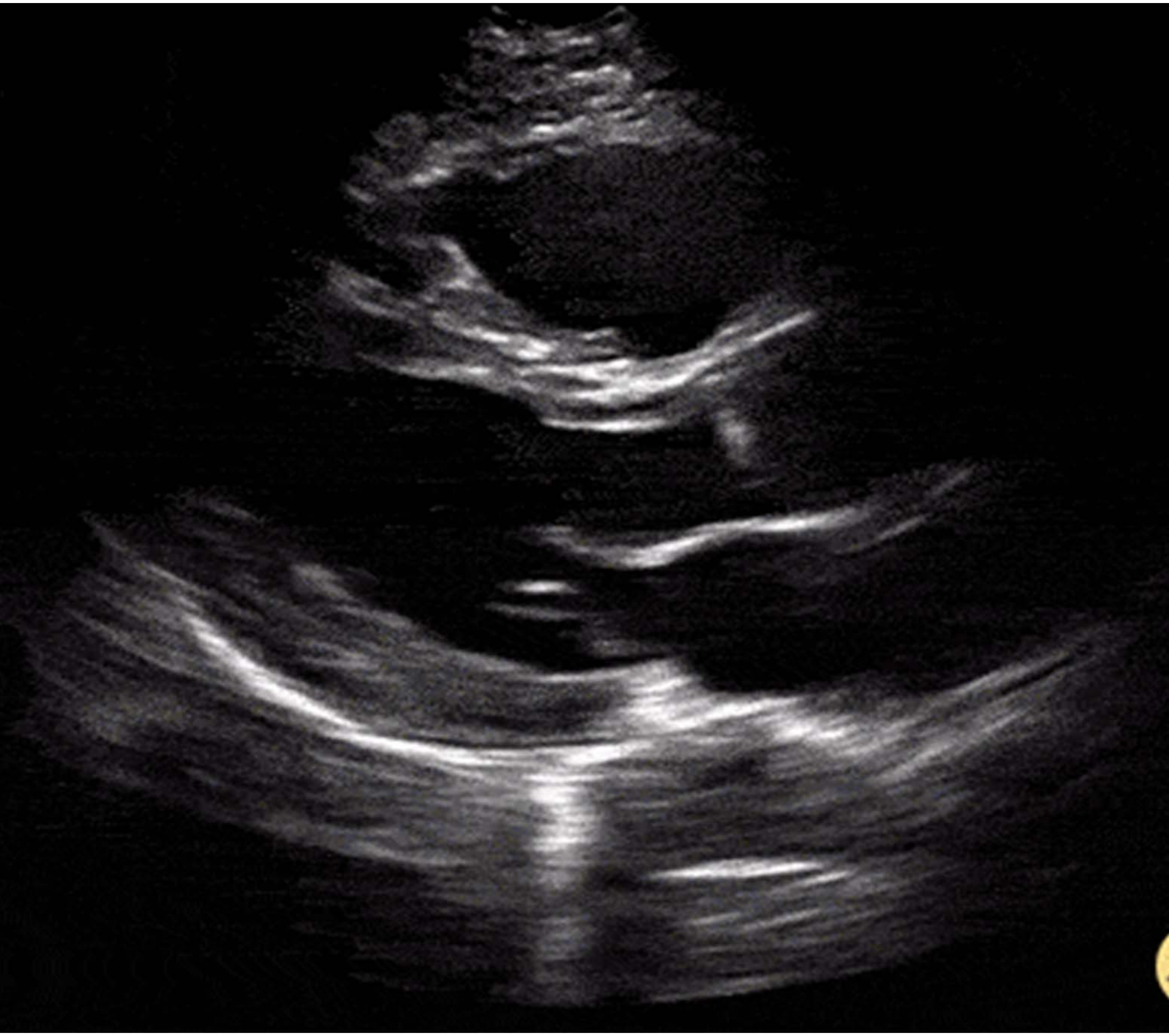
CARDIAC VTI AND COVID-19 PULMONARY FINDINGS



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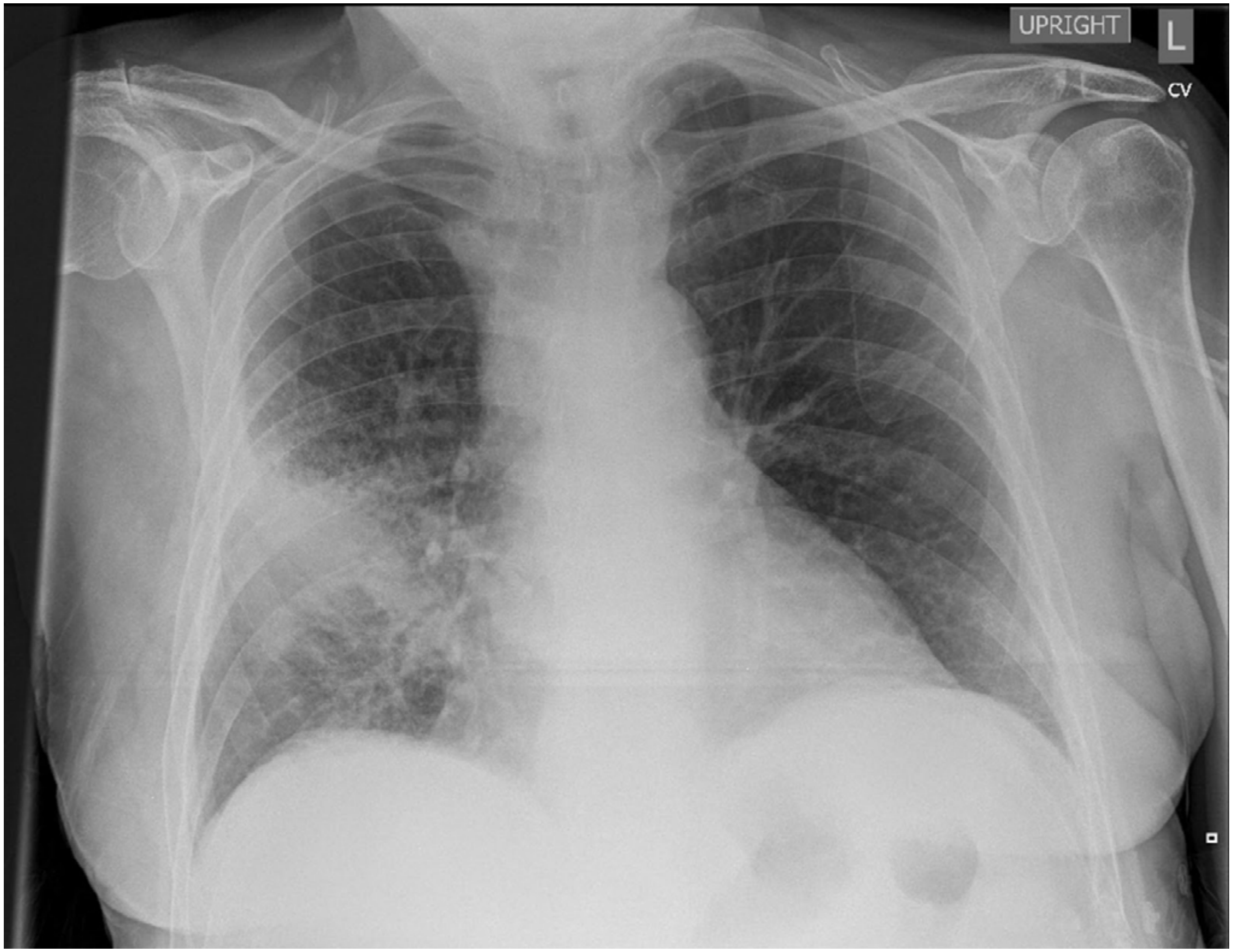
FINANCIAL DISCLOSURES

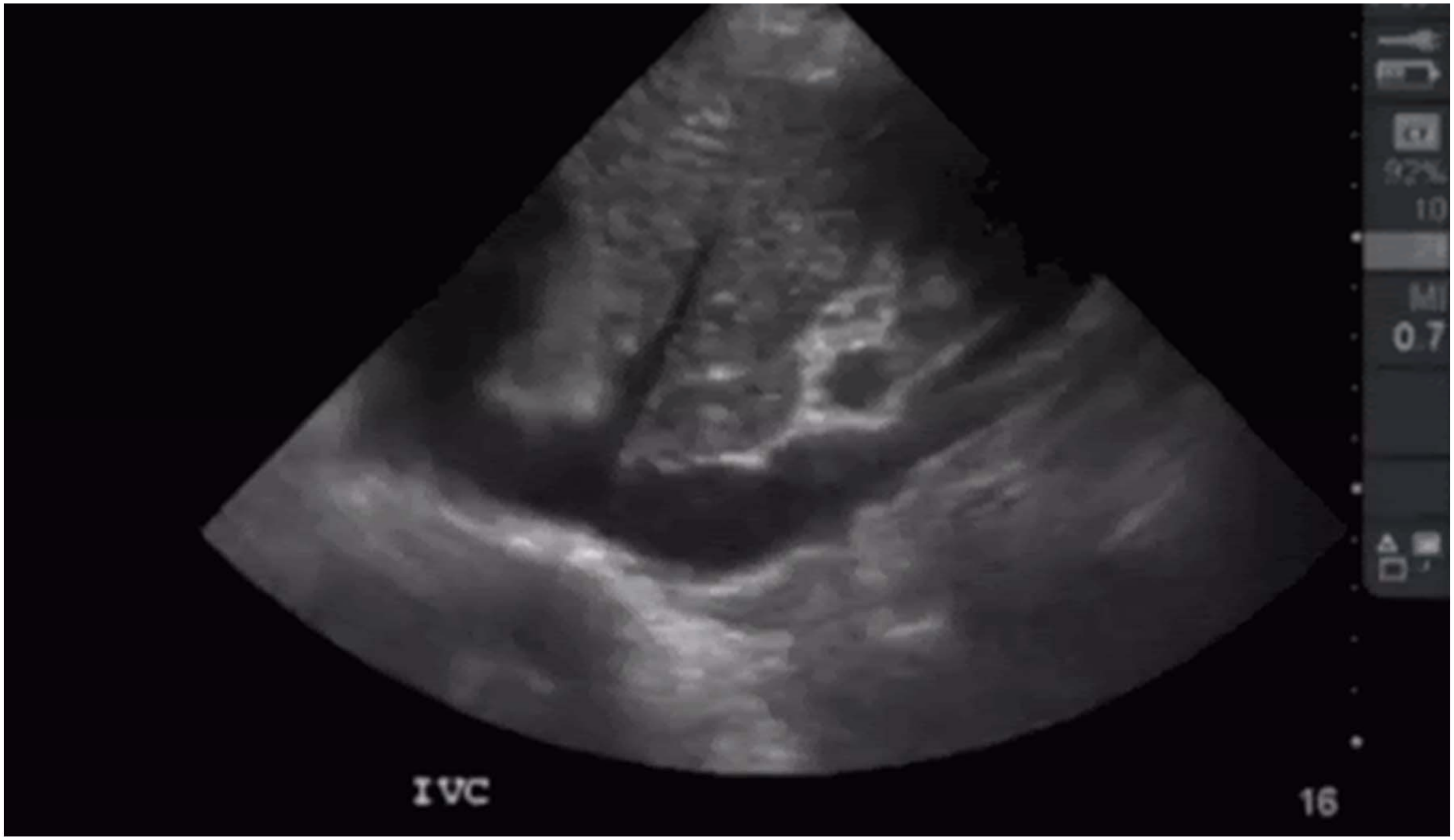
- None

CASE

An 87 year old female with PMH of CHF presents to the ED with fever and dyspnea. She received 1L NS from EMS and on arrival vital signs are BP 89/60, HR 120, SpO2 93% on RA, and T 38. Her WBC count is 18, her lactate is 2.6, and her CXR shows a new infiltrate. Will more fluids help? Will she respond to them?



