

Hemodynamic Assessment of Cardiogenic Shock

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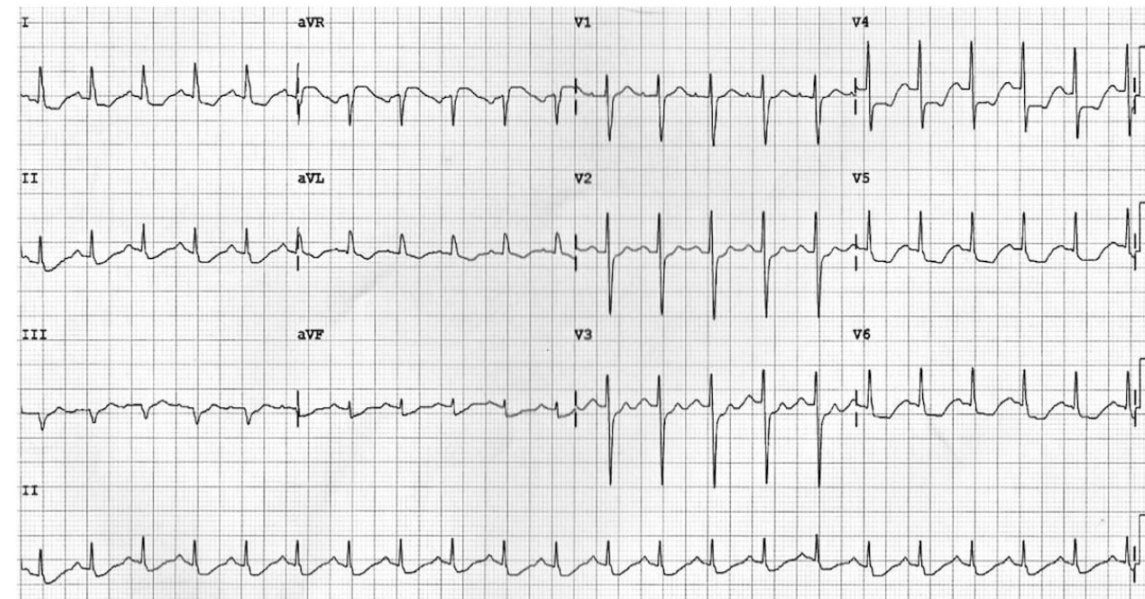
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Disclosures

- **None**

What's the next step?

- **65 y/o female with known paroxysmal atrial fibrillation presents to the emergency room with respiratory distress and hypotension.**
- **VS: BP 78/55 HR 115 Temp 99.9F O2Sat of 90% on 4L NC**
 - **Patient is in moderate distress appears diaphoretic**
 - **Rales bilateral and tachycardic**
 - **Extremities are cool to touch**
- **Labs:**
 - **CBC: 18.1 > 10.1/30.2 < 141 BMP 139/39 101/25 25/2.25 (baseline creatinine 1.20)**
 - **LFTs: AST 220 ALT 340 AlkPhos 452 T.bili 2.1**
 - **Lactate 3.1**
- **Radiology: CT PE- negative for pulmonary embolism, + pulmonary edema**



POCUS: “the LV looks down and the IVC is really dilated”

What's the next step?

- **Give pressors and fluids- this patient is in septic shock**
- **Give diuretics- this patient is in congestive heart failure**
- **Give inotropes- this patient is in cardiogenic shock**
- **Given fluids, pressors, and inotropes- who knows what it could be this patient is sick**

