Fluid Responsiveness

Louisa Palmer
Instructor of Anesthesia
Program Director Critical Care Fellowship and Director for Critical Care Ultrasound
Brigham and Women's Hospital, Department of Anesthesia

Focused Echo: What to look for?

4 E's

- Effusion
- EF
- Entrance
- Equality

Fluid Responsiveness

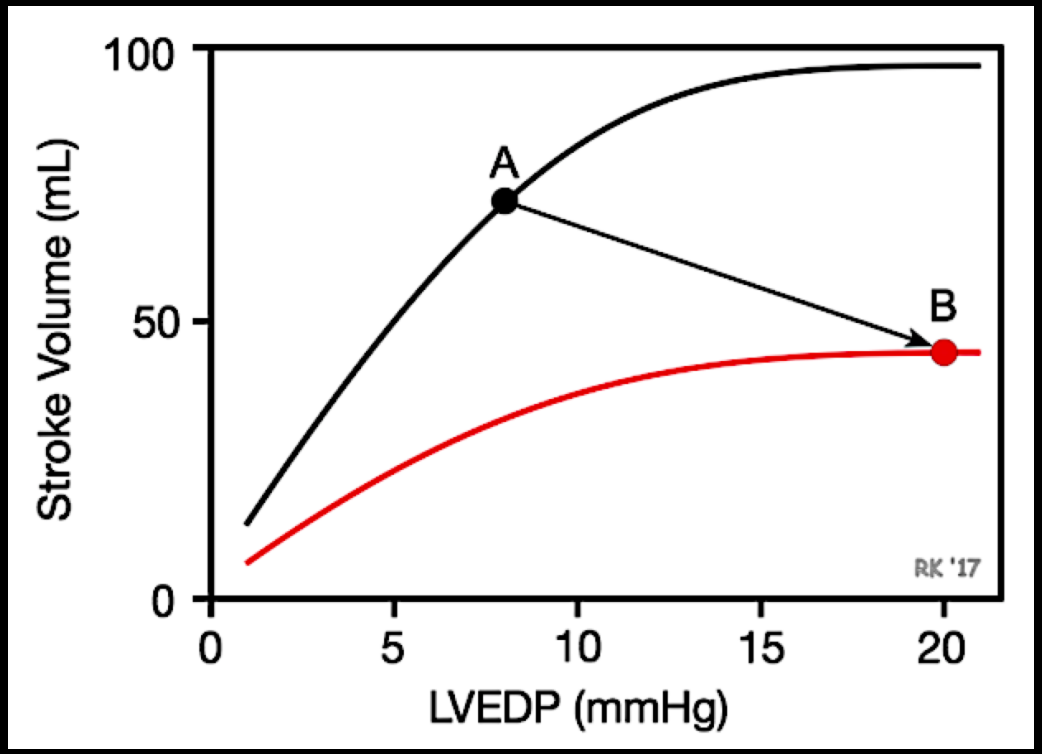
- Evolving Area
- No magic answer – always correlate with clinical picture
- Know the limitations for each study
- Fluid responsiveness does not mean given fluid!

Aims

- Static measurements of preload
  - Estimation of CVP using IVC collapsibility
  - Extubated spontaneously breathing patient
  - Predicting hypovolemia with LV end diastolic area
- Dynamic measurements of preload responsiveness
  - Estimation of fluid responsiveness using IVC distensibility
  - Intubated, passively ventilated patient

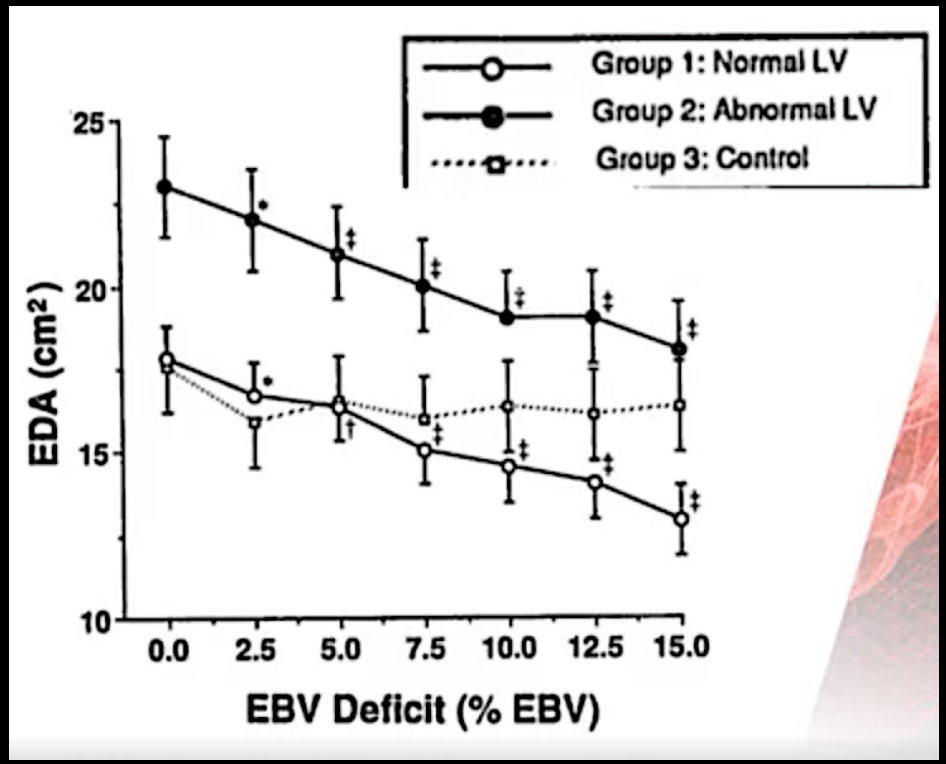
Preload

- Preload by itself doesn't predict utility of a fluid challenge
- Frank Starling Curve changes as someone becomes sick
- 60% of patients in septic shock can have some form of LV hypokinesis



