MHIF Research Highlights: October 2020

Transcatheter Cardiovascular Therapeutics 2020 – ONLINE NOW!

30+ MHI physicians and MHIF staff participated:

- 2 late-breaking clinical trial sessions
- 2 live cases
- 8 podium presentations
- 20+ virtual poster presentations

SPECIAL CALL OUTS:

- **Drs. Bapat, Cavalcante, Shakrullah** and **Sorajja** performed hybrid, open-transcatheter mitral valve-in-valve procedure
- **Drs. Brilakis** and **Burke** performed percutaneous coronary intervention of a chronic total occlusion (CTO)
- MHIF and **Dr. Garcia** announced first outcomes from the North American COVID-19 ST-Segment Elevation Myocardial Infarction (NACMI) Registry

MHIF FEATURED STUDIES:

COVID PACT
Comparing anticoagulation therapy in COVID+ patients in the ICU; Dr. Brandon Wiley

CONTACT:
Christine Majeski - Christine.majeski@allina.com

Proact Xa
Anticoagulation therapy with On-X aortic valve; Dr. Benjamin Sun

CONTACT:
Alyssa Taffe - Alyssa.taffe@allina.com

Thanks to our MHI physician partners who are helping us complete tasks to get patients enrolled in research studies as appropriate during COVID-19!

We appreciate our partnership with you!

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MHIF FEATURED STUDY:

COVID PACT

OPEN AND ENROLLING:

EPIC message: *Research MHIF Patient Referral*

CONDITION:	PI:	RESEARCH CONTACT:	SPONSOR:
COVID-19	Brandon Wiley, MD	Christine Majeski christine.majeski@allina.com | 612-863-3546	The TIMI Study Group

DESCRIPTION:

The purpose of this trial is comparing antiplatelet and anticoagulation strategies in critically ill COVID19 patients..

Patients will be randomized to 1:1 to these treatment arms and then further randomized into anti-platelet vs no antiplatelet treatments and followed for thrombotic complications.

CRITERIA LIST/ QUALIFICATIONS:

Inclusion:

- 18 or older
- Acute infection with severe acute respiratory syndrome coronarvirus 2 (SARS-CoV2)
- Currently admitted to an intensive care unit (ICU)

Exclusion:

- Ongoing (>48 hours) or planned full-dose (therapeutic) anticoagulation for any indication
- Ongoing or planned treatment with dual antiplatelet therapy
- Contraindication to antithrombotic therapy or high risk of bleeding
- History of heparin-induced thrombocytopenia
- Ischemic stroke within the past 2 weeks

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Point-of-Care Ultrasound
Applications for the Cardiologist

Brandon M. Wiley, MD, FACC, FASE

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1

Disclosures:
None

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Objectives

(Career Roadmap)

POCUS

Holistic POCUS Bedside Exam

LUNG ULTRASOUND

Diagnosis of Dyspnea
Prognosis in Heart Failure

LUS+Stress Echo
HFpEF
VHD

NOVEL CARDIOLOGY APPLICATIONS

Critical Care / Medicine — Medicine/Cardiology — Cardiology

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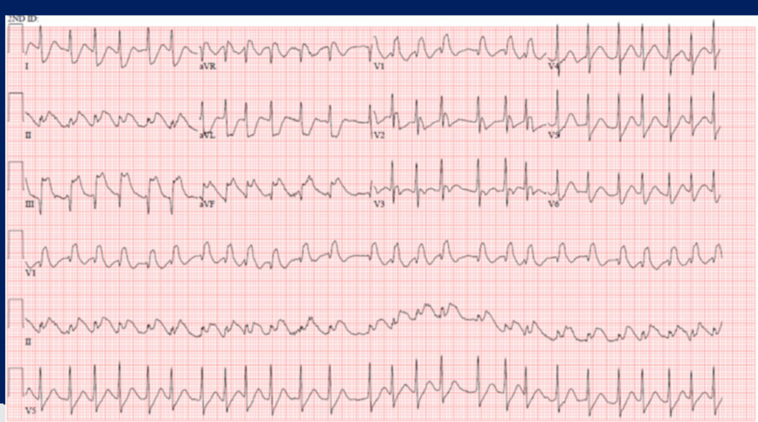
Case 1

Shock and Hypoxia after STEMI + CPR

55 year-old male presented to CVICU after VF/VT arrest and STEMI



- Cath PCI Cx/RCA
  - V-Fib x 6
- CVICU
  - Shock
    - Epi/norepi/vaso
  - Hypoxic (100% FiO2)

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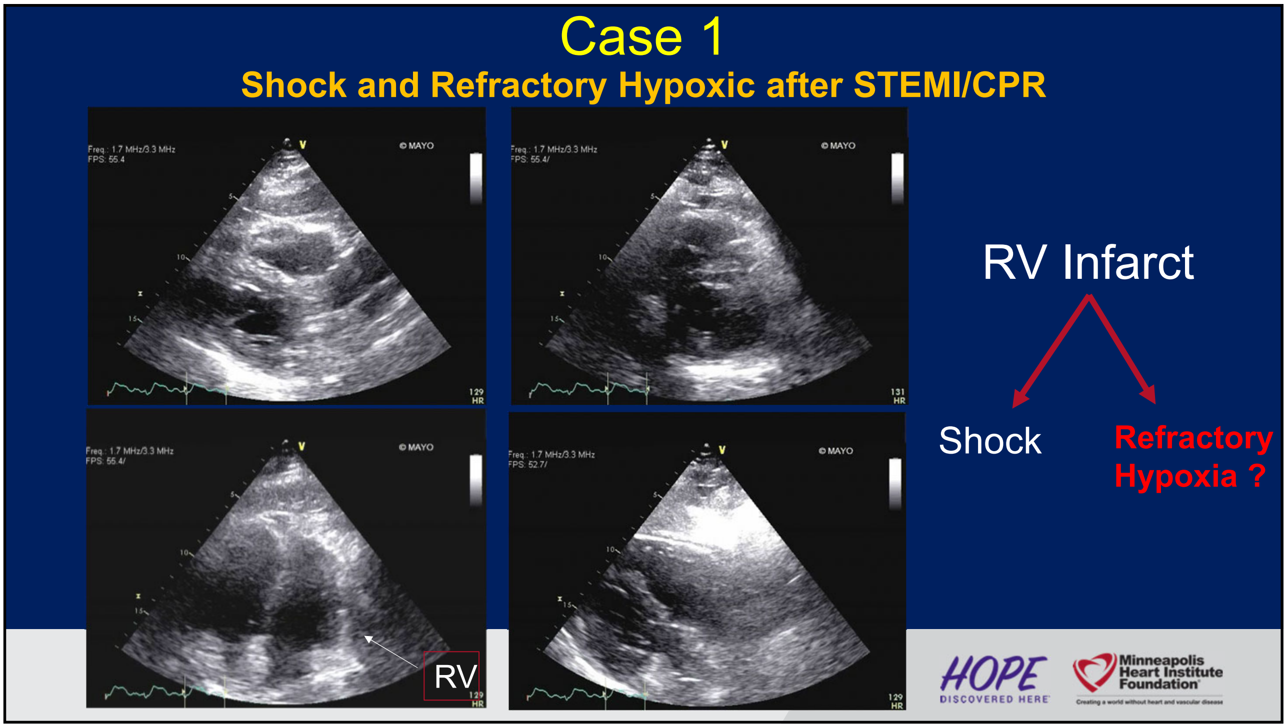
Case 1
Shock and Refractory Hypoxic after STEMI/CPR
RV Infarct
Shock
Refractory Hypoxia ?
RV
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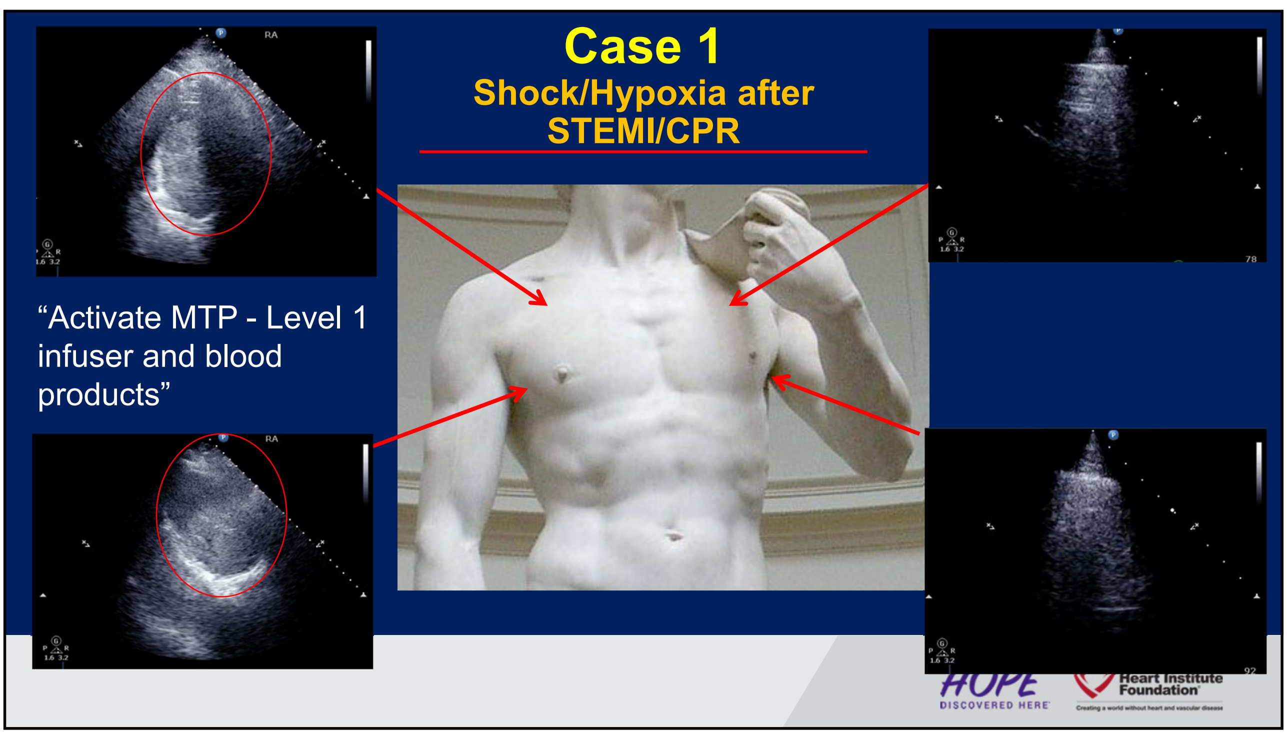
Case 1
Shock/Hypoxia after STEMI/CPR
"Activate MTP - Level 1 infuser and blood products"
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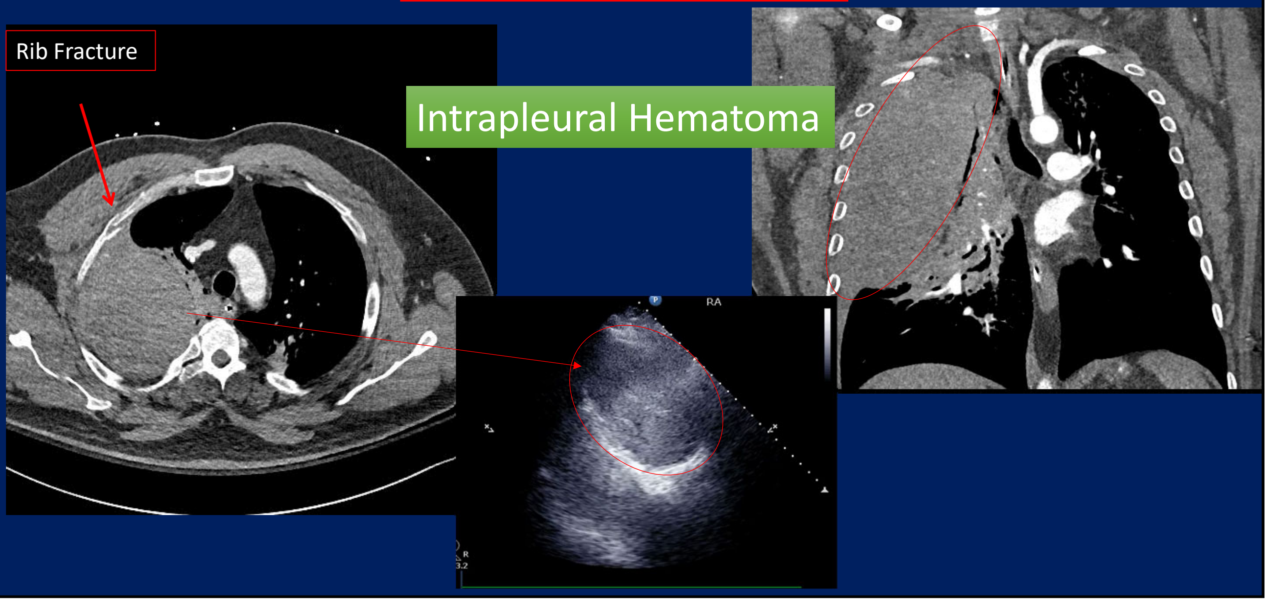
Case 1
Shock/Hypoxia after STEMI/CPR



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POCUS

POCUS is an ultrasound exam Performed and Interpreted by the Practitioner at the Bedside

POCUS is not Echocardiography

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Why is Point-of-Care Ultrasound Important?
The Traditional Bedside Clinical Exam is Difficult

- Jugular veins identified in 72-94% patients[1]
  - 50% accuracy for high vs low CVP
- Correct timing of cardiac murmur 66%[2]
  - Cause of murmur 26%[3]
  - Agreement among Cardiologists for *+S3 is ~30%*
- Study of 442 consecutive patients
  - Only 40% diagnosed appropriately by history and physical[4]

[1]McGee Am Heart J 1998
[2]Vukanovic-Criley Arch Intern Med 200
[3]March, Mayo Clinic Proc. 2005
[4]Paley, Arch Intern Med. 2011

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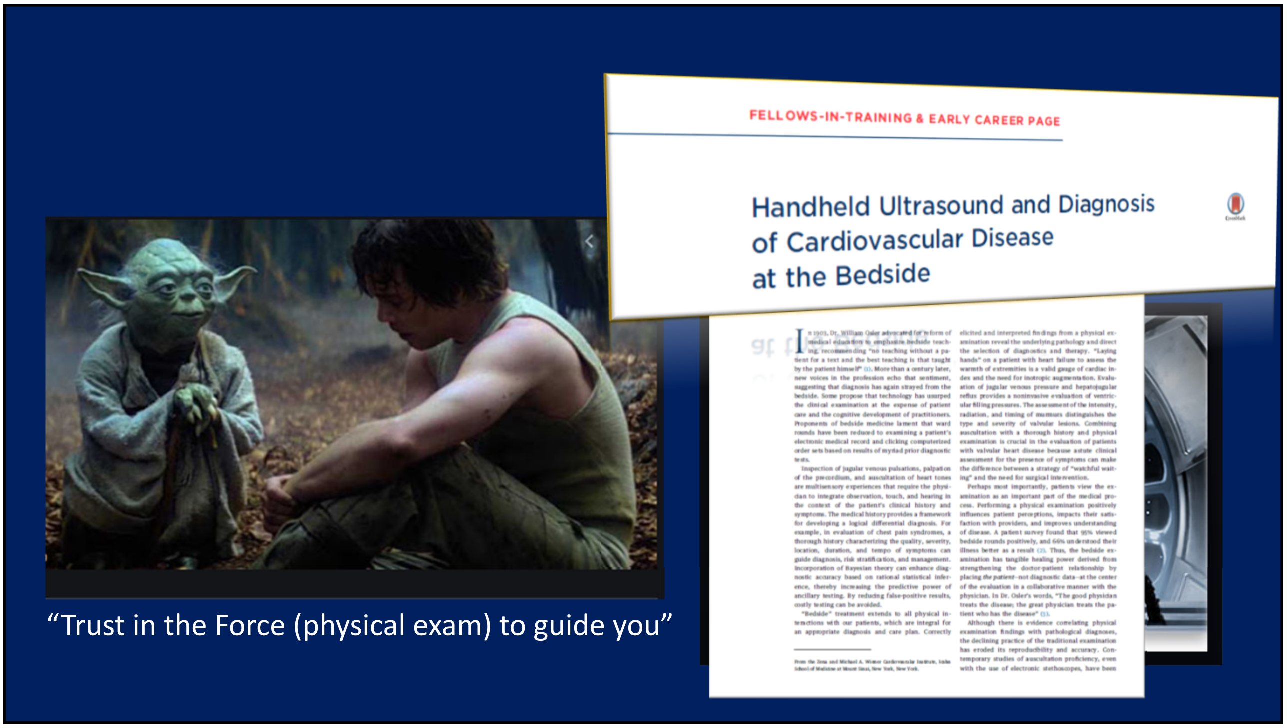
Why is Point-of-Care Ultrasound Important?
POCUS Improves the Clinical Exam

- POCUS reduces missed major CV exam findings 43% -> 21%
- Students+POCUS outperformed cardiologists
  - Etiology of systolic murmur 93% vs 62%
  - Detection of diastolic murmur 75% vs 16%
- Multicenter ICU study with 1,215 POCUS studies
  - Change in diagnosis 24.9%, change management 44.0%

Spencer, JACC. 2001
Bernier-Jean JICM 2015

10


FELLOWS-IN-TRAINING & EARLY CAREER PAGE
Handheld Ultrasound and Diagnosis of Cardiovascular Disease at the Bedside
"Trust in the Force (physical exam) to guide you"

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The Death of the Stethoscope
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The Death of the Stethoscope