Monitoring of CS



BLOOD PRESSURE



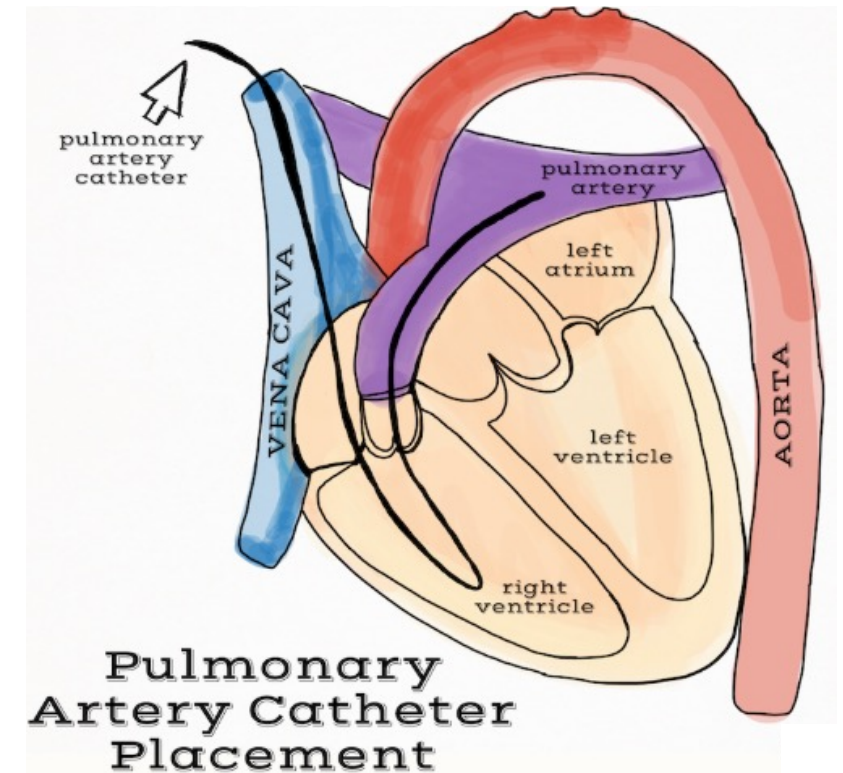
LABS



PHYSICAL EXAM

Monitor better- the role for PA Catheters

- **Controversial??**
- **Many sites would consider invasive hemodynamic assessment standard of care**
- **Allows for earlier and more accurate phenotype identification of shock**
- **Allows for tailored therapy**



Is some data enough?

- **CSWG collected retrospective data in CS patients from 8 tertiary care hospitals**
- **Outcomes analyzed in the CS group based on no-PA catheter data, partial, or complete prior to initiating MCS.**

Complete Hemodynamic Profiling With Pulmonary Artery Catheters in Cardiogenic Shock Is Associated With Lower In-Hospital Mortality



A. Reshad Garan, MD, MS,^{a,*} Manreet Kanwar, MD,^{b,*} Katherine L. Thayer, MPH,^c Evan Whitehead, MD,^d Elric Zweck, MSc,^{c,e} Jaime Hernandez-Montfort, MD, MPH,^f Claudius Mahr, DO,^g Jillian L. Haywood, MS,^c Neil M. Harwani, MS,^c Detlef Wencker, MD,^h Shashank S. Sinha, MD, MSc,ⁱ Esther Vorovich, MD,^j Jacob Abraham, MD,^k William O'Neill, MD,^l Daniel Burkhoff, MD, PhD,^m Navin K. Kapur, MD^c

Is some data enough?

