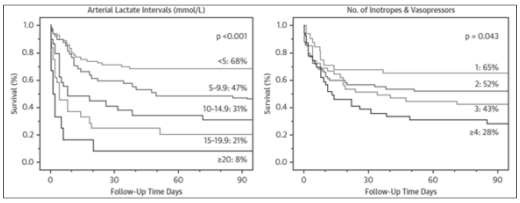
Don't wait too long…..



Fux et al. J Am Coll Cardiol. 2017 Oct 17;70(16):2094-2096

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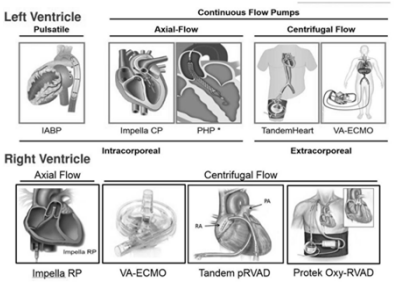
Acute Support Available



Esposito, Kapur. F1000Research 2017, 6(F1000 Faculty Rev):737

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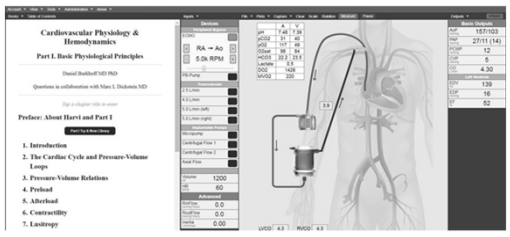
Computational Models?
Harvi Simulator



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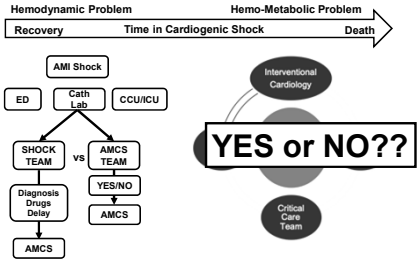
Streamlining the Decision Making Process



Kapur, TCT 2017

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MHI Protocol

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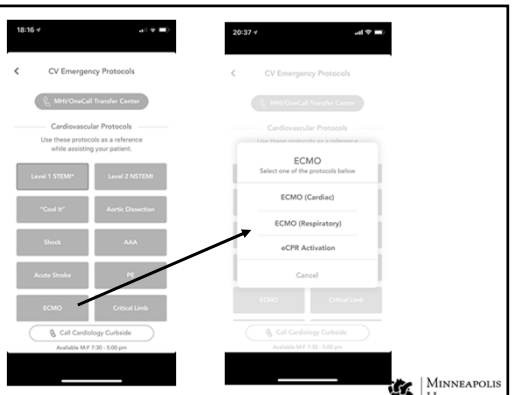

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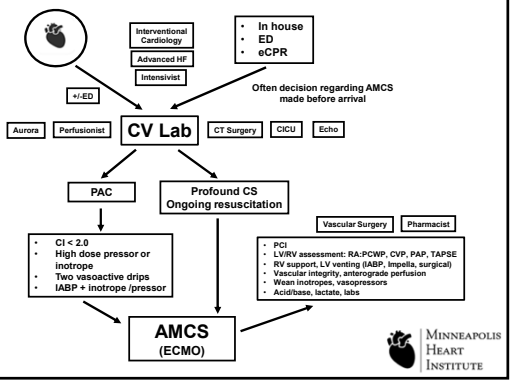
MHI Cardiogenic Shock Protocol (24/7/365)



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Conclusions

- Algorithms are inevitable and being developed for various situations including CS and high risk PCI.
- Institution specific but fundamentally based on ability to perform accurate clinical and hemodynamic assessment
- Streamlines the process of decision making and treatment
  - Pre-hospital and in the CV lab
- Optimizes the available resources of your institution and potential referral sites
- Provides predictability and consistency
- Important to review outcomes data to allow validation and adjustments in approach and algorithm

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Thank you

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