Escalation of Care in CS

When and How?

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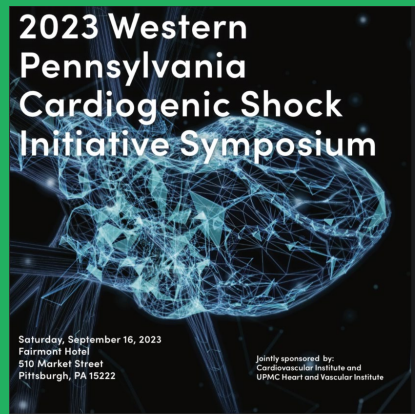


Disclosures

- Speakers Bureau/Honoraria: Inari Medical, Inc

Objectives

- Patient monitoring during Escalation
- Utility of Hemodynamic Profiling (Invasive vs. Non-Invasive)
- Escalation Strategies in AMI-CS vs. HF-CS, Utility of the Shock Team
- De-Escalation Strategies

Escalating and De-escalating Temporary Mechanical Circulatory Support in Cardiogenic Shock: A Scientific Statement From the American Heart Association

Bram J. Geller, MD, Chair, Shashank S. Sinha, MD, MSc, FAHA, Vice Chair, Navin K. Kapur, MD, FAHA, Marie Bakitas, DNSc, CRNP, Leora B. Balsam, MD, Joanna Chikwe, MD, Deborah G. Klein, MSN, ACNS-BC, FAHA, Ajar Kochar, MD, MHS, Sofia C. Masri, MD, Daniel B. Sims, MD, FAHA, Graham C. Wong, MD, MPH, FAHA, Jason N. Katz, MD, MHS, FAHA, Sean van Diepen, MD, MSc, FAHA, and on behalf of the American Heart Association Acute Cardiac Care and General Cardiology Committee of the Council on Clinical Cardiology; Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular and Stroke Nursing; Council on Peripheral Vascular Disease; and Council on Cardiovascular Surgery and Anesthesia

Matching CS treatment options

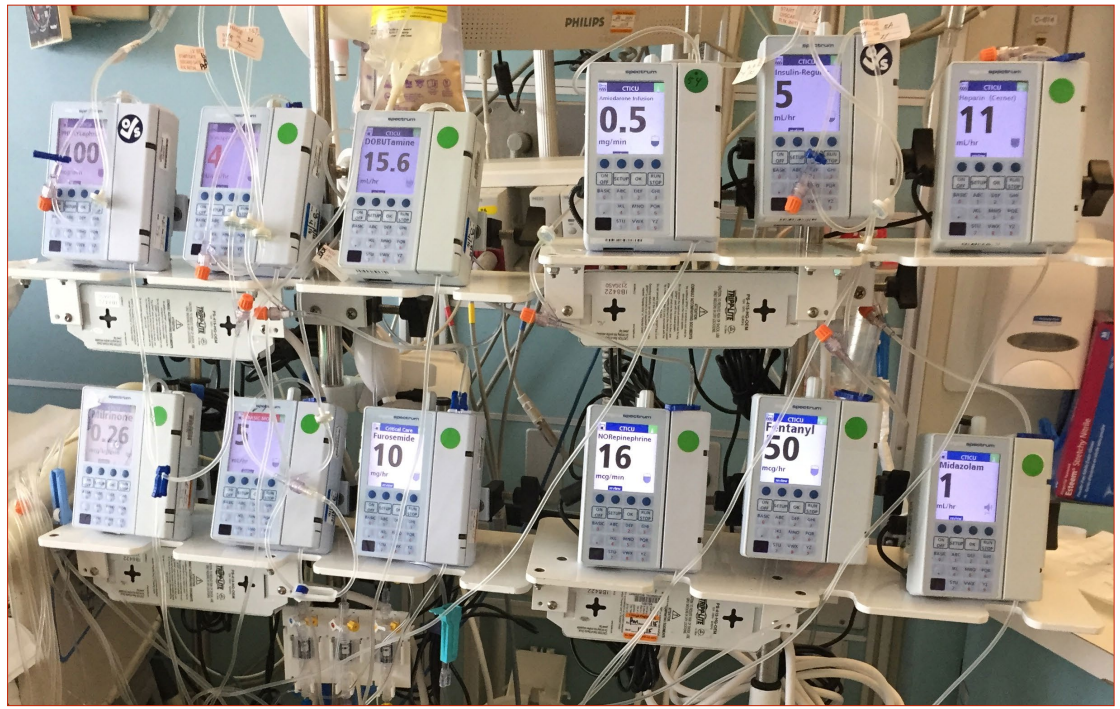
to Patient Needs

WHEN | HOW

When to consider device therapy:

▼

Escalating inotropes / pressor requirement



› Catheter Cardiovasc Interv. 2021 Aug 3. doi: 10.1002/ccd.29895. Online ahead of print.

Vasopressors independently associated with mortality in acute myocardial infarction and cardiogenic shock

Mir B Basir [1], Alejandro Lemor [1], Sarah Gorgis [1], Angela M Taylor [2], Behnam Tehrani [3], Alexander G Truesdell [3], Aditya Bharadwaj [4], Brian Kolski [5], Kirit Patel [6], Joseph Gelormini [7], Josh Todd [8], David Lasorda [9], Craig Smith [10], Robert Riley [11], Steve Marso [12], Robert Federici [13], Navin K Kapur [14], William W O'Neill [1], National Cardiogenic Shock Initiative Investigators

Increasing vasopressor requirements were independently associated with increasing mortality