Evolution of the Bedside

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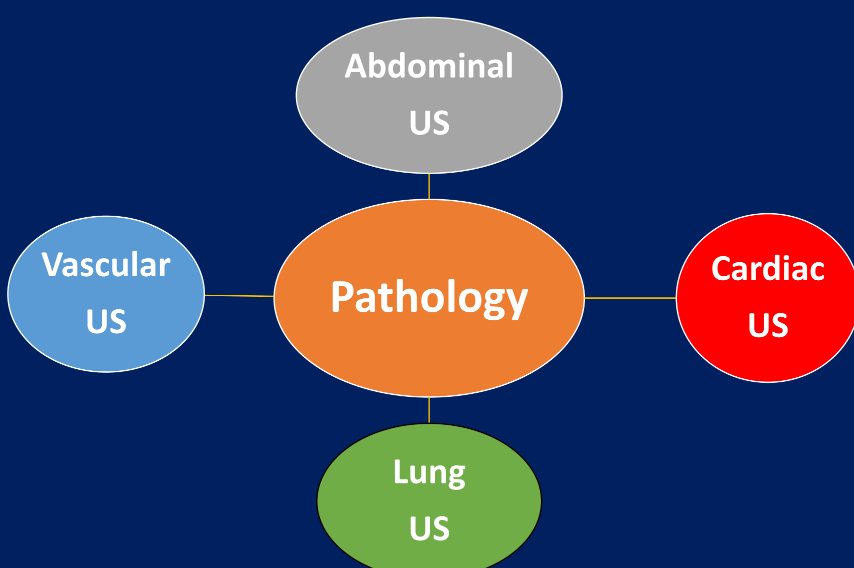
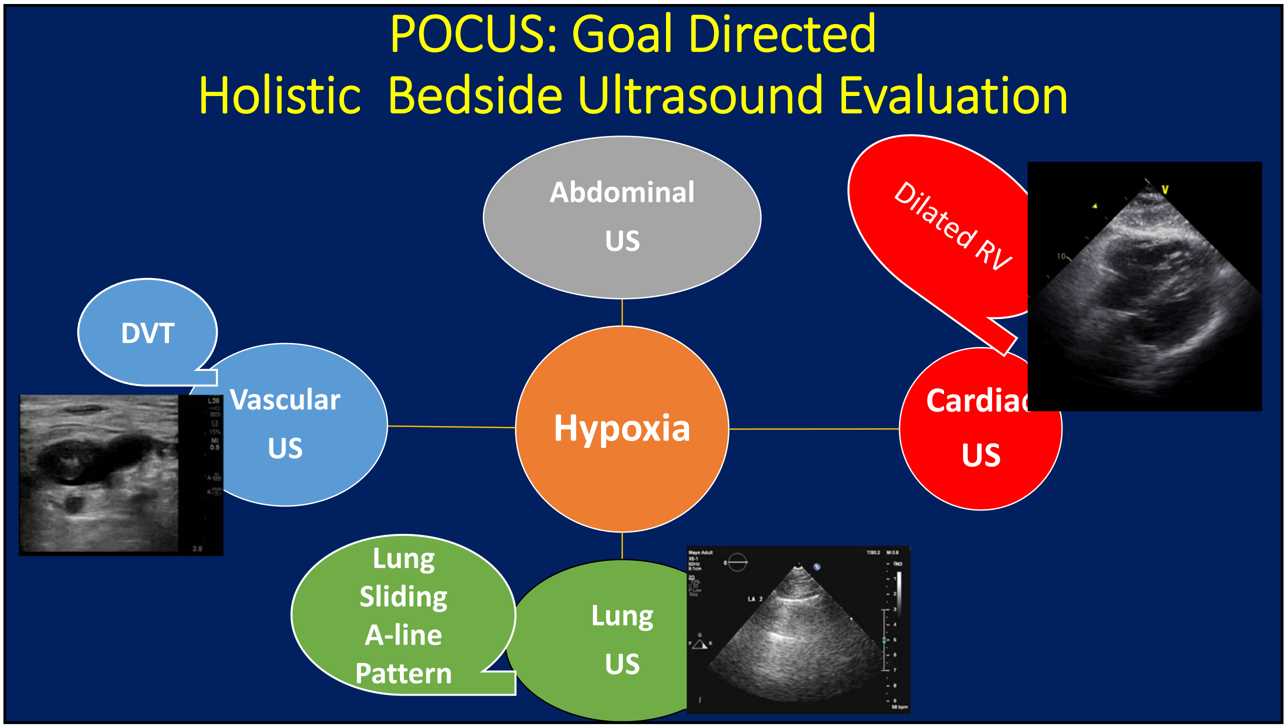
POCUS: Goal Directed
Holistic Bedside Ultrasound Evaluation



14


POCUS: Goal Directed
Holistic Bedside Ultrasound Evaluation
Abdominal US
Dilated RV
DVT
Vascular US
Hypoxia
Cardiac US
Lung Sliding A-line Pattern
Lung US

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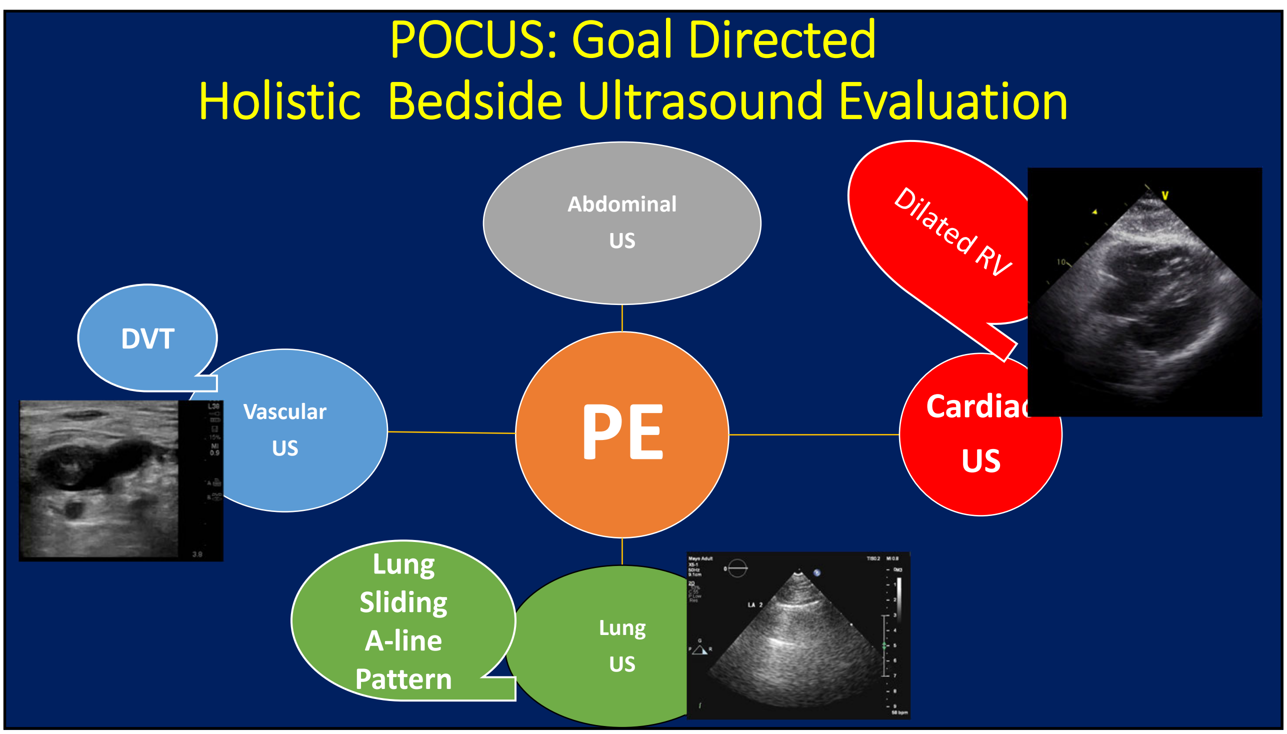
POCUS: Goal Directed
Holistic Bedside Ultrasound Evaluation
Abdominal US
Dilated RV
DVT
Vascular US
PE
Cardiac US
Lung Sliding A-line Pattern
Lung US

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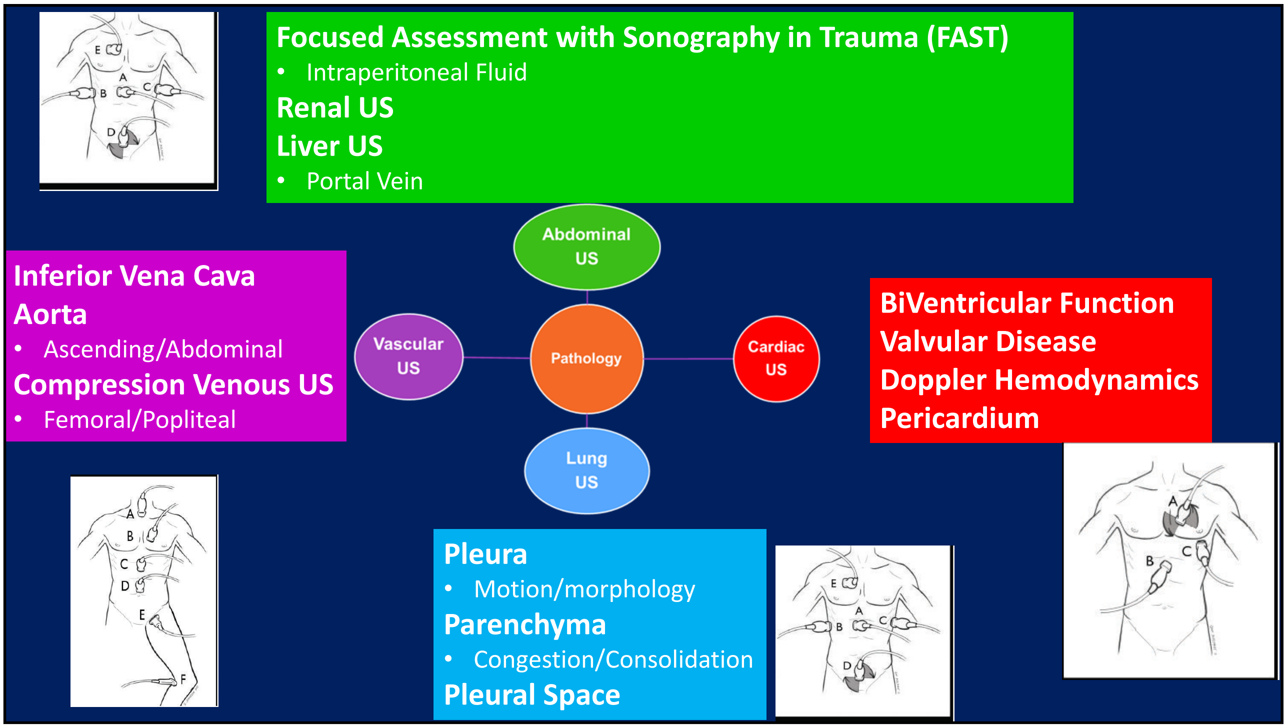
Focused Assessment with Sonography in Trauma (FAST)
• Intraperitoneal Fluid
Renal US
Liver US
• Portal Vein
Abdominal US
Inferior Vena Cava
Aorta
• Ascending/Abdominal
Compression Venous US
• Femoral/Popliteal
Vascular US
Pathology
Cardiac US
BiVentricular Function
Valvular Disease
Doppler Hemodynamics
Pericardium
Lung US
Pleura
• Motion/morphology
Parenchyma
• Congestion/Consolidation
Pleural Space

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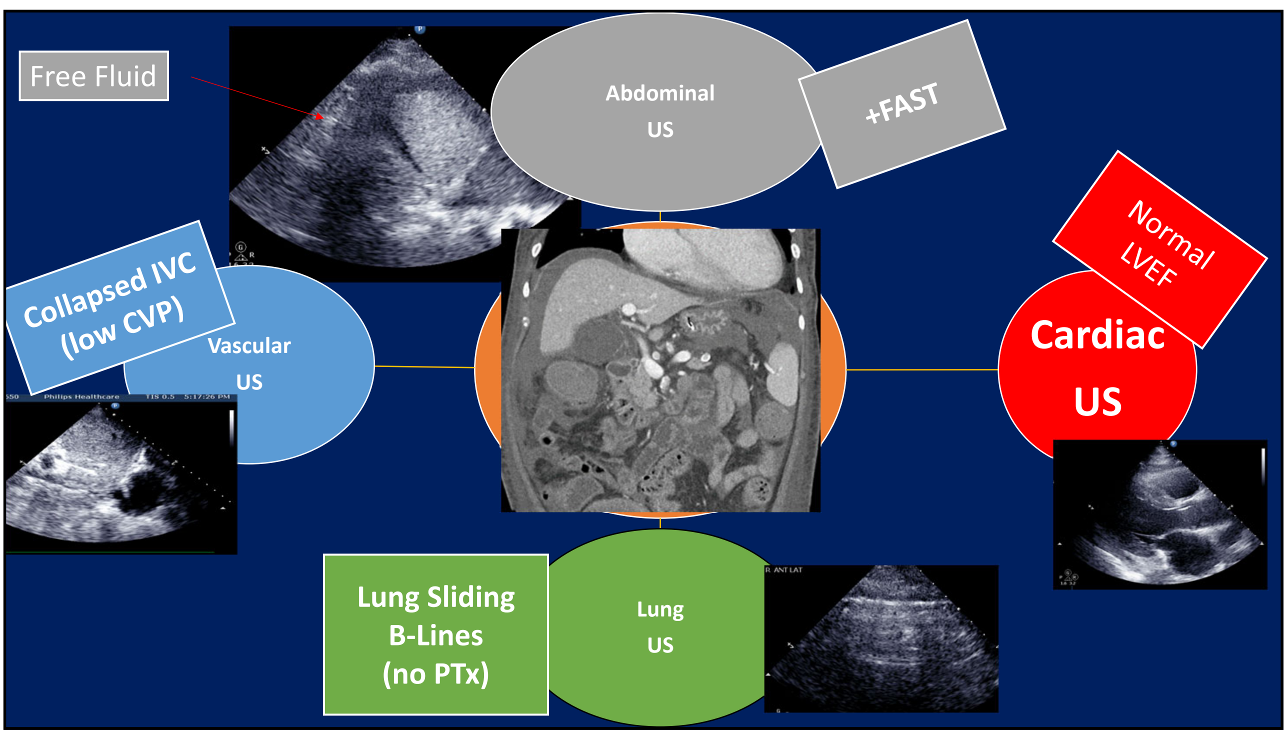
Free Fluid
Abdominal US
+FAST
Collapsed IVC (low CVP)
Vascular US
Normal LVEF
Cardiac US
Lung Sliding
B-Lines
(no PTx)
Lung US

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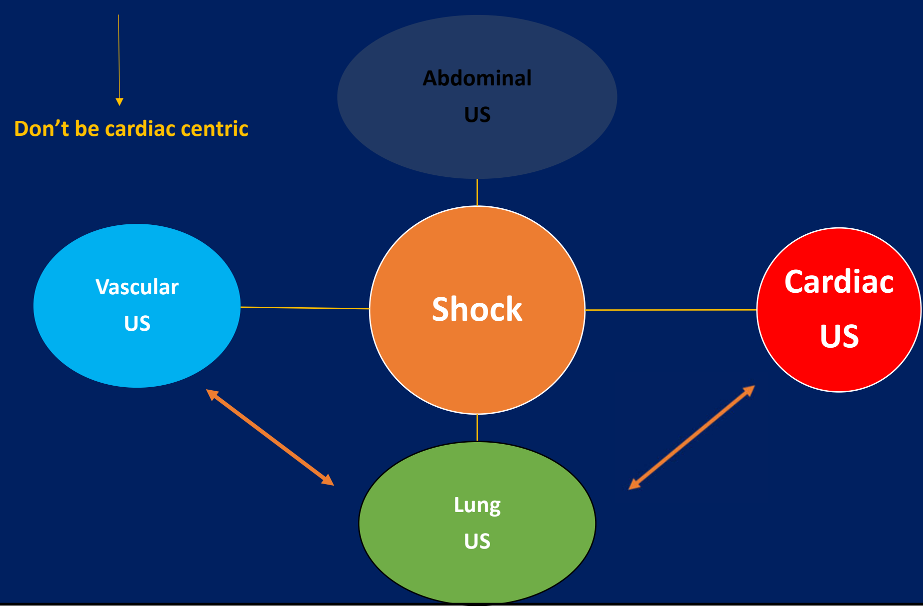
POCUS: Goal Directed
Holistic Bedside Ultrasound Evaluation