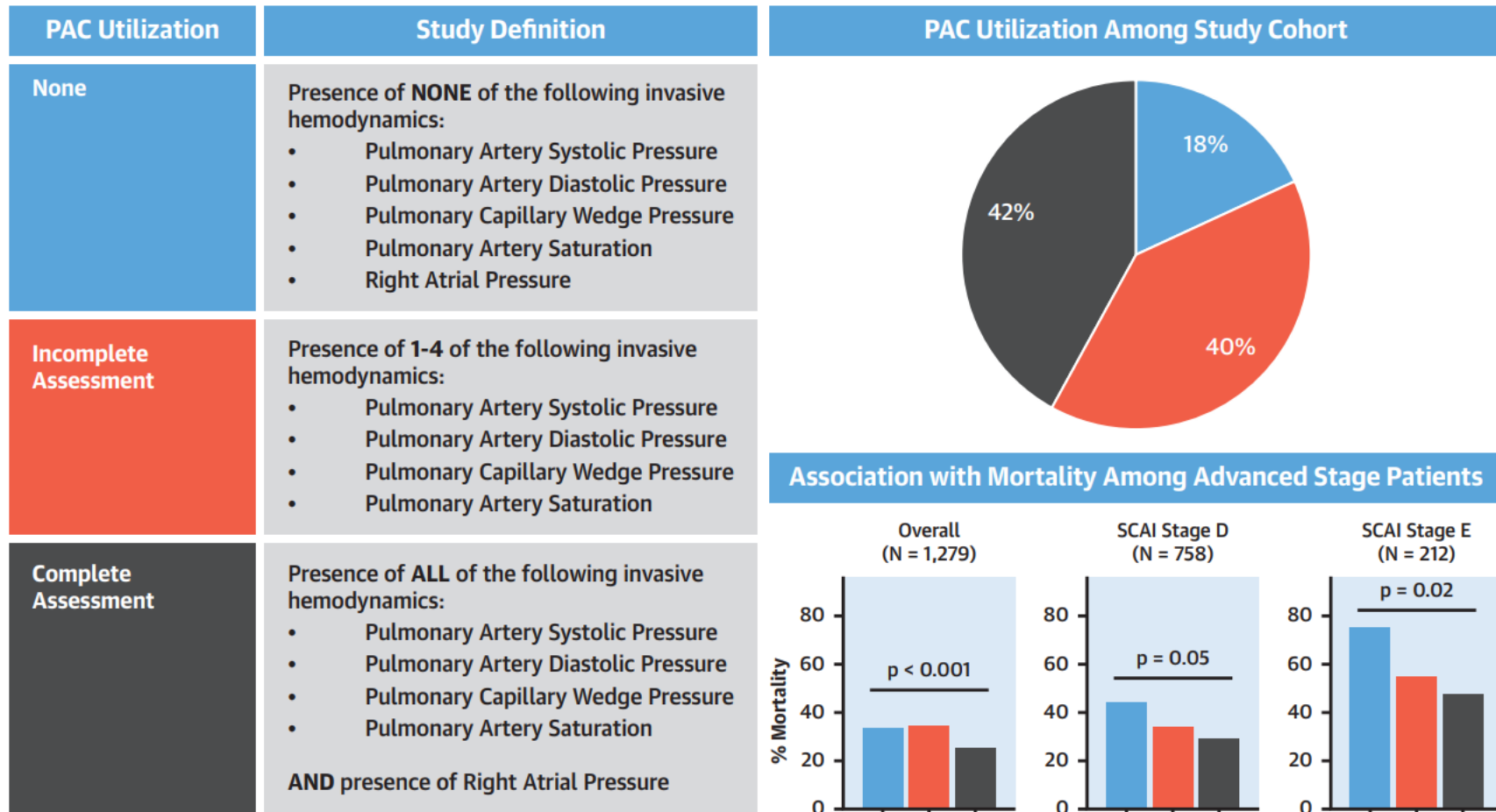
- **1,414 patients**
- **84% Stage D shock**
- **18.6% Stage C shock**
- **84% of patients supported with MCS**
- **PA catheter data not obtained in 18% prior to MCS**
- **42% had complete PA assessment prior to MCS**

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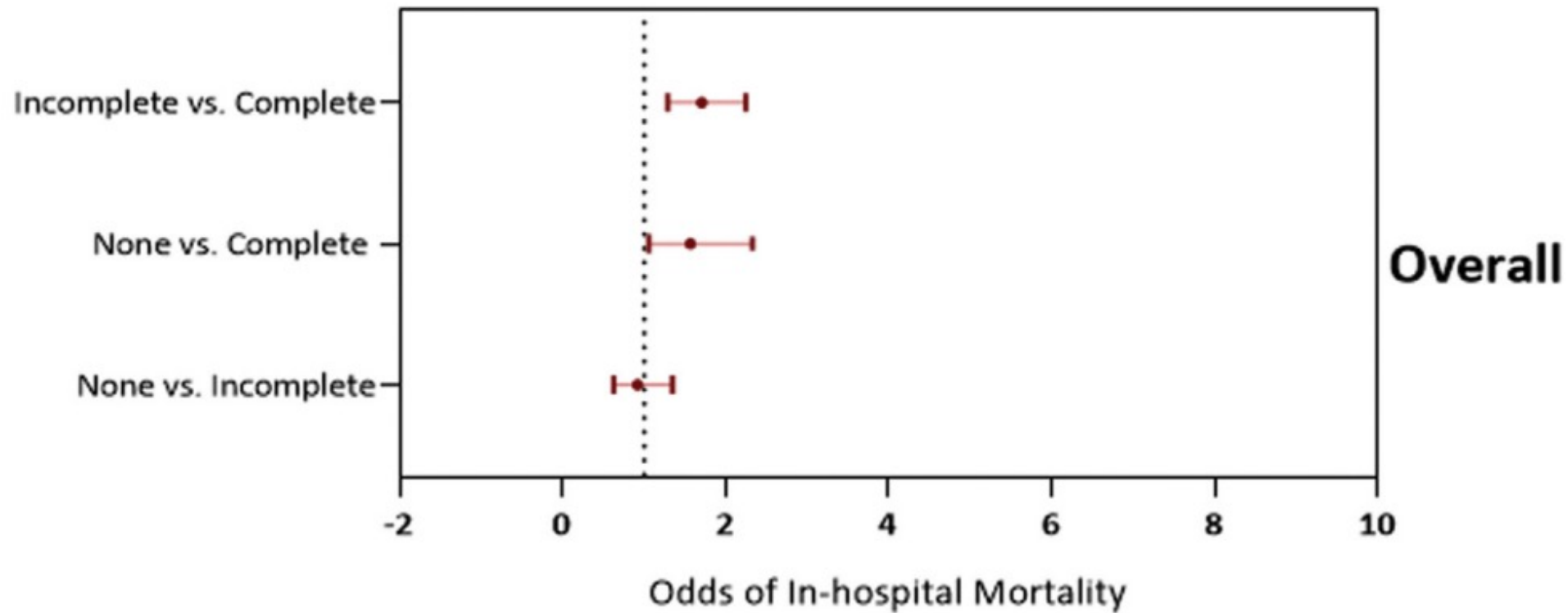
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CENTRAL ILLUSTRATION Frequency of Mortality Among PAC Use Overall and by SCAI Stage