Matching CS treatment options

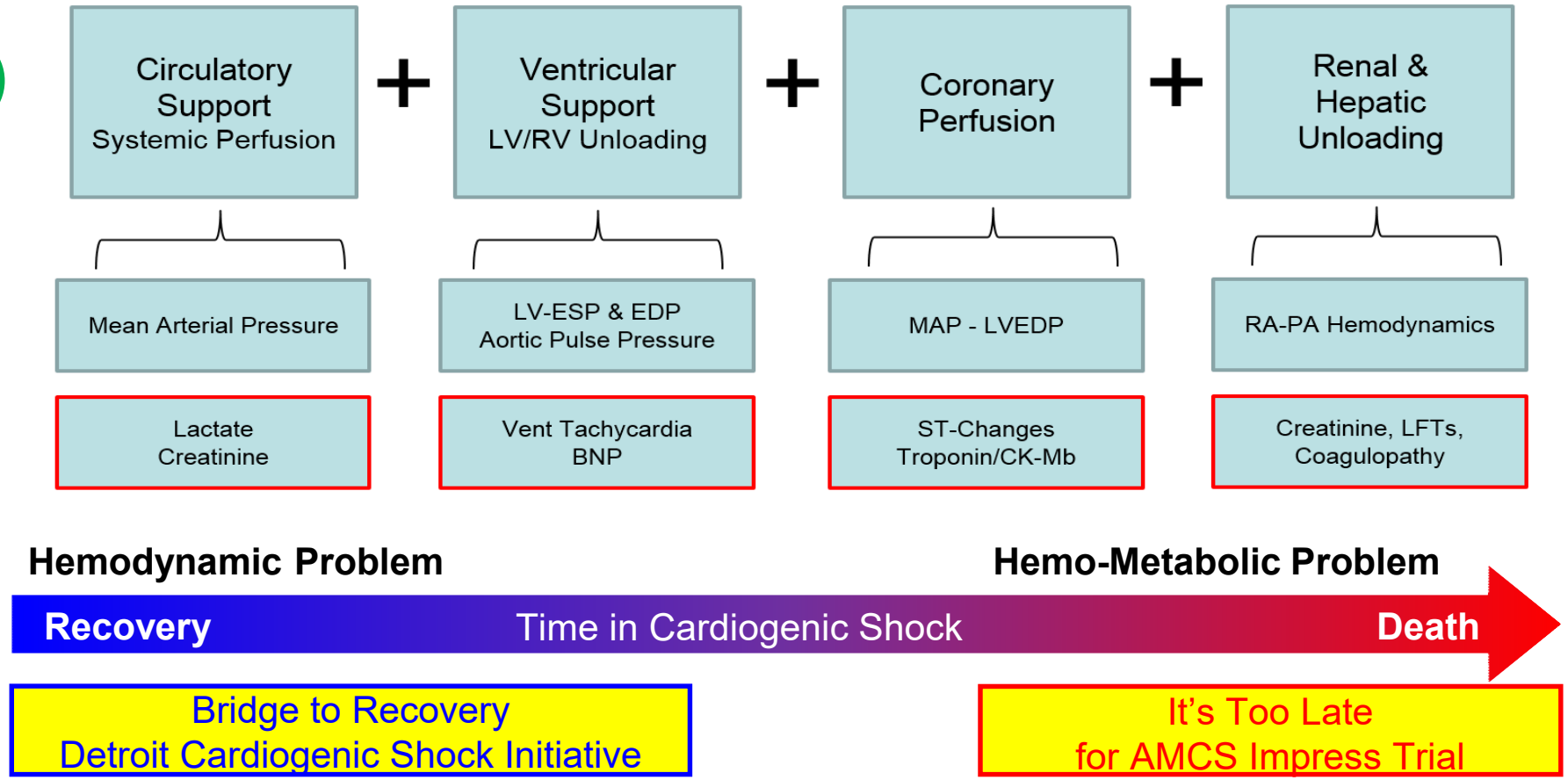
to Patient Needs

WHEN | HOW

HOW TO CHOOSE
device therapy:

▼

Acute MCS is a
Hemodynamic
Support Platform



Kapur and Esposito Curr Cardio Risk 2016 & F1000 2017

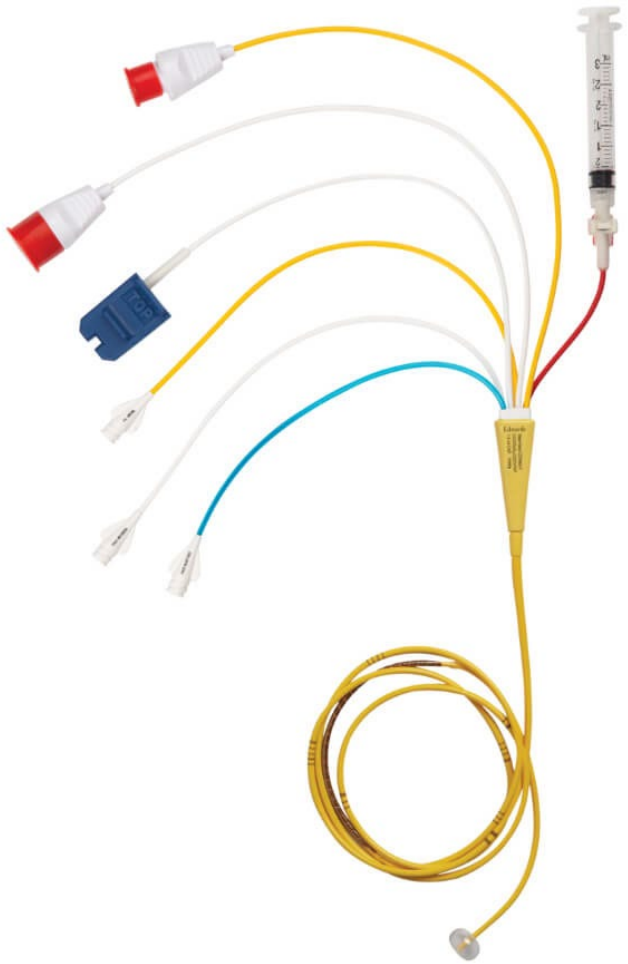
Central

Invasive Cardiac Hemodynamics

Metric	Calculation	Markers of cardiogenic shock
Cardiac index (CI)	CO/body surface area	≤2.2 L/min/m^2
Cardiac power output (CPO)	(MAP x CO)/451	<0.6 W
Cardiac power index (CPI)	(MAP x CI)/451	<0.4 W/m^2
Pulse pressure	systolic – diastolic blood pressure	<25 mmHg
Systemic vascular resistance (SVR)	[(MAP – CVP) / CO] x 80	variable