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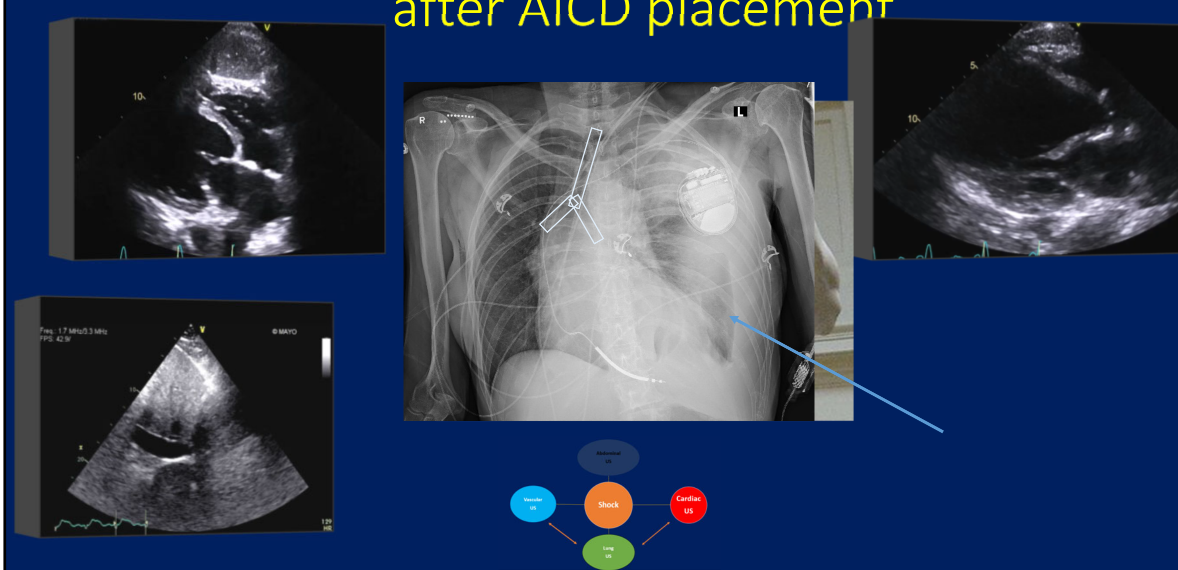
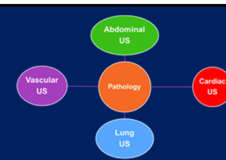
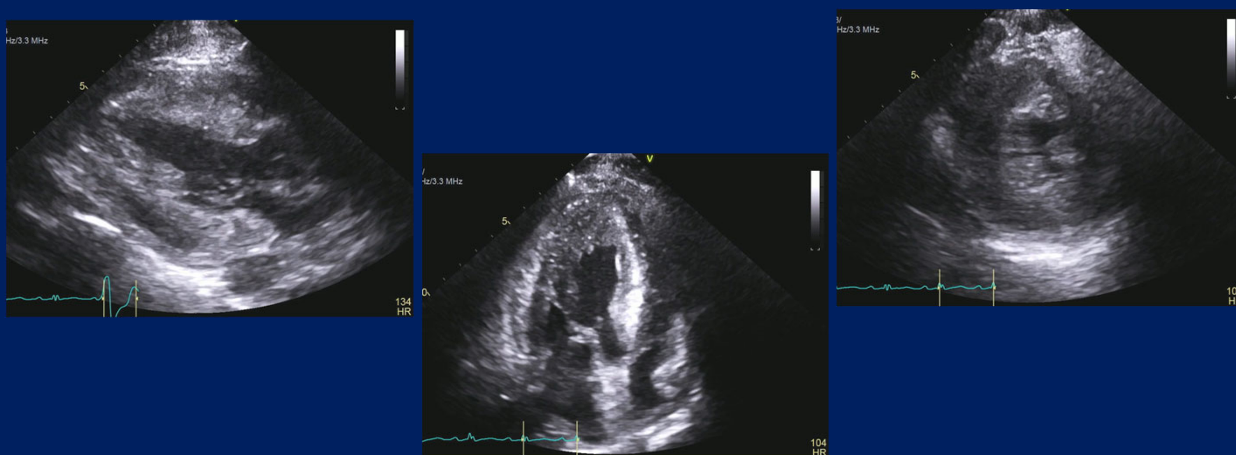
59 y.o. female w/ ICM presents with SHOCK after AICD placement



20

55 year-old female HoTN s/p MVA





Cardiac-Focused Diagnosis: Severe Hypertrophy of left ventricle

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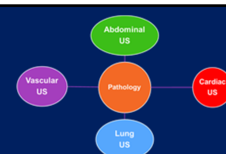
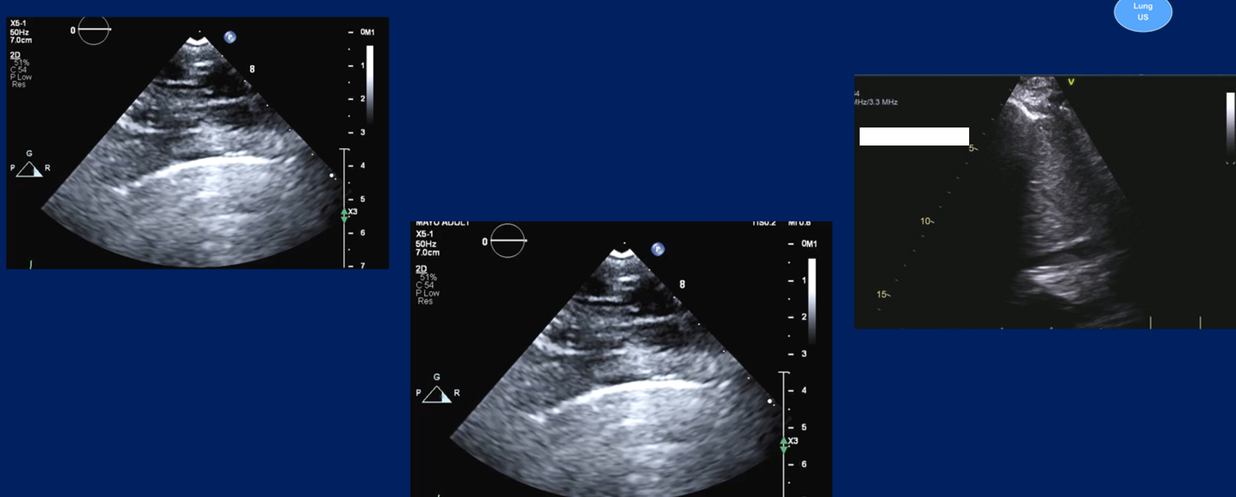
55 year-old female HoTN s/p MVA





Pseudo Hypertrophy of left ventricle from profound hypovolemia

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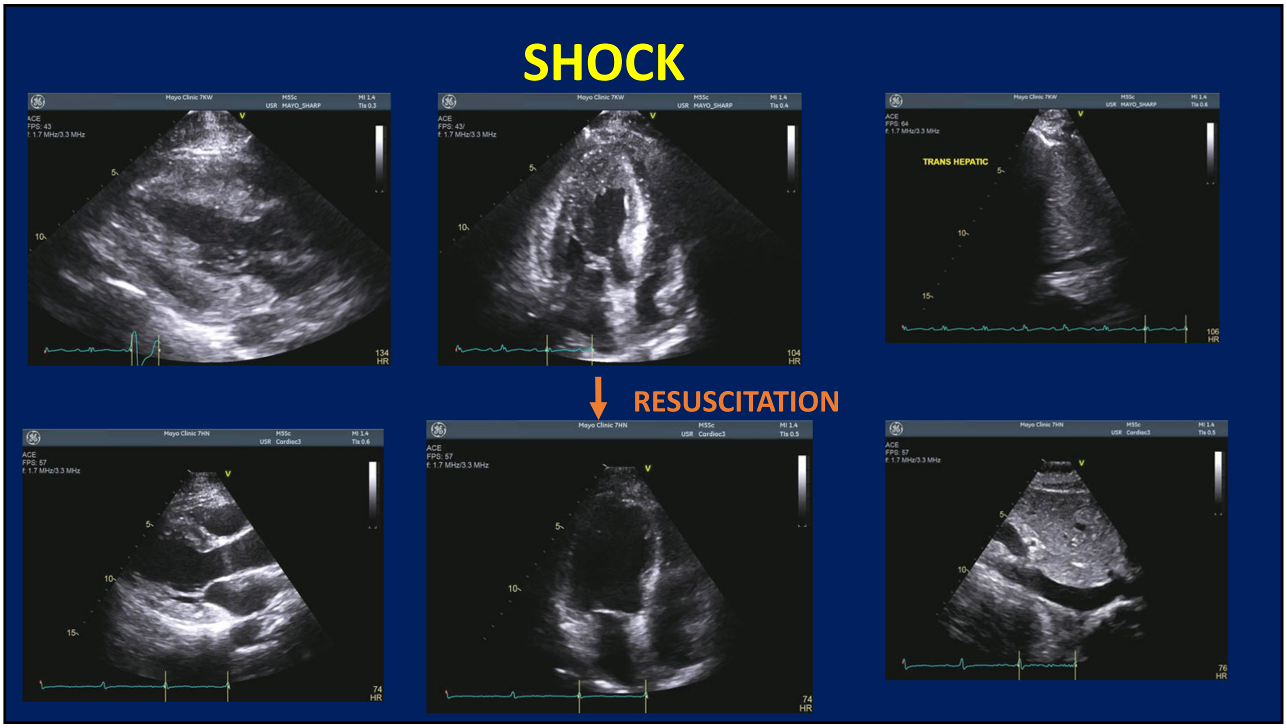
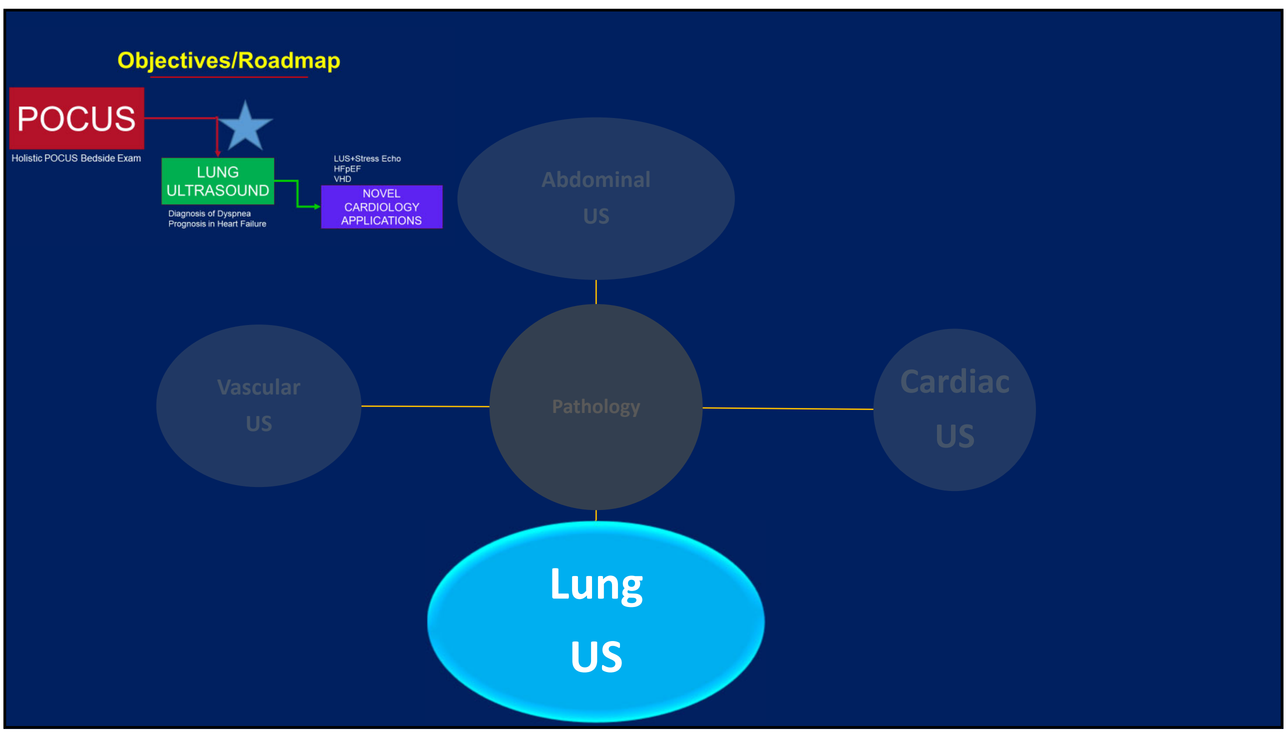

SHOCK
TRANS HEPATIC
RESUSCITATION

23


Objectives/Roadmap
POCUS
Holistic POCUS Bedside Exam
LUNG ULTRASOUND
Diagnosis of Dyspnea
Prognosis in Heart Failure
LUS+Stress Echo
HFpEF
VHD
NOVEL CARDIOLOGY APPLICATIONS
Abdominal US
Vascular US
Pathology
Cardiac US
Lung US

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Components of Lung Ultrasound

- Pleura
  - Morphology
  - Motion ("sliding")
  - Effusion
- Lung Parenchyma
  - Aeration pattern
- Diaphragm
  - Motion

Diagnose
- Pulmonary Edema
- Volume Status
- PCWP
- PNA/ARDS
- Pneumothorax
- Pleural Effusion
- Diaphragmatic Paralysis

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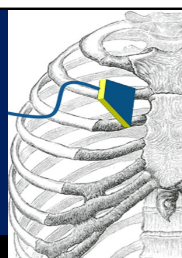
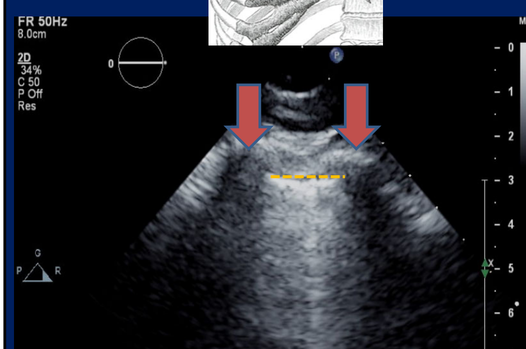
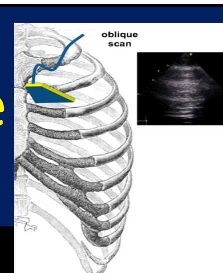
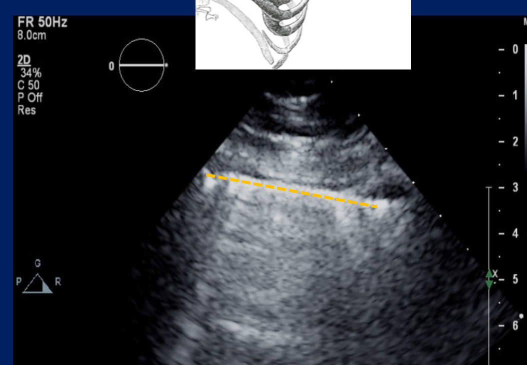
Scanning Technique









Probe indicator 12 o'clock position

Rotate probe axis

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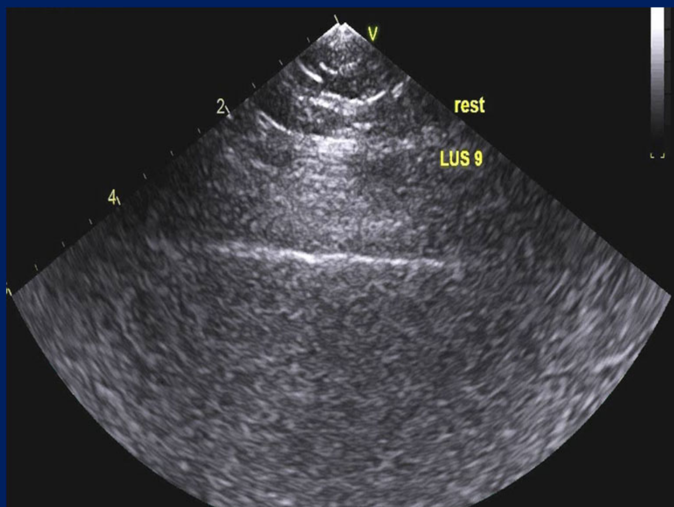
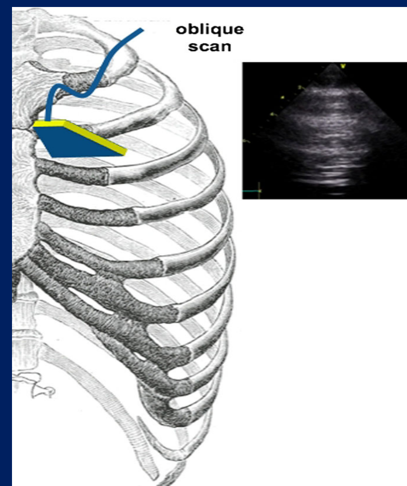
Oblique Scan – Probe Axis Parallel to Ribs





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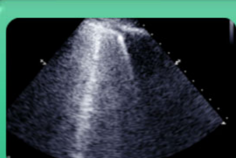
Lung Ultrasound Key Findings

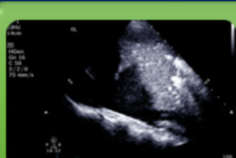
Assess pleural line

- Normal "lung sliding"
- Abnormal: no "lung sliding", irregular/thickened



Assess parenchyma

- Normal: nothing present ("A-Lines")
- Abnormal: B-Lines, Consolidation



Assess pleural space

- Normal: nothing present
- Abnormal: fluid

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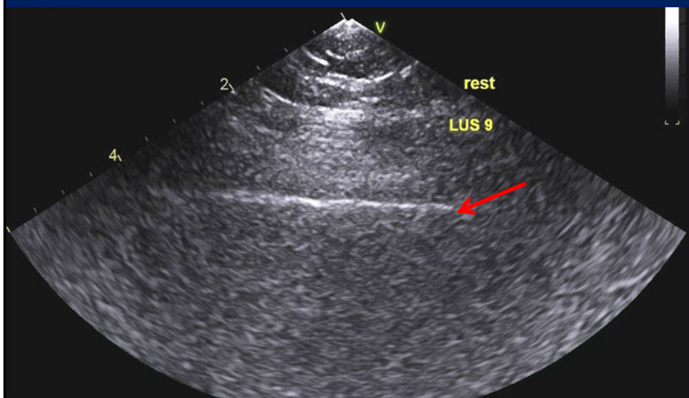
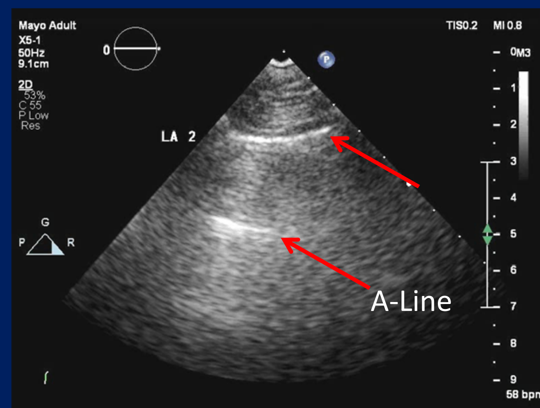
Normal Lung Ultrasound Findings