DO WE USE IVC?



G.E.L.

IVC COLLAPSE FOR FLUID RESPONSIVENESS

Question: Can IVC collapsibility (cIVC) predict fluid responsiveness in spontaneously breathing critically ill patients?

Study: Prospective, convenience. cIVC compared to ≥10% increase in CI on NICOM. Measured baseline diameter and cIVC, Δ after PLR, and Δ after 500 mL bolus.

n = 124

cIVC = (IVCmax-min)/max
NICOM = noninvasive hemodynamic monitoring system
PLR = passive leg raise
AUC = area under curve

RESULTS

- IVC diameter
- ΔcIVC after PLR
- ΔcIVC after bolus
- PLR alone

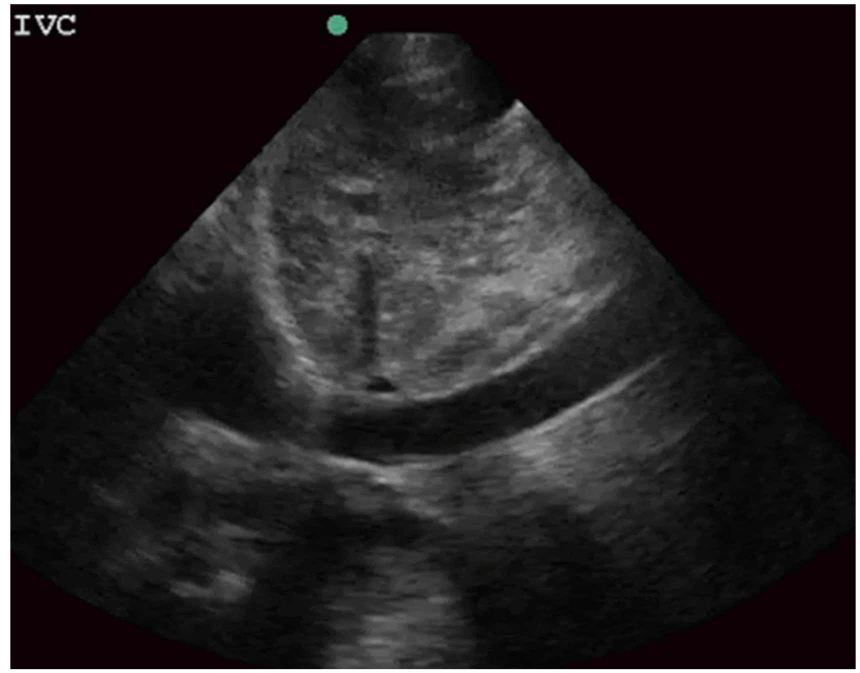
→ Did not predict fluid responsiveness

	AUC	+LR	-LR
Baseline cIVC >25% (best cutoff)	0.84	4.56	0.16

Corl KA, George NR, Romanoff J. Inferior vena cava collapsibility detects fluid responsiveness among spontaneously breathing critically-ill patients. Journal of critical care. 2017; 41:130-137.

A BETTER TOOL TO SEE “WHERE ARE WE NOW?”

Small/collapsible= low CVP



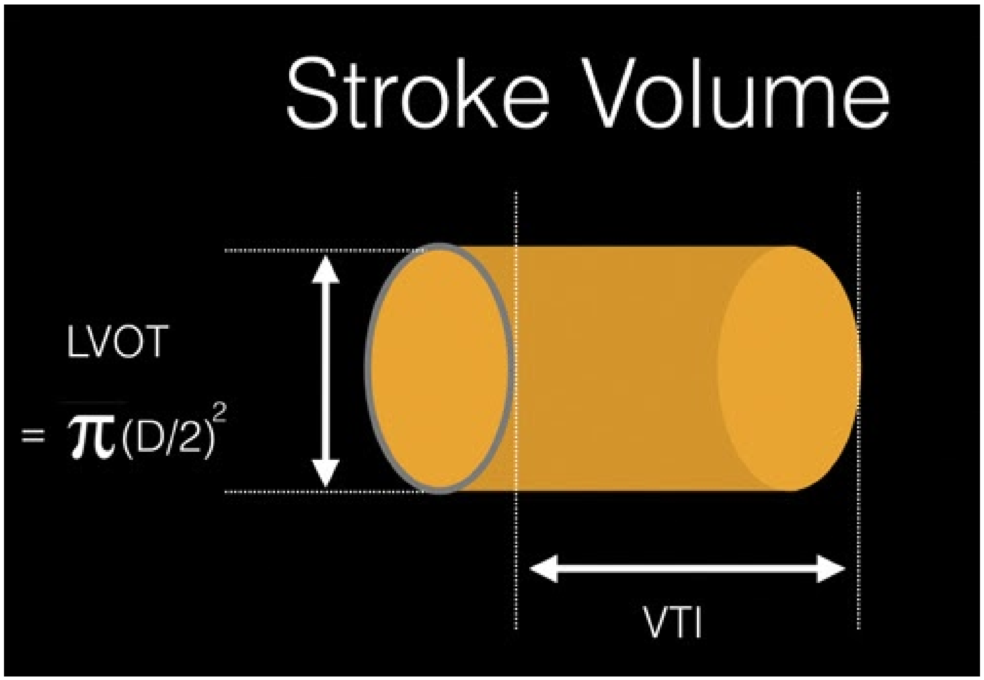
Large/plethoric, no variation=high CVP

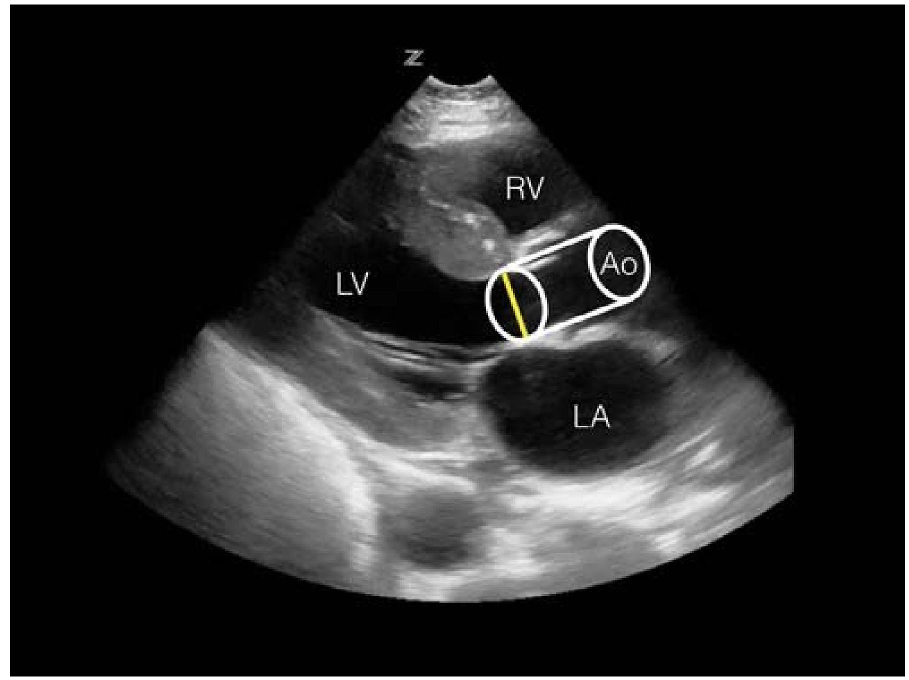
WHERE ARE WE GOING?

CO = ?