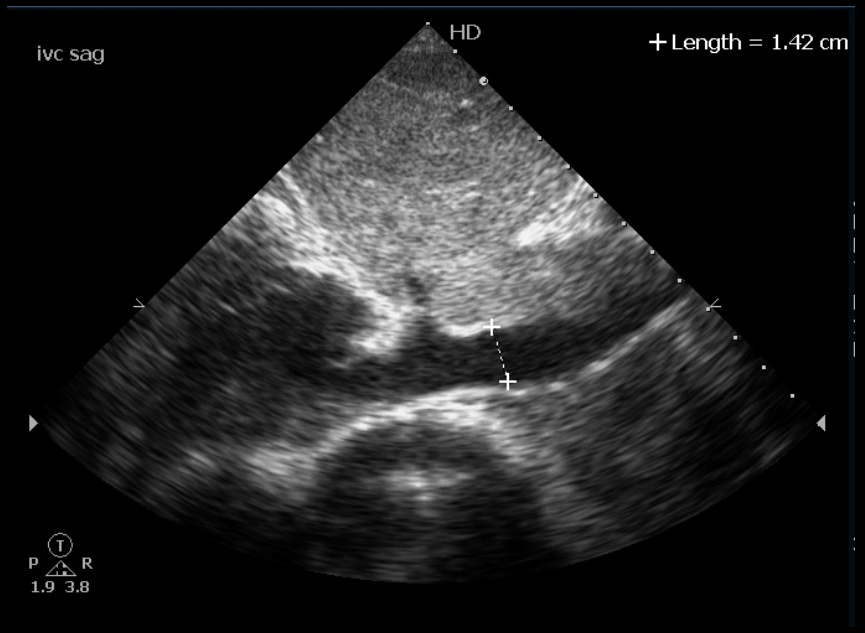
Static Measures of preload

- CVP
- End Diastolic Area
- Assessments for CVP/ EDA are only relevant if serial measurements taken