Pleural Sliding and A-Lines





A-Lines + pleural sliding = aerated (dry) lung

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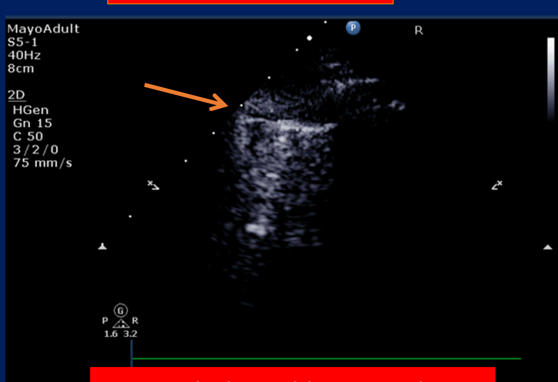
Pneumothorax

Absence of "Lung Sliding" and B-Lines

Pneumothorax

Normal



Parietal pleural layer without interface with visceral layer (no B-lines)

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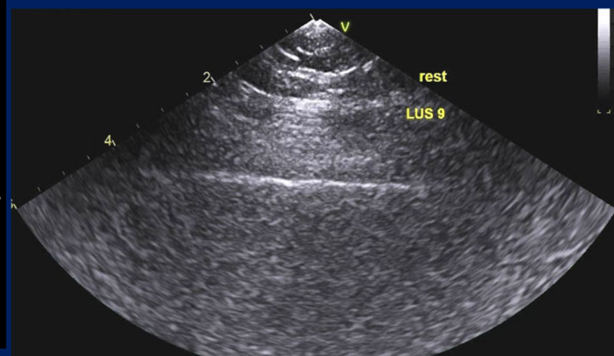
Pleural Line Abnormalities
Fibrotic/Intrinsic Lung Disease or Infectious/Inflammatory



Pneumonia/Fibrotic Lung
- Subpleural consolidations

Normal pleural line

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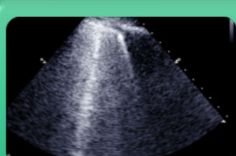
Lung Ultrasound Key Findings

Assess pleural line
- Normal "lung sliding"
- Abnormal: no "lung sliding", irregular/thickened



Assess parenchyma
- Normal: nothing present ("A-Lines")
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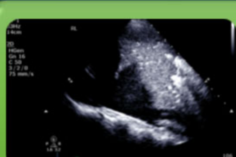

Assess pleural space
- Normal: nothing present
- Abnormal: fluid

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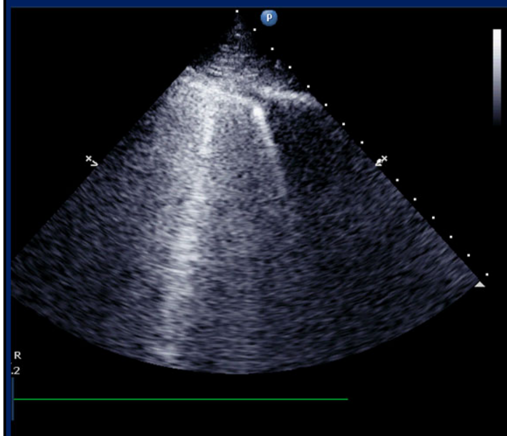
Abnormal Lung Ultrasound Findings: B-Lines – "Interstitial Process"



B-lines

- Correspond to ***increased lung density*** (decreased aeration)
  - **Fluid (extravascular lung water)**
  - **Inflammation**
  - **Fibrosis**
- ≥ 3 B-Lines in intercostal space (zone)
  - **Interstitial process**

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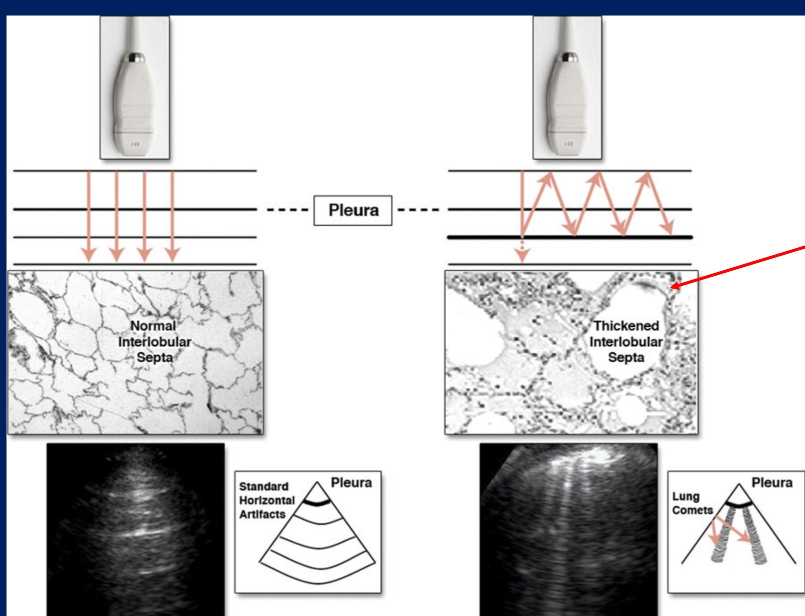
B-Line Pattern



Increased Lung Density

Fluid
Fibrosis
Inflammation

B-Lines

Mallamaci et al. JACC:IMG 2010

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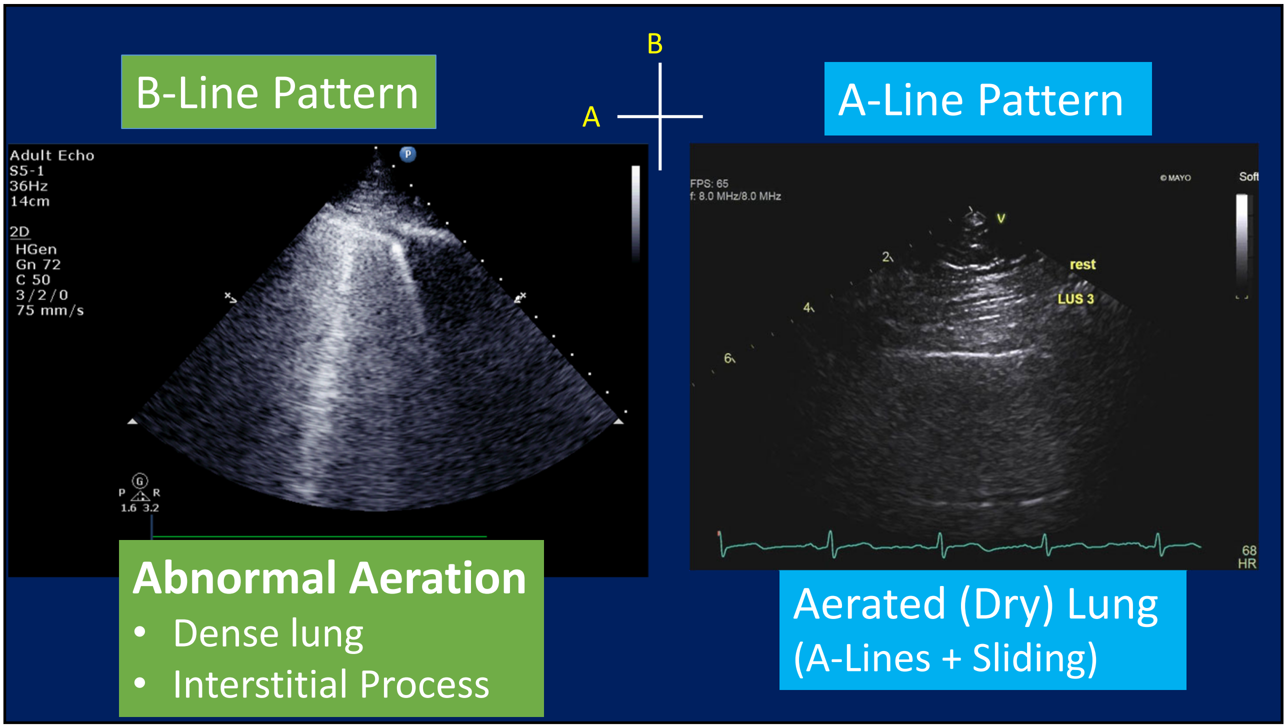
B-Line Pattern
B
A
A-Line Pattern
Abnormal Aeration
• Dense lung
• Interstitial Process
Aerated (Dry) Lung
(A-Lines + Sliding)

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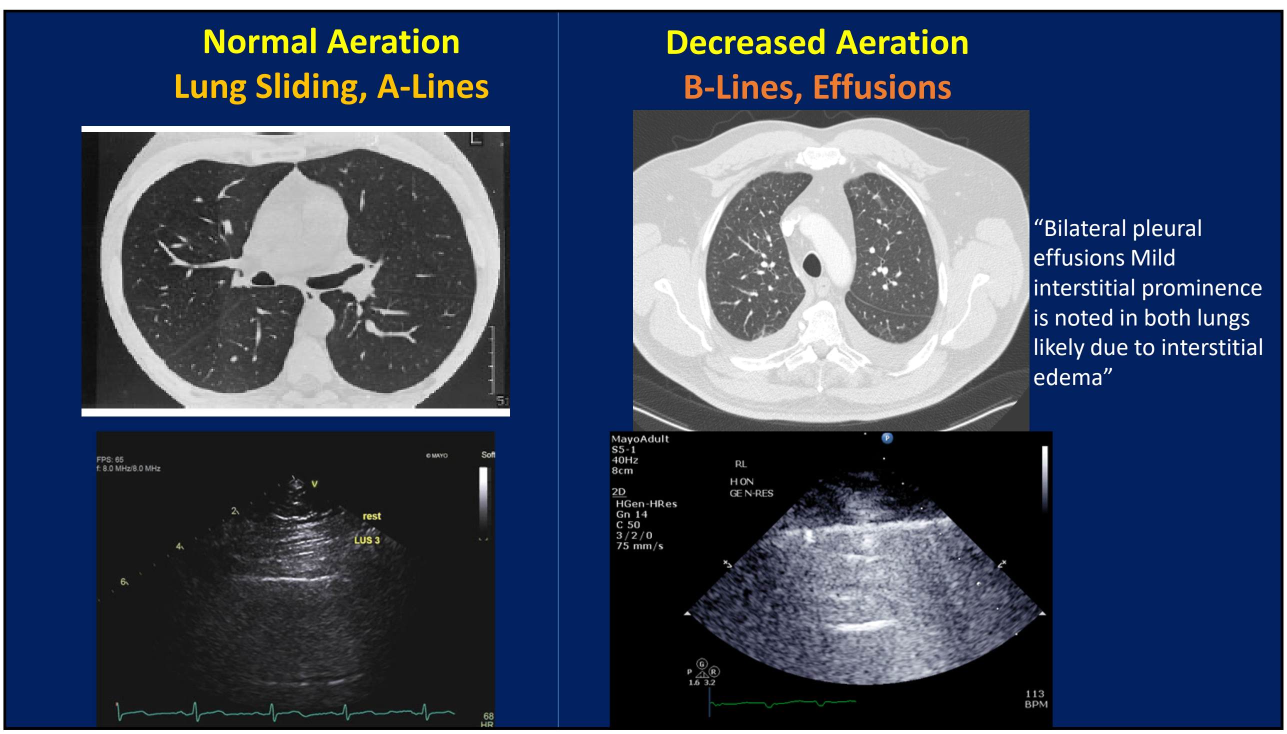
Normal Aeration
Lung Sliding, A-Lines
Decreased Aeration
B-Lines, Effusions
"Bilateral pleural effusions Mild interstitial prominence is noted in both lungs likely due to interstitial edema"

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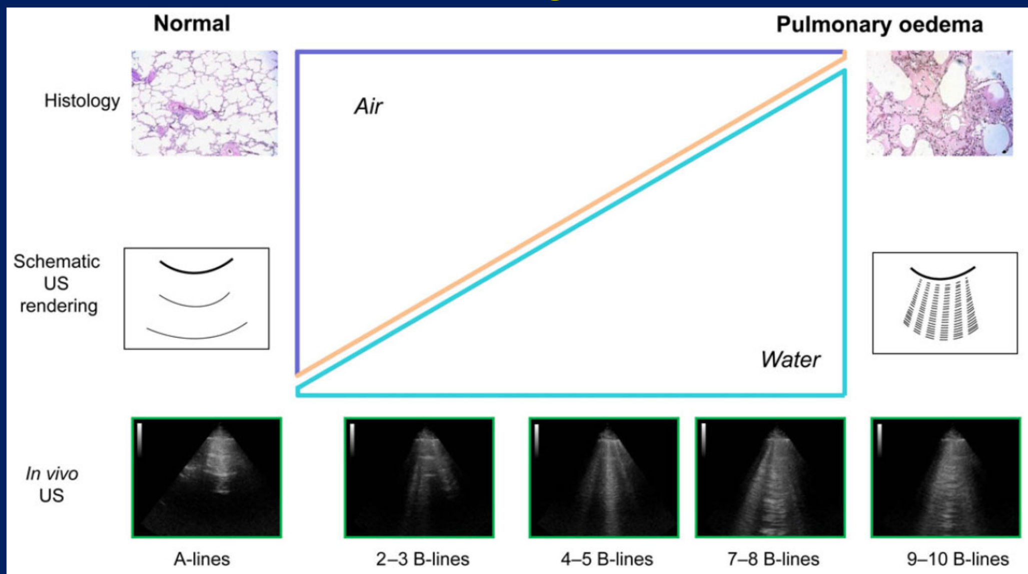
B-Lines Increase with Increased Lung Density from Extravascular Lung Water (Edema)



Picano E., Pellikka PA,. European Heart Journal 2016

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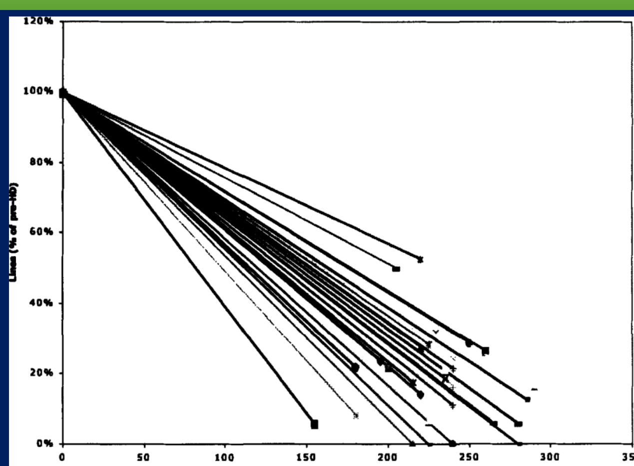
B-Lines Decrease with Fluid Removal

Change in B-Lines Pre- and Post-dialysis



Noble VE et al. 2009 Chest

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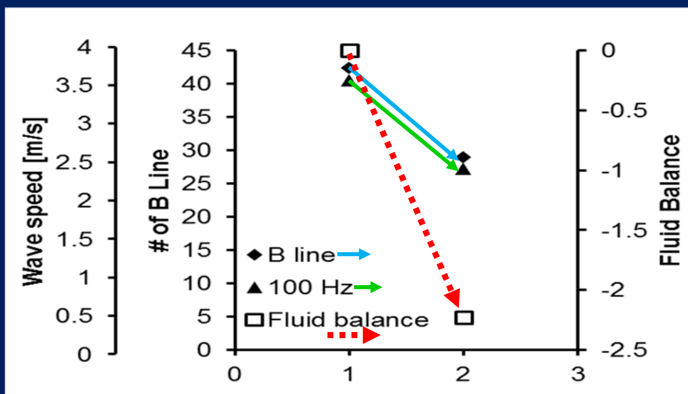
B-Lines Decrease Corresponds to Increased Lung Compliance



- Patients admitted with AHF
- Lung ultrasound surface wave elastography
- Diuresis over 24 hours
  - Avg diuresis 2.1L
  - Avg decrease in B-Lines 13
  - Decrease in lung surface wave speed
    - Decreased stiffness
    - Increased compliance

Wiley BM, Zhou B, Pandompatam G, Olgun-Kucuk H, Zhang X (manuscript under review)

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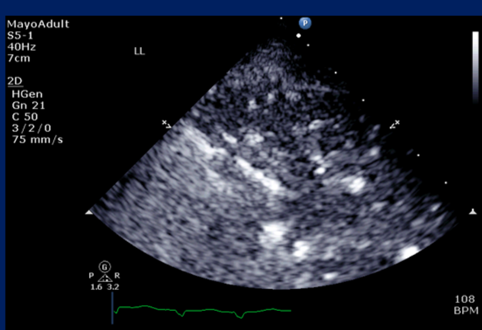
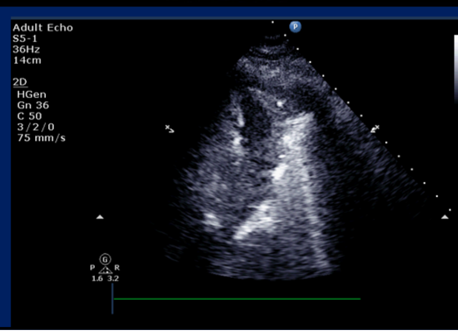
Consolidation




- Subpleural echo-poor region
- Tissue-like echotexture
- “Hepatization” of lung



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Lung Ultrasound Key Findings

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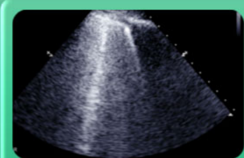