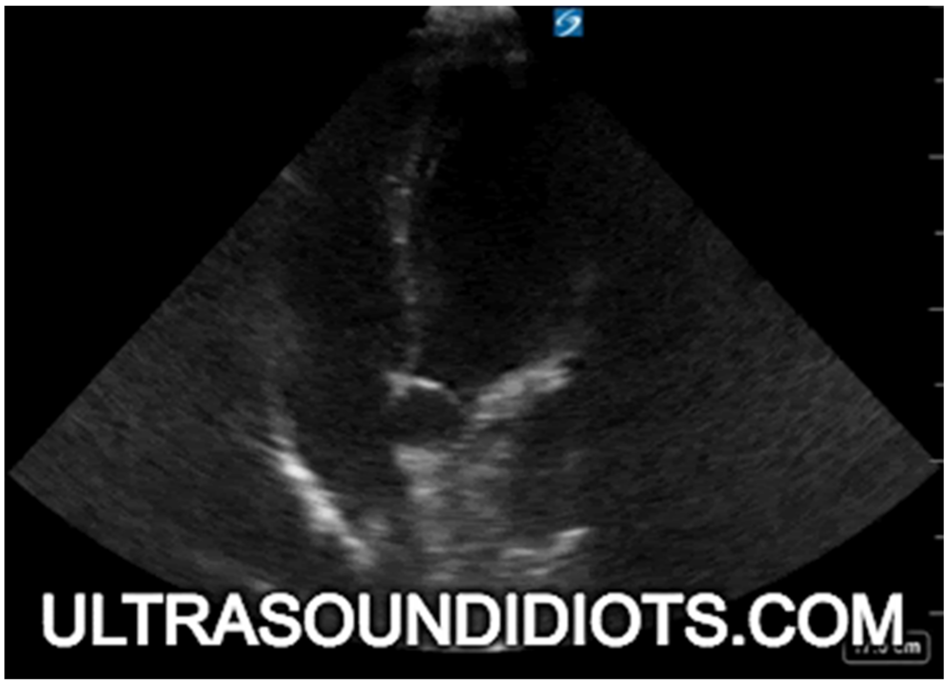
$$CO = SV \times HR$$

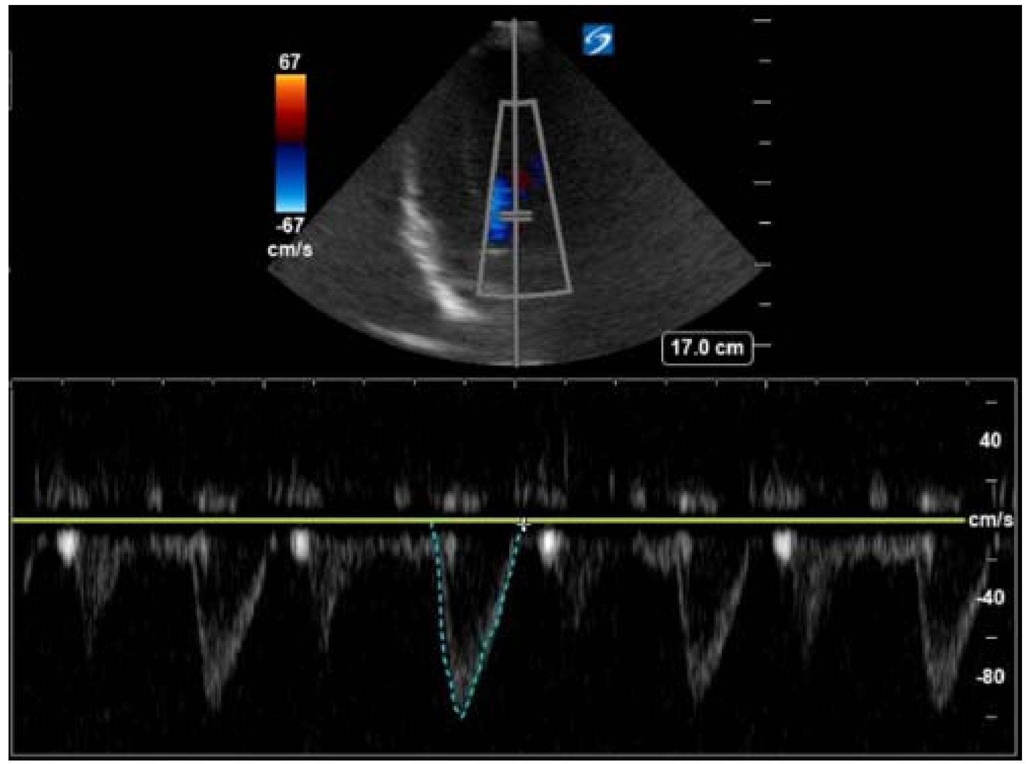
SV = cross sectional area of LVOT x VTI



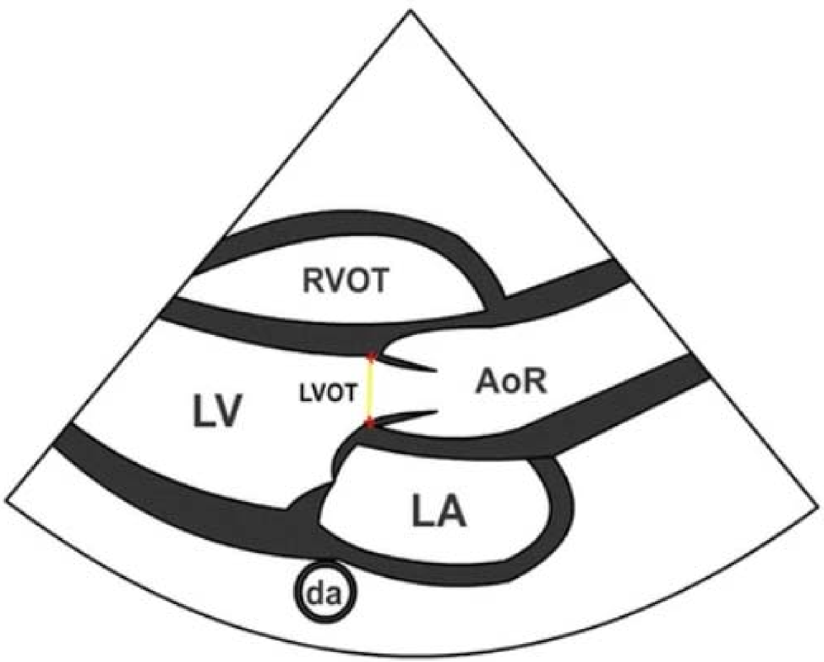


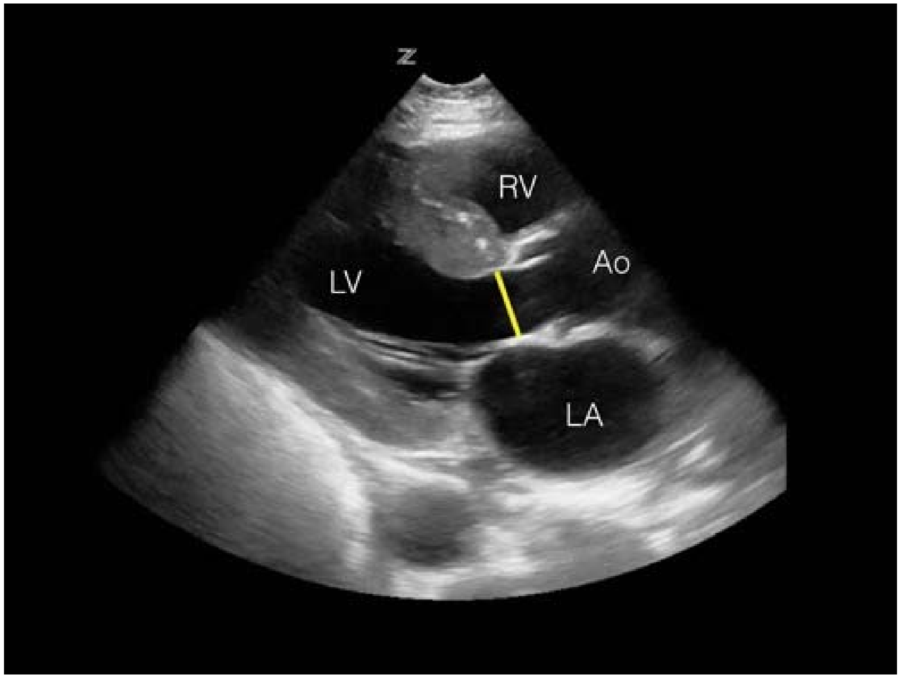
VTI = Velocity time index



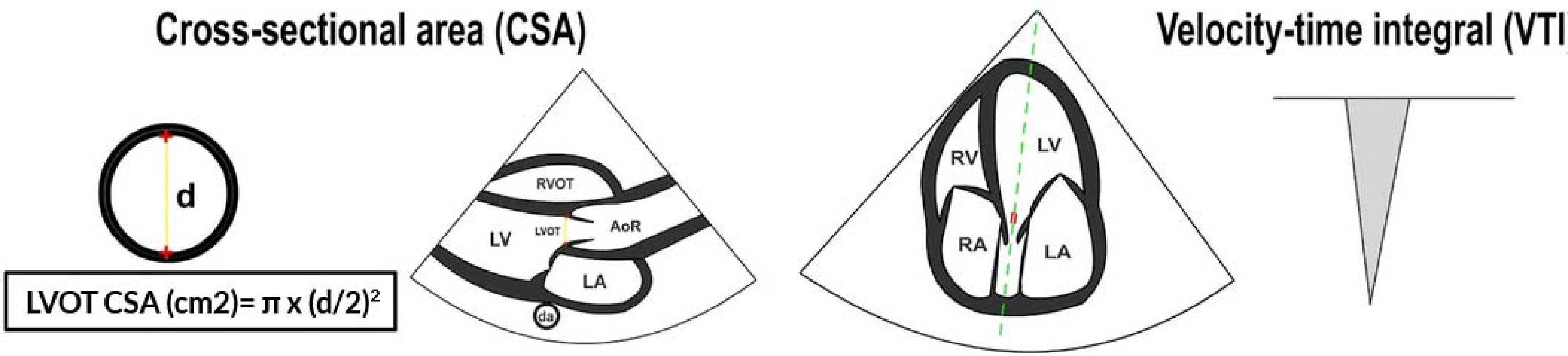


PSLA





LVOT Cross sectional Area (cm2) = $\pi \times (d/2)^2$



LVOT CSA (cm2)= $\pi \times r^2$

SV= CSA x VTI

CO= SV x HR

https://echocardiographer.org/Calculators.home.html

Echo Calculators

Home | Echo Physics | Transthoracic | Transesophageal | Reference Values | Image Library | Tutorials | Echo Calculators | Self Assessment | Contact Us

Cardiac Output/Stroke Volume | Qp/Qs (Shunt) | Aortic Valve Area (Stenosis) | Mitral Regurgitation (EROA/PISA)

FYI: This calculator will not work in IE 8 or 9 but works in other browsers

Cardiac output can be calculated by echo across any structure where one can measure cross sectional area and some information about velocity of blood flow. This could be the aorta, the pulmonic artery, or across any of the valves.

The easiest and least variable place to measure cardiac output is at the left ventricular outflow tract (LVOT). The LVOT diameter changes very little through systole and diastole and is assumed to be constant and closely approximating a circle in shape, however this introduces some error as it is in fact elliptical in many patients.

Cardiac Output and Stroke Volume Calculator

Plug in your information below to calculate the cardiac output:

Heart Rate: 120 beats/min

LVOT VTI: 14 cm

LVOT diameter: 2 cm

Calculate | Reset

Stroke Volume 44 ml

Cardiac Output 5.3 L/min

Normal VTI = 18 – 22cm

For Heart rates between 55-95 bpm

If HR < 55 VTI should be > 18cm

If HR >95 VTI should be < 22cm

Goldman JH, Schiller NB, Lim DC, Redberg RF, Foster E. Usefulness of stroke distance by echocardiography as a surrogate marker of cardiac output that is independent of gender and size in a normal population. Am J Cardiol. 2001 Feb 15;87(4):499-502, A8. doi: 10.1016/s0002-9149(00)01417-x. PMID: 11179548.