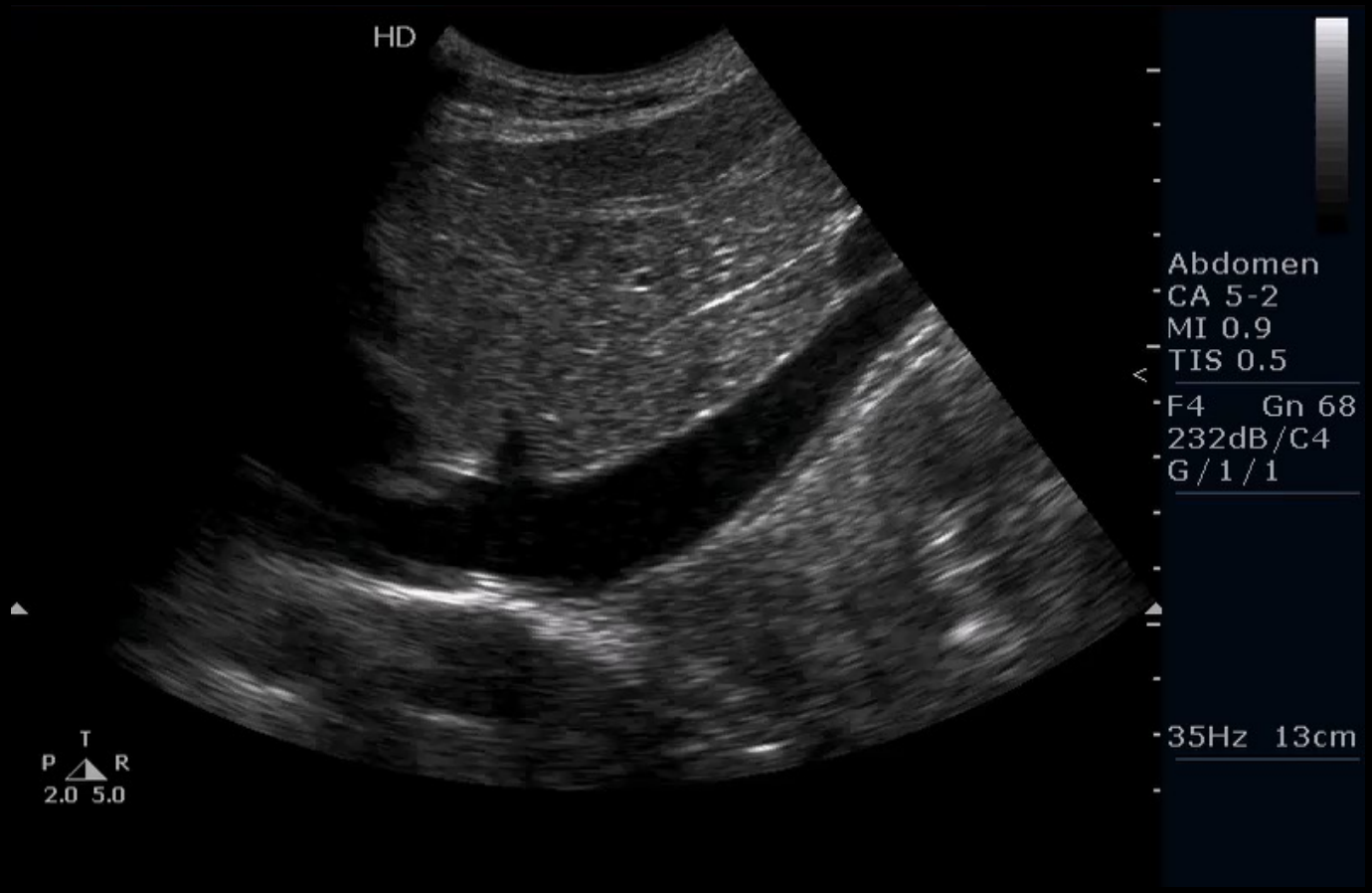


Cheung AT et al. Echocardiographic and hemodynamic indexes of left ventricular preload in patients with normal and abnormal ventricular function. *Anesthesiology* 1994

