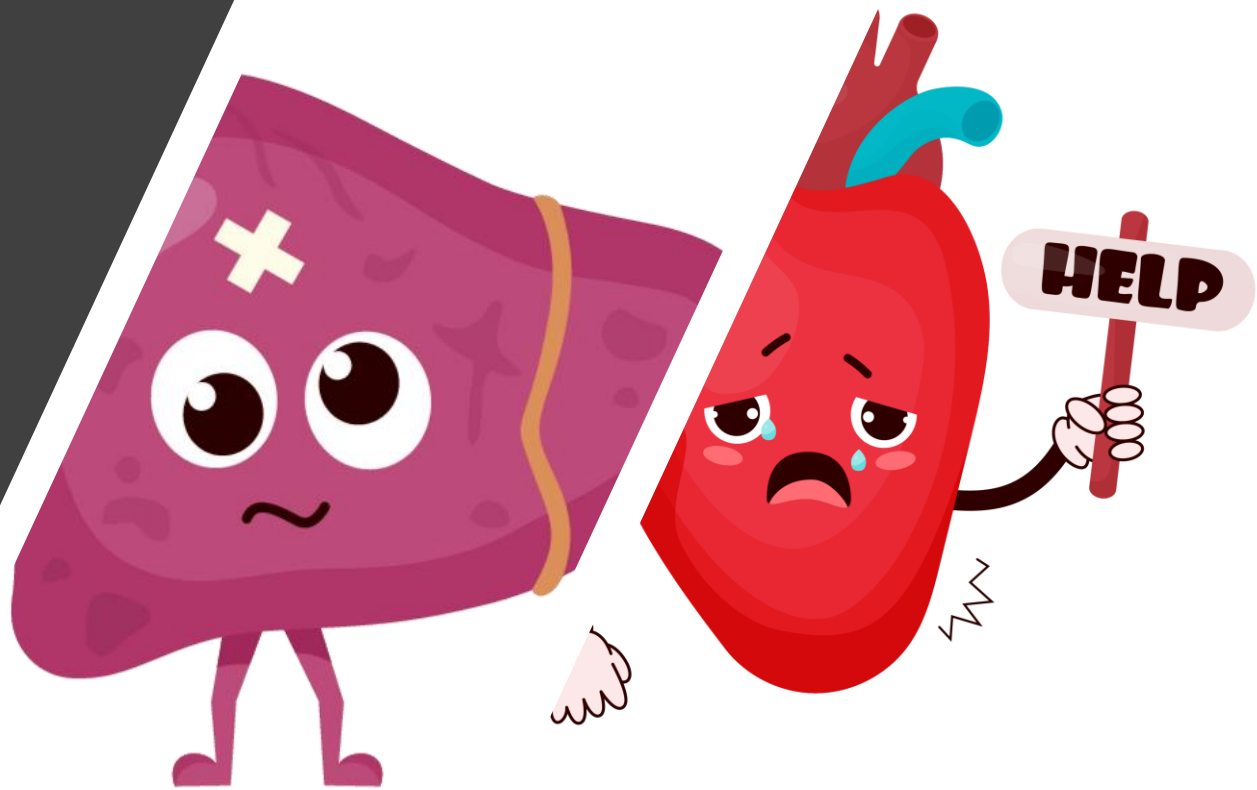
SHOCK

A brief refresher for brain people

Roger Cheng, MD

Assistant Professor of Neurology

Rutgers-RWJMS



No disclosures for this topic

What we will cover today:

Overview of shock states

Recognition and clinical findings

Differential diagnosis

Initial management

Not covered: in depth monitoring, fancy ICU stuff, advanced management (I only have 20 min, give me a break…)

Meanwhile, on the stroke floor…

- 68 F, h/o afib, CAD, HFrEF 40%
- R MCA stroke s/p extended window thrombectomy

- Now HD #6, 2 AM
- BP 95/55, HR 116, irregular
- UOP only 200 ml last shift
- Patient sleepier most of the previous day

- Nursing asks that you come and assess the patient now (or they will call the rapid response team)

- Is there a problem here?
- How bad is the problem?
- How do you know?

What is “shock” anyway?

- State of organ or tissue **hypoperfusion** where oxygen delivery is unable to meet metabolic demand

“Pre-Shock”