Now what?

Intensive Care Med (2007) 33:1125–1132
DOI 10.1007/s00134-007-0646-7

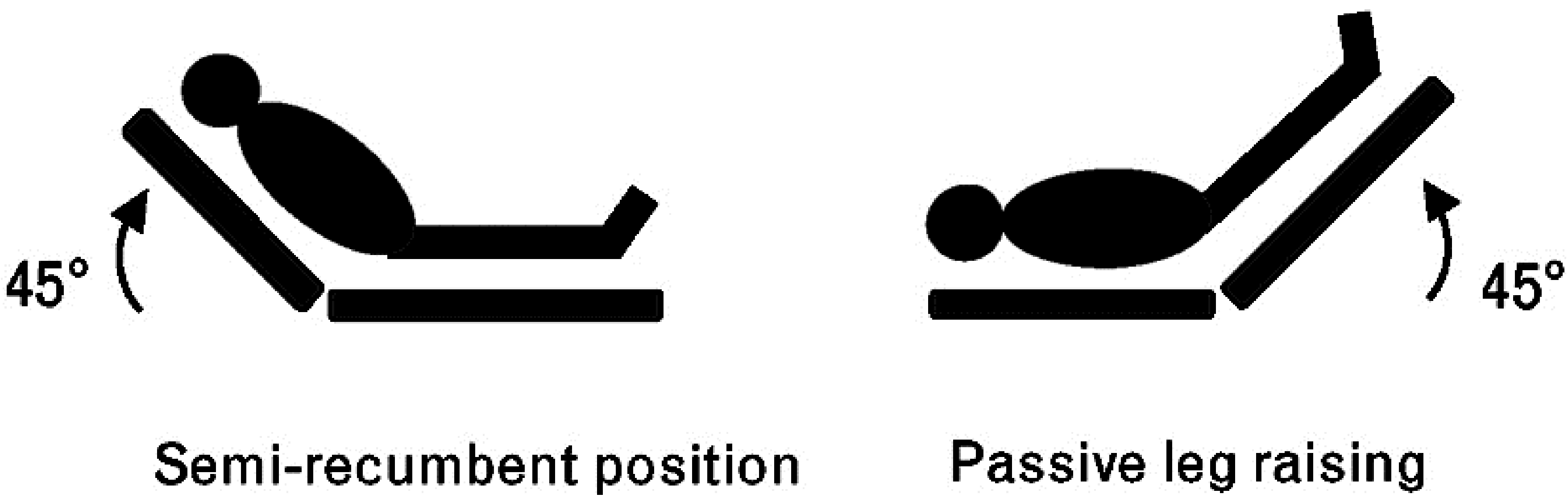
ORIGINAL

Bouchra Lamia
Ana Ochagavia
Xavier Monnet
Denis Chemla
Christian Richard
Jean-Louis Teboul

Echocardiographic prediction of volume responsiveness in critically ill patients with spontaneously breathing activity

A passive leg raising induced increase in stroke volume of 12.5% or more predicted an increase in stroke volume of 15%or more after volume expansion with a sensitivity of 77% and a specificity of 100%

Passive leg raise



BACK TO THE CASE

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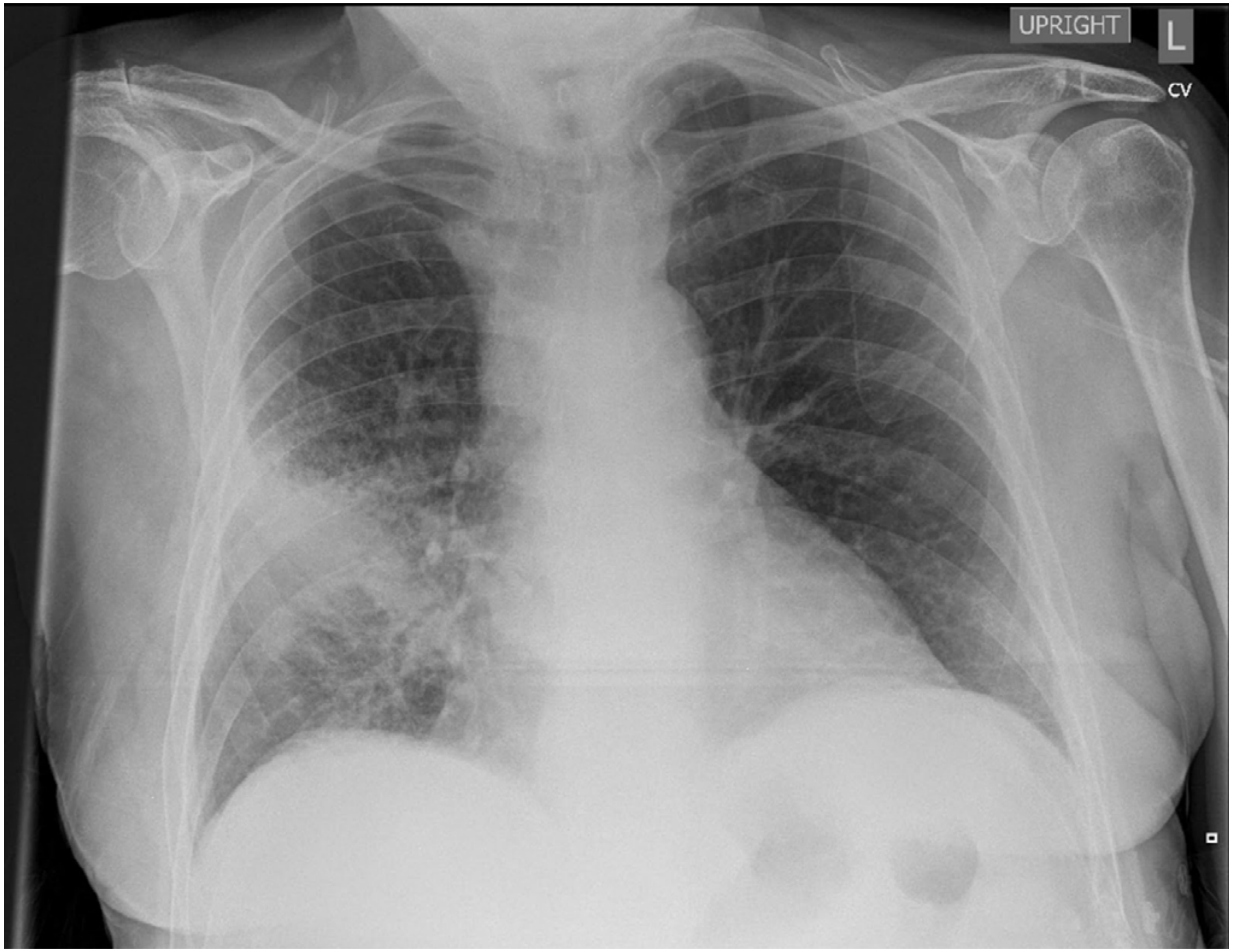
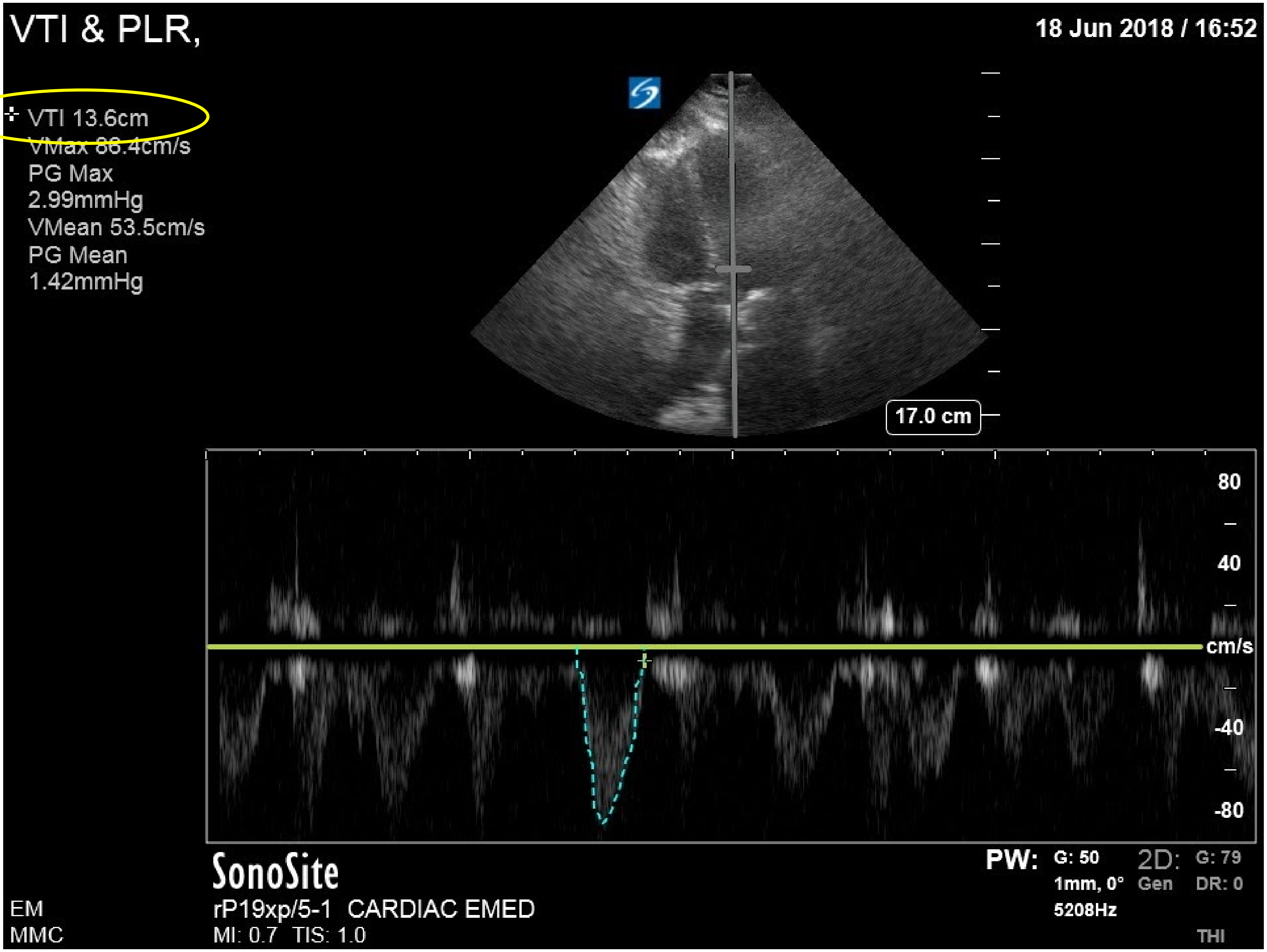