Right Ventricular Metrics	Calculation	Markers of RV dysfunction
Right atrial pressure (RAP)		>10/15 mmHg
Right atrial pressure (RAP) / Pulmonary capillary wedge pressure (PCWP)		>0.86 (in acute MI) >0.63 (after LVAD)
Pulmonary artery pulsatility index (PAPi)	(PASP-PADP) / RAP	≤0.9 (in acute MI) <1.85 (after LVAD)
Right ventricular stroke work index (RVSWI)	0.0136 x SVi x (mPAP–RAP)	<6 g/m/beat/m^2

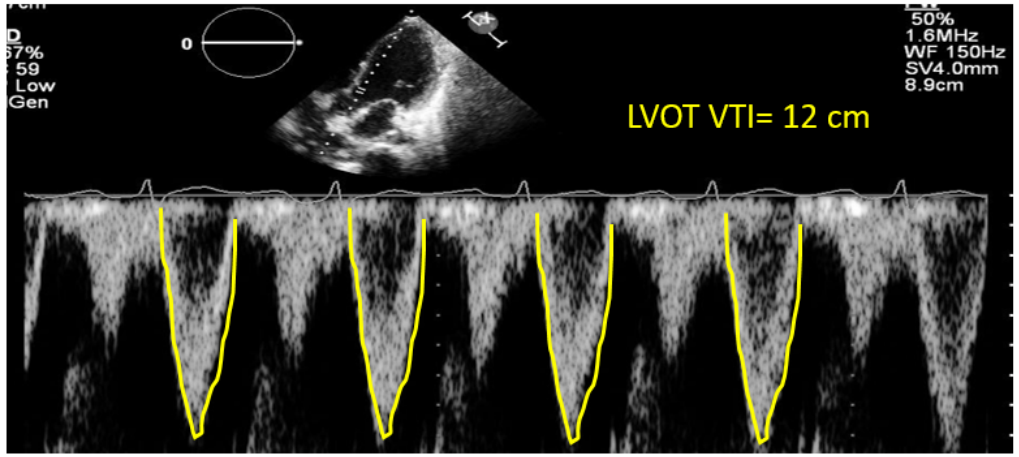
Pulmonary Vascular Metrics	Calculation	Markers of pulmonary vascular disease
Transpulmonary pressure gradient (TPG)	mPAP-PCWP	≥12 mmHg
Diastolic pulmonary gradient (DPG)	PADP-PCWP	≥7 mmHg



Hemodynamic Phenotyping

- Invasive (PAC)
- Non-invasive methods (Echo)

Serial Assessments of Stroke Volume & Cardiac output

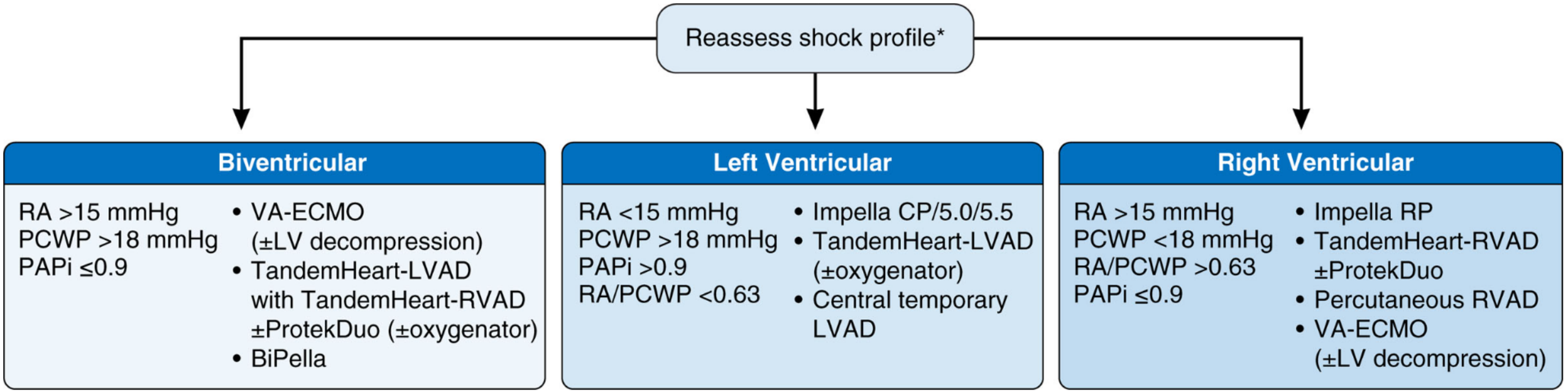


Measure LVOT Diameter
Measure LVOT VTI

$SV = 3.14(D/2)^2 \times LVOT\ VTI$

$CO = SV \times HR$

IS IT THE LV, RV OR BOTH?