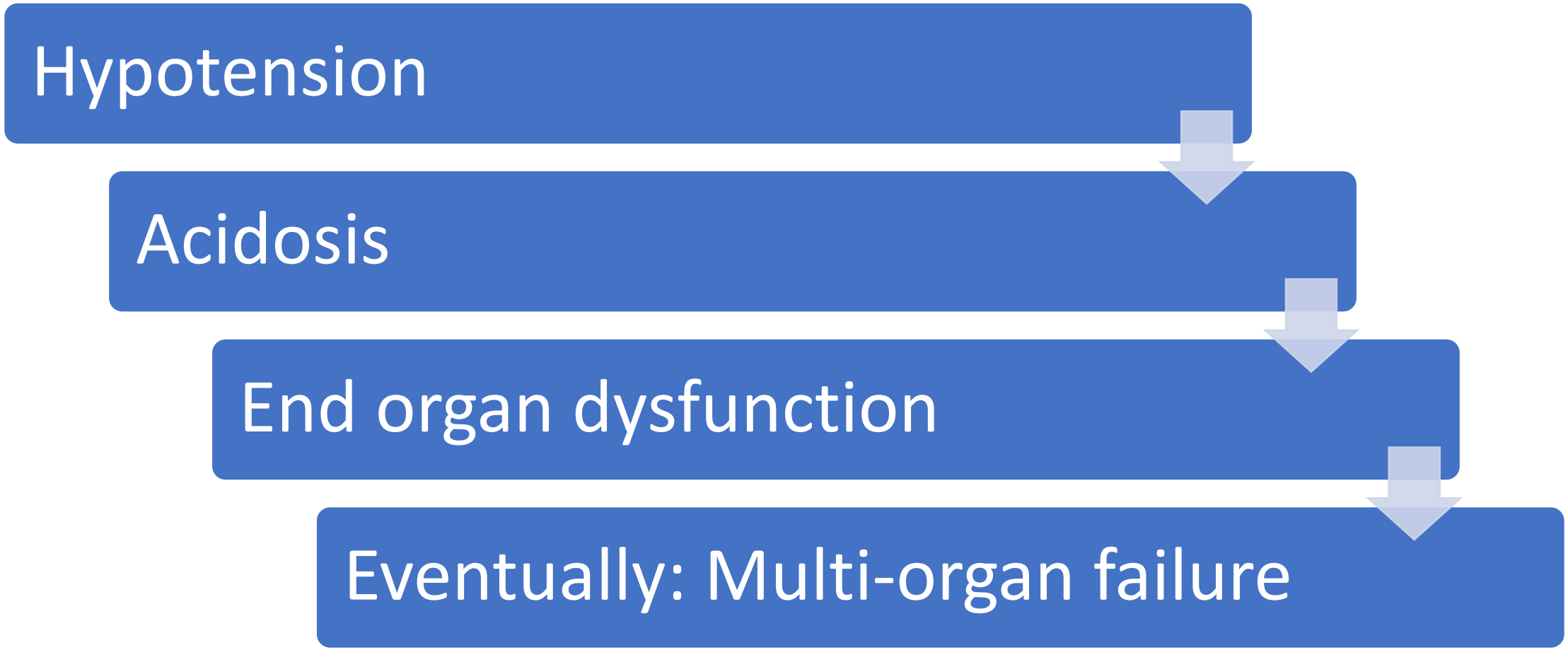
Physiologic compensation is occurring

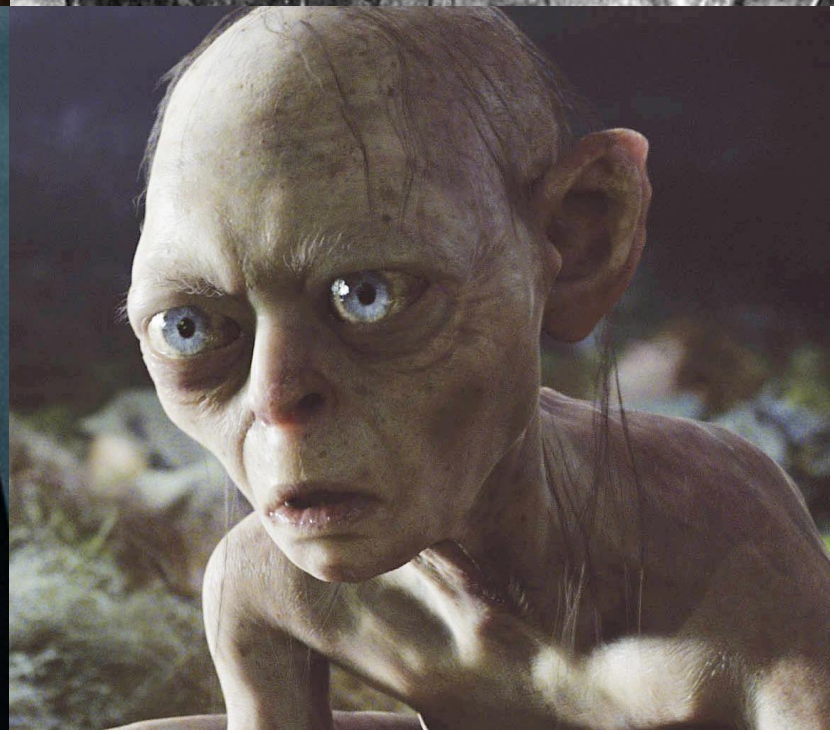
BP can be normal or high

Symptoms will be subtle, particularly in a healthy patient

- Tachycardia, tachypnea, elevated lactate

Shock


Hypotension
Acidosis
End organ dysfunction
Eventually: Multi-organ failure



Types of shock

Who are the suspects?

- DISTRIBUTIVE
- HYPOVOLEMIC
- CARDIOGENIC
- OBSTRUCTIVE

Distributive

“Tank is too big”

Vasodilation/lack of vascular tone

- Infectious/inflammatory
- Anaphylaxis
- Endocrine
- Neurologic

Hypovolemic

“Tank is empty”

Not enough circulating volume

- Hemorrhage
- Dehydration
- Other fluid loss

Cardiogenic

“Pump doesn’t work”

Insufficient cardiac output

- Ischemia/myocardial infarction
- Cardiomyopathy/reduced ejection fraction
- Tachy/bradyarrhythmia
- Sympathetic dysfunction

Obstructive

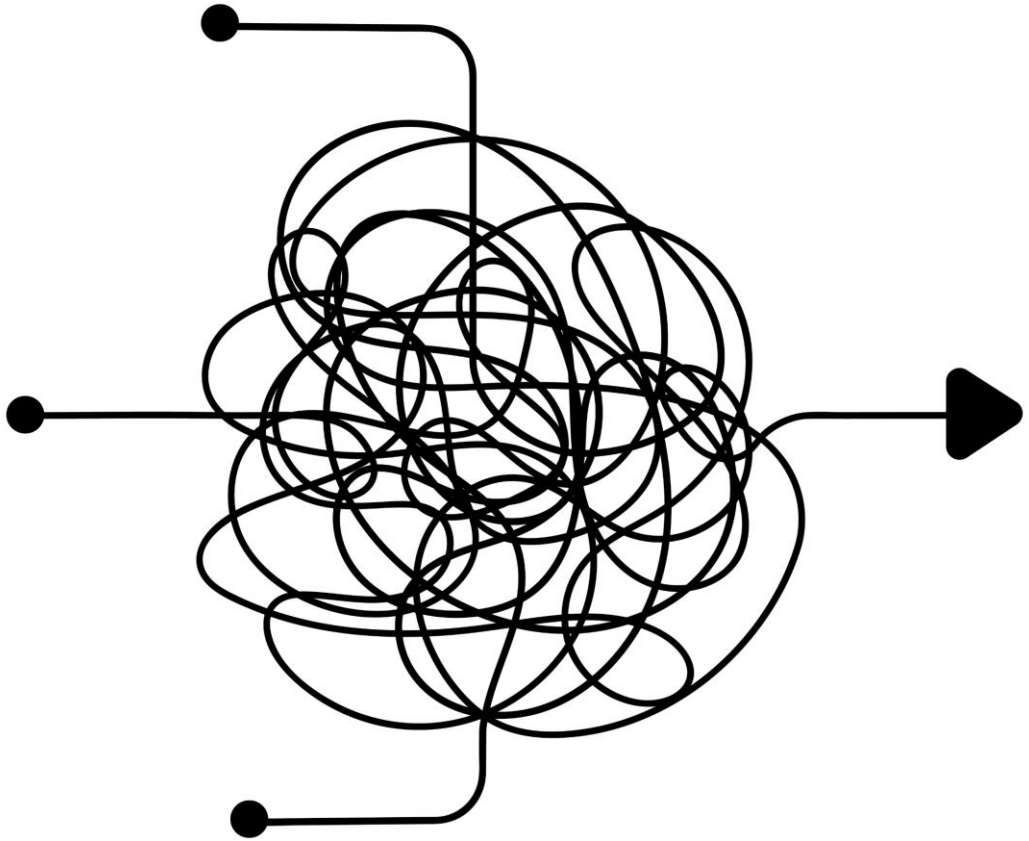
“Pump is blocked”

