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When MAP Misleads: Rethinking Perfusion Targets in Shock

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Disclosures

- None

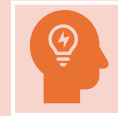
Objectives



Review cardiogenic shock the associated mortality, and survivorship.



Explain the role and limitations of using MAP.



Distinguish macrocirculation from microcirculation



Identify alternative markers of perfusion and shock severity beyond MAP.



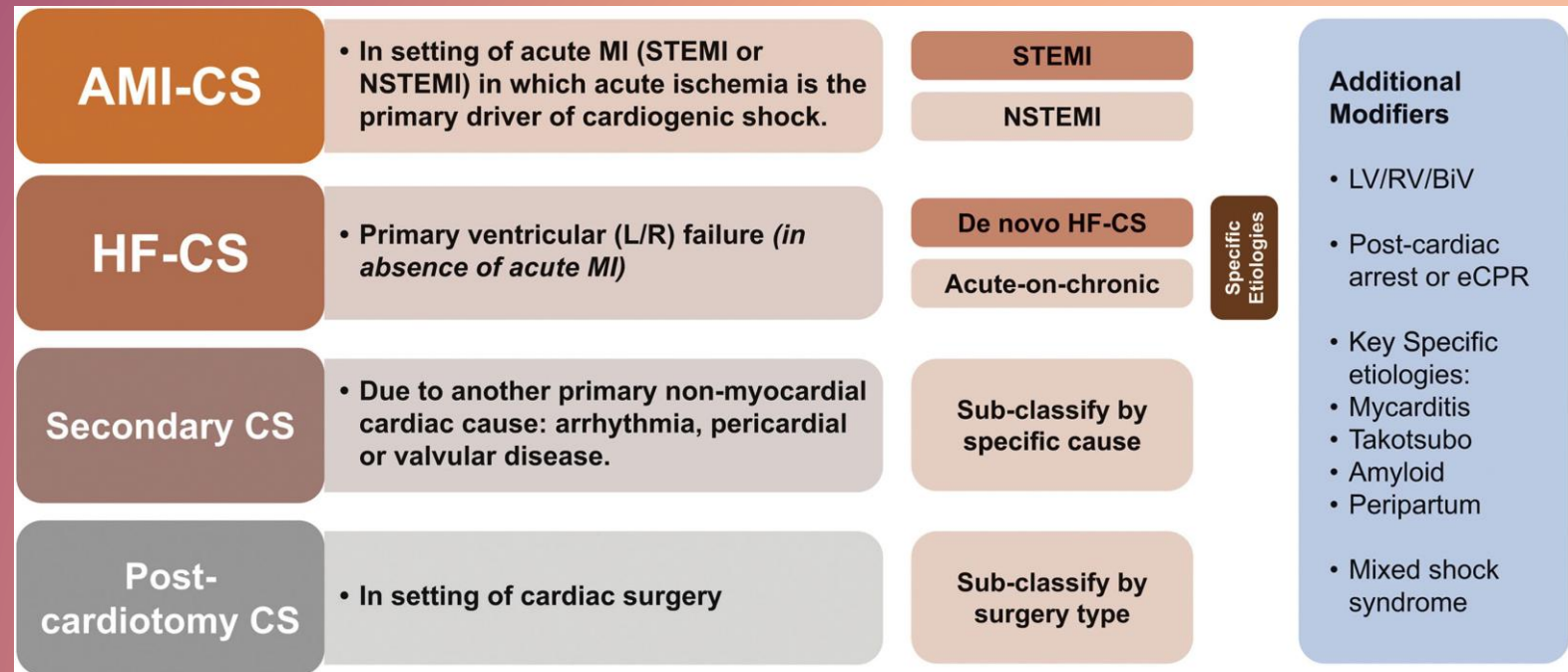
Individualize perfusion goals to patient needs and optimize survivorship.

How Did We Get Here?