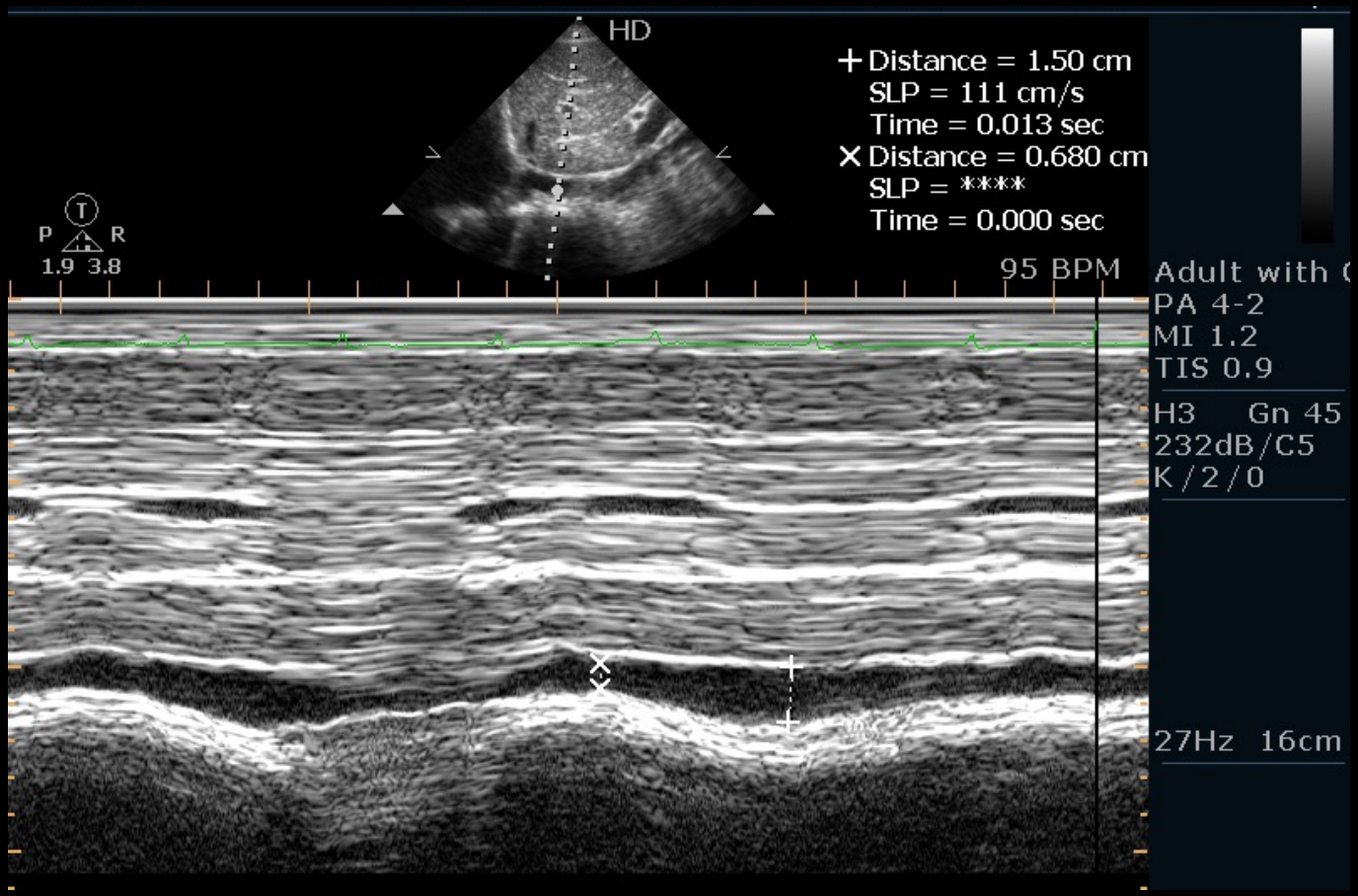
IVC sagittal – Subcostal position

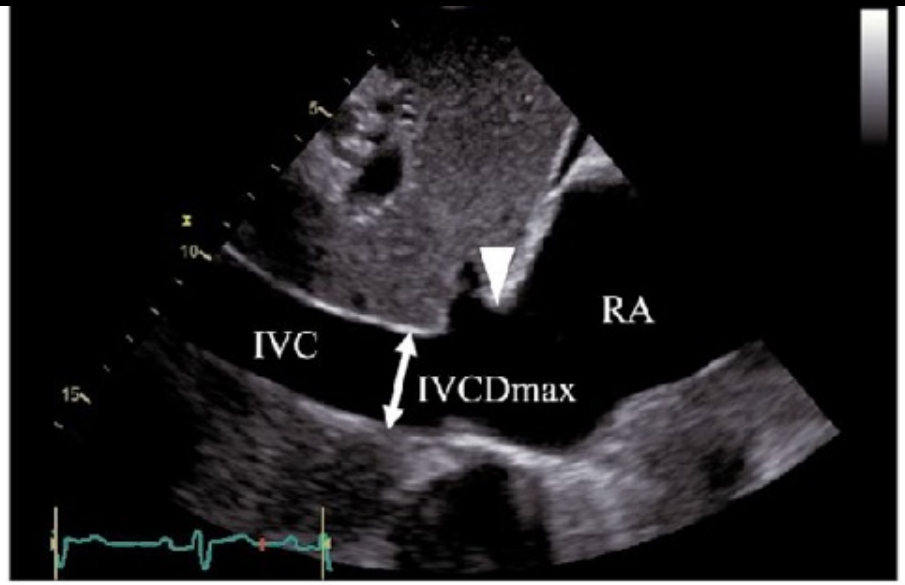


IVC for CVP estimation

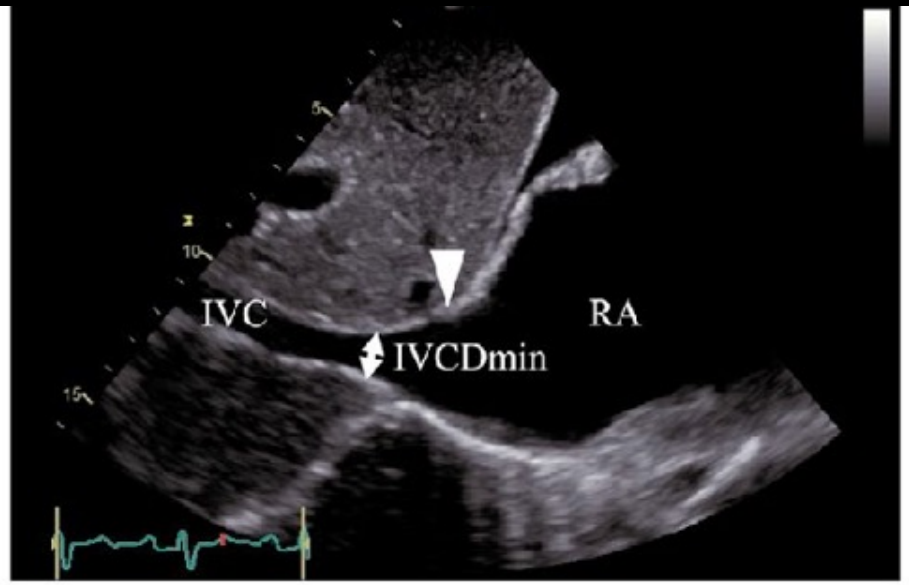


IVC Collapsibility with M mode