Shock Teams

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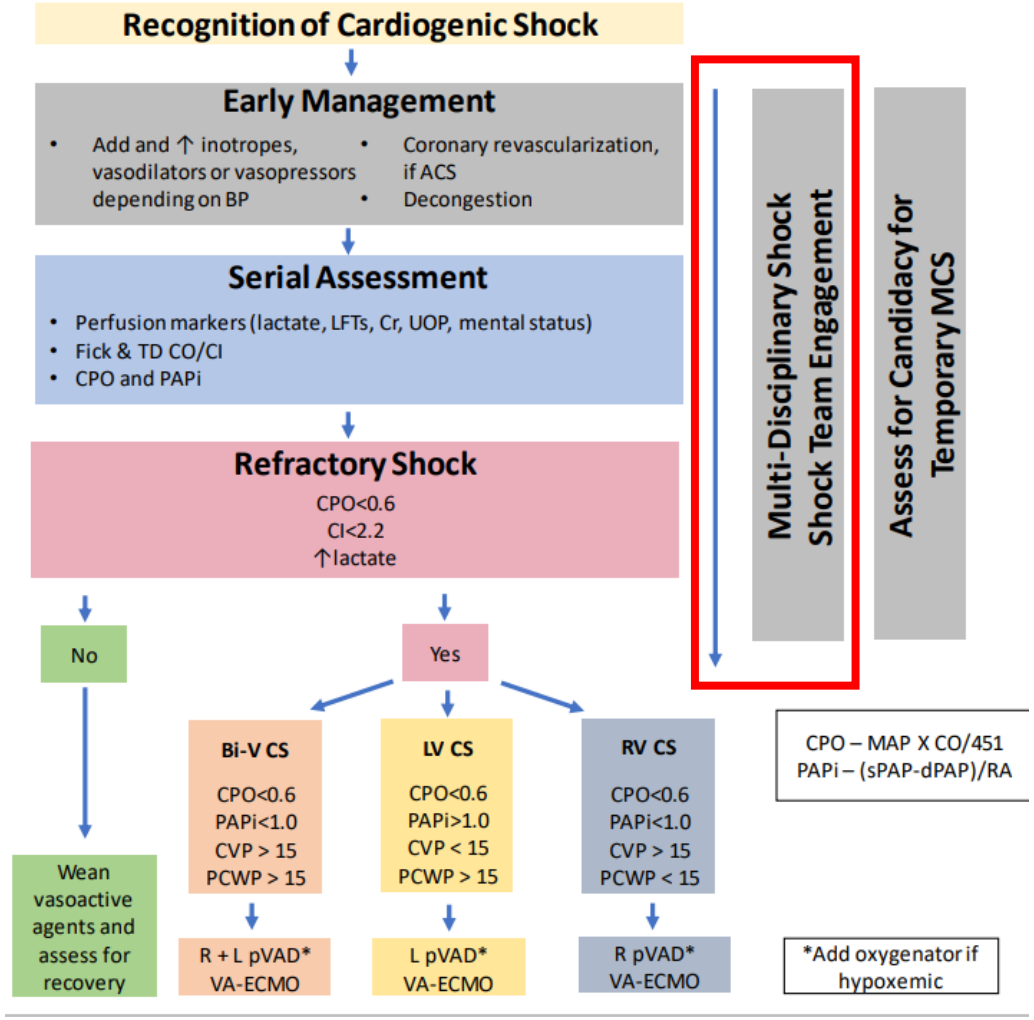
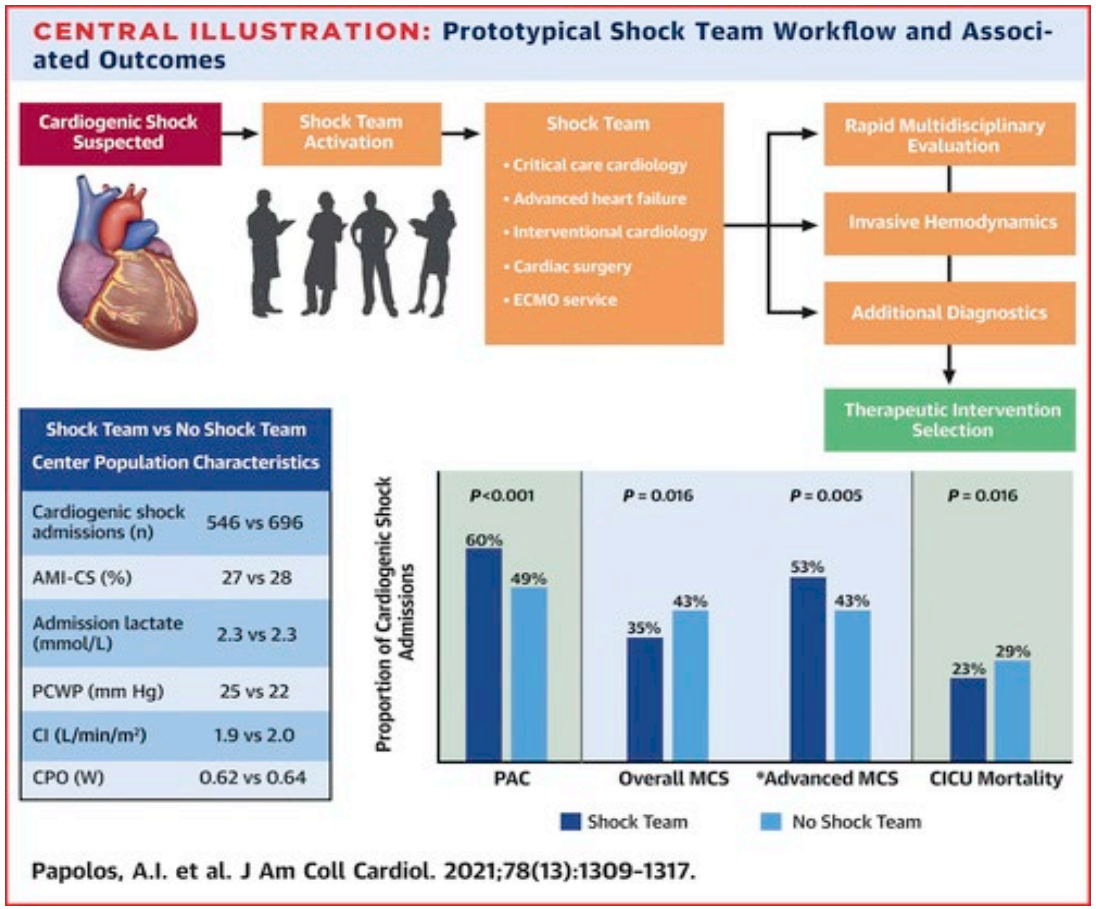