VTI & PLR,
18 Jun 2018 / 16:52
VTI 13.6cm
VMax 86.4cm/s
PG Max
2.99mmHg
VMean 53.5cm/s
PG Mean
1.42mmHg
17.0 cm
80
40
cm/s
-40
-80
SonoSite
PW:
G: 50
1mm, 0°
5208Hz
2D:
Gen
G: 79
DR: 0
THI
EM
MMC
rP19xp/5-1 CARDIAC EMED
MI: 0.7 TIS: 1.0

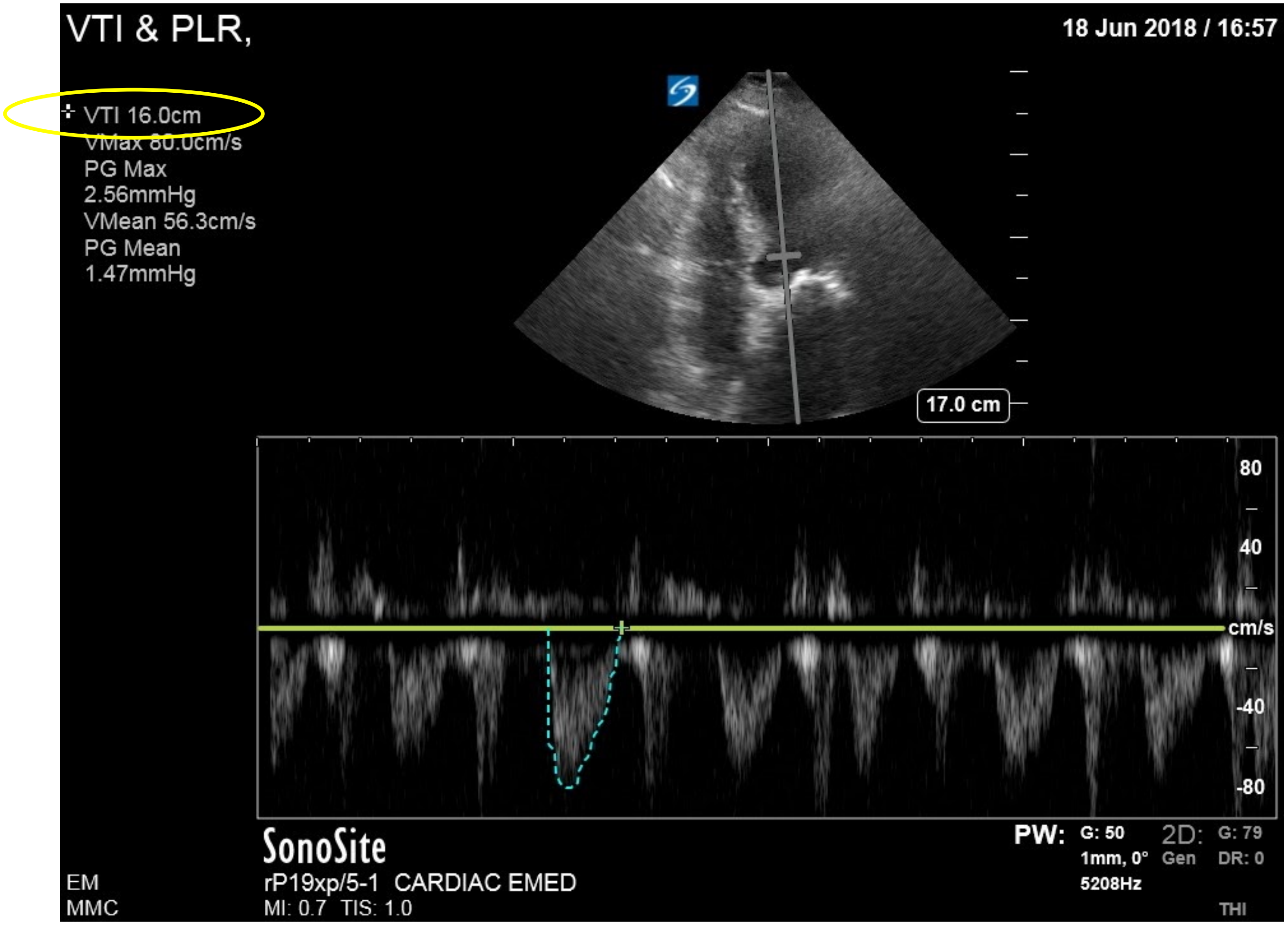
VTI = 13.5 cm

Passive leg raise

Semi-recumbent position

Passive leg raising

VTI = 16 cm



Repeat measurement of VTI (16.0 cm) immediately following passive leg raise maneuver. A 15% increase in VTI from baseline (13.6 cm -> 16.0 cm) indicating a favorable response to volume challenge.

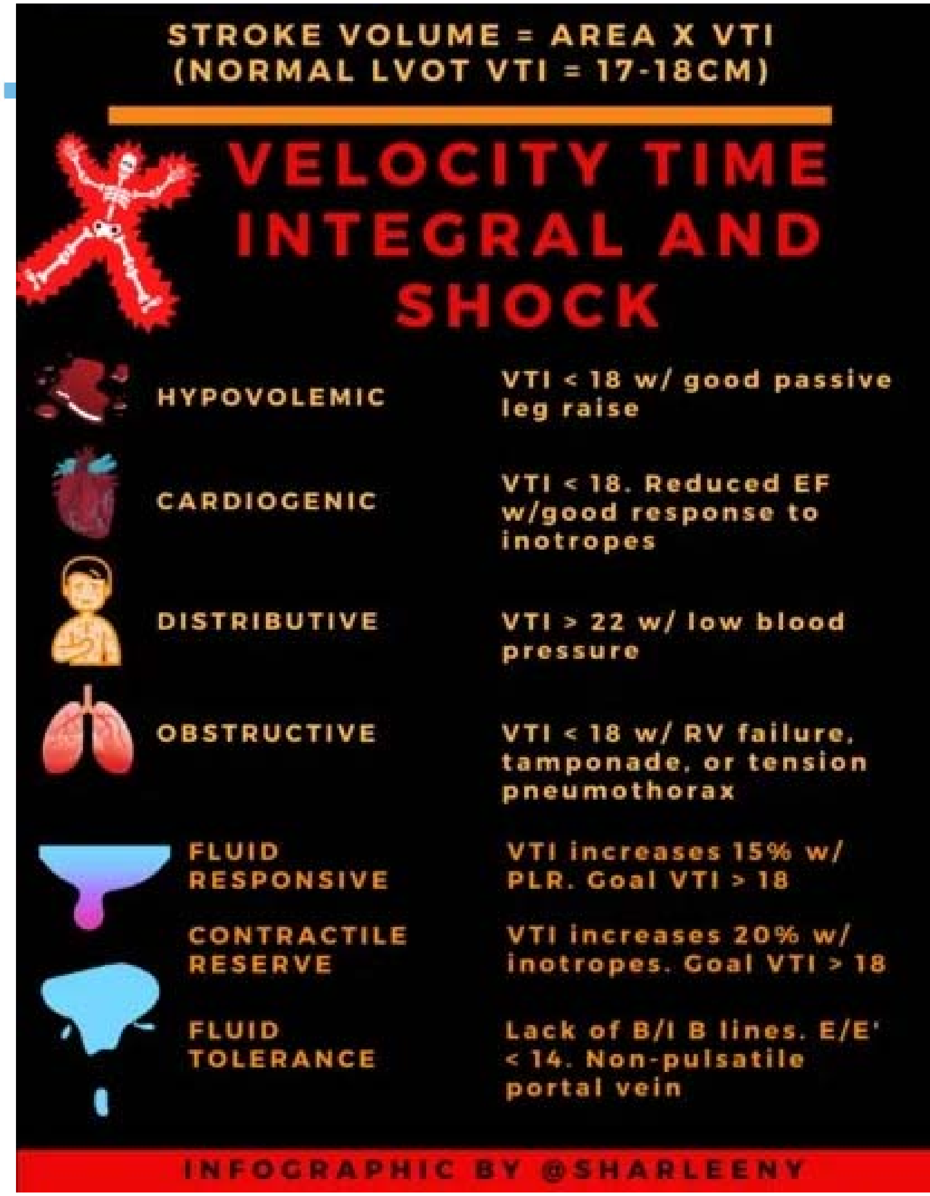

SWR
kindernetz

Consideration

Shock — Inadequate organ perfusion and delivery of nutrients necessary for normal tissue and cellular function. Initially may be reversible but life threatening if not treated promptly.

	CAUSED BY	SKIN	PCWP (PRELOAD)	CO	SVR (AFTERLOAD)	TREATMENT
Hypovolemic shock	Hemorrhage, dehydration, burns	Cold, clammy	↓↓	↓	↑	IV fluids
Cardiogenic shock	Acute MI, HF, valvular dysfunction, arrhythmia	Cold, clammy	↑ or ↓	↓↓	↑	Inotropes, diuresis
Obstructive shock	Cardiac tamponade, pulmonary embolism, tension pneumothorax	Cold, clammy	↑ or ↓	↓↓	↑	Relieve obstruction
Distributive shock	Sepsis, anaphylaxis	Warm	↓	↑	↓↓	IV fluids, pressors, epinephrine (anaphylaxis)
	CNS injury	Dry	↓	↓	↓↓	

Type of Shock	Typical assessment
Hypovolemic Shock	VTI less than 18 with good response to PLR. - Always check LV/RV/IVC. - Look out for the dagger shaped doppler- suggests some kind of outflow obstruction - Kissing LV walls/small chambers - Look for a source of volume loss
Cardiogenic Shock	VTI less than 18. Reduced EF with a good response to inotropic agents. - Can still be fluid responsive
Distributive Shock	VTI more than 22 with low blood pressure. Clinical correlation is important! - Early on hyperdynamic LV - Later on reduced EF with a low VTI. - Lung/Abdomen US to look for a source.
Obstructive Shock	VTI less than 18 with RV failure or tamponade or tension pneumothorax. - RV failure Common in ARDS with mechanical ventilation. All McConnells is not PE - RV free wall measurement to rule in chronic RV issues (care to exclude trabeculations) - EKG tracing helpful to rule in/out tamponade (Interventional cardiology is helpful here!) - Lung US to rule out pneumothorax. - Pericardial effusion with signs of chamber collapse



CORE ULTRASOUND
LEARN • EXPLORE • SHARE

5 Minute Sono · May 14, 2021 · 1 min read

Volume Responsiveness LVOT VTI

This post was peer reviewed by Terren Trott, MD on May 14, 2021

If you'd like to see the old version (circa 2017), **click here**.