End-expiratory period

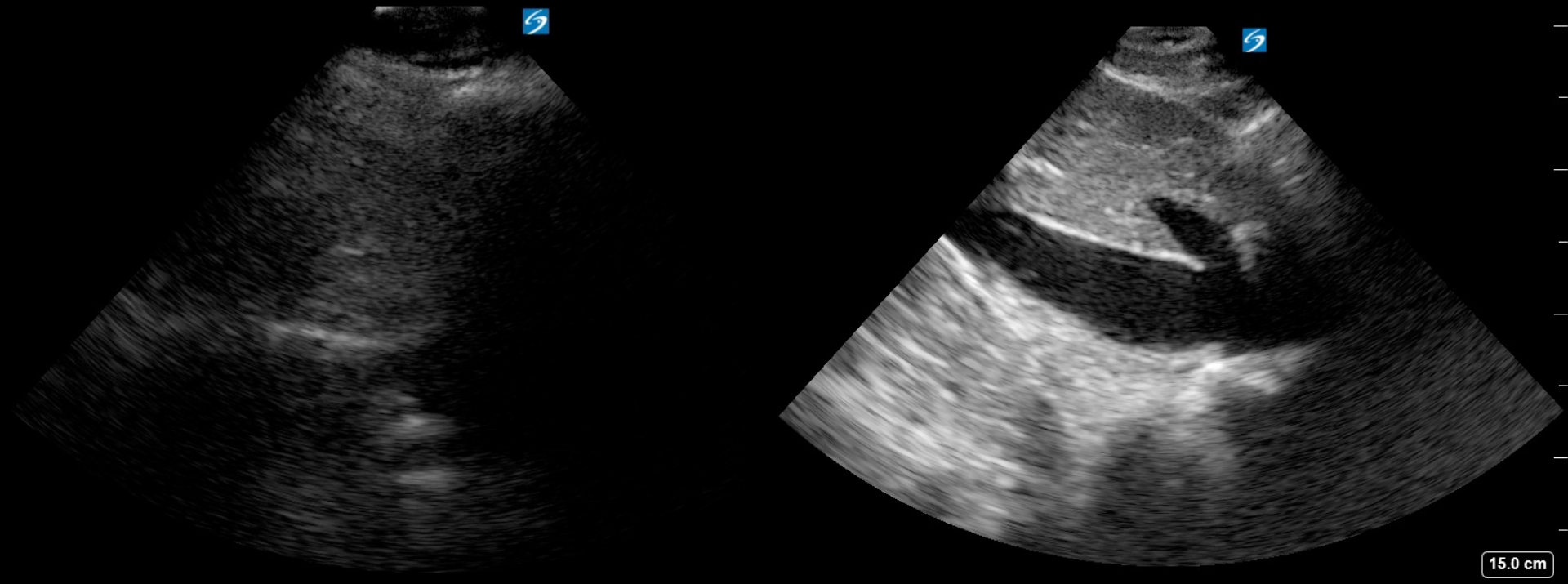


After brief sniff

	Normal (0-5)	Intermediate (5-15)		High (>15)
IVC diameter	<= 2.1cm	<= 2.1cm	>2.1cm	>2.1cm
collapse with sniff	>50%	<50%	>50%	<50%