Management and Outcomes of Cardiogenic Shock in Cardiac ICUs With Versus Without Shock Teams

FREE ACCESS

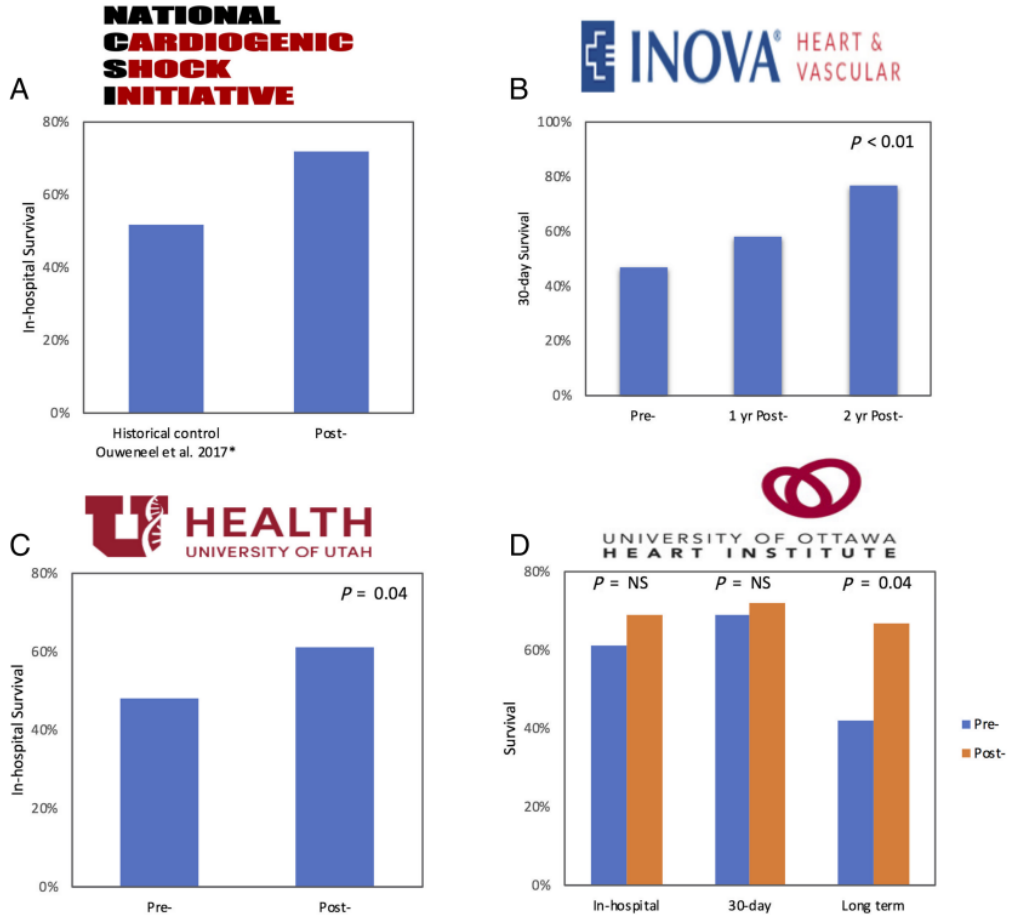
Original Investigation

Alexander I. Papolos, Benjamin B. Kenigsberg, David D. Berg, Carlos L. Alviar, Erin Bohula, James A. Burke, Anthony P. Carnicelli,



This is Team Sport

Figure 1 Survival outcomes pre-shock and post-shock team/protocol implementation in the (A) National Cardiogenic Shock Initiative, (B) INOVA Heart and Vascular Institute Shock Team Protocol, (C) Utah Cardiac Recovery shock team, and (D) University of Ottawa Heart Institute Code shock team. *Data from the IMPRESS in Severe Shock Trial.[12] **No baseline institutional survival outcomes or controls reported in the National Cardiogenic Shock Initiative.