Assess parenchyma

- Normal: nothing present ("A-Lines")
- Abnormal: B-Lines, Consolidation

Assess pleural space

- Normal: nothing present
- Abnormal: fluid

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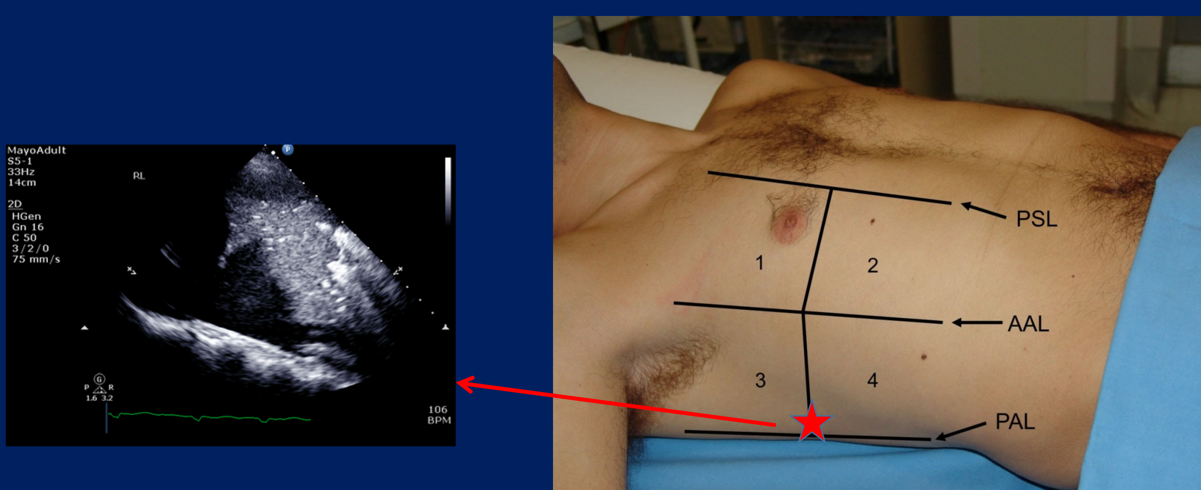
Pleural Effusion



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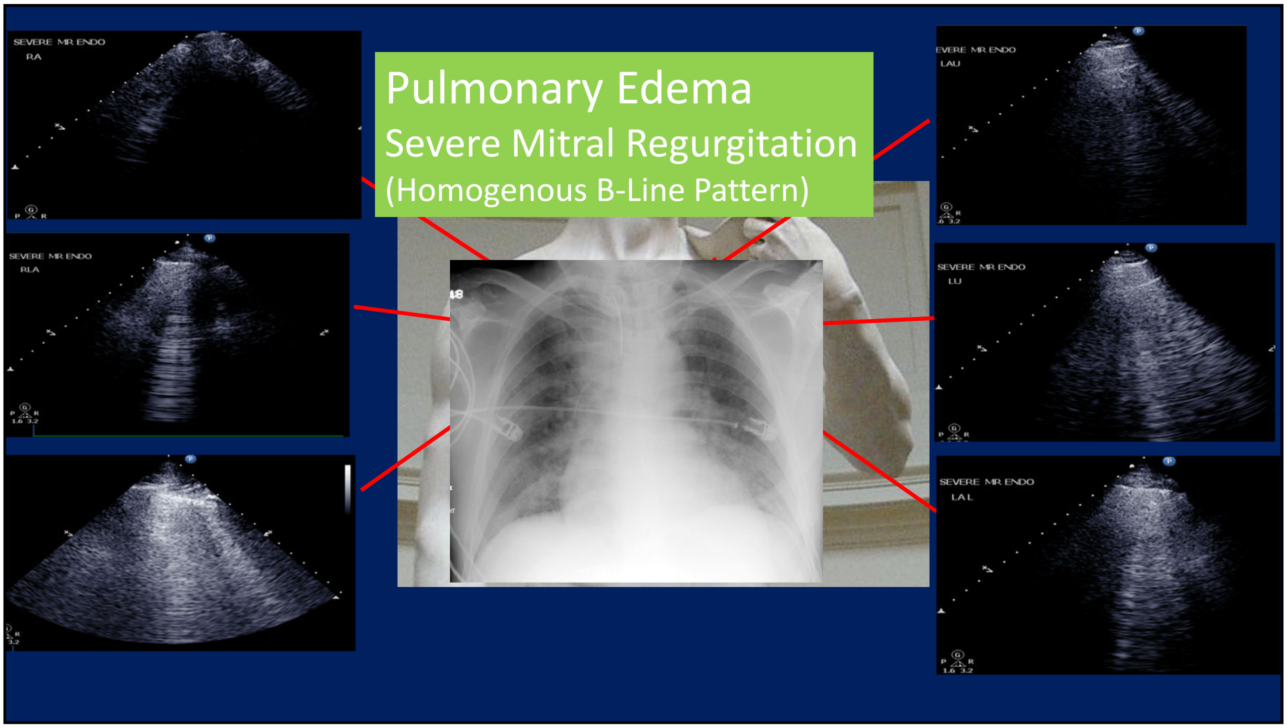
Pulmonary Edema
Severe Mitral Regurgitation
(Homogenous B-Line Pattern)
SEVERE MR ENDO RA
SEVERE MR ENDO RLA
SEVERE MR ENDO LAU
SEVERE MR ENDO LU
SEVERE MR ENDO LAL

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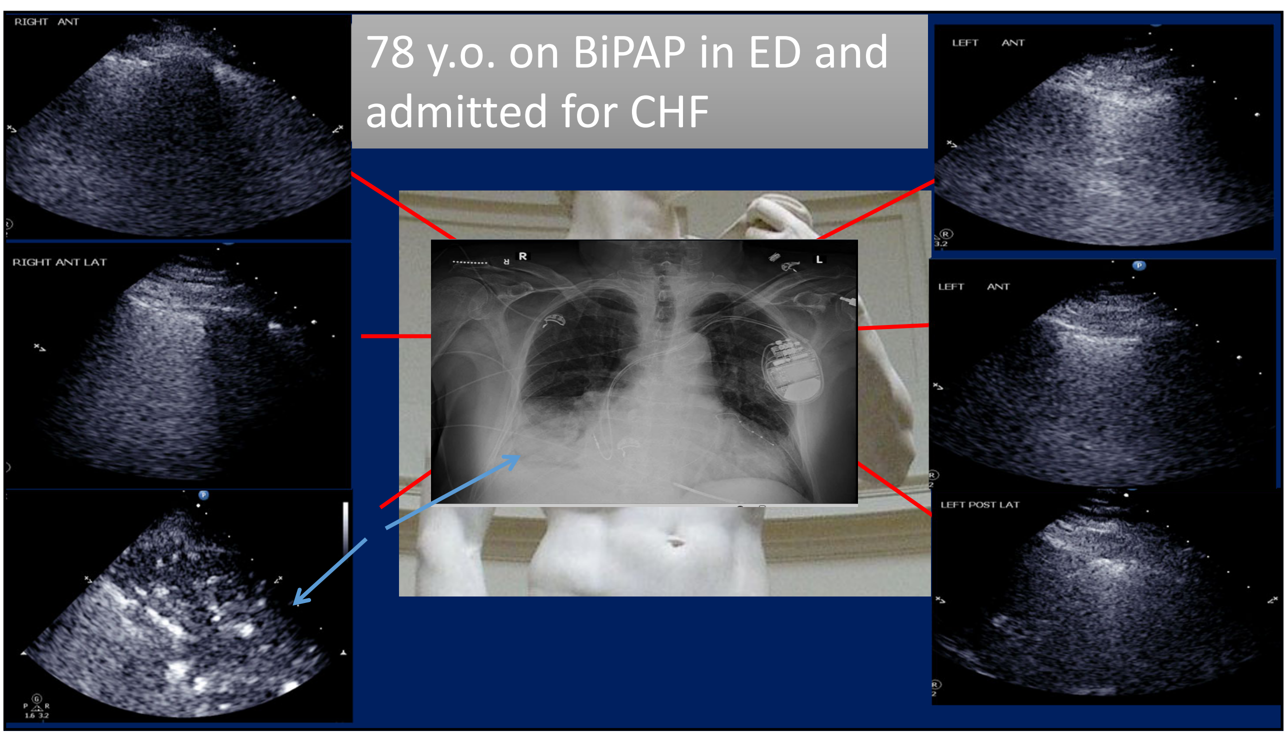
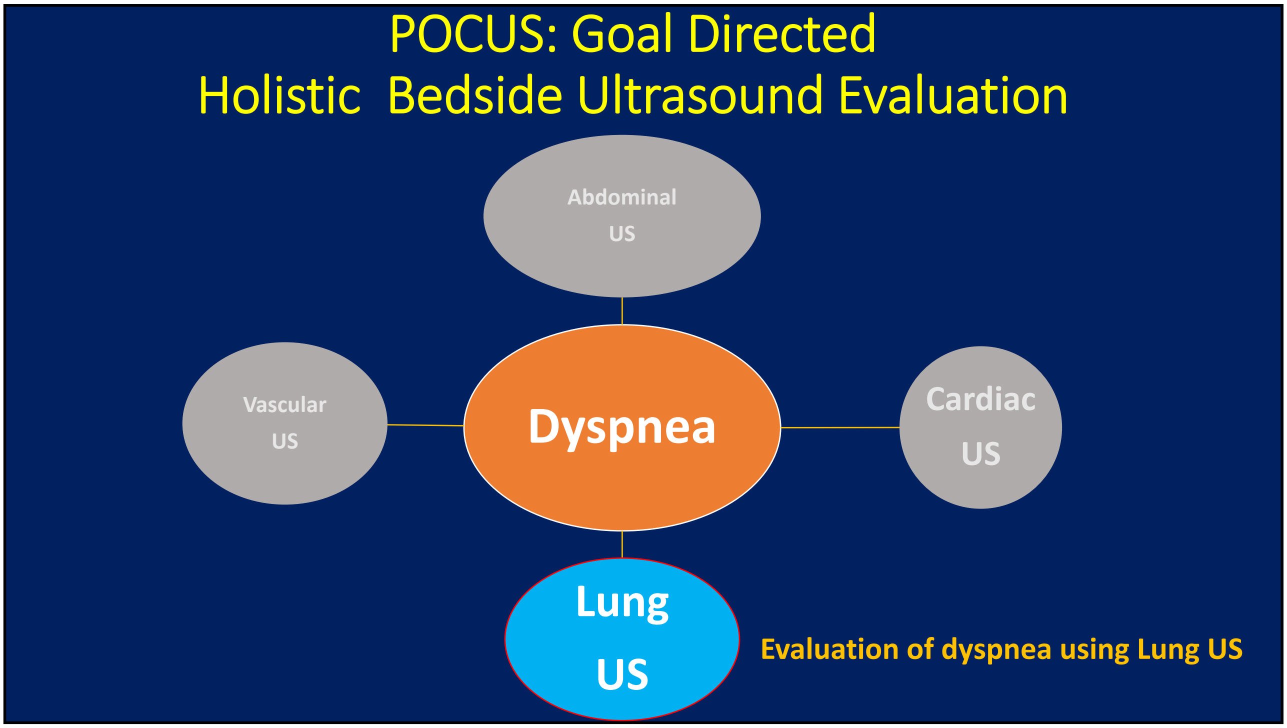
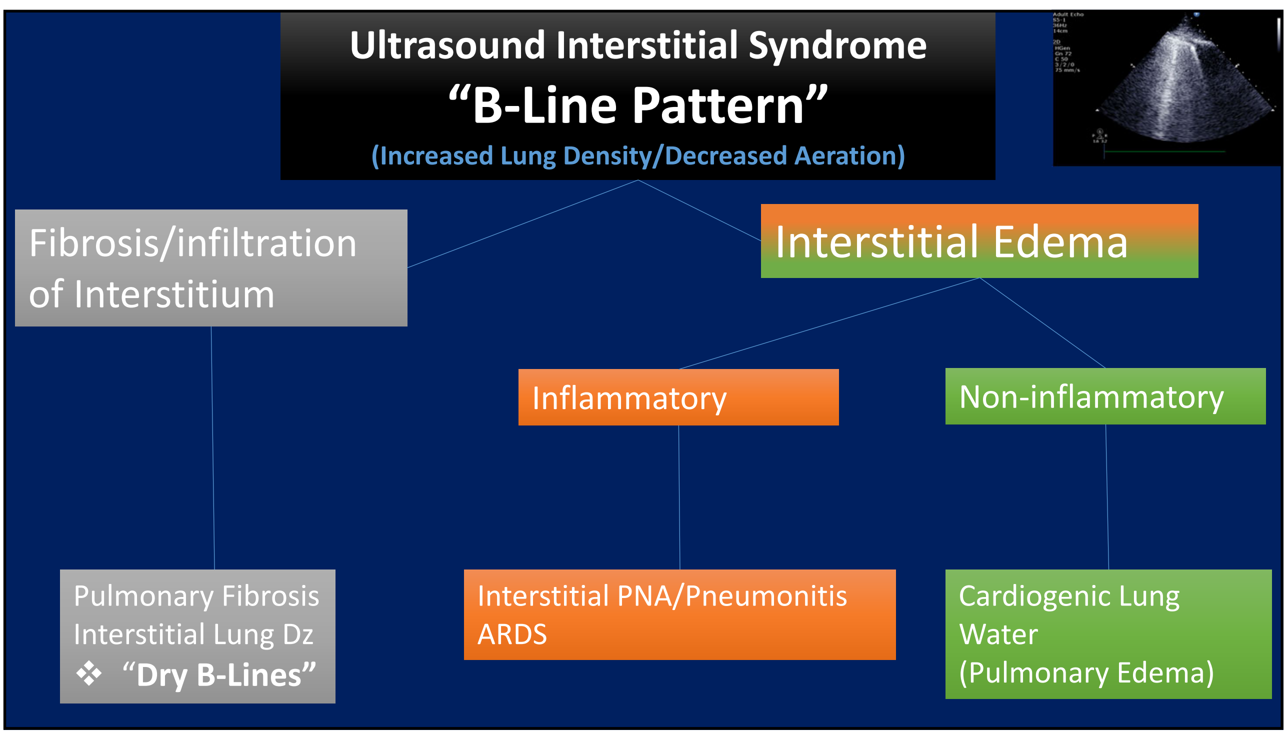

78 y.o. on BiPAP in ED and admitted for CHF
RIGHT ANT
RIGHT ANT LAT
LEFT ANT
LEFT ANT
LEFT POST LAT

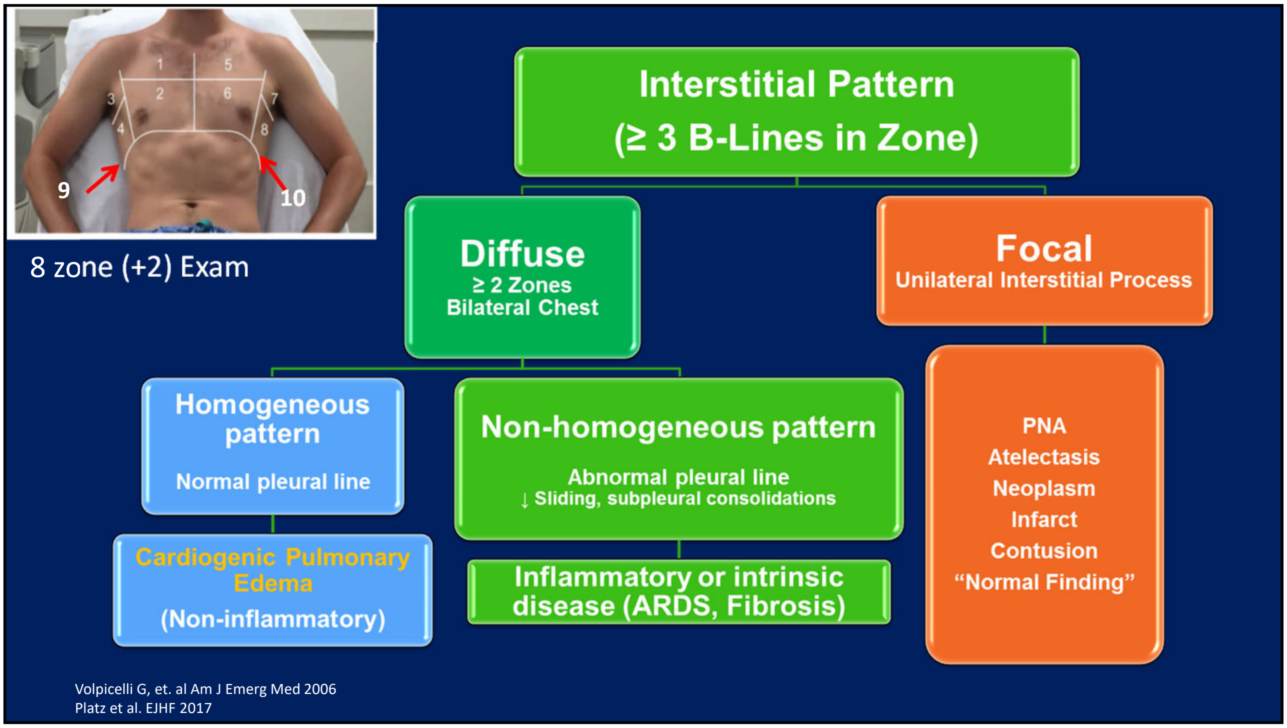
44


POCUS: Goal Directed
Holistic Bedside Ultrasound Evaluation
Abdominal US
Vascular US
Dyspnea
Cardiac US
Lung US
Evaluation of dyspnea using Lung US