Extra-cardiac cause of cardiac failure

- Pulmonary vascular
  - Pulmonary embolism
  - Pulmonary HTN
- Mechanical
  - Tamponade
  - Tension pneumothorax
  - Restrictive cardiac disease
  - Abdominal compartment syndrome

Shock is often mixed

- Neurogenic – distributive/cardiogenic
- Endocrine – distributive/cardiogenic
- Septic – distributive, hypovolemic, cardiogenic
- Trauma
- Resuscitation may alter the physiology
  - Fluid resuscitation → cardiogenic, obstructive



	Preload	Pump	Afterload	Perfusion
Invasive monitoring (PA catheter)	PCWP, (CVP)	CO, CI	SVR	SvO_2 (65%)
Non-invasive surrogates	Edema, skin turgor, JVD, IVC size, ΔP_{pleth} , BNP	HR, cardiac ultrasound, cardiac enzymes	Skin temperature, capillary refill, end organ function, serum lactate, $ScvO_2$	
Distributive	⇔ to ↓	↑	↓	↑
Hypovolemic	⇔ to ↓	⇔ to ↓	↑	⇔ to ↓
Cardiogenic	↑	↓	↑	↓
Obstructive	Depends	↓	↑	Depends

OK, I’m at the bedside…

What can I do to figure this out?

Which vital signs are most useful?

Blood pressure?

Heart rate?

Respiratory rate?

Pulse ox?

Do I have to touch the patient?