Pulmonary findings in Covid-19

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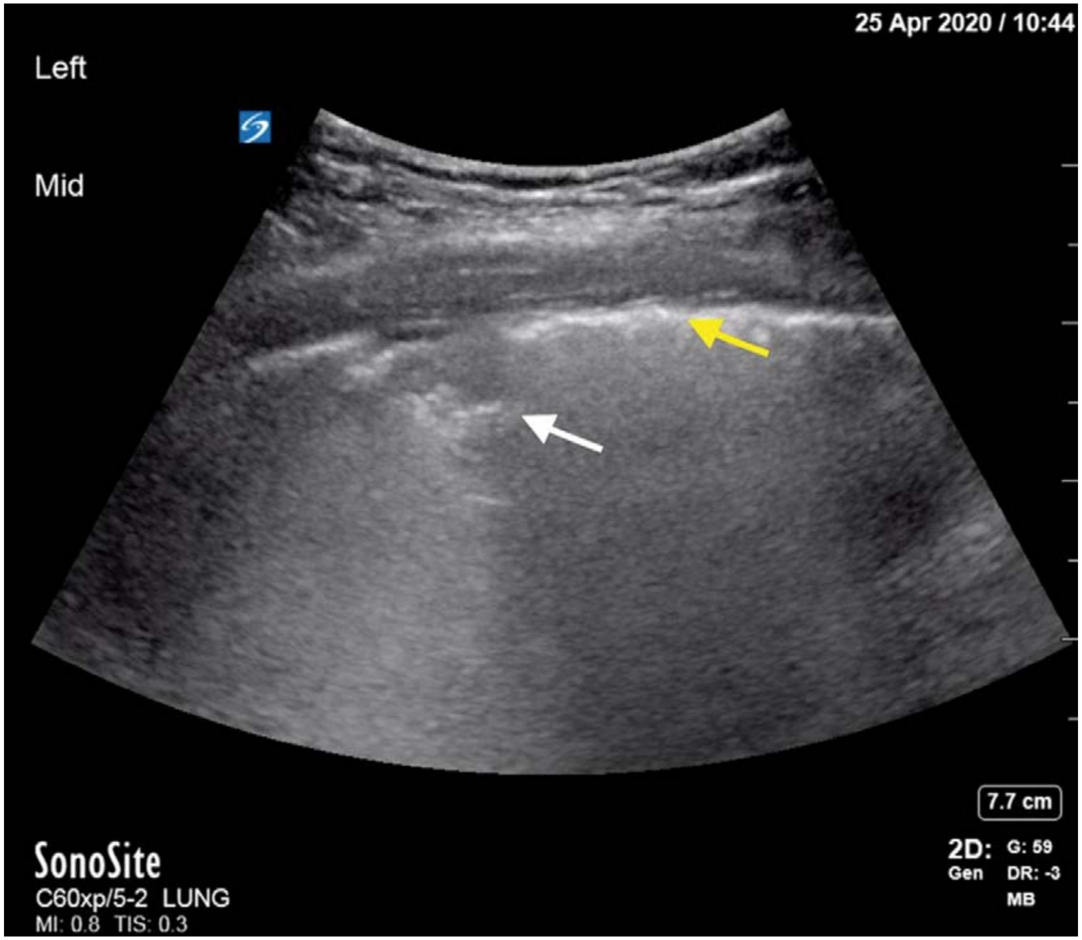
CT Versus Ultrasound Findings in COVID-19	
Adapted from Table 1 of Peng et al 2020 [1]	
CT Findings	**Ultrasound Findings**
Thickened pleura	Thickened, irregular pleural line
Ground glass shadow and effusion	B lines (multifocal, discrete, or confluent)
Pulmonary infiltrating shadow	Confluent B lines
Subpleural consolidation	Small consolidations
Translobar consolidation	Translobar consolidation +/- air bronchograms
More than two lobes affected	Multilobar distrubtion of abnormalities

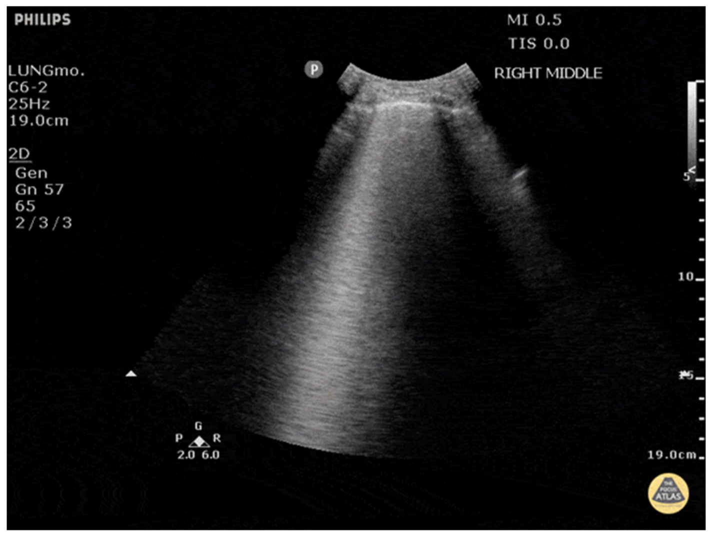
Thickened irregular pleural line + subpleural consolidation