Perfusion Targets	2017 ACC/AHA Scientific Statement on CS ⁸	2022 AHA/ACC Guideline for the Management of Heart Failure ^a	Management of CS Complicated MI: An Update 2019 ⁷	2021 ESC Guidelines for Diagnosis and Treatment of Acute and Chronic Heart Failure ^b
Hemodynamic targets	No clear sBP or MAP recommendations	No clear sBP or MAP recommendations	No clear sBP or MAP recommendations. Suggest that MAP >65 mmHg probably not required	No clear sBP or MAP recommendations. In AHF with sBP >110 mmHg, IV vasodilators may be considered as initial therapy to improve symptoms and reduce congestion (Class IIb)
Physical exam targets	Use cold/warm and wet/dry descriptors to highlight hemodynamic phenotypes. Longitudinal CVP trends may provide information on trends in fluid status	Severity of congestion and adequacy of perfusion should be assessed to guide triage and initial therapy (Class I)	Not specified	Use wet/dry and warm/cold, as well as mental confusion, dizziness, and narrow pulse pressure. Emphasize that hypoperfusion is not always accompanied by hypotension
Renal targets	Suggest serial monitoring of urine output and creatinine. Include KDIGO guidelines that CRRT be considered when "life-threatening changes in fluid, electrolyte, and acid-base balance" exist	Not specified	Suggest serial monitoring of urine output and creatinine RRT initiated with AKI and uremia, refractory volume overload, metabolic acidosis, and/or refractory hyperkalemia (Class IIb)	Suggest serial monitoring of urine output and creatinine
Lactate targets	Suggest serial monitoring of arterial lactate q1-4 h	Not specified	Not specified	Suggest serial monitoring and when peripheral hypoperfusion is suspected
Additional variables for serial monitoring	Suggest using serial perfusion markers including SvO ₂ or ScvO ₂ LFTs, mental status, and other invasive hemodynamic variables	Not specified	Not specified	NT-pro-BNP recommended at admission, predischarge
Vasoactive agent selection	Norepinephrine may be vasopressor of choice as associated with fewer arrhythmias Note that optimal first-line vasoactive medication in CS remains unclear Provides pragmatic considerations based on etiology and phenotype of shock	In patients with CS, intravenous inotrope support should be used to maintain systemic perfusion and preserve end-organ performance (Class I) Choice of inotrope guided by blood pressure, concurrent arrhythmias, and availability	Norepinephrine is vasoconstrictor of choice when low BP and insufficient tissue perfusion pressure (Class IIb) Inotropes (ie, dobutamine) may be given simultaneously to norepinephrine to improve cardiac contractility (Class IIb)	Consider inotropes and/or vasopressors for sBP <90 mmHg and hypoperfusion who do not respond to standard treatment, including fluid challenge to improve peripheral perfusion and maintain end-organ function (Class IIb) Inotropic agents not recommended routinely, due to safety concerns, unless patient has symptomatic hypotension and evidence of hypoperfusion (Class III) Vasopressor therapy, preferably norepinephrine, may be considered in patients with CS to increase BP and vital organ perfusion (Class IIb) Consider RRT for persistent hypoperfusion and organ dysfunction (Class IIa)