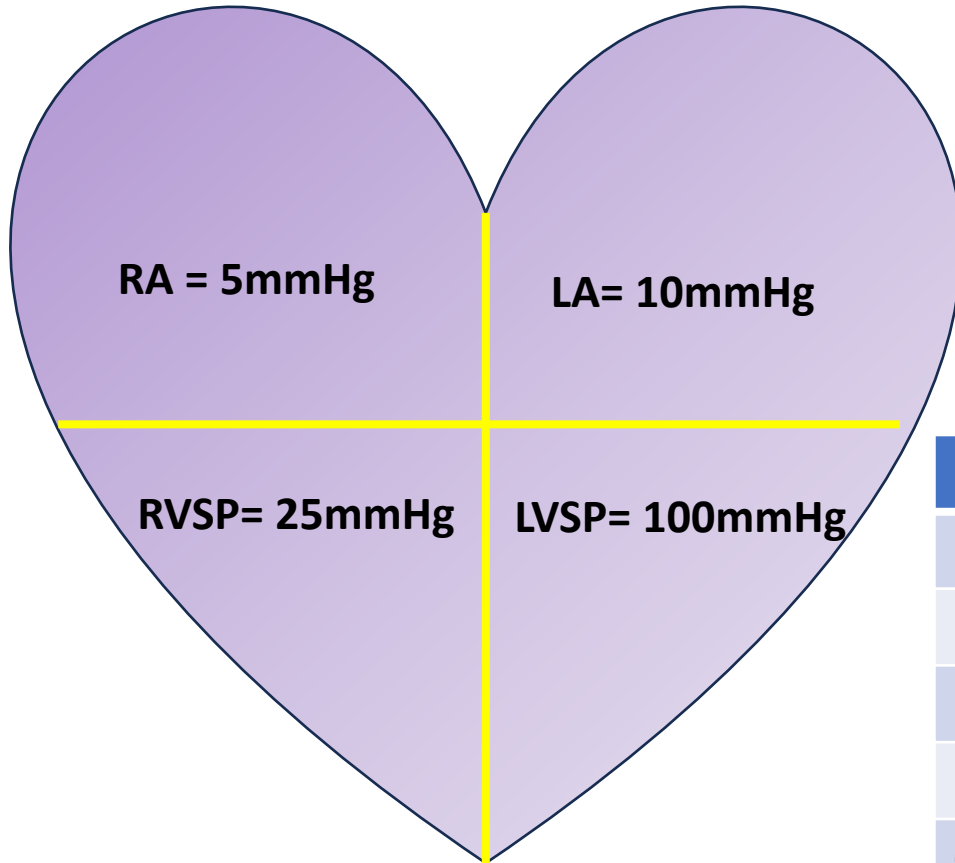


Garan, A.R. et al. *J Am Coll Cardiol HF*. 2020;8(11):903-13.

PAC = pulmonary artery catheter; SCAI = Society of Cardiovascular Angiography and Interventions.