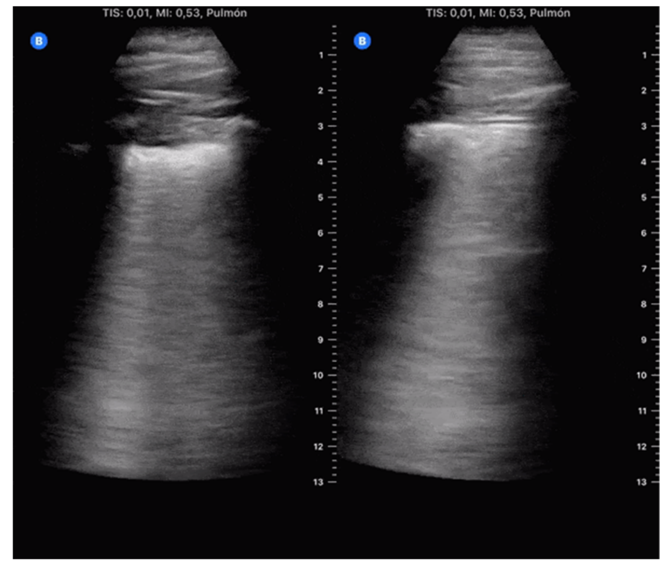


Thickened irregular pleural line

B lines

Confluence of B lines

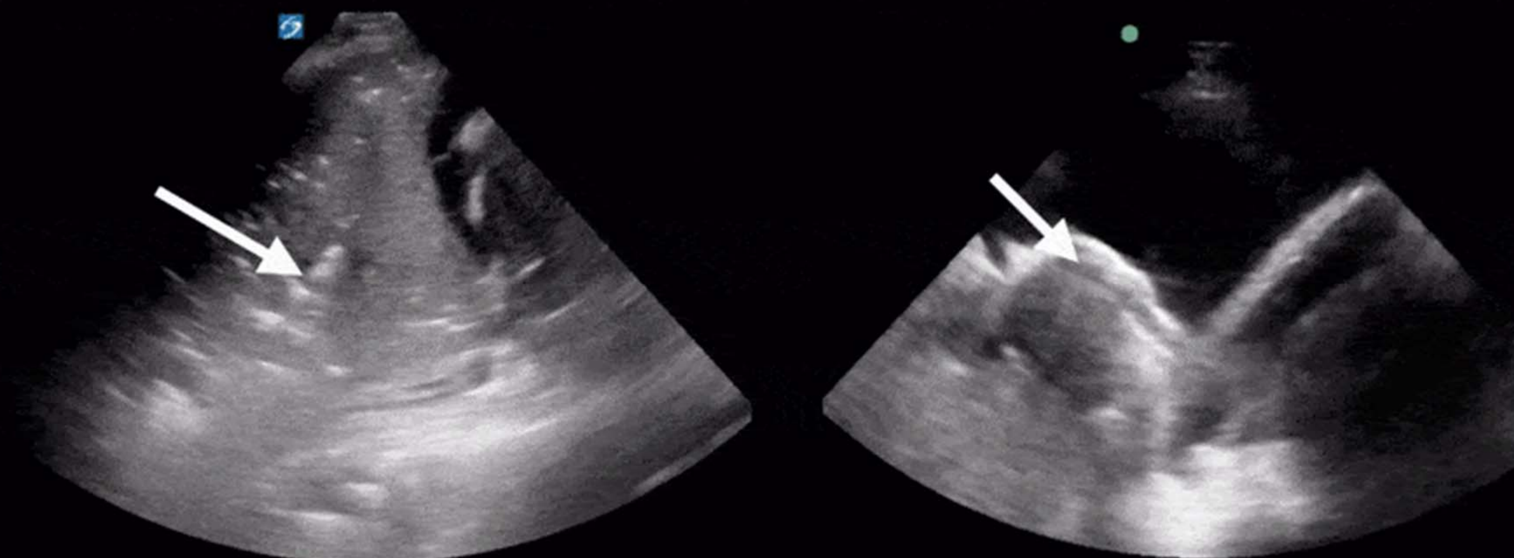




AIR BRONCHOGRAMS ON ULTRASOUND

ABaCCUS
UNIVERSITY OF ALBERTA CRITICAL CARE ULTRASOUND

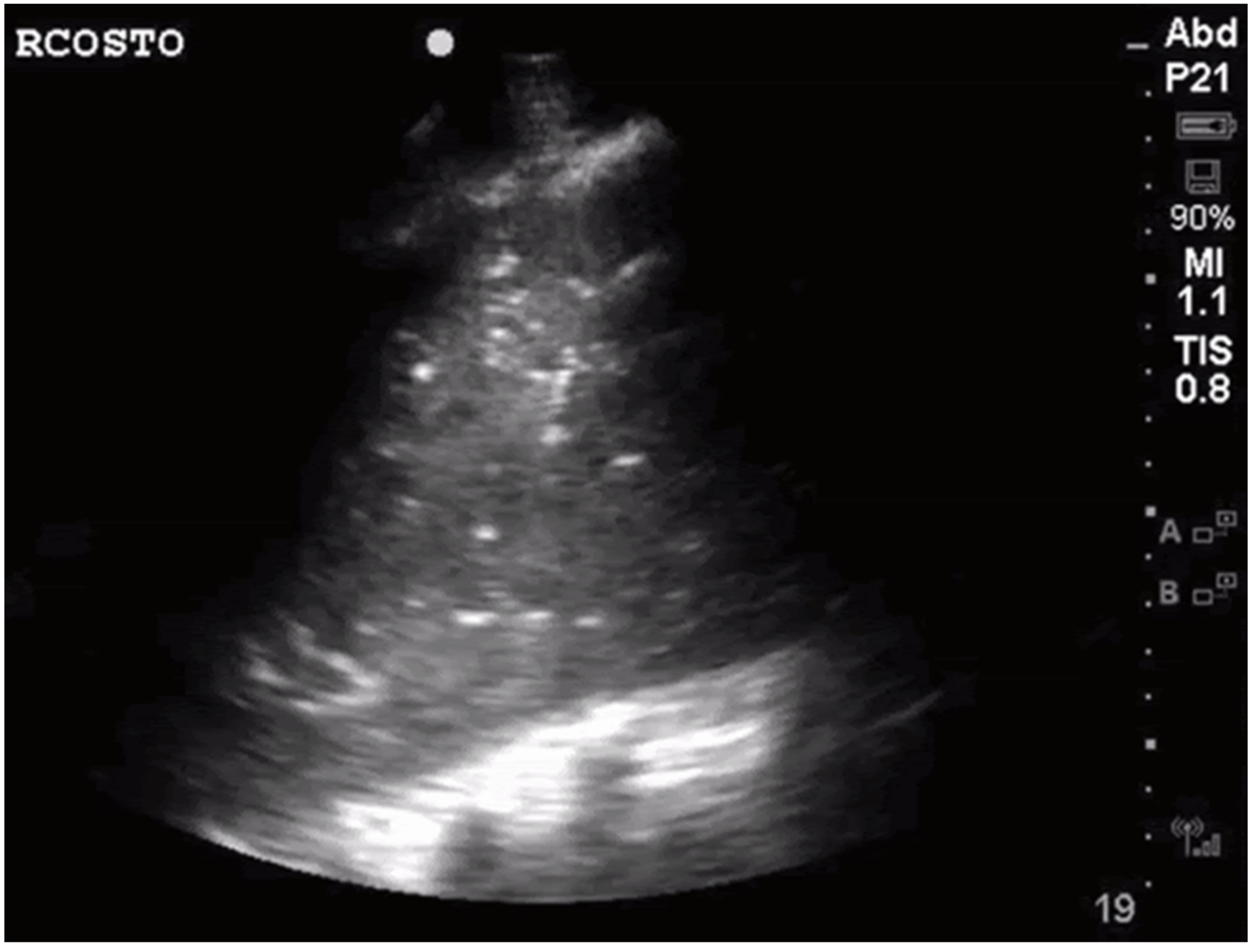
Opacification of alveolar spaces surrounding air-filled bronchioles; enables visualization of well-defined tissue/air interface; dynamic air bronchograms (AB) are bronchioles still in continuity with central airways, move dynamically with respiration, and are more often seen in infected consolidation; static AB are bronchioles ex-communicated from the main trachea-bronchial tree, often seen secondary to another process including large effusions, substantial atelectasis, but can also be seen in infected consolidation.



DYNAMIC

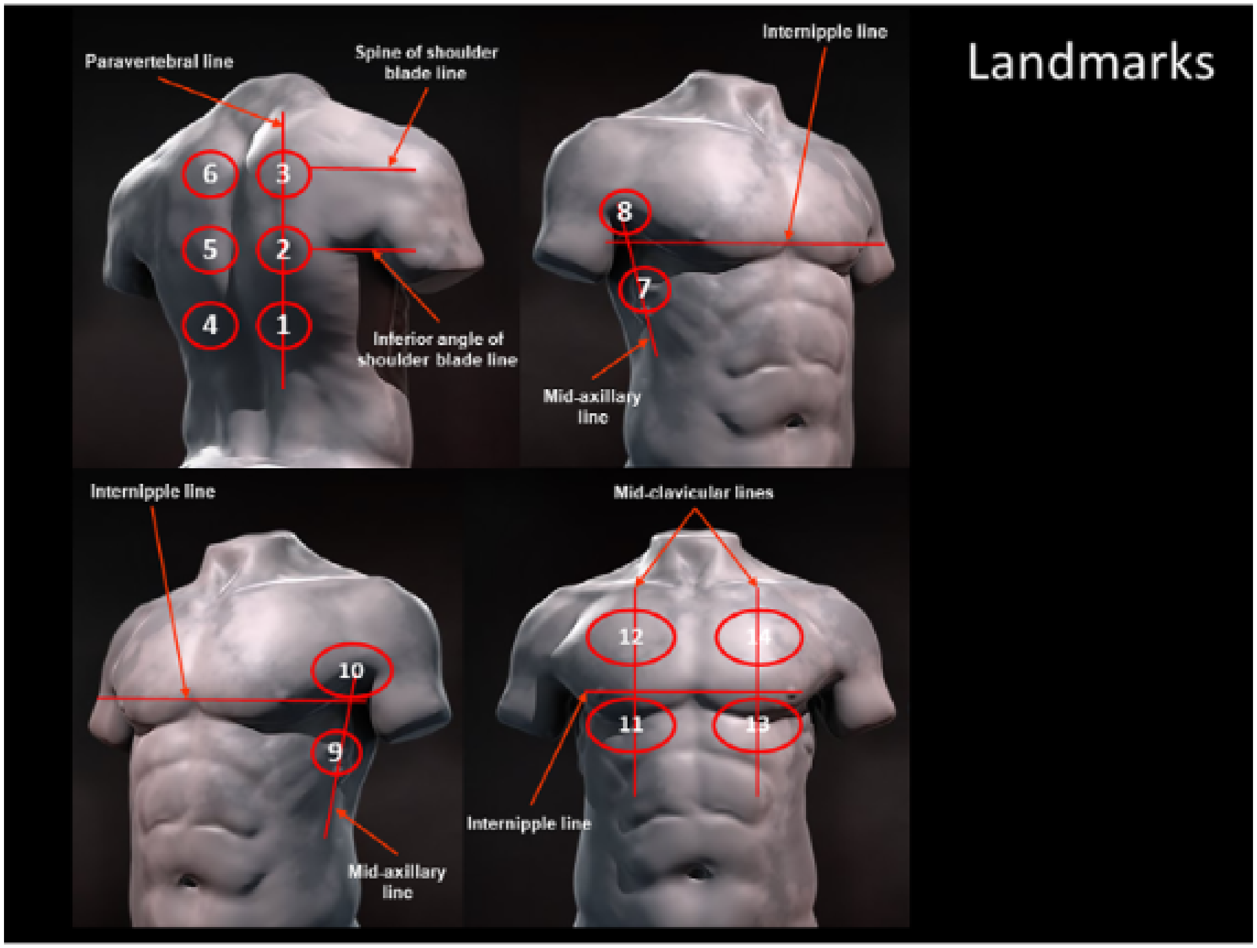
STATIC

Dynamic air bronchogram

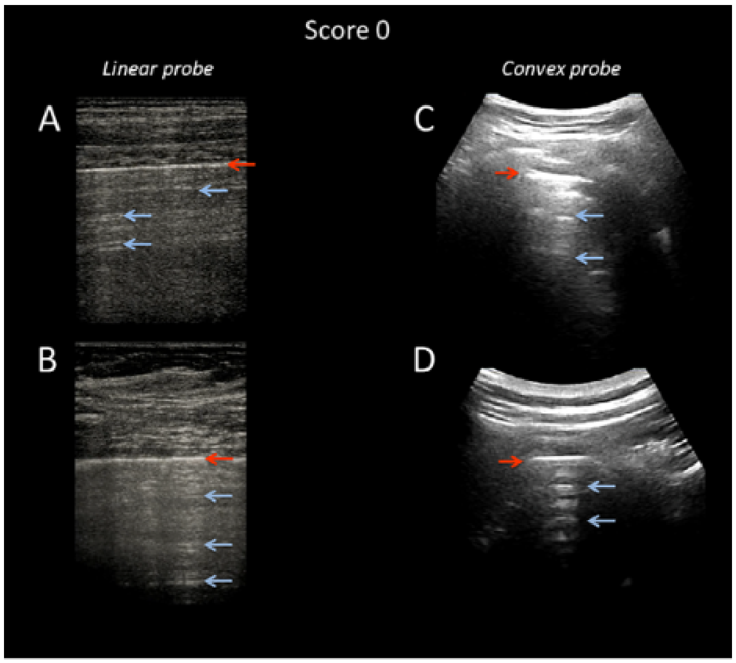


Consolidation of lung “AKA Hepatization”

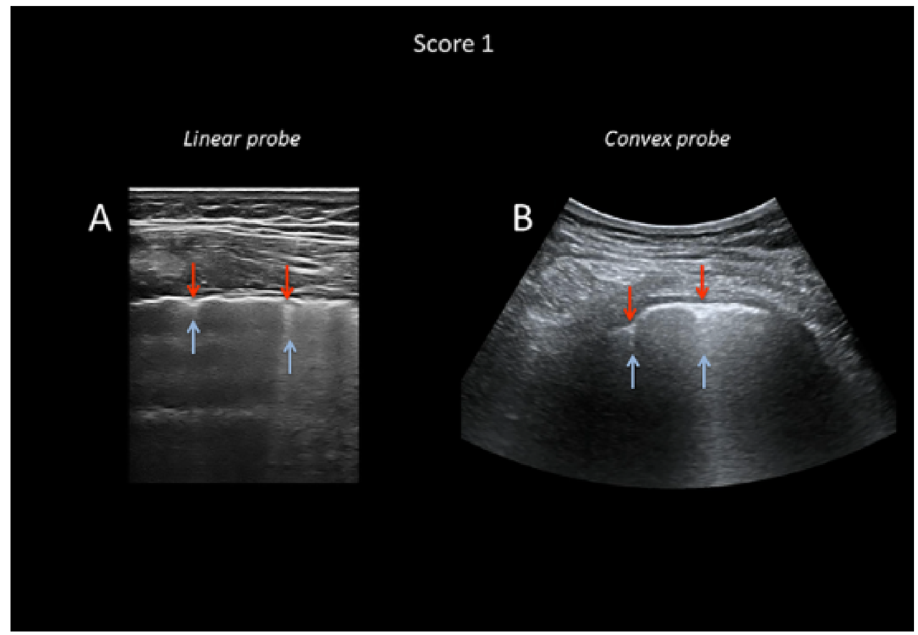
Soldati et al.