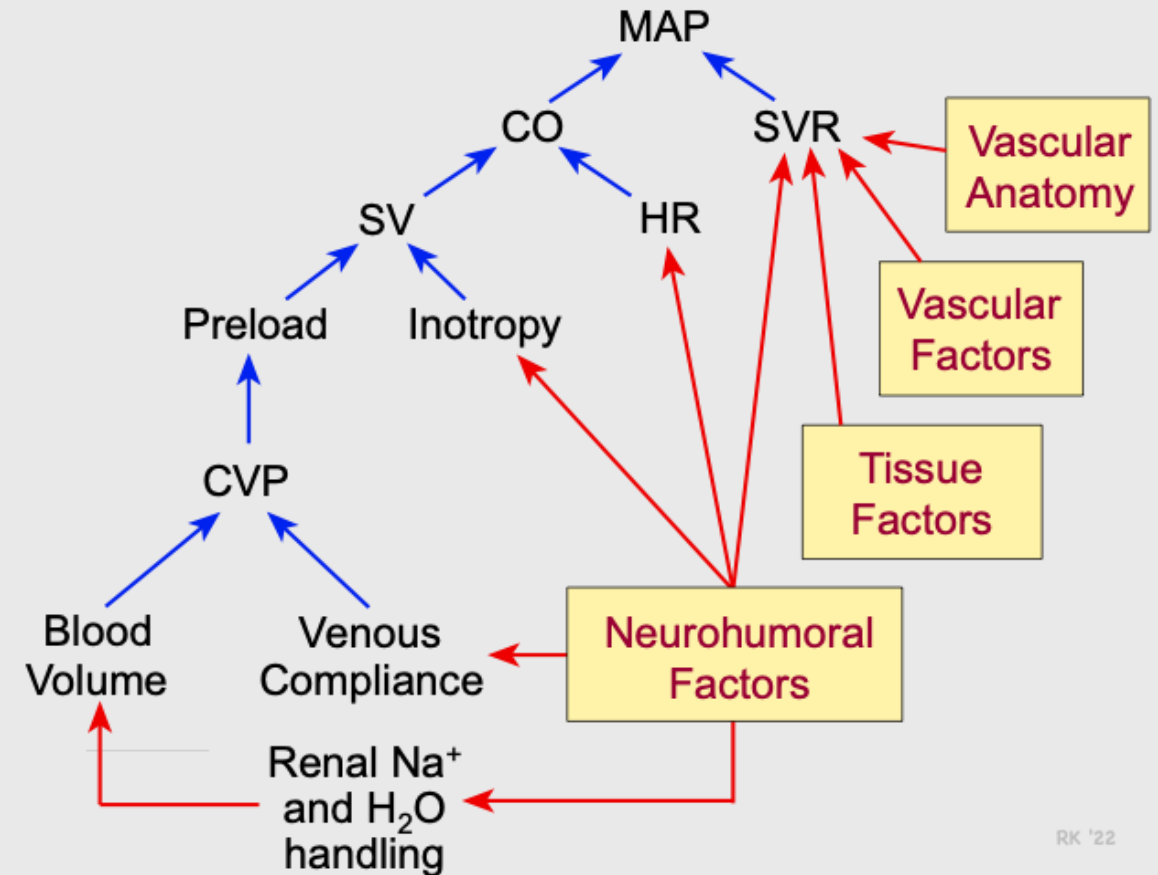
Cardiogenic Shock: More Than Hypotension

- Cardiogenic Shock
 - Acute
 - Acute on chronic
 - Secondary causes
 - Post-cardiotomy
 - Other causes