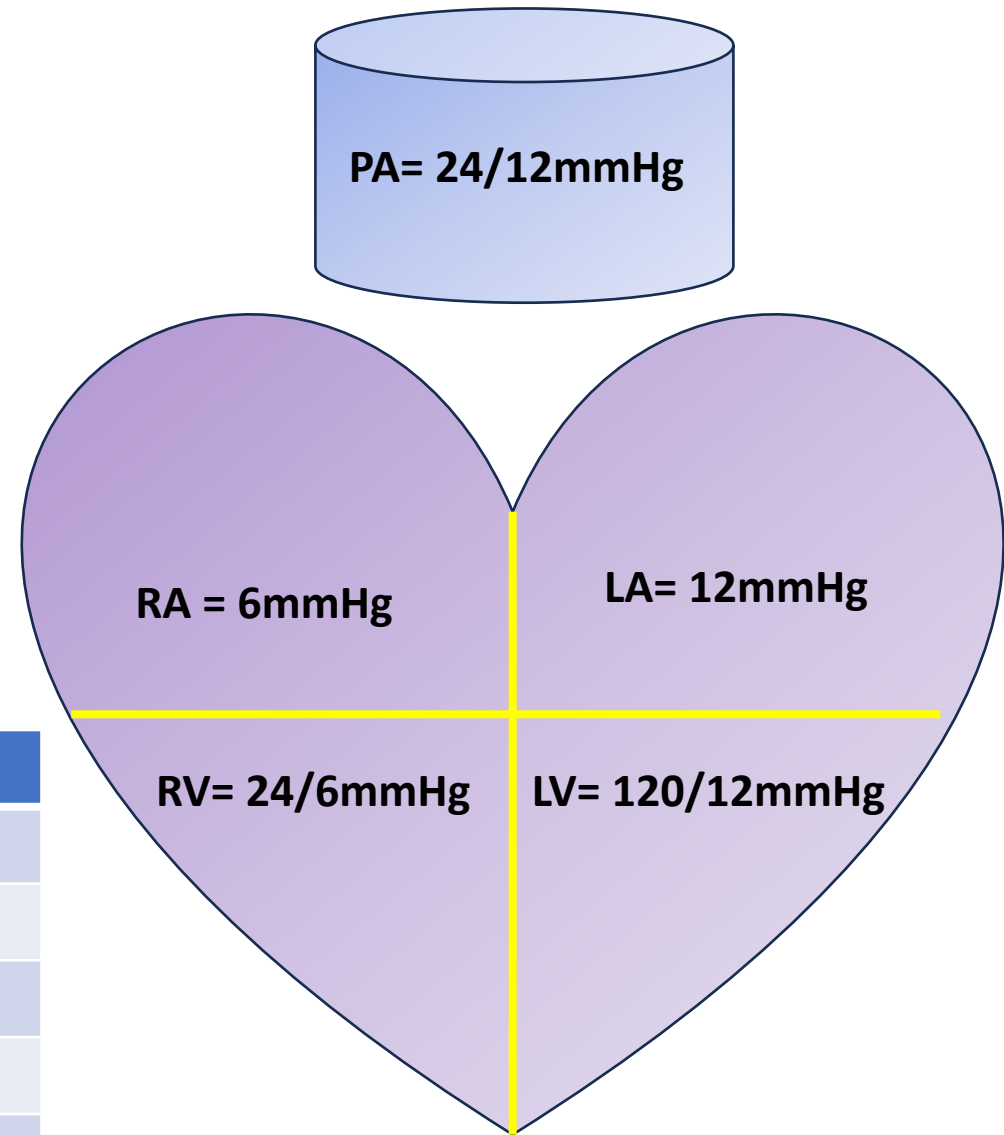


Beyond getting the data



Nickle, Quarter, Dime, a dollar

Normal Parameters
RAP = 0-8mmHg
RV = 20-30/0-8mmHg
PA = 20-30/8-15mmHg
PCWP = 8-12mmHg
CO: 4-8 L/min
CI: 2.2 L/min/m-sq
SVR: 800-1200 dynes