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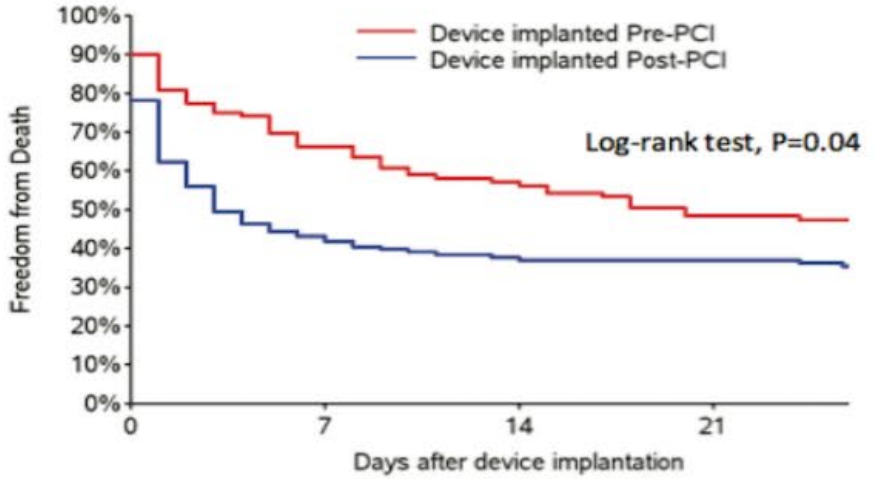
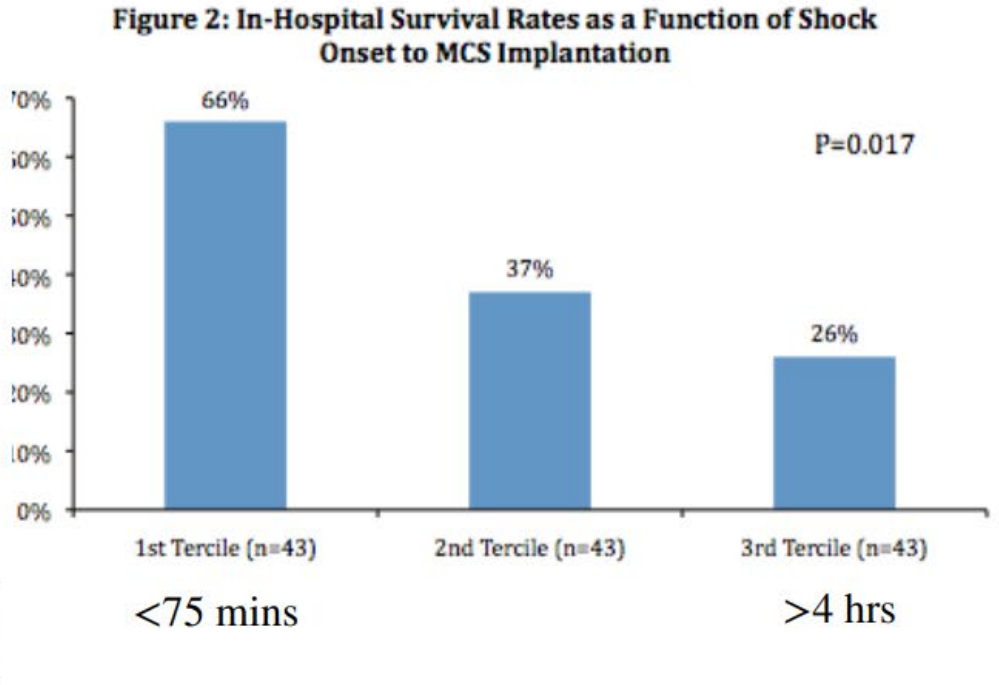
Delaying MCS in AMI-CS = Worse Outcomes



B. Kaplan-Meier Curve for Freedom from Death (to 30 Days) by Device Implanted Pre/Post PCI. The separation of the Kaplan-Meier curves occurs very early post-PCI reinforcing that early MCS is a key determinant in clinical outcomes.



Basir M, Schreiber T, Grines C, et al. Effect of Early Initiation of Mechanical Circulatory Support on Survival in Cardiogenic Shock. Am. J. of Cardiology, 2016.

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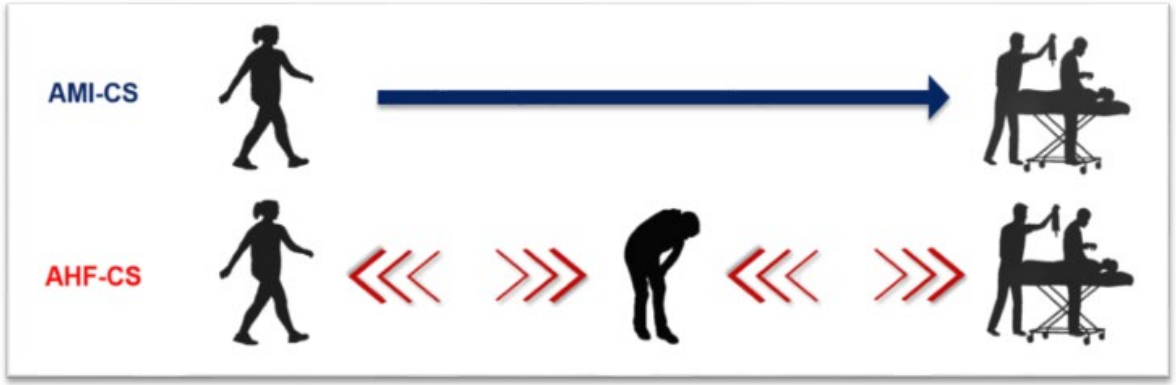
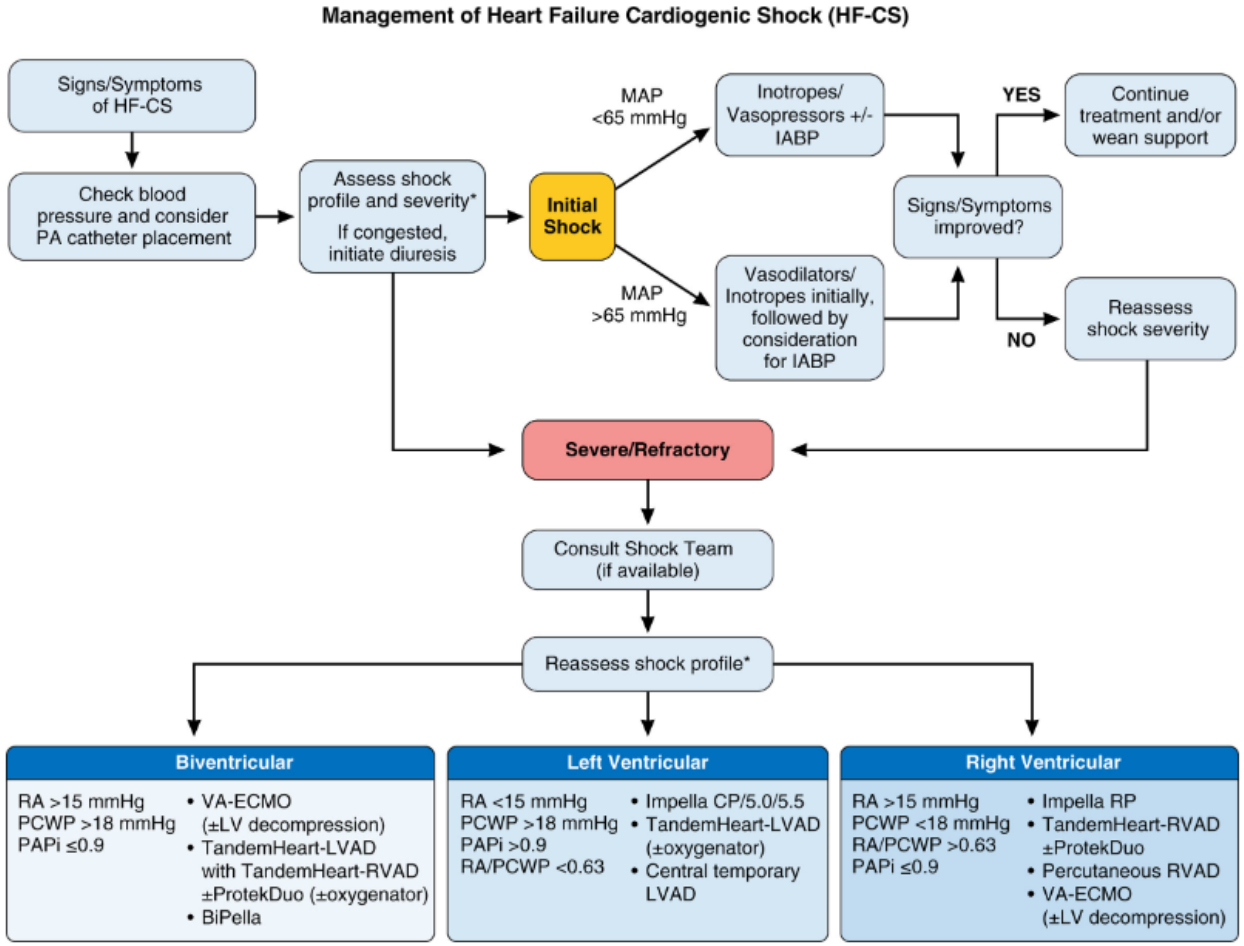
Not all Shock Created Equal