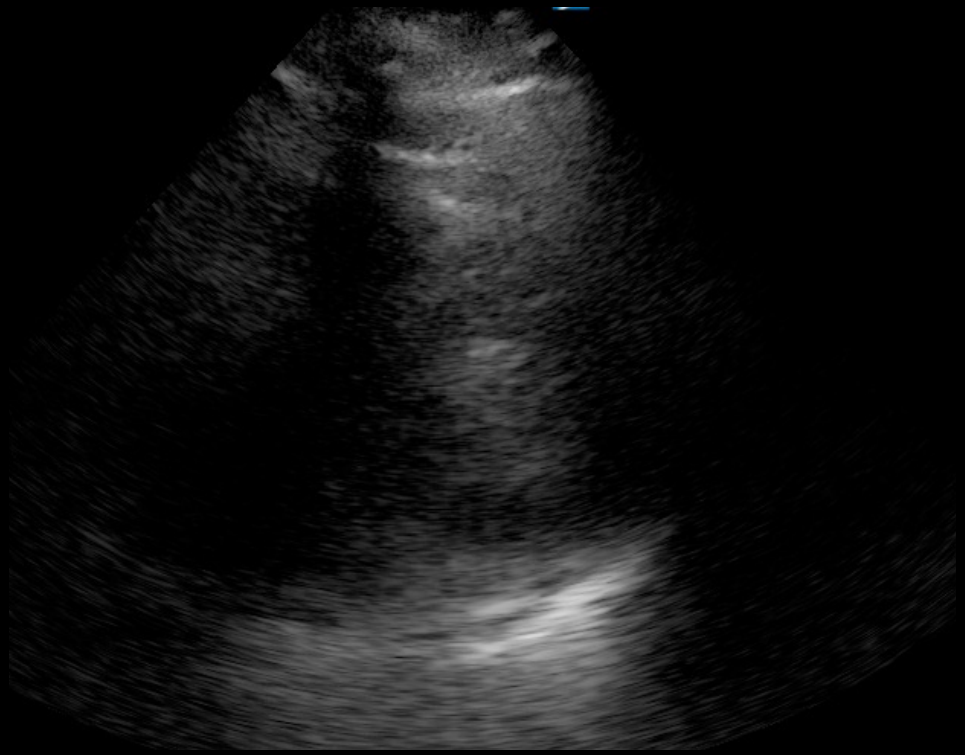
J Am Soc Echocardiogr 2010;23:685-713

IVC Collapsibility/ Size



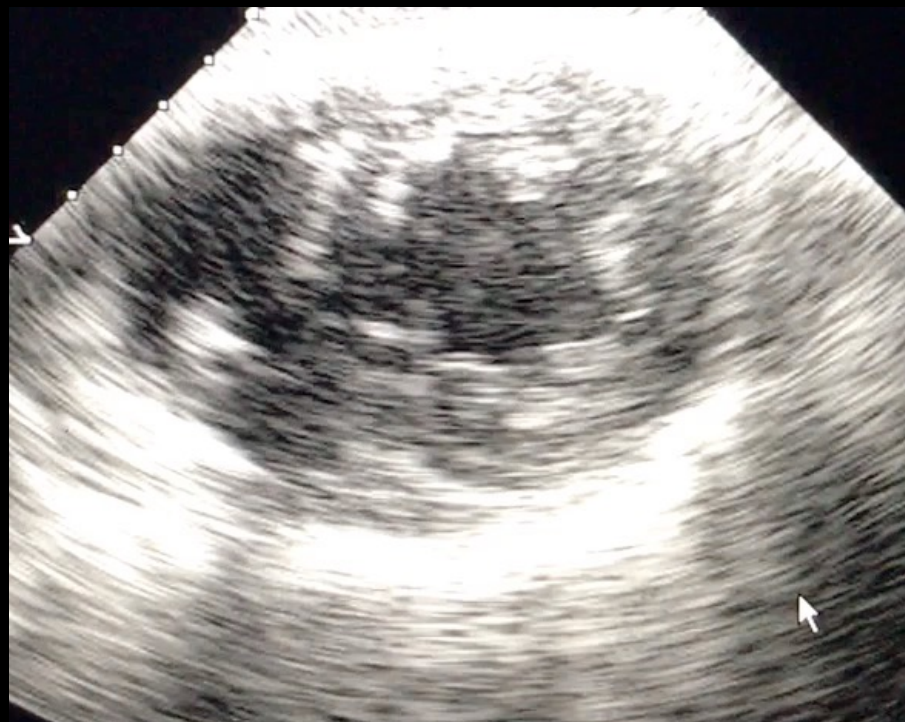
Limitations

- Requires extubated, spontaneously breathing patient
- Tamponade
- Cor Pulmonale
- Abdominal compartment/pregnancy
- IVC moving out of plane
- Angle of measurement
- Young, athletic individuals have large IVCs