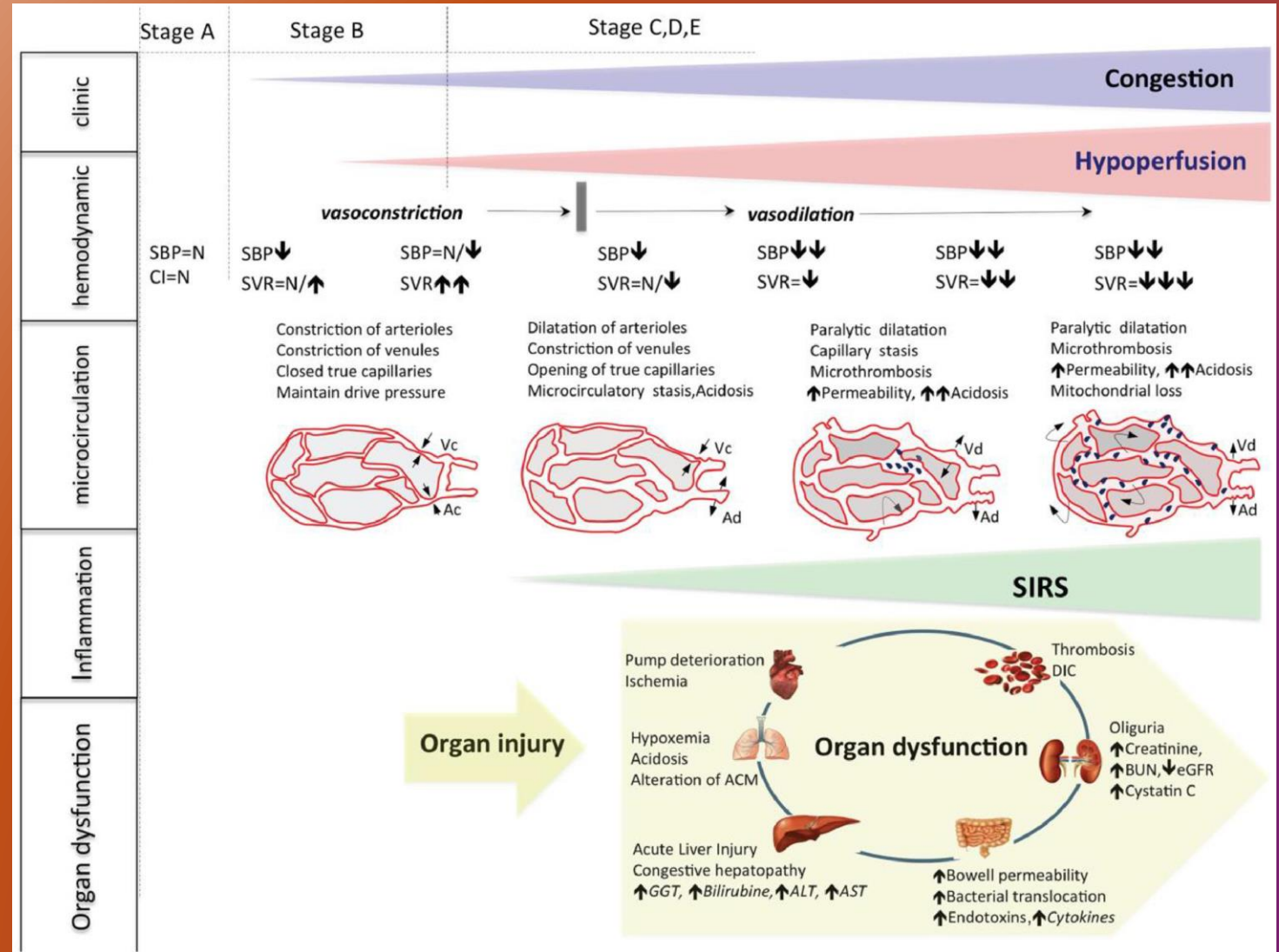
MAP and Macrocirculation

- Why do we use MAP?
- MAP and SBP
- Factors influencing MAP.
 - $CO = HR \times SV$
 - HR
 - SV
 - Preload/RAP
 - Afterload
 - PCWP
 - Formulas
 - $MAP = DP + 1/3(SP - DP)$
 - $MAP = CO \times SVR$



Micro-circulation: Where Oxygen Delivery Happens

- Global Tissue Perfusion
 - Lactate
 - ScvO₂
 - SvO₂
- Peripheral Tissue Perfusion
 - Capillary refill time
 - Peripheral perfusion index
 - Sublingual microcirculation
- Regional Tissue Oxygenation
 - NIRS



When MAP Misleads....

- A MAP ≥ 65 does not exclude
 - Low cardiac output
 - Elevated lactate
 - How quickly lactate clears
 - Oliguria/AKI
 - Altered mental status
 - Delayed capillary refill
 - Progressive ventricular failure
 - Microcirculatory dysfunction
- Vasoconstriction
 - Increased afterload
 - Reduced stroke volume
 - Increase myocardial O₂ needs
 - Impair peripheral perfusion