Skin temperature

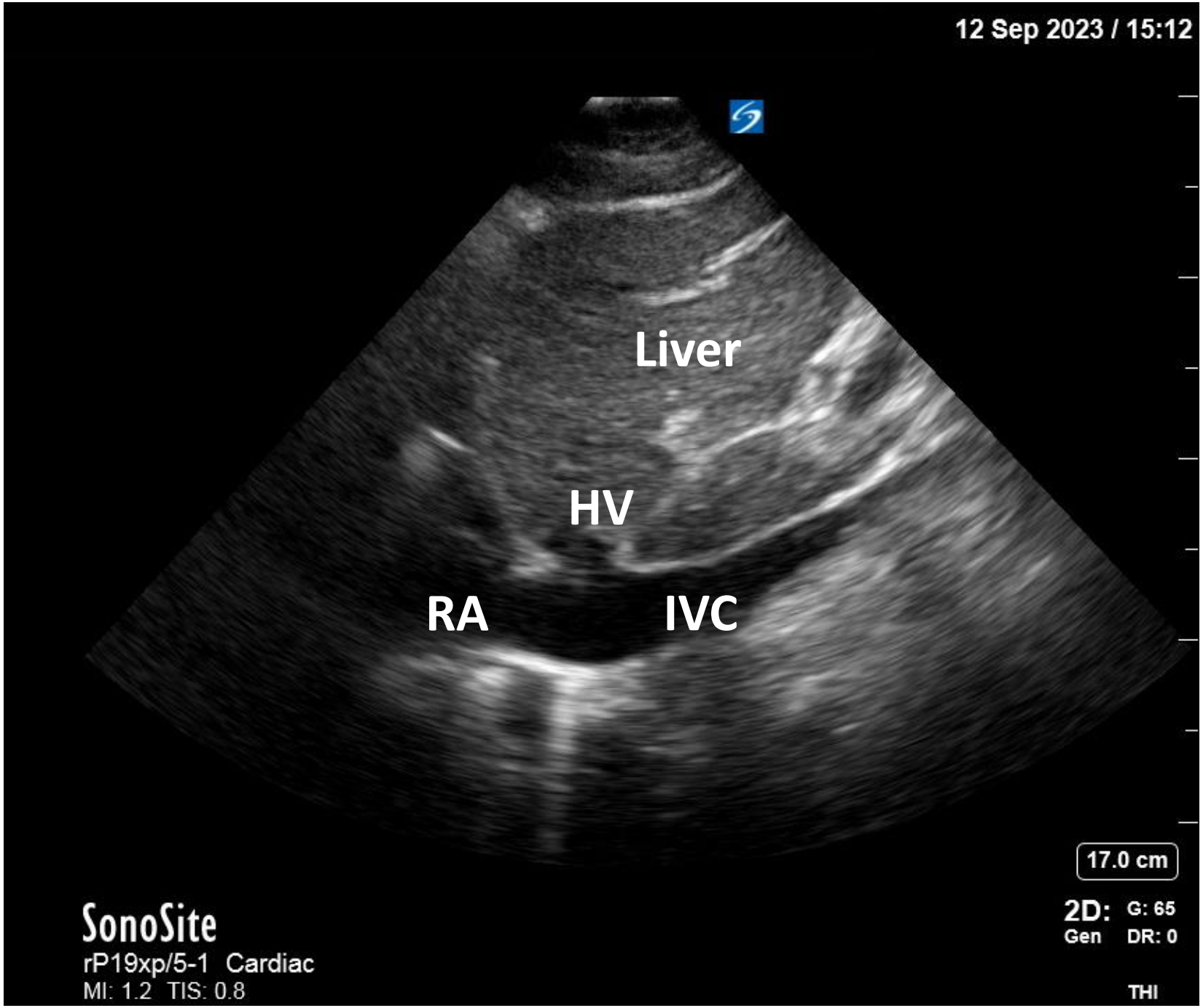
Edema/JVD

Mental status

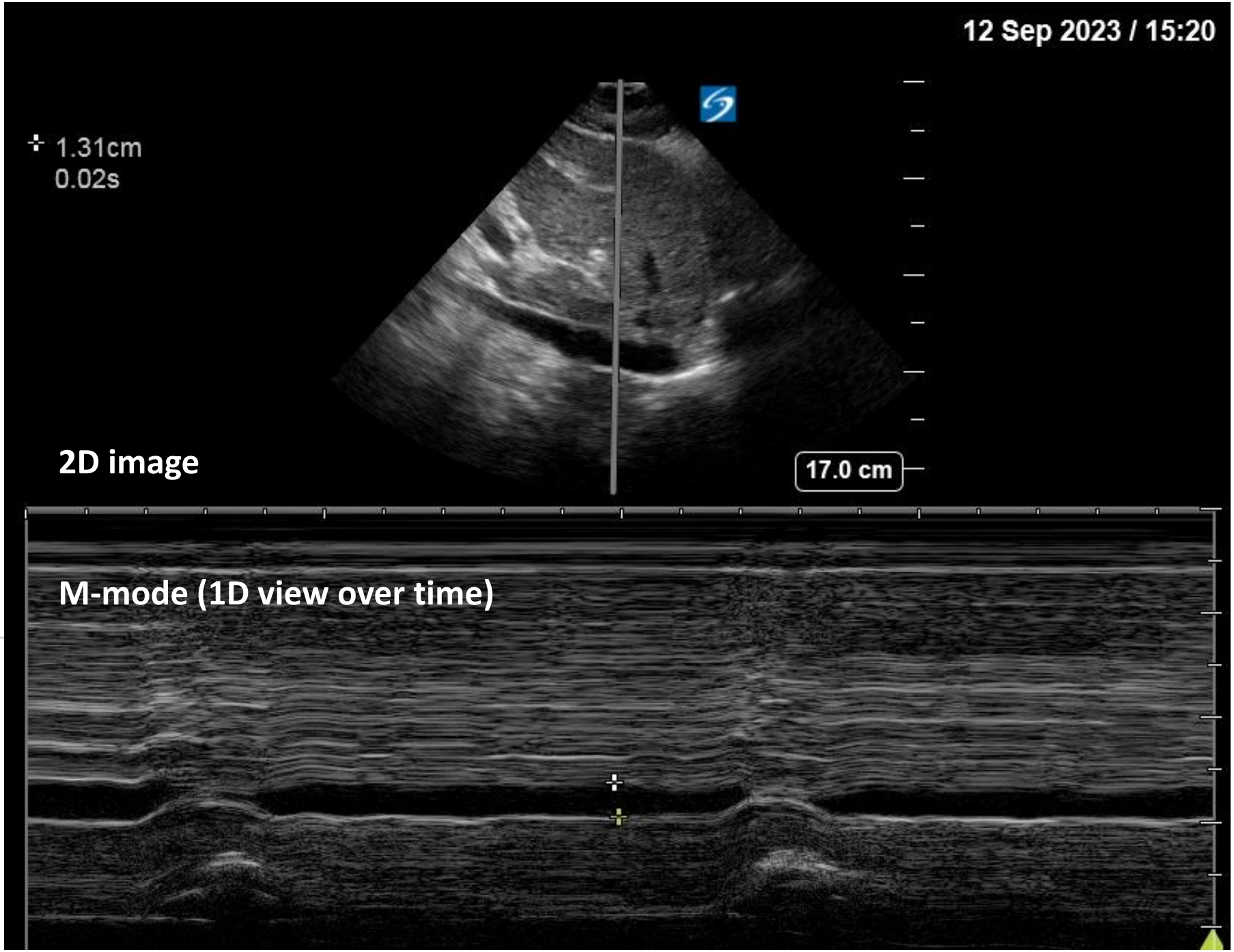
Others?