HF-CS Escalation



Weaning Protocols

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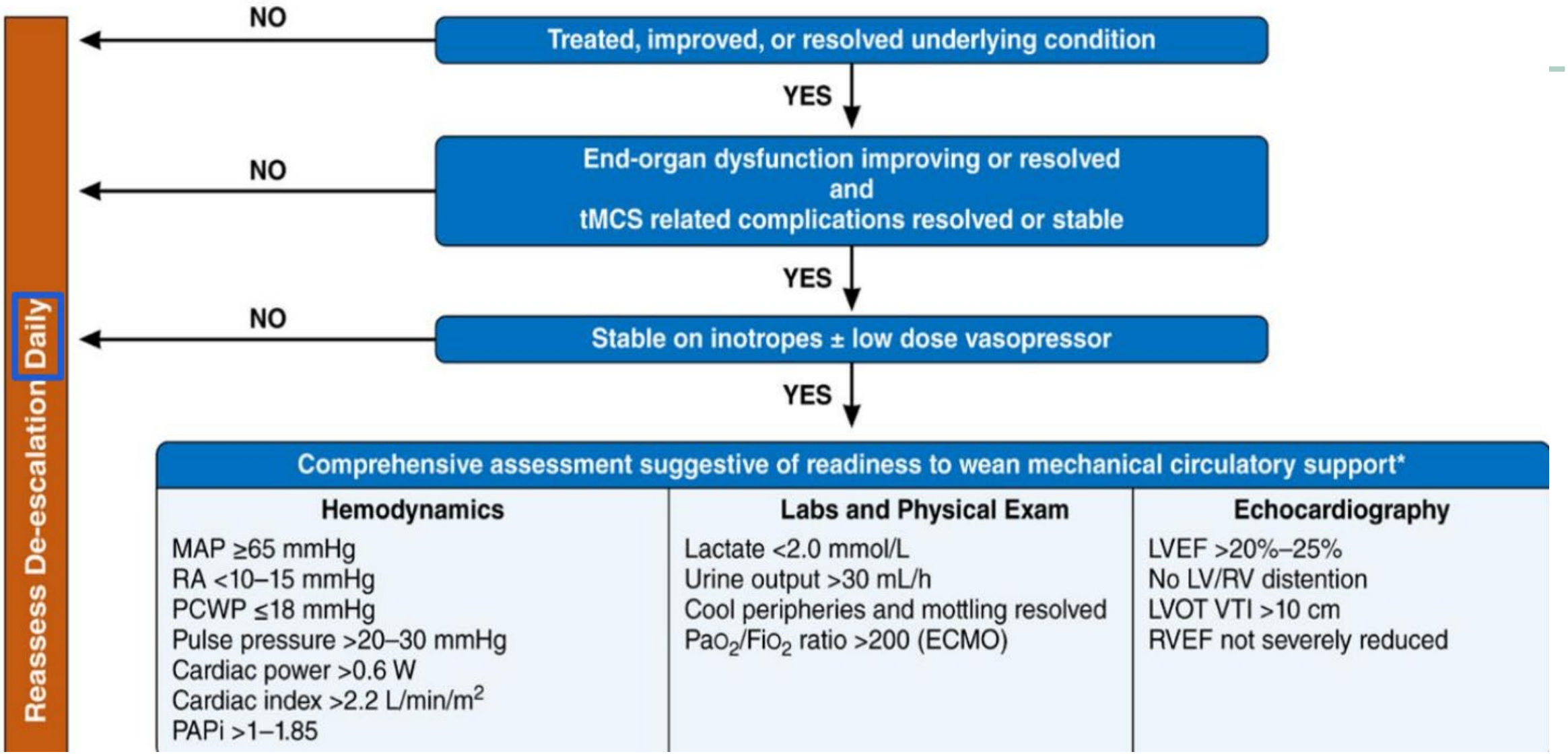
When to De-escalate t-MCS