45


Ultrasound Interstitial Syndrome
"B-Line Pattern"
(Increased Lung Density/Decreased Aeration)
Fibrosis/infiltration of Interstitium
Interstitial Edema
Inflammatory
Non-inflammatory
Pulmonary Fibrosis
Interstitial Lung Dz
❖ "Dry B-Lines"
Interstitial PNA/Pneumonitis
ARDS
Cardiogenic Lung Water
(Pulmonary Edema)

46


1
2
3
4
5
6
7
8
9
10
8 zone (+2) Exam
Interstitial Pattern
(≥ 3 B-Lines in Zone)
Diffuse
≥ 2 Zones
Bilateral Chest
Focal
Unilateral Interstitial Process
Homogeneous pattern
Normal pleural line
Non-homogeneous pattern
Abnormal pleural line
↓ Sliding, subpleural consolidations
PNA
Atelectasis
Neoplasm
Infarct
Contusion
"Normal Finding"
Cardiogenic Pulmonary Edema
(Non-inflammatory)
Inflammatory or intrinsic disease (ARDS, Fibrosis)
Volpicelli G, et. al Am J Emerg Med 2006
Platz et al. EJHF 2017

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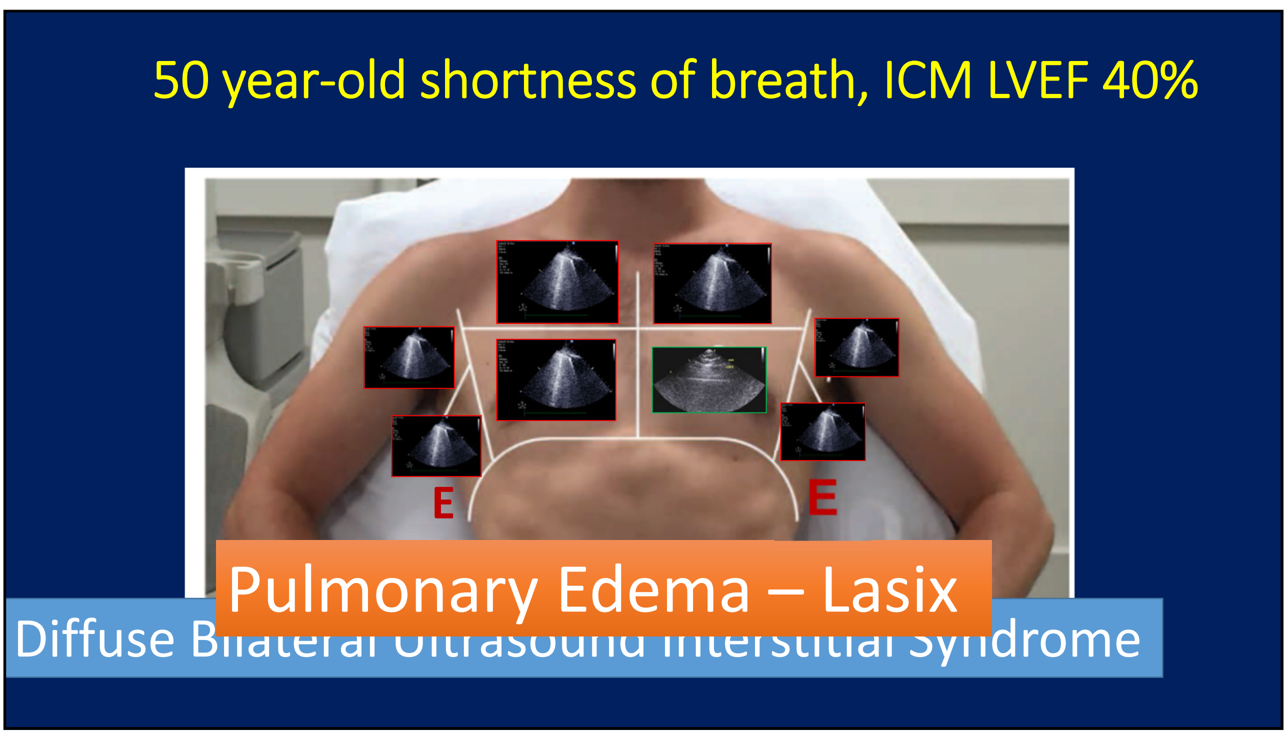
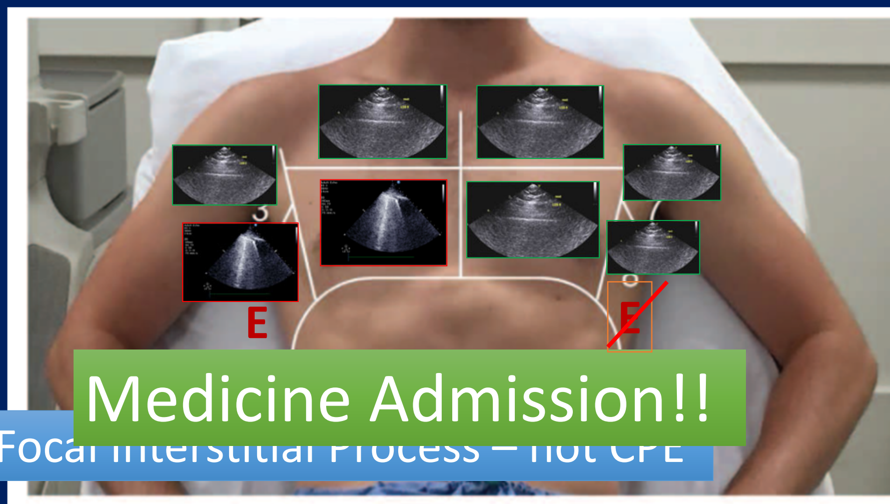

50 year-old shortness of breath, ICM LVEF 40%
E
E
Pulmonary Edema – Lasix
Diffuse Bilateral Ultrasound Interstitial Syndrome

48

50 year-old shortness of breath, ICM LVEF 40%



Medicine Admission!!

Focal Interstitial Process – not CPE

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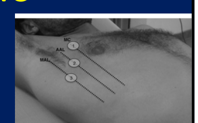
LUS Excellent Diagnostic Test in ED for Cardiogenic Pulmonary Edema



- SIMEU study of 1,005 pts presenting to ED with dyspnea
  - 6-Zone anterior lung ultrasound
  - CARDIOGENIC vs NON-CARDIOGENIC etiology

	Sens.	Spec.	PPV	NPV
Clinical	**85.3%**	**90%**	**88%**	**87%**
LUS ≥2 zones (bilateral) 3 ≥ B-Lines	**90.5%**	**93.5%**	**92.3%**	**92%**
LUS + Clinical	**97%**	**97.4%**	**97%**	**97.4%**
CXR	**69.5%**	**82.1%**	**76.8%**	**75.9%**

Pivetta et al. SIMEU Group, 2015. Chest

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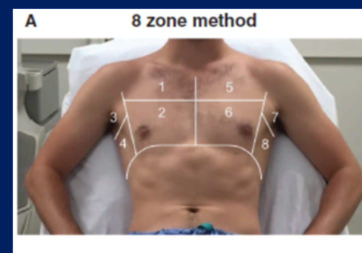
Data Supports use of LUS for Diagnosis of Acute Pathology

- Diagnosis of Heart Failure in ED (B-Line pattern)
  - **85.3% sens., 92.7% spec.** (LR+ 7.4, LR-0.16)
    - **CXR 56.9% sens**. 89.2% spec
    - BNP (<100pg/ml) LR- 0.14
- Diagnosis of pneumothorax
  - **90.9% sens., 98.2% spec.**
    - **CXR 50.2% sens.**, 99.4% spec.
- Diagnosis of PNA
  - 80-90% sens., 70-90% spec.



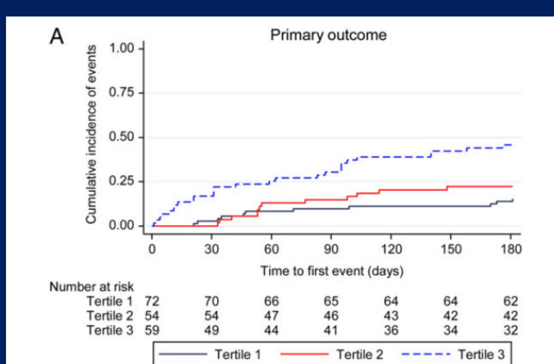
Martindale JL et al. 2016 Acad Em Med
Llamas-Alvarez AM et al. 2017 Chest
Alrajhi et al. 2012 Chest

51

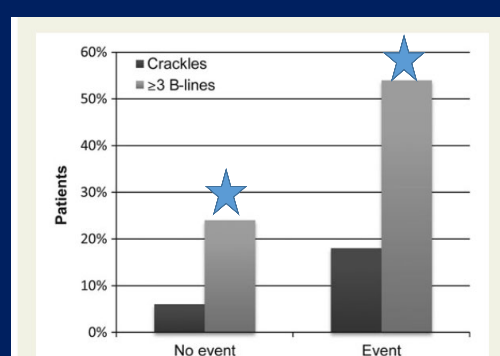
Detection and prognostic value of pulmonary congestion by lung ultrasound in ambulatory heart failure patients† Eur Heart J 2016

Elke Platz[1,2]*, Eldrin F. Lewis[2,3], Hajime Uno[2,4], Julie Peck[5], Emanuele Pivetta[6,7], Allison A. Merz[8], Dorothea Hempel[9], Christina Wilson[10], Sarah E. Frasure[1,2], Pardeep S. Jhund[11], Susan Cheng[2,3], and Scott D. Solomon[2,3]

Increased B-Lines correlate with worse prognosis in ambulatory HF patients



Adjusted HR 4.08 (2.09-10.31) combined all cause mortality and hospitalization at 180 days



★ Portable Vscan US device, 8 zones

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JACC: HEART FAILURE VOL. 7, NO. 10, 2019
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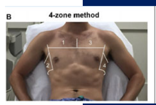
Lung Ultrasound in Acute Heart Failure

Prevalence of Pulmonary Congestion and Short- and Long-Term Outcomes



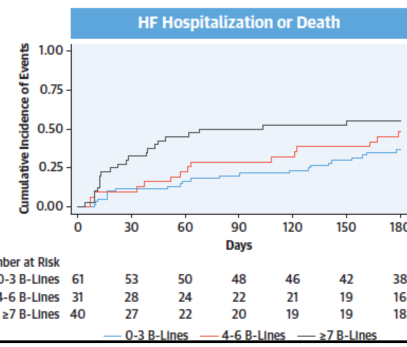
Elke Platz, MD, MS,[a,b,*] Ross T. Campbell, MBChB,[c,*] Brian Claggett, PhD,[b,d] Eldrin F. Lewis, MD, MPH,[b,d] John D. Groarke, MD, MPH,[b,d] Kieran F. Docherty, MBChB,[c] Matthew M.Y. Lee, MBChB,[c] Allison A. Merz, BA,[a,b] Montane Silverman, BA,[a,b] Varsha Swamy, BS,[a,b] Moritz Lindner, MD,[a,b] Jose Rivero, MD,[b,d] Scott D. Solomon, MD,[b,d] John J.V. McMurray, MBChB, MD[c]

- 349 patients with ADHF (97% feasible)
- 4 zone LUS
- **35% no rales, 11% no congestion on CXR**
- Divided into tertiles of B-Line burden
  - BNP increased
  - No diff in LVEF (39%) or comorbidities
- ❑ In-hospital and Long-Term Primary Composite End-Point increased across tertiles

TABLE 2 In-Hospital Outcomes by Admission B-Line Tertile (N = 349)

	0-4 B-Lines (n = 121)	5-9 B-Lines (n = 131)	≥10 B-Lines (n = 97)	p Trend
Hospital length of stay, days	5 (3-9)	7 (3-13)	8 (4-13)	0.008
In-hospital all-cause death	1 (0.8)	2 (1.5)	4 (4.1)	-
ICU admission for worsening HF or cardiac arrest	3 (2.5)	4 (3.1)	1 (1.0)	-
LVAD during baseline admission	1 (0.8)	1 (0.8)	1 (1.0)	-
Intravenous inotropes	4 (3.3)	12 (9.2)	9 (9.3)	-
Composite outcome	5 (4.1)	16 (12.2)	14 (14.4)	-
Unadjusted OR (95% CI)	Reference	1.82 (1.14-2.88)	3.29 (1.31-8.30)	0.011
Model 1: adjusted OR (95% CI)	Reference	2.18 (1.31-3.64)	4.75 (1.70-13.25)	0.003
Model 2: adjusted OR (95% CI)	Reference	2.25 (1.24-4.07)	5.05 (1.54-16.54)	0.007
Model 3: adjusted OR (95% CI)	Reference	2.10 (1.20-3.70)	4.43 (1.43-13.67)	0.010

CENTRAL ILLUSTRATION Cumulative Incidence of HF Hospitalization or Death by Pre-Discharge B-Line Tertiles (n = 132)



Number at Risk	0	30	60	90	120	150	180
0-3 B-Lines	61	53	50	48	46	42	38
4-6 B-Lines	31	28	24	22	21	19	16
≥7 B-Lines	40	27	22	20	19	19	18

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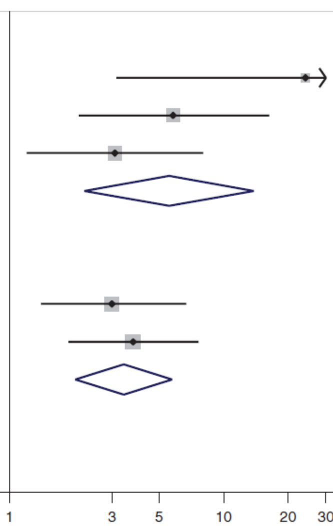
Increased Burden of B-Lines Identifies HF Patients at High Risk for HF Readmission or Death

Author	Year	n	Events, n	HR (95% CI)	Weight (%)
Acute Heart Failure (pre-discharge)					
Gargani	2015	99	18	24.12 (3.15, 184.55)	16.10
Coiro	2015	60	18	5.80 (2.10, 16.30)	40.38
Cogliati	2016	149	34	3.10 (1.20, 8.02)	43.52
Subtotal (I_2 = 40.3%, P = 0.187)				5.55 (2.24, 13.80)	100.00
Chronic Heart Failure					
Gustafsson	2015	104	24	3.00 (1.40, 6.70)	44.46
Platz	2016	185	50	3.78 (1.88, 7.63)	55.54
Subtotal (I_2 = 0.0%, P = 0.666)				3.41 (2.02, 5.75)	100.00



NOTE: Weights are from random effects analysis

>15 B-Lines (28 zones)

≥ 3 B-Lines (5-8 zones)

Platz et al. EJHF 2017

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Integration of LUS into Echocardiogram

Outpatient ECHO
Indication: possible CHF?

Final Impressions

1. Severe mitral valve regurgitation with mild anterior leaflet override and a posteriorly direct jet. Apical displacement of the leaflets and annular dilation suggest a functional etiology.
2. Mitral regurgitation ERO (PISA) 0.53 cm^2.
3. Mitral regurgitant volume (PISA) 73 ml.
4. Moderate−severe left ventricular enlargement. Estimated ejection fraction 45−50%. Mild global hypokinesis.
5. Normal right ventricular size with mildly reduced systolic function.
6. Estimated right ventricular systolic pressure 56 mmHg (systolic blood pressure 122 mmHg).
7. Dilated inferior vena cava with reduced inspiratory collapse (<50%).
8. Lung ultrasound performed. Evidence of B−lines suggestive of pulmonary edema.

Encourage the early detection of heart failure – before rales, weight gain

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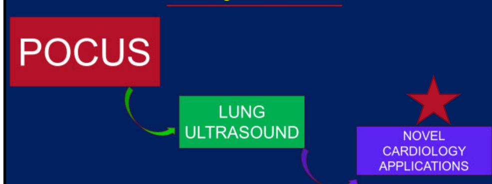
Objectives



Novel Applications of POCUS Techniques in Evaluation of Cardiovascular Disease

- ❑Lung US + Stress Test

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ESC European Society of Cardiology — European Heart Journal (2019) 0, 1–11 — CLINICAL RESEARCH — Heart failure/cardiomyopathy

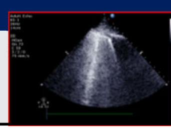
The haemodynamic basis of lung congestion during exercise in heart failure with preserved ejection fraction

Yogesh N.V. Reddy, Masaru Obokata, Brandon Wiley, Katlyn E. Koepp, Caitlin C. Jorgenson, Alexander Egbe, Vojtech Melenovsky, Rickey E. Carter, and Barry A. Borlaug

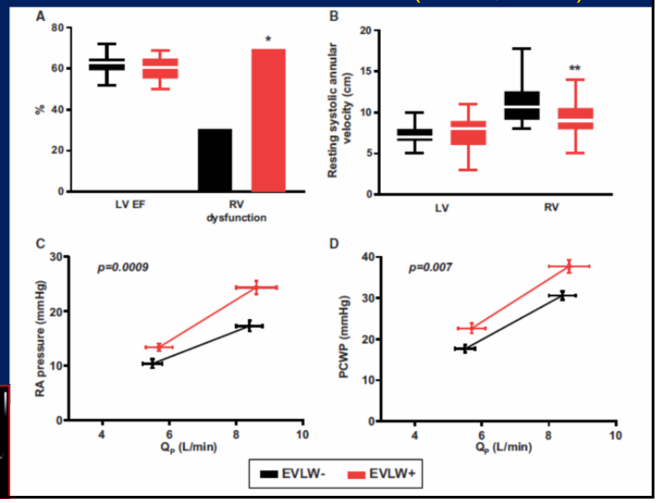
Lung Ultrasound + Invasive Exercise Test
Etiology of Dyspnea

EVLW[+] WITH STRESS

- ❑ Resting RV dysfunction
  - No difference in LVEF
- ❑ ↑ PCWP
- ❑ ↑ RAP
- ❑ ↓ RV-PA coupling
  - S'/mPAP; FAC/mPAP; TAPSE/mPAP
- ❑ ↑ Hemoconcentration
  - ❑ Loss of H20 from vascular space



HFpEF (n = 61 patients)
Exercise EVLW/B-Lines (n=33; 54%)



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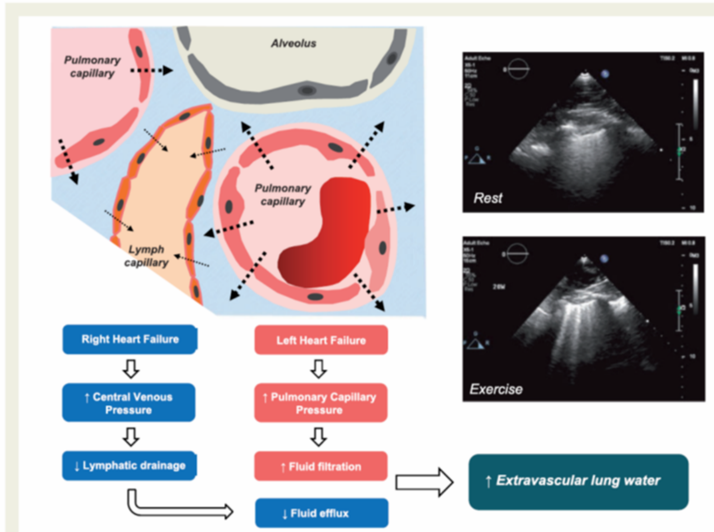
Lung Ultrasound + Invasive Exercise Test
Etiology of Dyspnea



Take home figure Development of extravascular lung water associated with both increased pulmonary capillary wedge pressure leading to fluid filtration, as well as increased right atrial and central venous pressure potentially impeding lymphatic lung water drainage.