Hocus POCUS

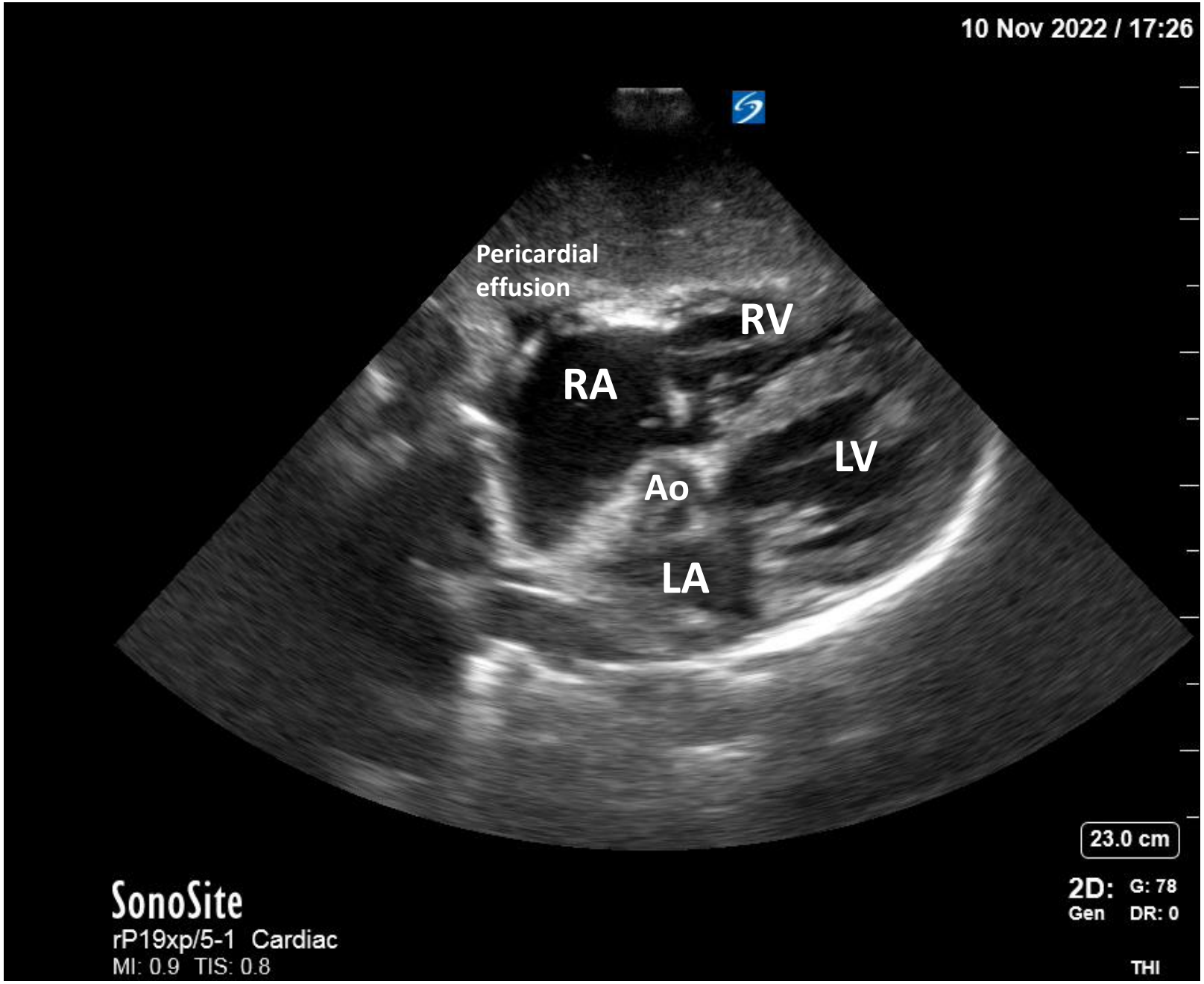
Inferior vena cava



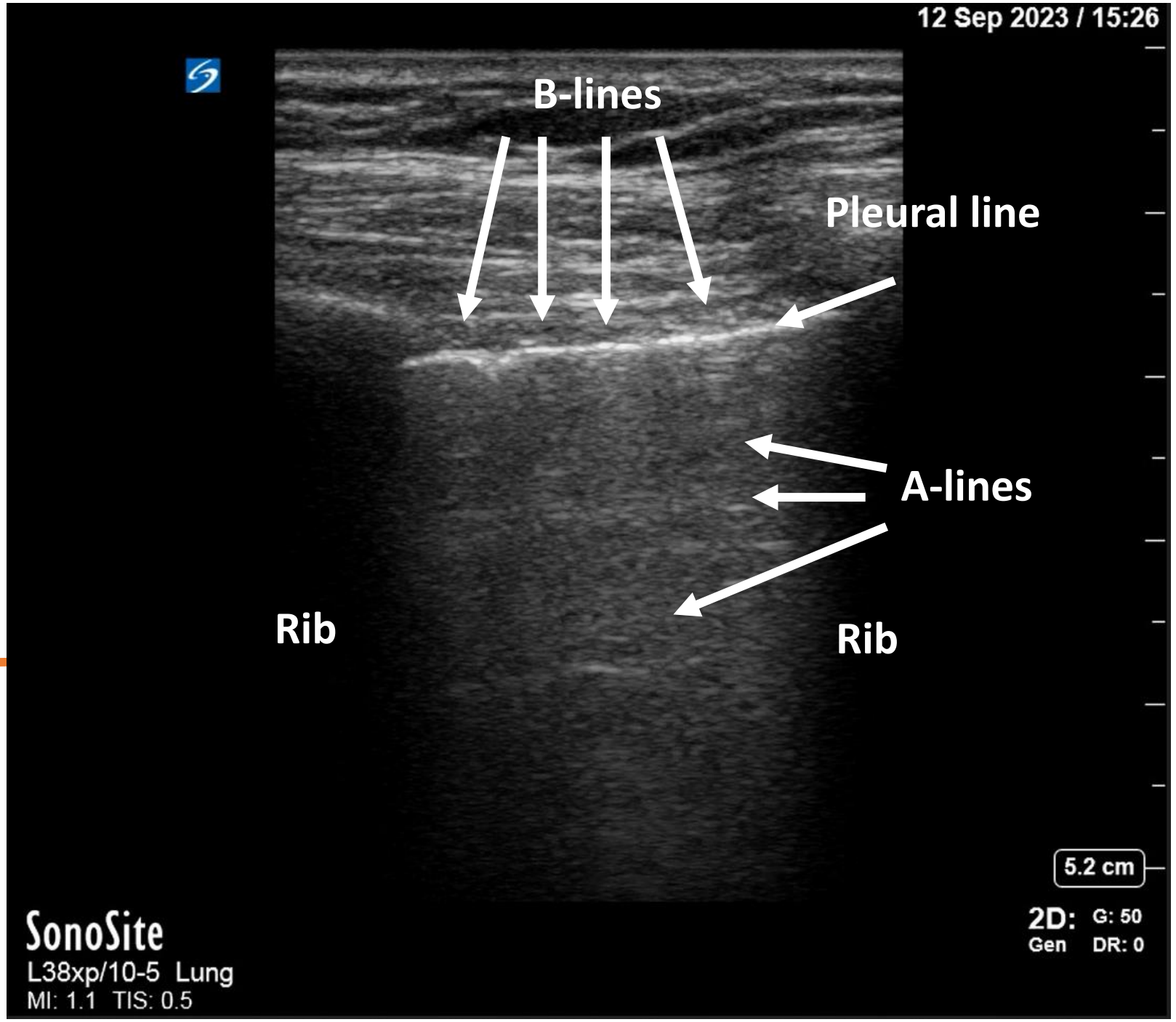
IVC Measurement

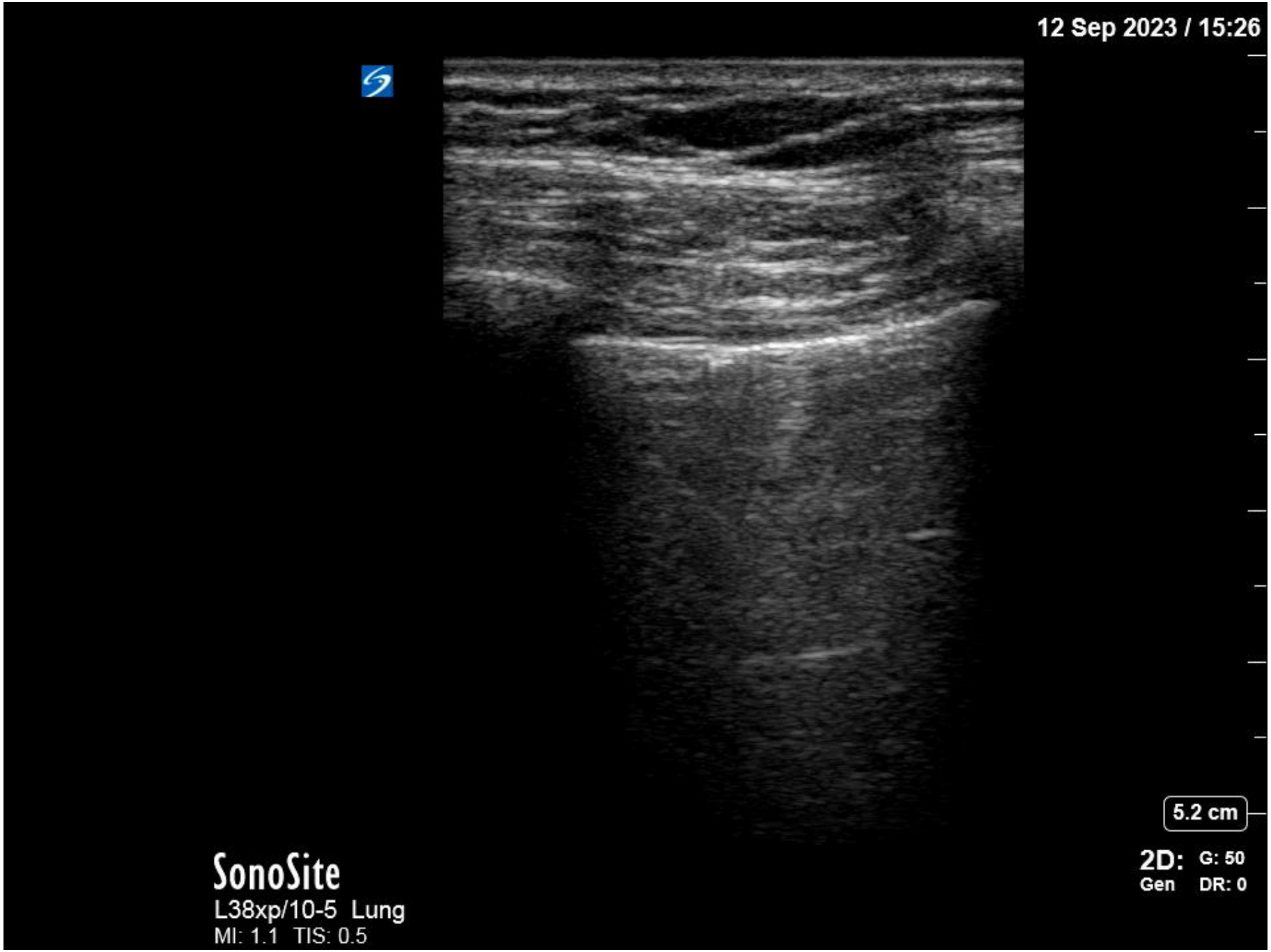


Sub-xiphoid cardiac view



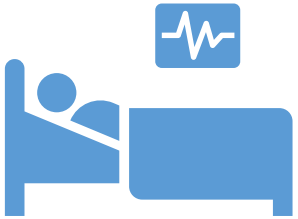
Lung Ultrasound




12 Sep 2023 / 15:26
5.2 cm
2D: G: 50
Gen DR: 0
SonoSite
L38xp/10-5 Lung
MI: 1.1 TIS: 0.5


12 Sep 2023 / 15:29
5.2 cm
SonoSite
L38xp/10-5 Lung
MI: 1.1 TIS: 0.6
M: G: 50
2D: G: 50
Gen DR: 0

Back to our patient…



Vital Signs

HR 124, irregular

BP 92/58

Temp 37.5 C

RR 24

SpO2 98% on 3L NC

Exam

Drowsy, disoriented to time and place

Gurgling respirations, diffuse rhonchi

1+ pitting edema bilateral ankles

Skin warm

Differential diagnosis?

Aspiration/infection → sepsis
Cerebral edema, hemorrhage → brain compression
Acute heart failure exacerbation (volume overload, RVR)
HYPOvolemia (“intravascular depletion?”)
Nothing, it’s 3 AM and he’s just tired?

	Preload	Pump	Afterload	Perfusion
Invasive monitoring (PA catheter)	PCWP, (CVP)	CO, CI	SVR	SvO_2 (65%)
Non-invasive surrogates	Edema, skin turgor, JVD, IVC size, ΔP_{pleth} , BNP	HR, cardiac ultrasound, cardiac enzymes	Skin temperature, capillary refill, end organ function, serum lactate, $ScvO_2$	
Distributive	↔ to ↓	↑	↓	↑
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Cardiogenic	↑	↓	↑	↓
Obstructive	Depends	↓	↑	Depends

Will any tests help?