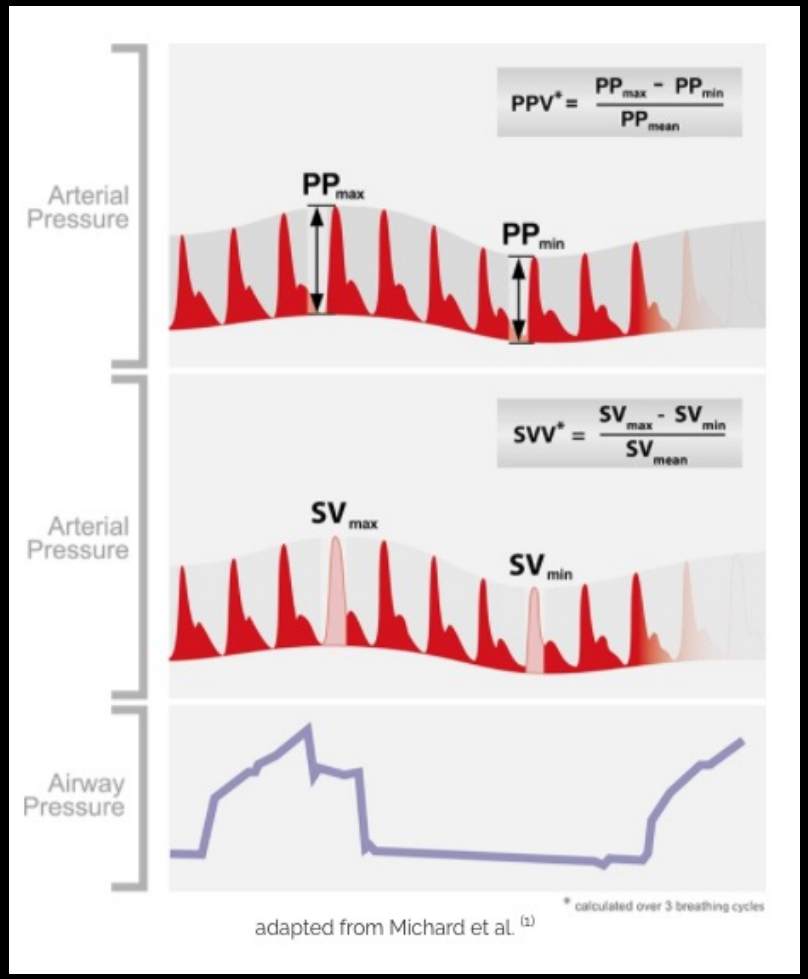
Severe Hypovolemia if EDA <5.5cm2/m2

Always assess RV. Underloaded LV could be due to RV dysfunction



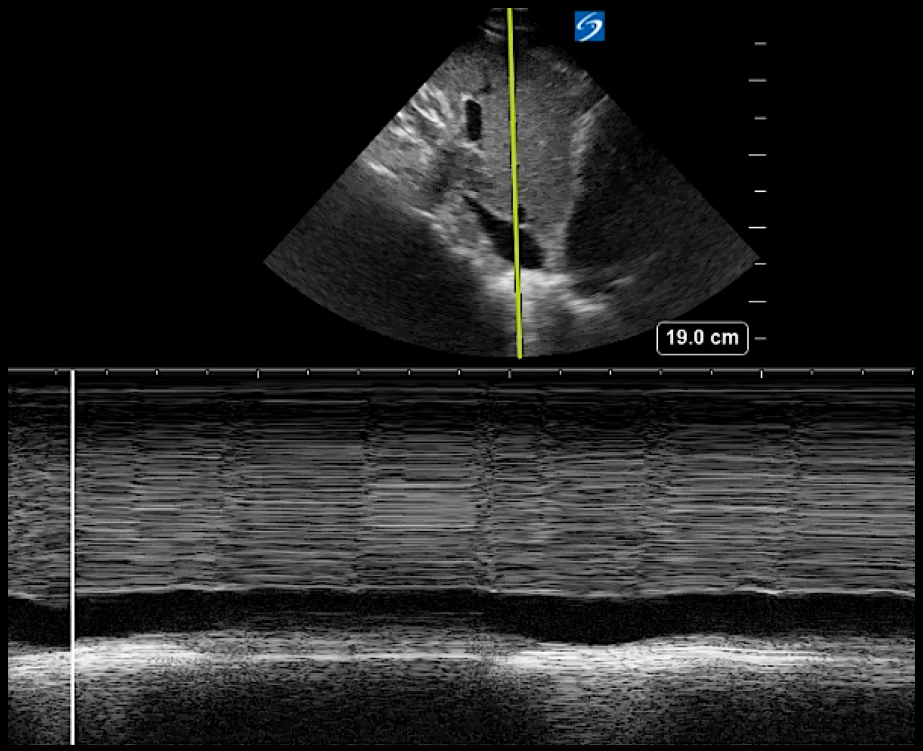
Preload Responsiveness

Preload Responsiveness: SVV/PPV

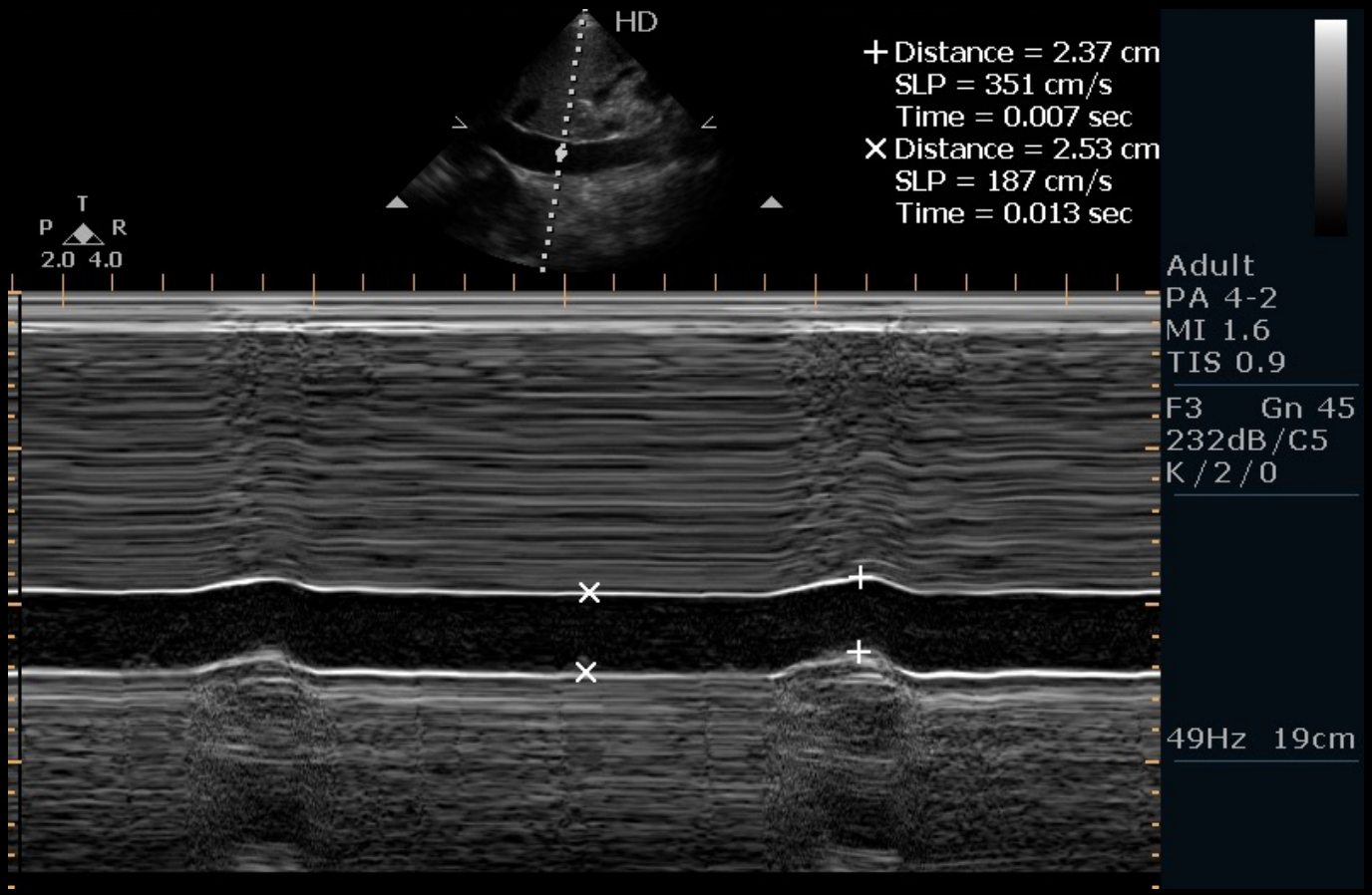


Vena Cava Distensibility

- During inspiration IVC distends on PPV
- Threshold: IVC 12% passive ventilation
- Limitations: Tamponade, Cor pulmonale, Assisted breathing, abdominal compartment, hyperinflation, dyspnea/ extreme effort, severe TR, IVC moving out of plane