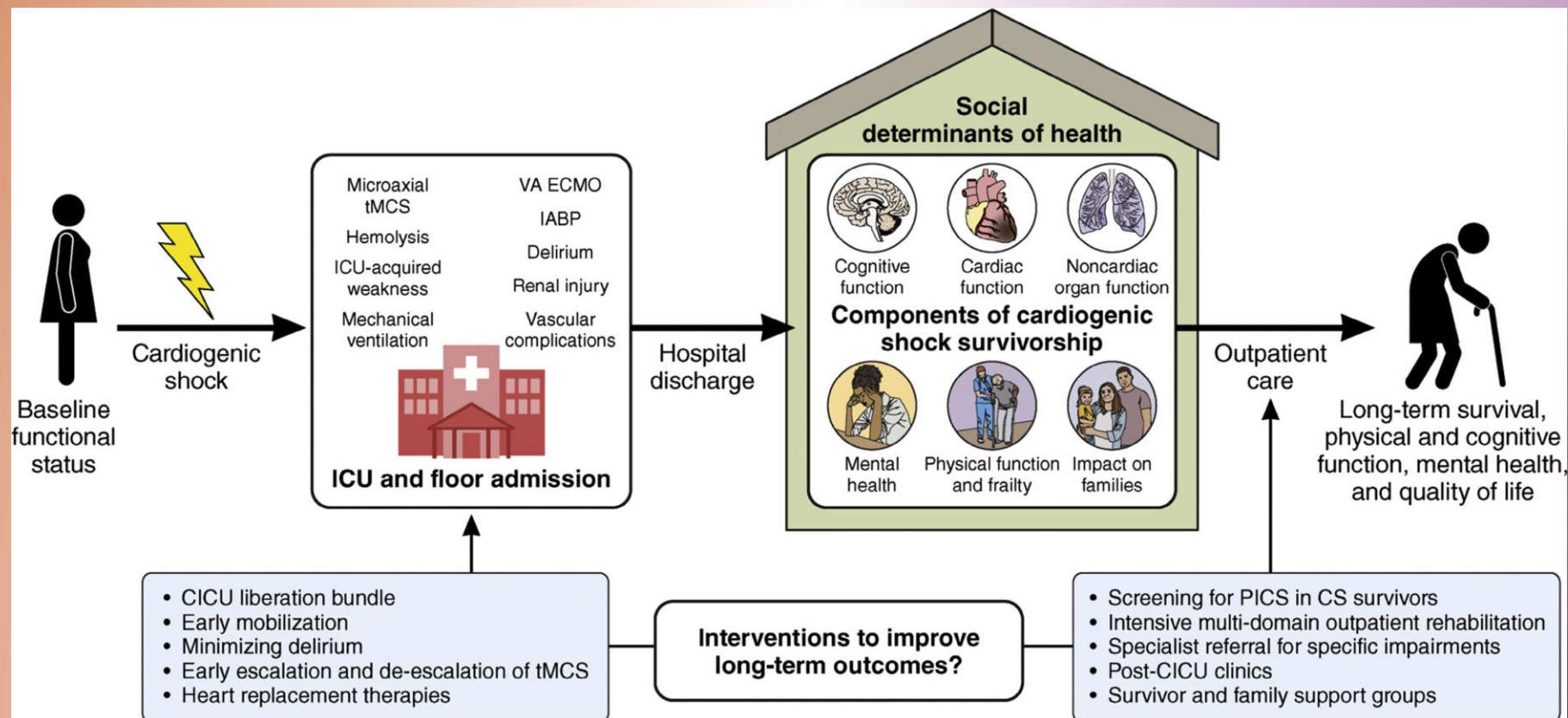
Additional Perfusion Targets

- Cardiac Power Output (CPO)
 - $CPO \leq 0.06$
- Pulmonary Artery Pulsatility Index (PAPi)
 - $PAPi \leq 1.0$
- Peripheral perfusion
 - Capillary refill
 - Skin temperature
 - Mottling
 - Urine output
 - Mental status
 - Lactate trends