BMP

146	110	44
4.5	18.1	1.9

110

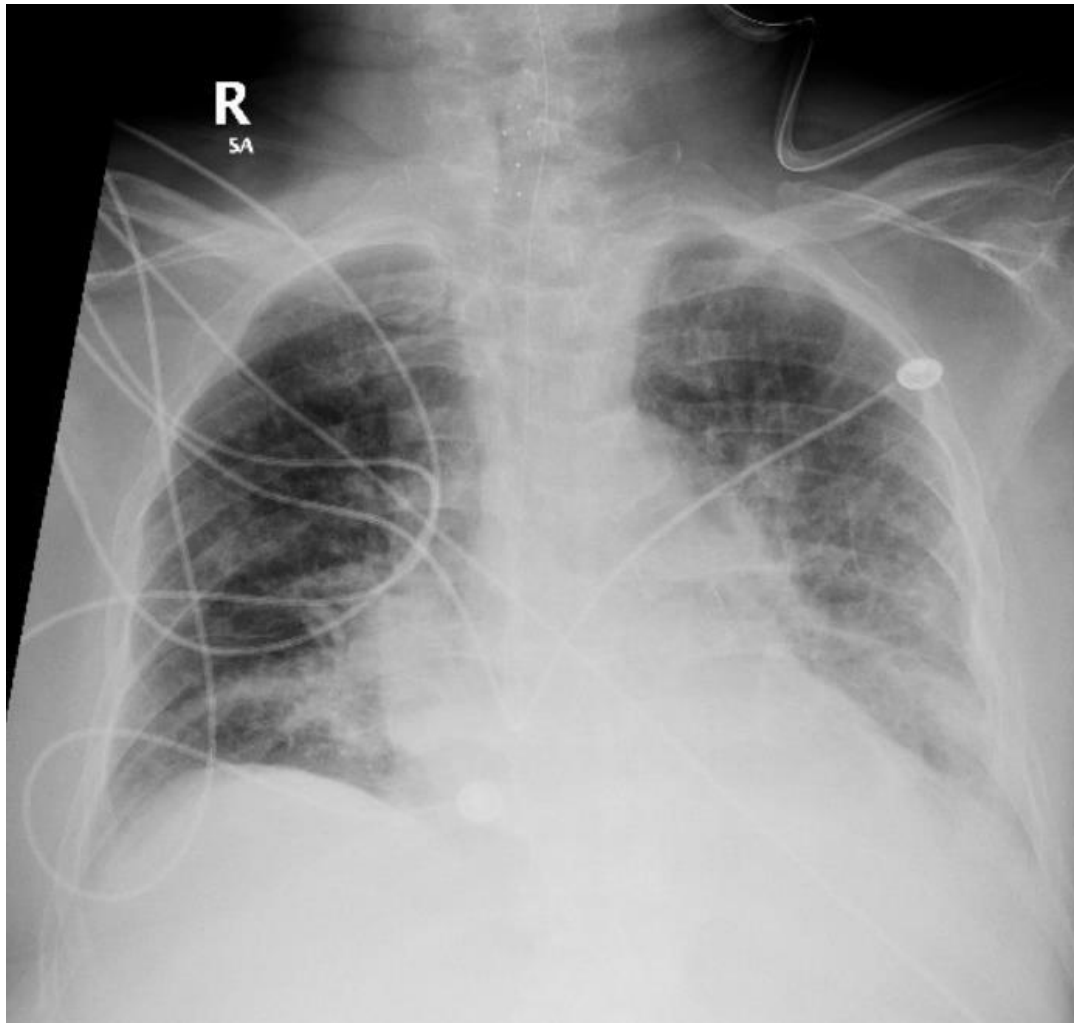
CBC:

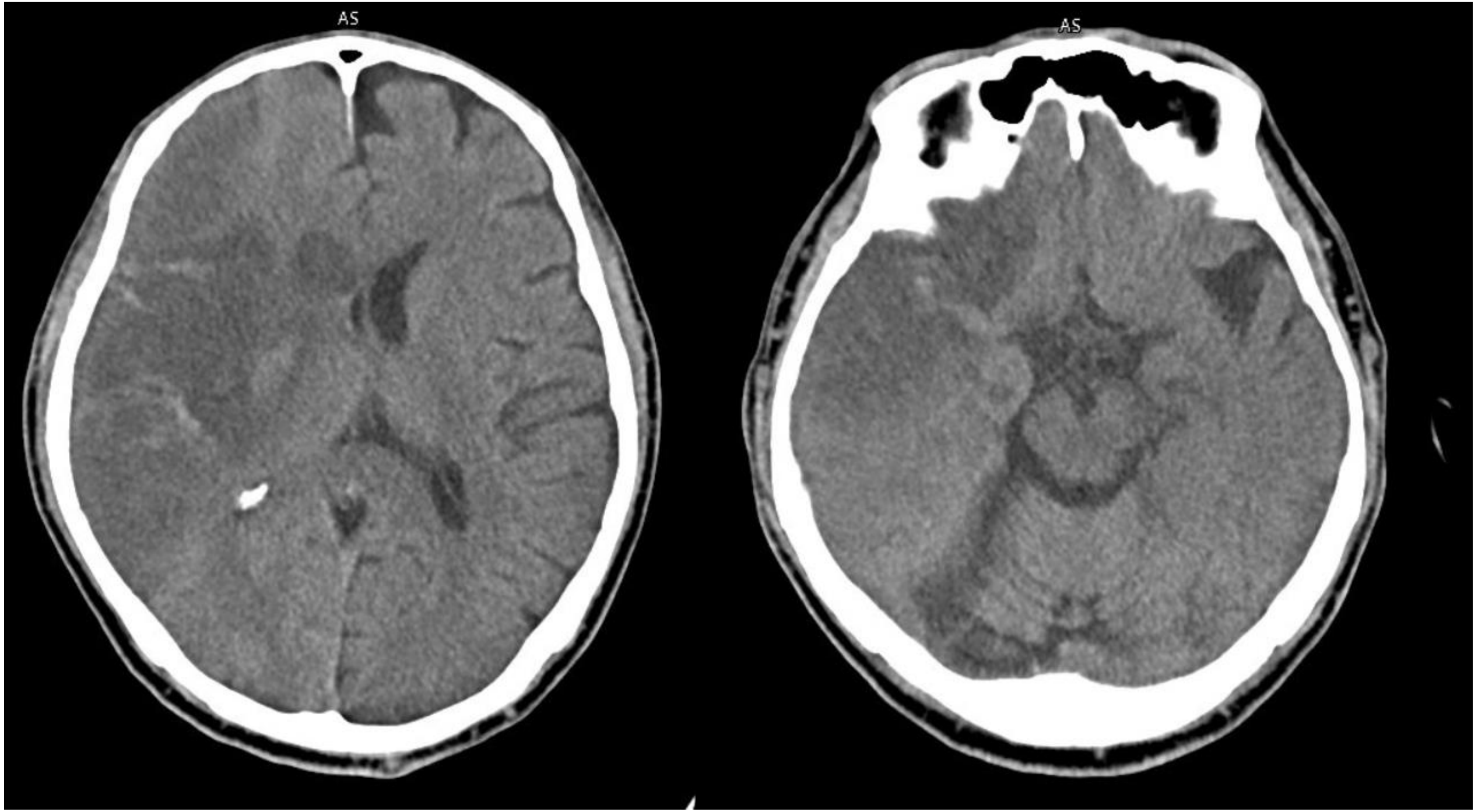
	30	
13.2	8.9	142

ABG: 7.35/32/110

Lactate: 2.5

Procalcitonin: 0.2

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Likely diagnosis?

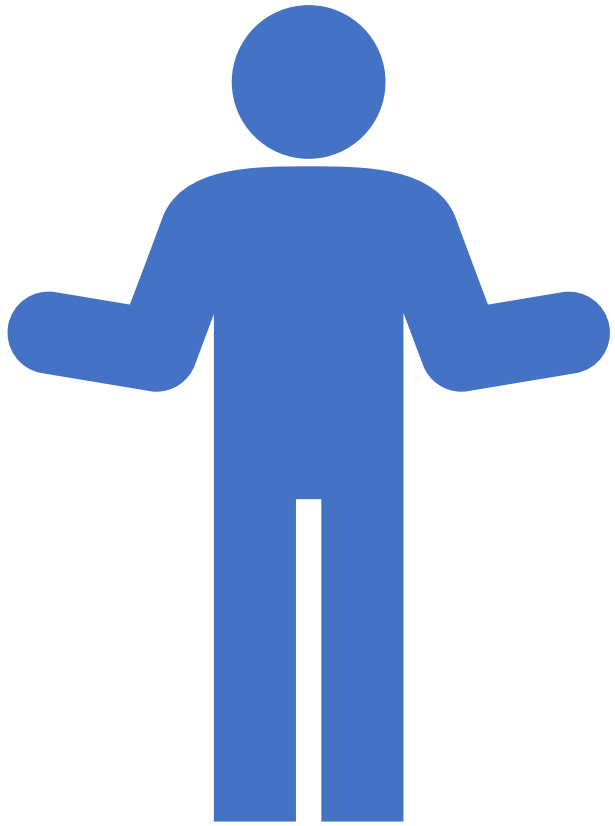
Sepsis

Possible aspiration

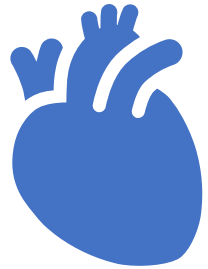
(Give antibiotics)

Distributive shock

Early cardiogenic shock?



Now what?

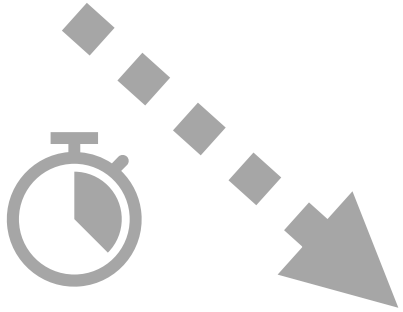


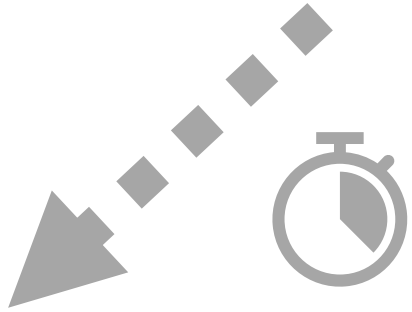
Fill the tank

Distributive, hypovolemic

Help the pump

Cardiogenic, obstructive





Fix the underlying problem

Filling the tank

A reasonable first step for (relative) hypovolemic states

How much?

EGDT is probably out

Individualized therapy better, but no clear guidelines on how

With what?

Balanced fluids generally better

Normal saline if concern for high ICP

Blood is also a fluid

How much is too much?

“Fluid responsiveness” is a complex topic

Straight leg raise

PVI/ΔPOP, PPV

Ultrasound

Urine output, lactate

What are the downsides?

Hemodilution

Congestive failure

Helping the pump

Vasopressors – increase afterload (SVR)

- Phenylephrine
- Vasopressin

Inotropes – increase contractility (CO/CI)

- Dobutamine
- Isoproterenol
- Milrinone

“Inopressors” – balanced effects (dose dependent)

- Norepinephrine
- Epinephrine
- Dopamine

What are the downsides?

Ischemia

Peripheral

Cardiac

Mesenteric

You have to call ICU

Learning points

Shock is the state where O_2 supply does not meet demand

Early symptoms can be subtle

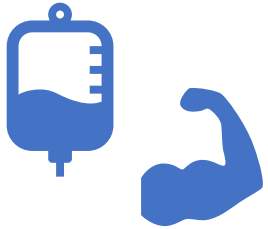
Patient may be normotensive

There are 4 main types of shock

Distributive, hypovolemic, cardiogenic, obstructive

Most real situations are mixed or undifferentiated

Find the clinical features



Initial resuscitation usually involves volume or pressors

Buy time to fix the underlying problem

Think about the downsides of your interventions