Soldati et al.

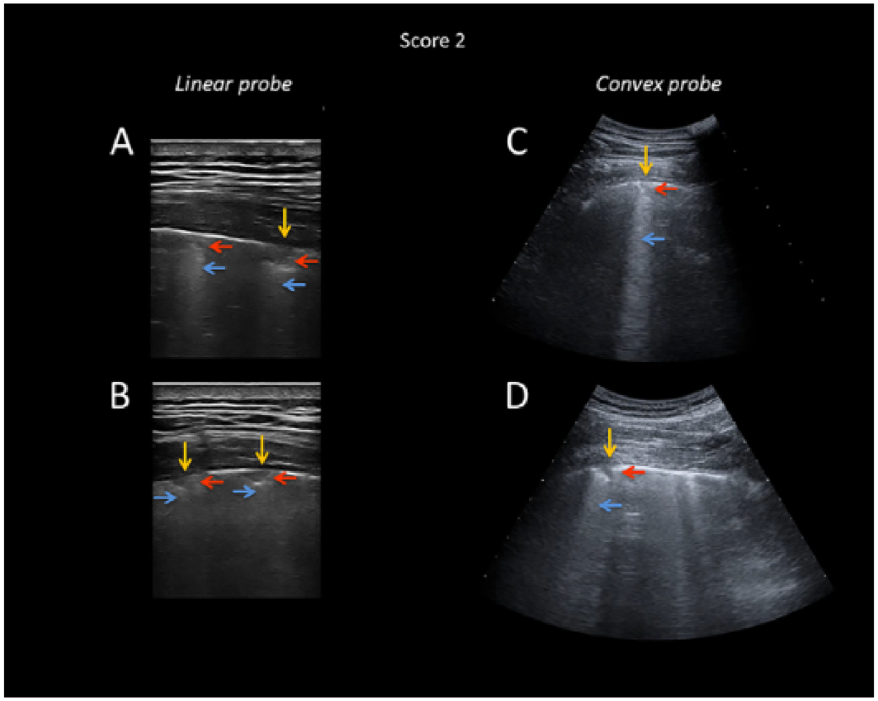


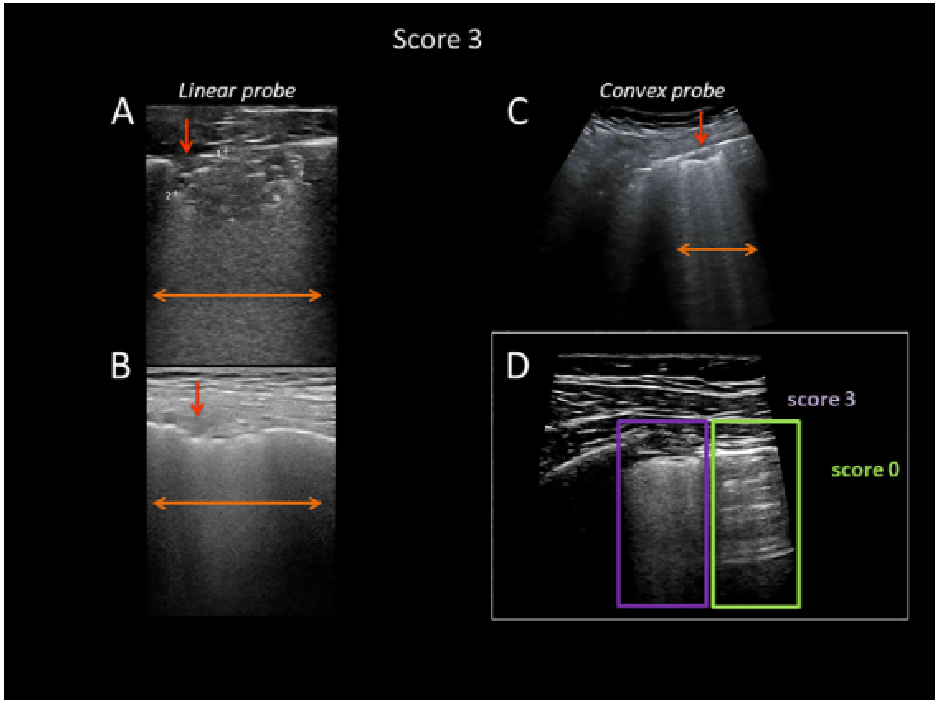
Normal, continuous pleural line with a-lines present



Irregular pleural lines with b-lines

Soldati et al.





Broken pleural lines with subpleural consolidations and more diffuse b-lines

Consolidations and confluence of B lines

Delmonaco *et al. Ultrasound J* (2021) 13:41
https://doi.org/10.1186/s13089-021-00243-5

The Ultrasound Journal

SHORT COMMUNICATION **Open Access**

First diagnosis of multisystem inflammatory syndrome in children (MIS-C): an analysis of PoCUS findings in the ED

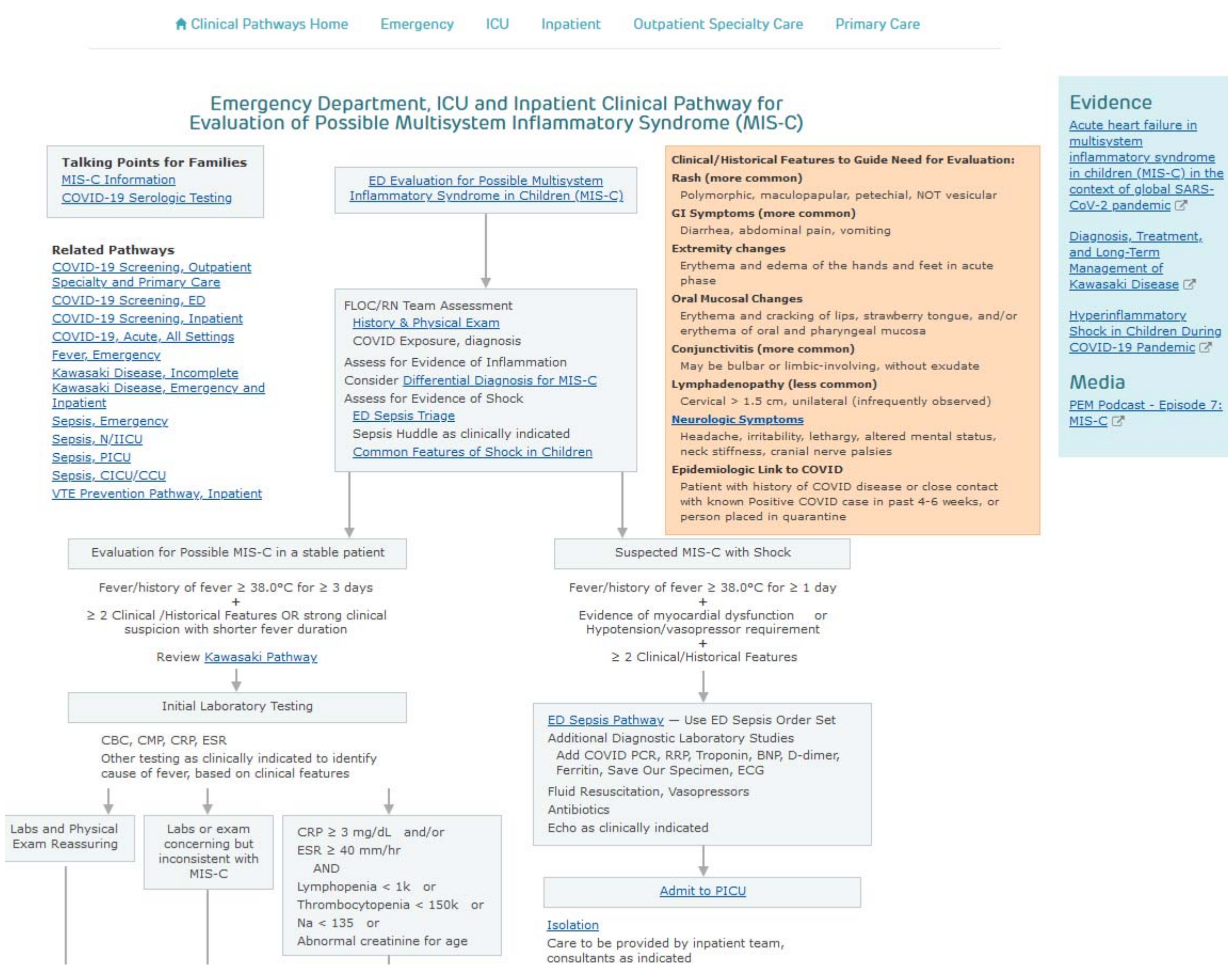
Angelo G. Delmonaco[1], Andrea Carpino[2*], Irene Raffaldi[1], Giulia Pruccoli[3], Emanuela Garrone[1], Francesco Del Monte[2], Lorenzo Riboldi[2], Francesco Licciardi[3], Antonio F. Urbino[1] and Emilia Parodi[3]

Abstract

Children with multisystem inflammatory syndrome (MIS-C) tend to develop a clinical condition of fluid overload due both to contractile cardiac pump deficit and to endotheliitis with subsequent capillary leak syndrome. In this context, the ability of point-of-care ultrasound (PoCUS) to simultaneously explore multiple systems and detect polyserositis could promote adequate therapeutic management of fluid balance. We describe the PoCUS findings in a case-series of MIS-C patients admitted to the Emergency Department. At admission 10/11 patients showed satisfactory clinical condition without signs and symptoms suggestive for cardiovascular impairment/shock, but PoCUS showed pathological findings in 11/11 (100%). In particular, according to Rapid Ultrasound in SHock (RUSH) protocol, cardiac hypokinesis was detected in 5/11 (45%) and inferior vena cava dilatation in 3/11 (27%). Peritoneal fluid was reported in 6/11 cases (54%). Lung ultrasound (LUS) evaluation revealed an interstitial syndrome in 11/11 (100%), mainly localized in posterior basal lung segments. We suggest PoCUS as a useful tool in the first evaluation of children with suspected MIS-C for the initial therapeutic management and the following monitoring of possible cardiovascular deterioration.

Keywords: SARS-CoV-2 infection, MIS-C, Children, PoCUS, LUS

CHOP MIS-C Pathway



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