Assess for microcirculatory dysfunction
No substitution for your physical exam

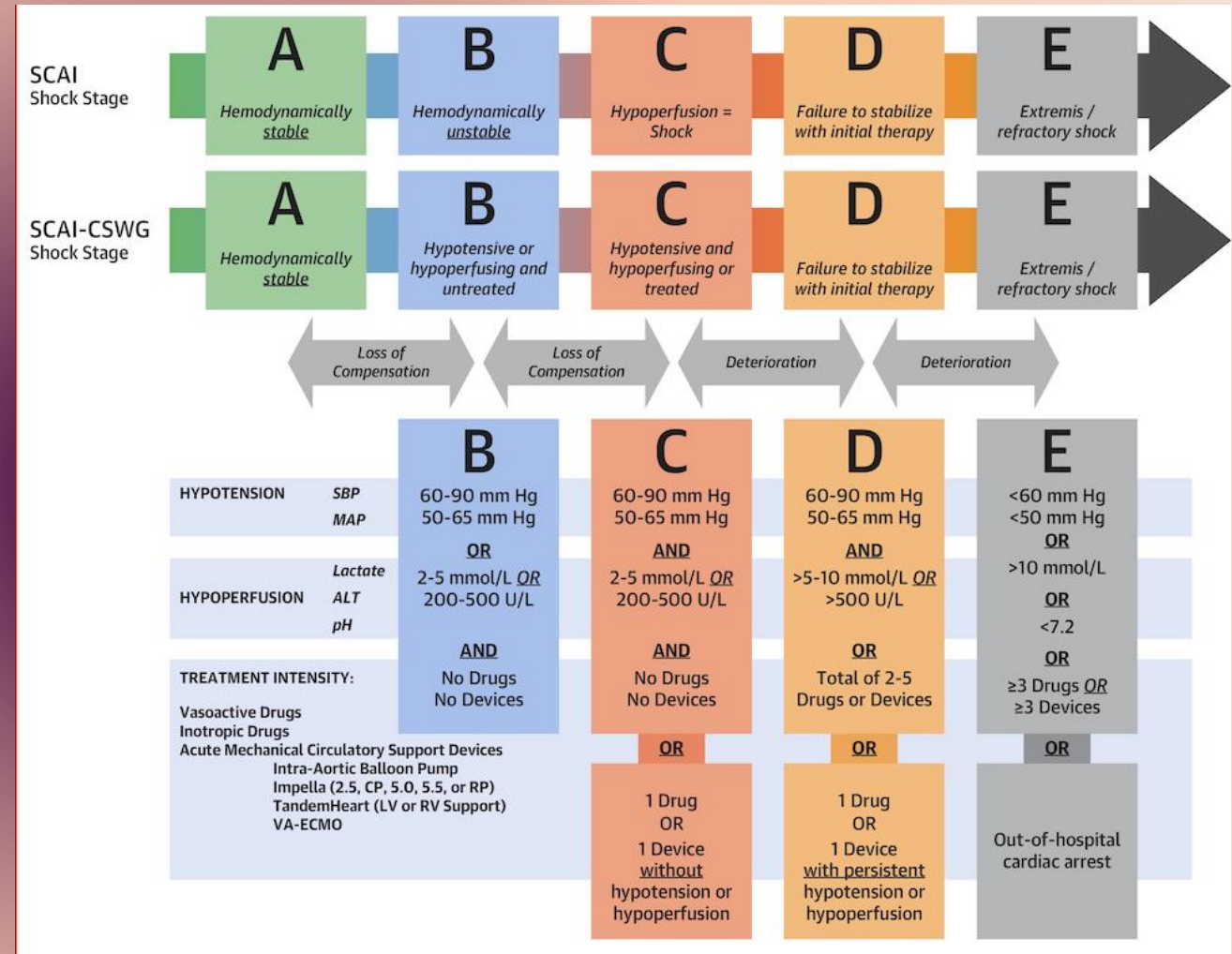
Survivorship

- Physical function
- Neurocognitive function
- Cardiac and non-cardiac organ function
- Quality of life



Take Home Messages

- Recognize shock severity
 - SCAI shock classification
 - Provides a framework to assess risk, initiation of shock, and progression
 - Macro/Micro circulatory assessment
 - Cardiac surgery population
- Repeated assessments
- Treat physiology
- Multidisciplinary team approach



Questions?

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