- **Daily** evaluations for weaning appropriateness
- Goal: **partial or full myocardial recovery** (ideally resolution of **underlying** cause of shock)
  - Minimal IV vaso-active medications
  - Improved contractility per echocardiography
- Improvement in end-organ **hypo-perfusion**
- Euvolemia!
- **MCS related complications (vascular injury, bleeding, etc.)*

When to De-escalate t-MCS



How to De-escalate t-MCS

- **Step-wise** decrease in support that is device specific

- Timing intervals of support decrements:
  - **Rapid:** 15 minutes (e.g. high risk PCI)
  - **Standard:** q2-4 hours (e.g. decompensated heart failure)

- Concomitant **anticoagulation** is necessary to minimize risk of thrombo-embolic events

Device specific approach for t-MCS De-Escalation

	Device	Weaning increment	Rapid weaning frequency	Standard weaning frequency	Lowest level before decannulation
LV support*	IABP	From 1:1 to 1:2 to 1:3 (or 1:4/1:8, depending on the manufacturer) Alternatively, may decrease volume serially by 10%–25%	Direct from full support to 1:3 (or 1:4) 75% reduction of volume	Every 2–4 h	1:3 (or 1:4/1:8) 75% reduction of volume
	Impella 2.5, CP, or 5.5	P1–P2	Every 5 min	Every 2–4 h	P2
	TandemHeart LVAD	0.5 L/min	Every 5 min	Every 2–4 h	2 L/min
RV support*	Impella RP	P1–P2	Every 5 min	Every 2–4 h	P2 (though maintain flows >1.5 L/min)
	TandemHeart RVAD ±ProtekDuo	0.5 L/min	Every 5 min	Every 2–4 h	2 L/min
Biventricular support*	VA-ECMO	0.5–1 L/min	Every 5–15 min	Every 2–4 h	1–2 L/min (generally not maintained at 1 L/min)

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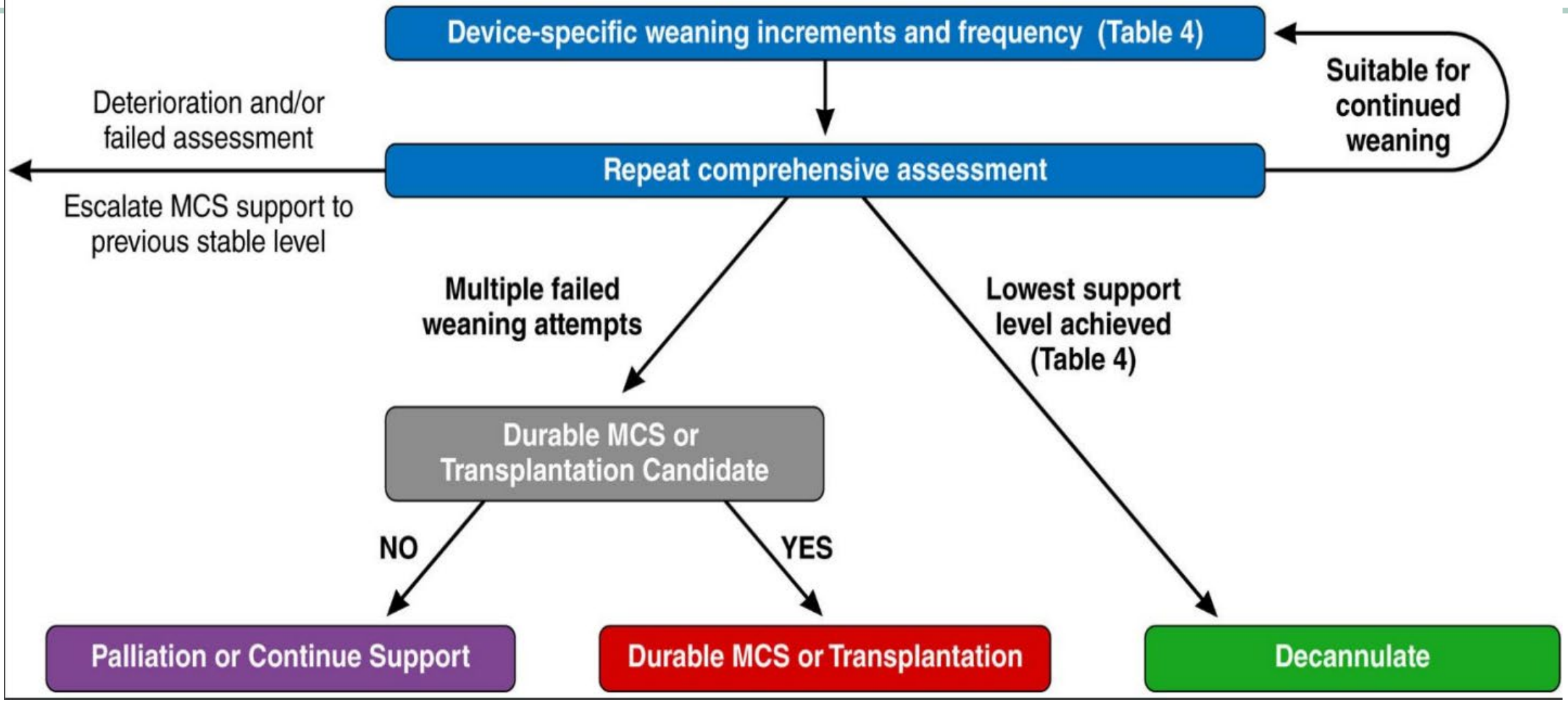
How to wean t-MCS



Conclusion

- **Early, upfront** therapy must match patient's needs
- **Clinical, hemodynamic, metabolic and imaging** parameters should help guide escalation and de-escalation strategies
- **Multidisciplinary shock teams** can help facilitate care
- **Daily** assessment of readiness to wean
- Have a **method** to your "exit" strategies

Thank you

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