Rule of 6's

Identifying the phenotype

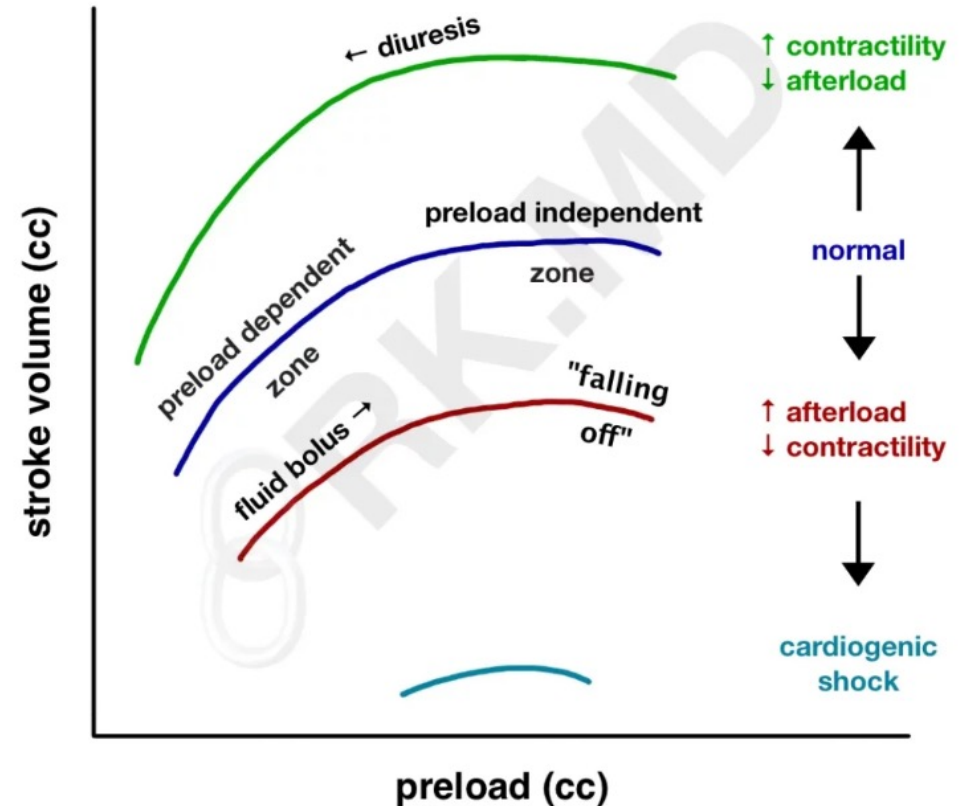
- **Left side predominant**
- **Right side predominant**
- **Both**
- **Mixed**

Just kidding...