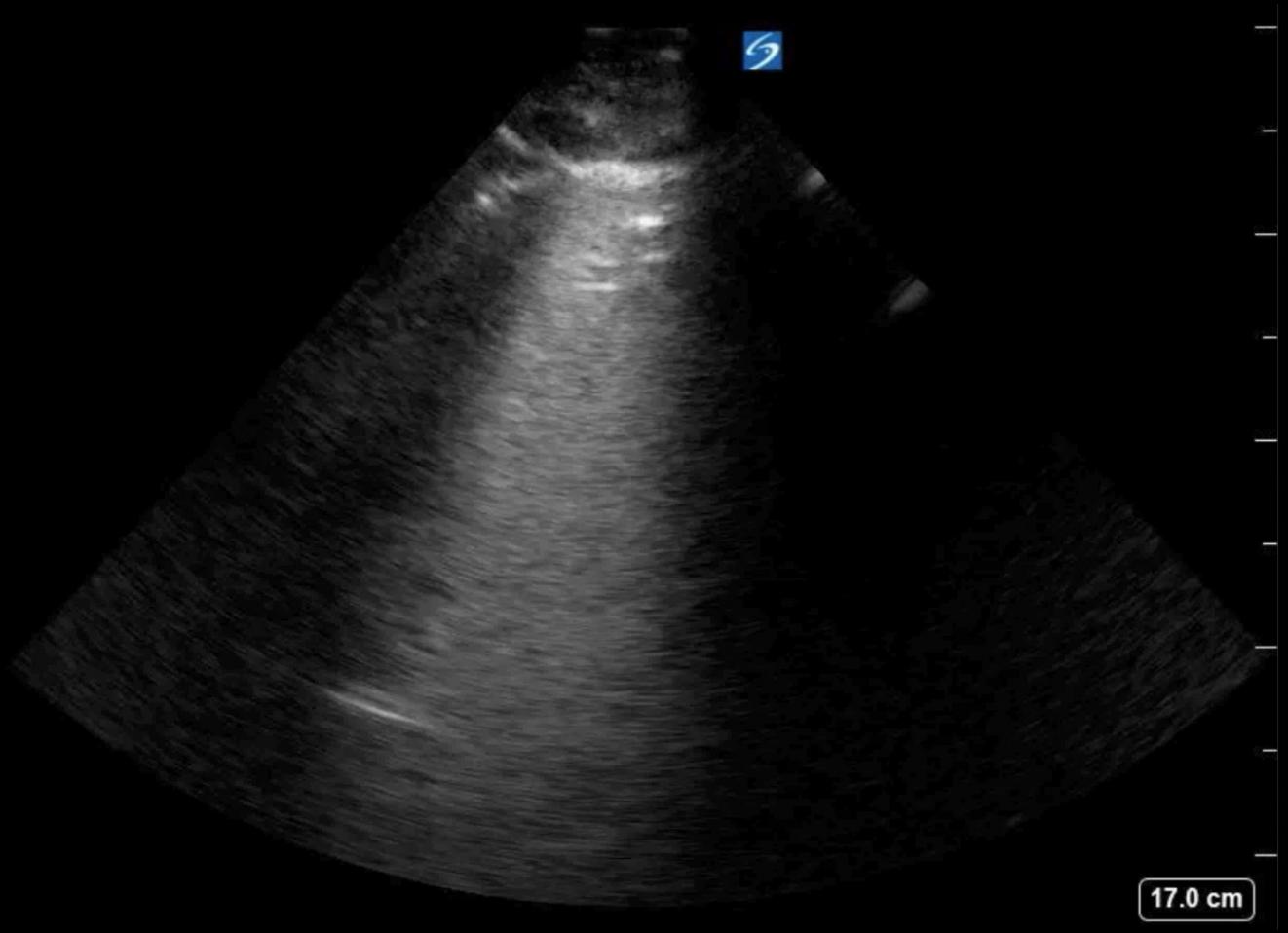
IVC Distensibility



Limitations

- Small validation cohorts
- Tamponade
- Cor pulmonale
- Assisted breathing
- Abdominal compartment
- Hyperinflation
- Severe TR
- IVC moving out of plane

Fluid Tolerance



- Measurements of static preload include CVP, IVC collapsibility, EDA
- Only helpful if serial measurements obtained
- Dynamic response to changes in preload include SVV and Vena Cava distensibility
- Only possible with passive ventilation
- Always correlate with clinical picture. Just because a patient is preload responsive does not mean give fluid!

Question

- A 72yo F w hx obesity, htn, CAD, DM is admitted with septic shock from necrotizing fasciitis. She undergoes multiple debridements for source control. On HD7 she is intubated and sedated in the ICU on Pressure Support settings 10/8. She is hypotensive requiring low dose levophed. A point of care ultrasound is performed to look at her IVC distensibility. The percentage change in diameter of her IVC with respiration is 15%. The following is true:
  - A) Her IVC respiratory variation suggests that she is fluid tolerant
  - B) Her IVC variation suggests that she is fluid responsive
  - C) Her IVC variation suggests that she has tamponade physiology
  - D) Her IVC variation suggests increased respiratory effort