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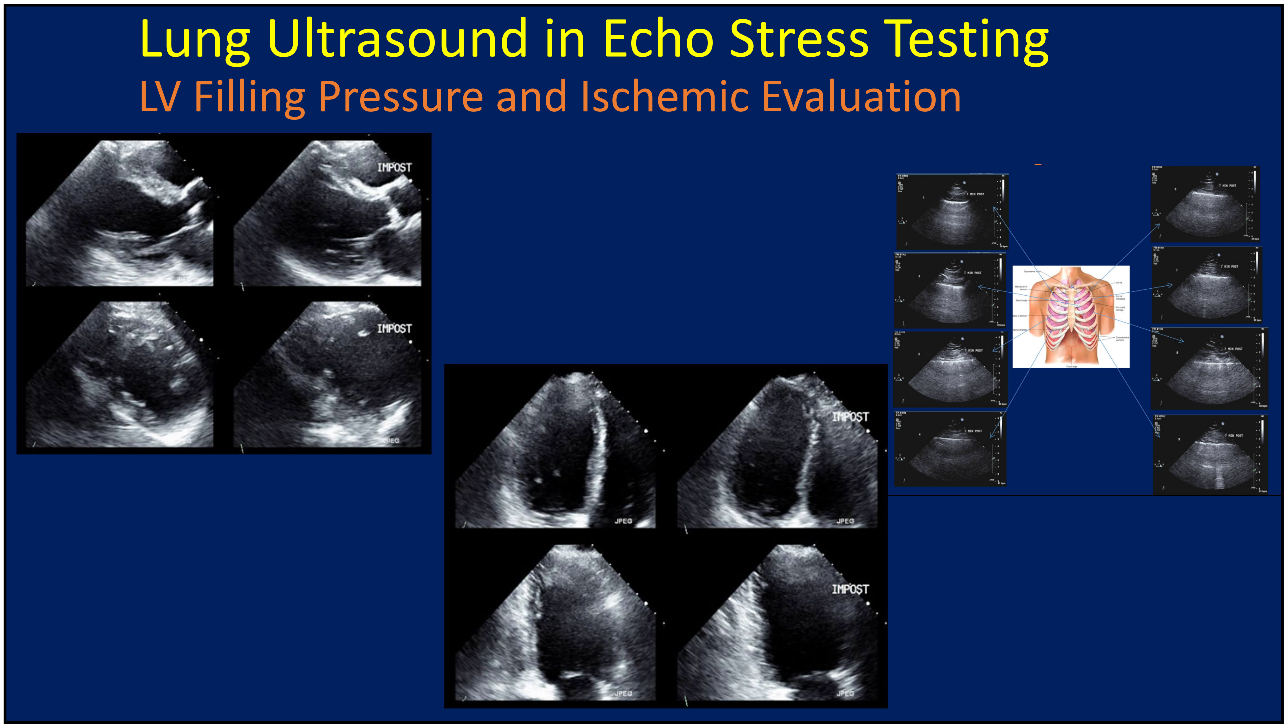
Lung Ultrasound in Echo Stress Testing
LV Filling Pressure and Ischemic Evaluation
IMPOST
IMPOST
IMPOST
IMPOST

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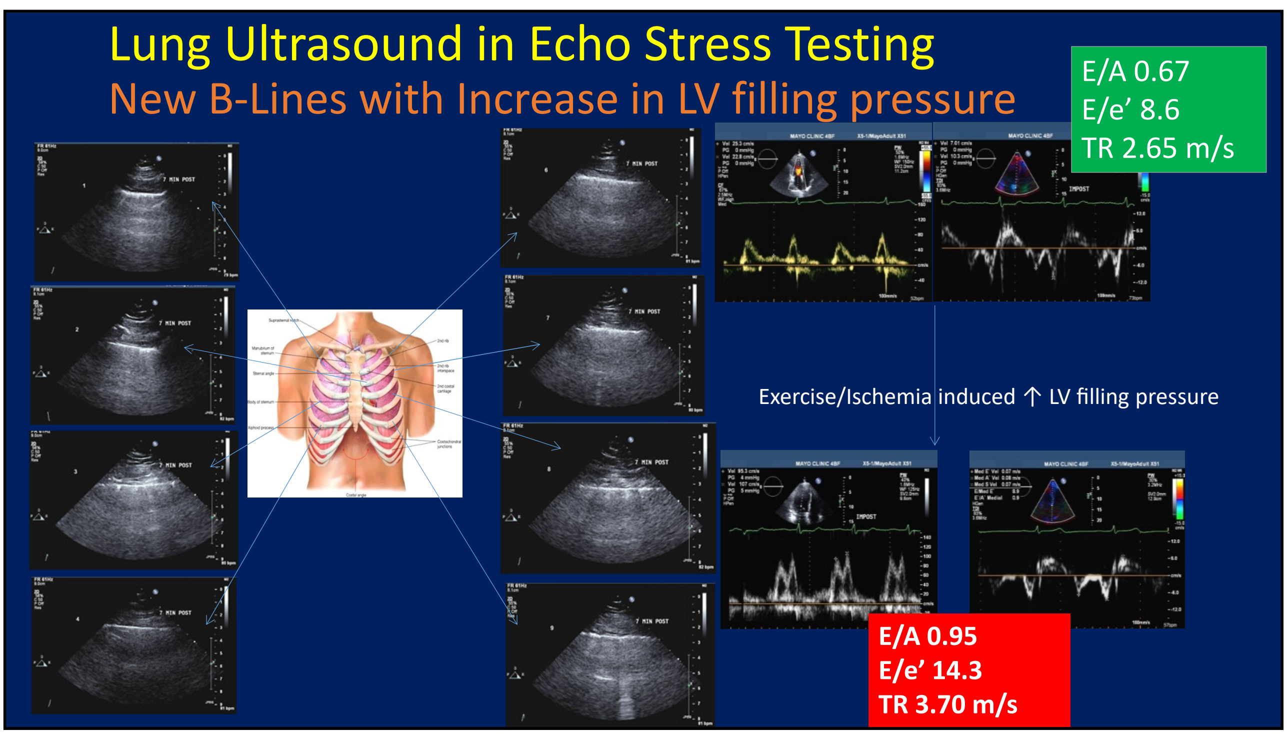
Lung Ultrasound in Echo Stress Testing
New B-Lines with Increase in LV filling pressure
E/A 0.67
E/e' 8.6
TR 2.65 m/s
Exercise/Ischemia induced ↑ LV filling pressure
E/A 0.95
E/e' 14.3
TR 3.70 m/s

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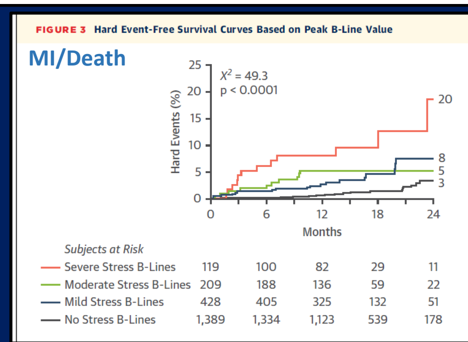
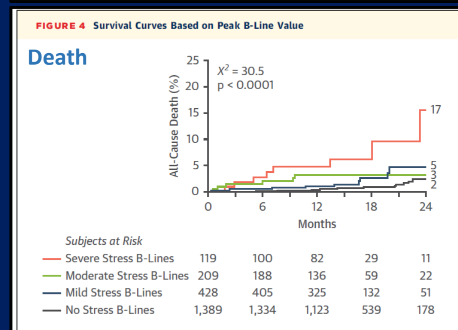
CLINICAL RESEARCH J Am Coll Cardiol Img 2020

Lung Ultrasound and Pulmonary Congestion During Stress Echocardiography

Maria Chiara Scali, MD, PhD,[a,*] Angela Zagatina, MD,[b] Quirino Ciampi, MD, PhD,[c] Lauro Cortigiani, MD,[d]





B-Line Score: mild 2-4, mod 5-9, severe ≥ 10

Methods

- 2,145 patients, prospective, stress echo
- LUS (4-zone AA/MA) pre- and post-stress
  - B-Line burden graded (none, mild, mod, severe)

Key Results

- Feasibility 100%
- Mortality/MI increased across groups
  - Mortality 8x in severe B-Line group
- Multivariable analysis for death/MI
  - Severe B-Lines (≥ 10) HR 3.544 p = 0.006
    - Heart rate reserve 2.276 (p=0.01), CFVR 2.178 p=(0.03), age 1.031 (p=0.04)

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JACC: CARDIOVASCULAR IMAGING
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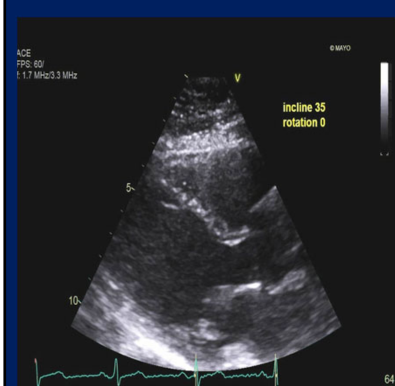
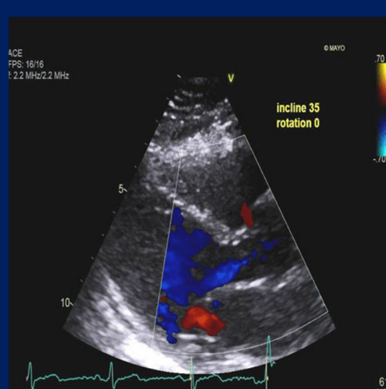
IMAGING VIGNETTE

Lung Ultrasound During Stress Echocardiography Aids the Evaluation of Valvular Heart Disease Severity

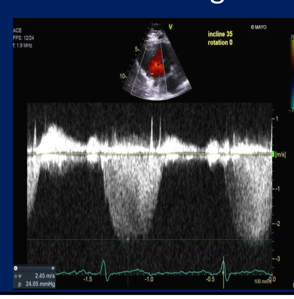
Brandon M. Wiley, MD, Charles E. Luoma, RDCS, Hilal Olgun Kucuk, MD, Ratnasari Padang, MBBS, PhD, Garvan C. Kane, MD, PhD, Patricia A. Pellikka, MD

Mean gradient
5 mmHg @60 BPM





TR velocity 2.45 m/s
RVSP 29 mmHg



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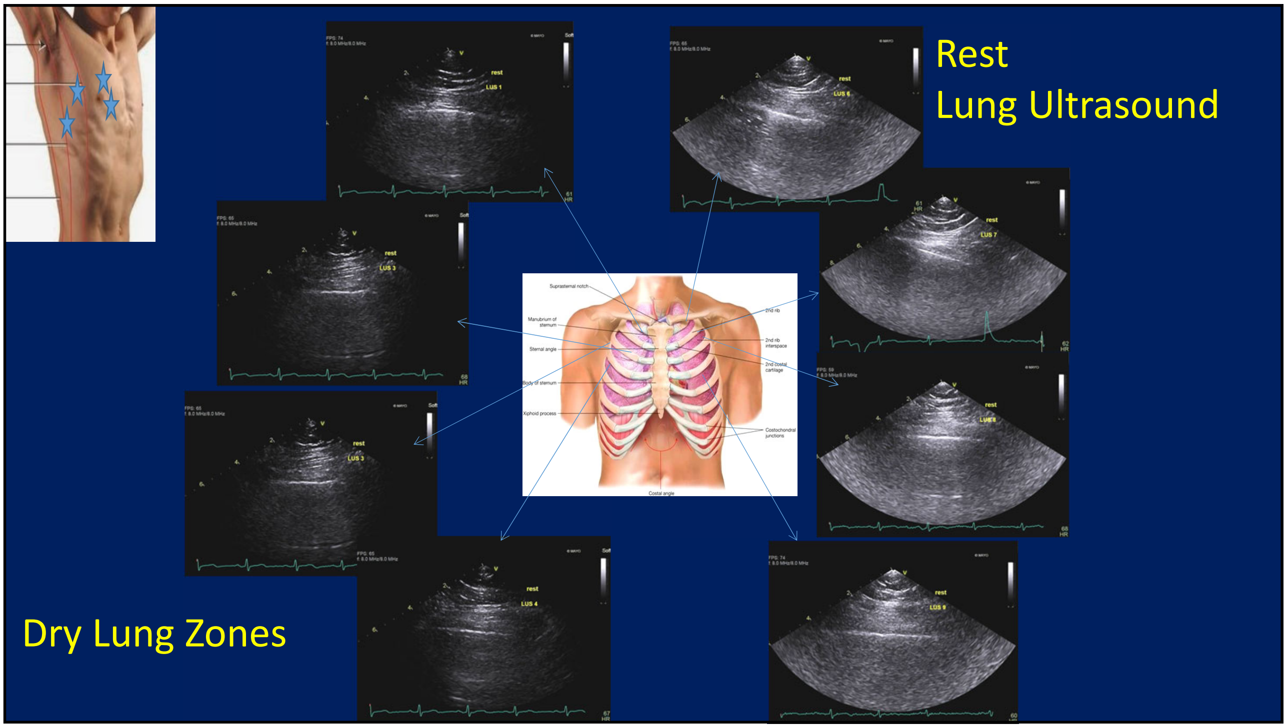
Rest
Lung Ultrasound
Dry Lung Zones

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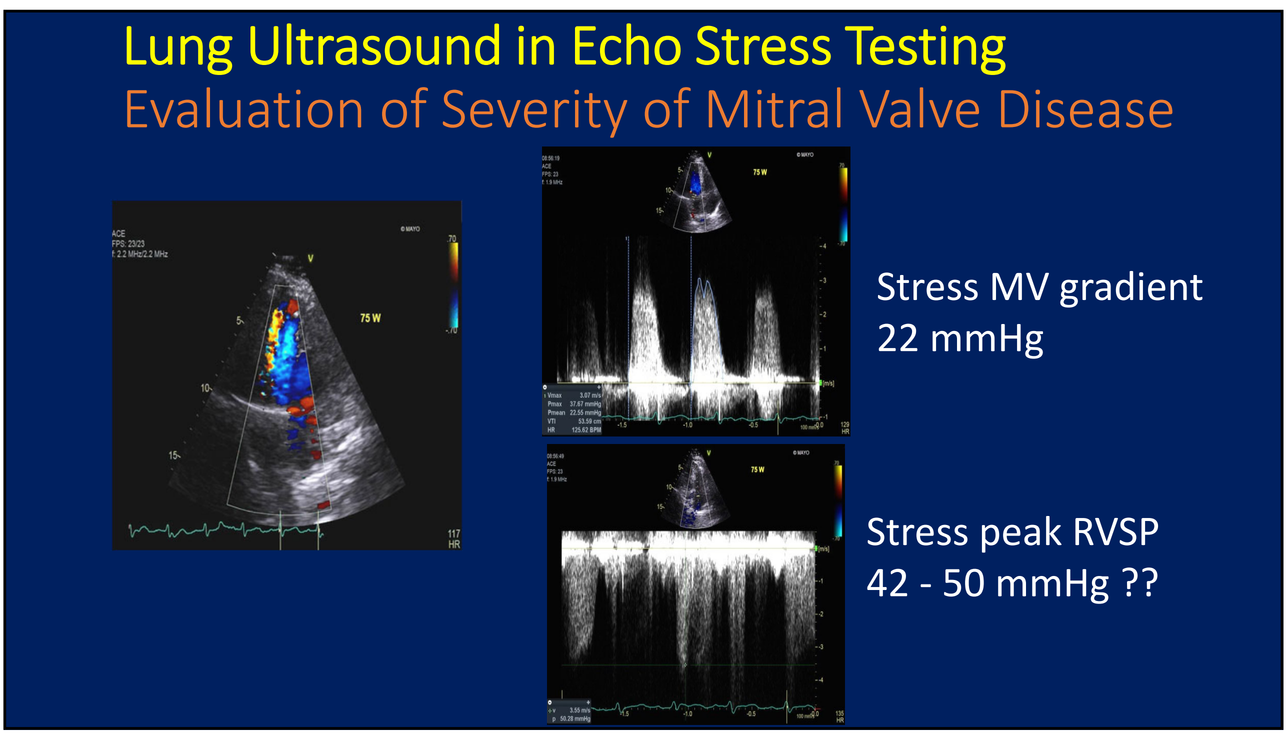
Lung Ultrasound in Echo Stress Testing
Evaluation of Severity of Mitral Valve Disease
Stress MV gradient
22 mmHg
Stress peak RVSP
42 - 50 mmHg ??