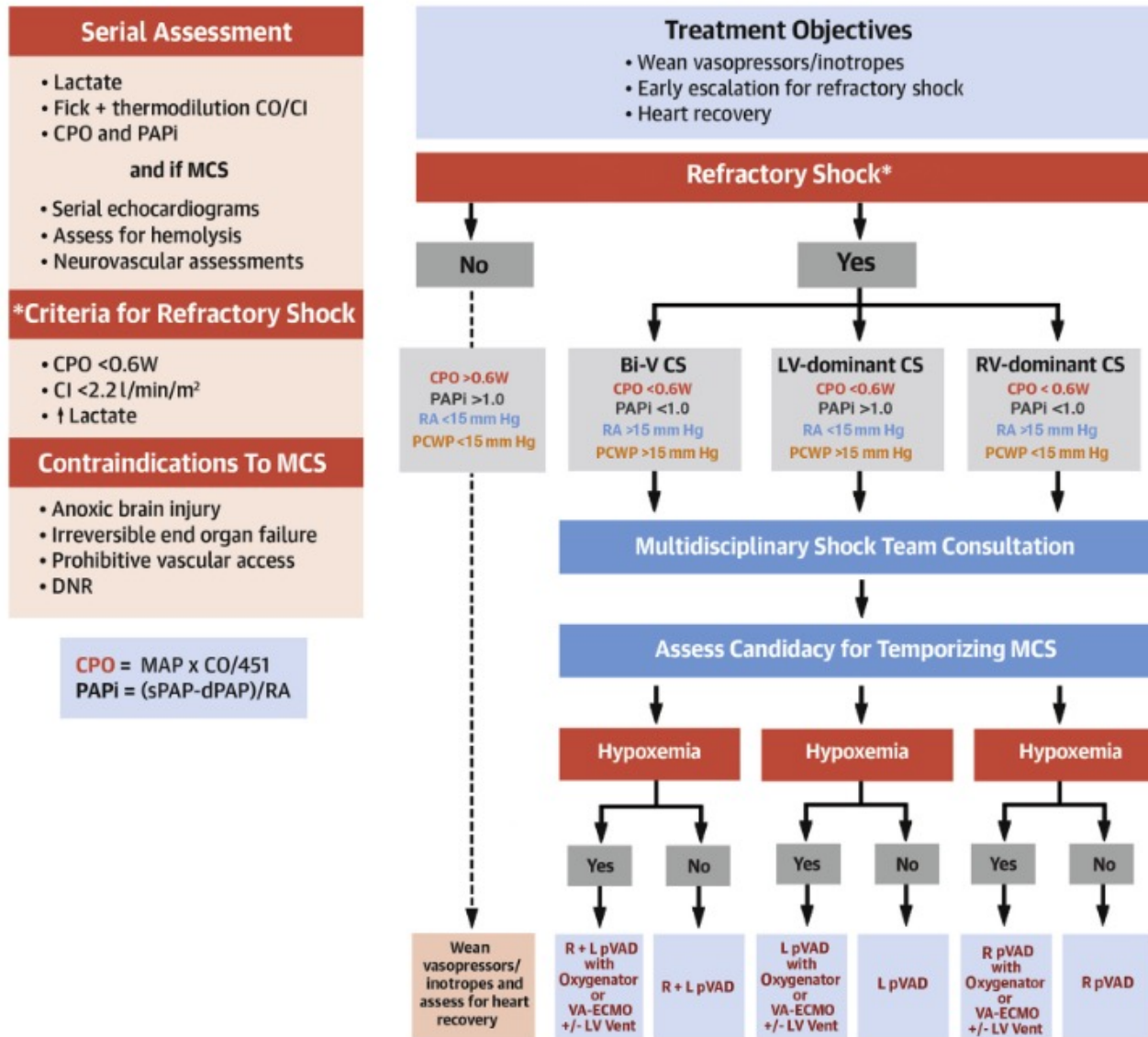
- **What can we affect?**
 - Pre-load: CVP, PCWP, LVEDP
 - Afterload: SVR or PVR
 - Contractility: ?
 - Output and mixed venous saturation (normal 60-80%)

- **Output Calculation- look at both sides!!**
- **LV → Cardiac Power Output (CPO) = $MAP \times CO / 451$**
- **RV → Pulmonary artery pulsatility index (PAPI) = $(PASP - PADP) / CVP$**

FRANK-STARLING LAW



CICU Management of Cardiogenic Shock



Mixed Shock

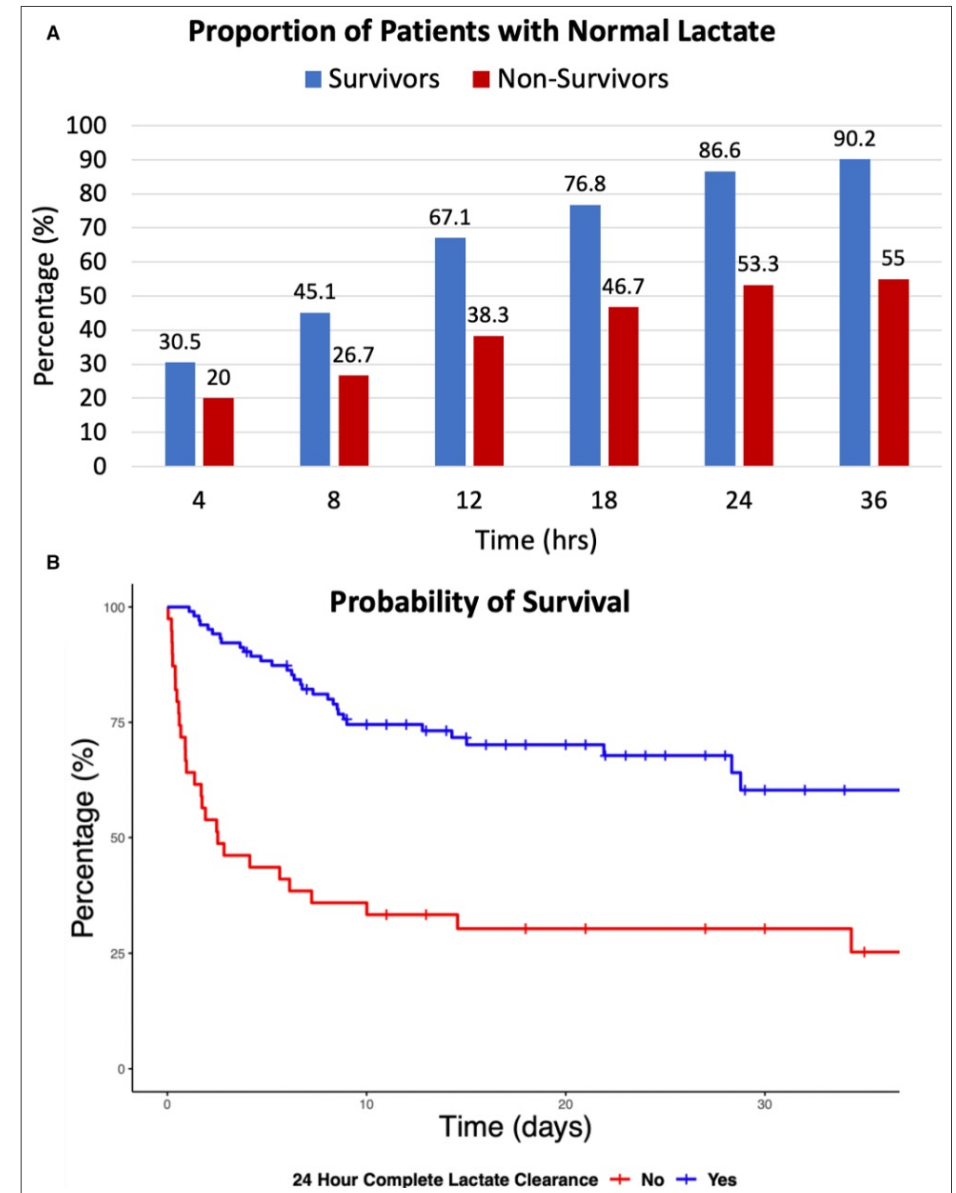
- $SVR = (MAP - CVP) / CO$

	<i>MAP</i>	<i>PAWP</i>	<i>CO</i>	<i>SVR</i>	<i>Svo₂</i>	<i>Lactate</i>
Hypodynamic						
Hypovolemic hemorrhage, dehydration	↓	↓	↓	↑	↓	↑
Cardiogenic myocardial infarction	↓	↑	↓	↑	↓	↑
Obstructive pulmonary embolism, pericardial tamponade, tension pneumothorax	↓	↔↑	↓	↑	↓	↑
Hyperdynamic						
Distributive sepsis, adrenal insufficiency, anaphylaxis	↓	↔↓	↔↑	↓	↔↑	↑

CO, cardiac output; *MAP*, mean arterial pressure; *PAWP*, pulmonary arterial wedge pressure; *Svo₂*, venous oxygen saturation; *SVR*, systemic vascular resistance.

Pre-Shock

- Blood pressure can be a poor surrogate of perfusion
- Normotensive pre-shock
 - SBP > 90mmHg AND CI < 2.2 with elevated SVR
- Hypotensive pre-shock
 - SBP < 90mmHg AND CI > 2.2
- Check and follow lactate levels



Back to our patient

- Started on norepinephrine/vasopression and taken to the cath lab.
 - RA: 16mmHg
 - RV: 32/17mmHg
 - PA: 31/17mmHg, mean 23mmHg
 - PCWP: 19mmHg
 - CO/CI: 2.2/1.6
 - PA Sat: 30%
 - MAP: 63mmHg

- CPO: $(MAP \times CO)/451 =$

- PAPI: $(PASP - PADP)/CVP =$

- SVR: $80(MAP - CVP)/CO =$

Do you want the PA catheter left in?

Re-assess

- Lab calls: 1 of 2 bottles are positive for Gram Negative Rods

	<i>MAP</i>	<i>PAWP</i>	<i>CO</i>	<i>SVR</i>	<i>Svo₂</i>	<i>Lactate</i>
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Summary

- **Complete hemodynamic assessment with a PA catheter has been associated with decreased mortality in CS**
- **Obtaining, understanding, and tailoring therapy based on the results can improve patient outcomes**
- **Don't forget mixed and pre-shock**
- **Shock is dynamic and multiple etiologies may be at play- reassess!**

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Questions?