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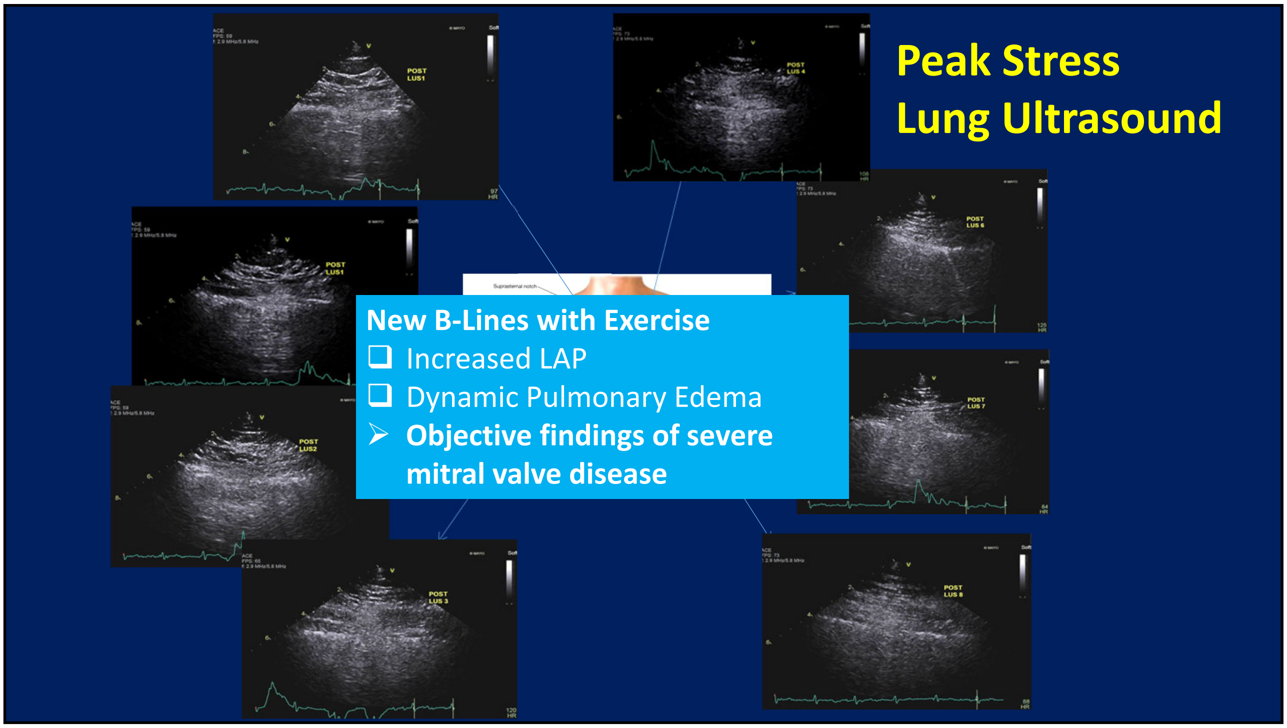

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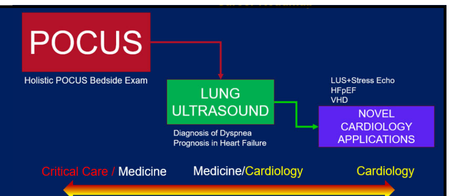
Summary



- Holistic POCUS Bedside Exam
  - Guide diagnosis/therapeutics at bedside
- Lung Ultrasound
  - Etiology of dyspnea
  - Monitor fluid status
  - Prognostic value in ambulatory/hospitalized heart failure
- Novel applications
  - LUS+Stress Echo
    - Etiology of dyspnea (HFpEF)
    - LV filling pressure, VHD
    - Prognosis in stress echo

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SHOCK

RESUSCITATION

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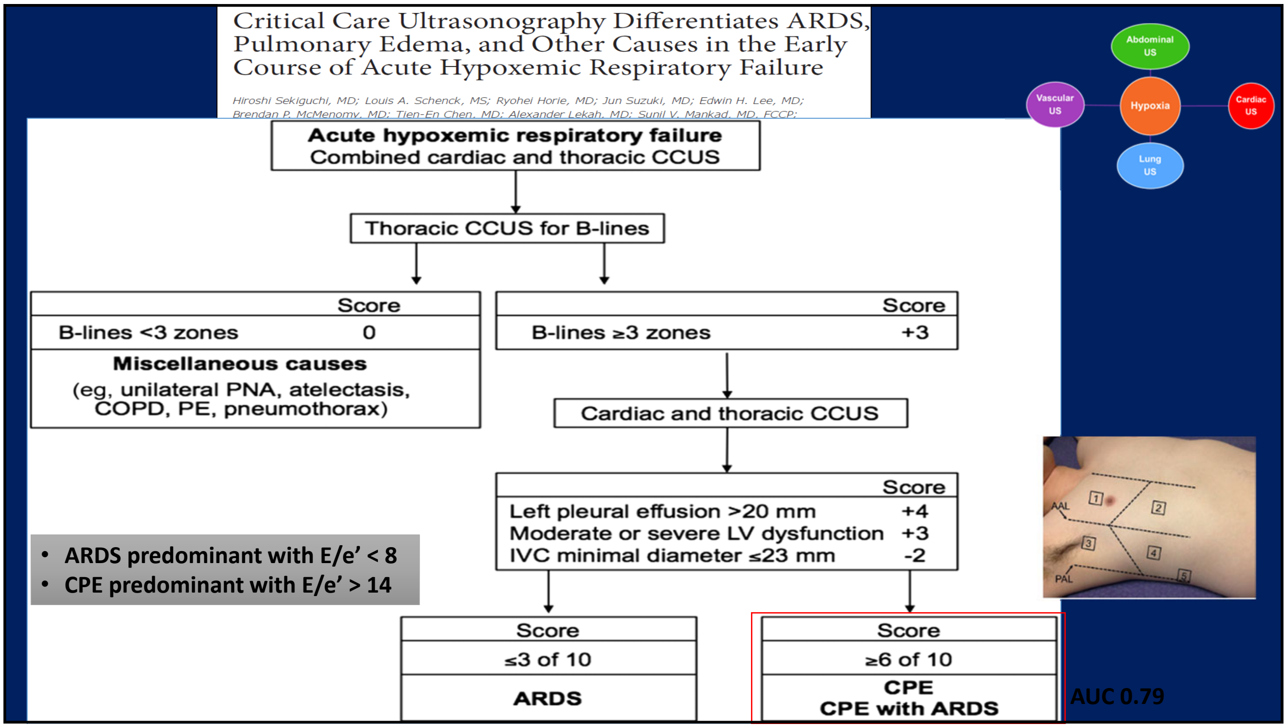
Critical Care Ultrasonography Differentiates ARDS, Pulmonary Edema, and Other Causes in the Early Course of Acute Hypoxemic Respiratory Failure
Hiroshi Sekiguchi, MD; Louis A. Schenck, MS; Ryohei Horie, MD; Jun Suzuki, MD; Edwin H. Lee, MD;
Abdominal US
Vascular US
Hypoxia
Cardiac US
Lung US
Acute hypoxemic respiratory failure
Combined cardiac and thoracic CCUS
Thoracic CCUS for B-lines
Score
B-lines <3 zones 0
Miscellaneous causes
(eg, unilateral PNA, atelectasis, COPD, PE, pneumothorax)
Score
B-lines ≥3 zones +3
Cardiac and thoracic CCUS
Score
Left pleural effusion >20 mm +4
Moderate or severe LV dysfunction +3
IVC minimal diameter ≤23 mm -2
• ARDS predominant with E/e' < 8
• CPE predominant with E/e' > 14
AAL
PAL
Score
≤3 of 10
ARDS
Score
≥6 of 10
CPE
CPE with ARDS
AUC 0.79

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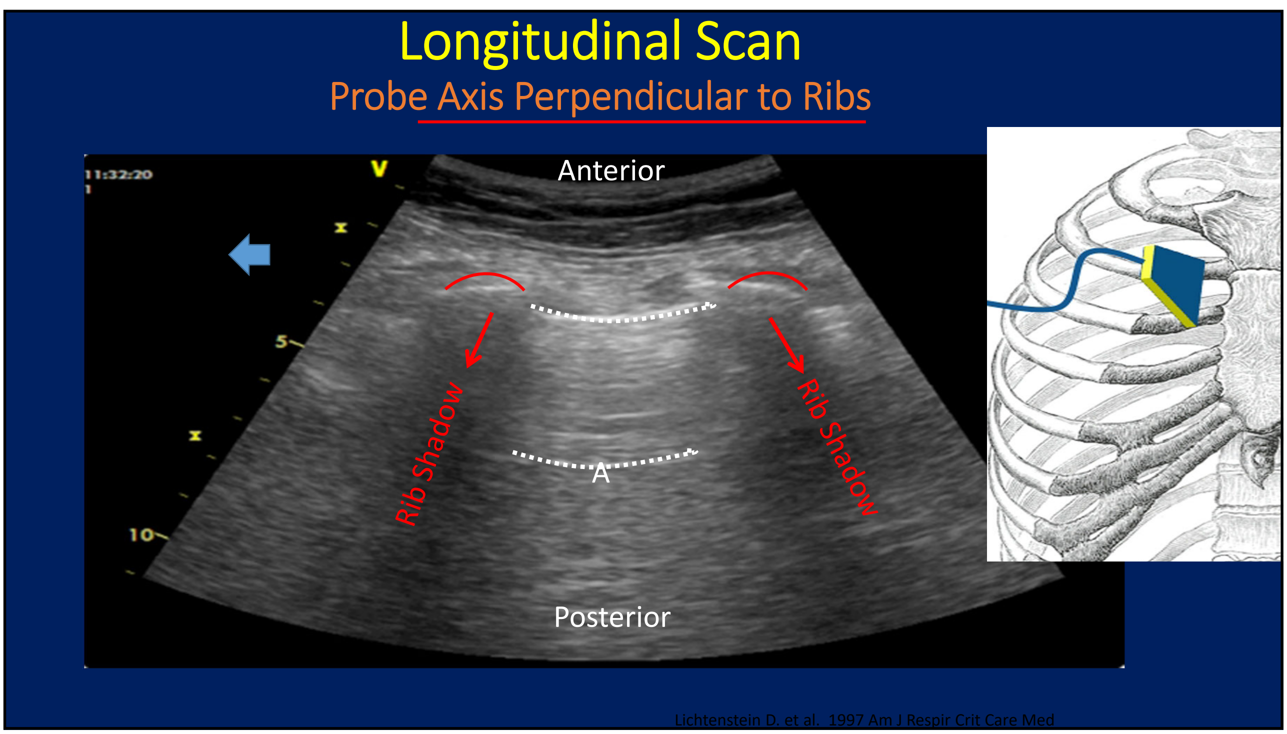
Longitudinal Scan
Probe Axis Perpendicular to Ribs
Anterior
Rib Shadow
Rib Shadow
A
Posterior
Lichtenstein D. et al. 1997 Am J Respir Crit Care Med

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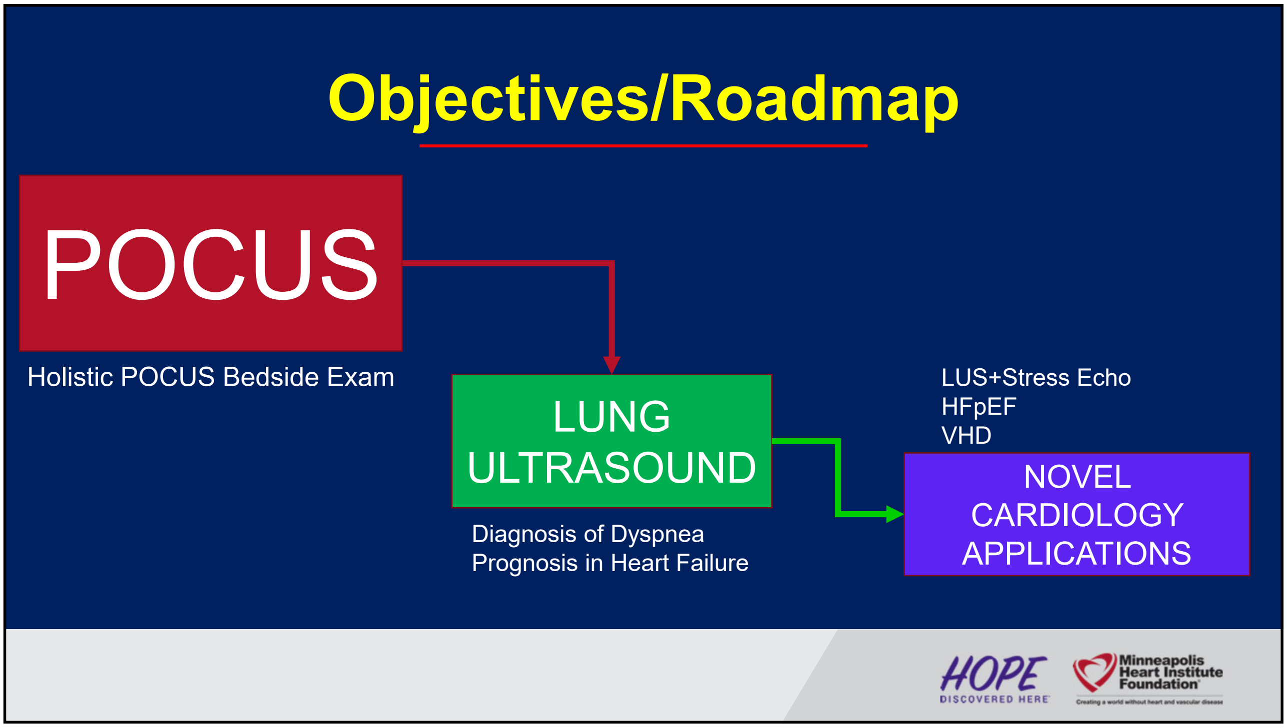
Objectives/Roadmap
POCUS
Holistic POCUS Bedside Exam
LUNG ULTRASOUND
Diagnosis of Dyspnea
Prognosis in Heart Failure
LUS+Stress Echo
HFpEF
VHD
NOVEL CARDIOLOGY APPLICATIONS
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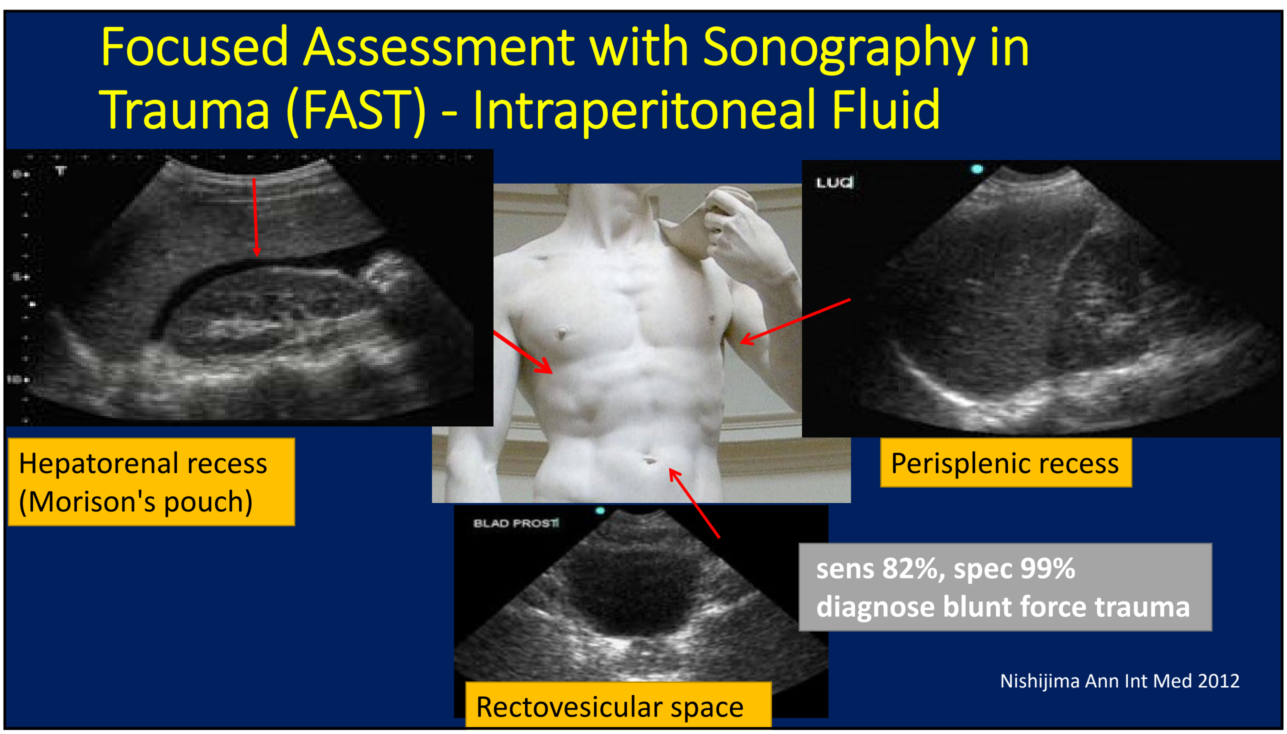
Focused Assessment with Sonography in Trauma (FAST) - Intraperitoneal Fluid
Hepatorenal recess (Morison's pouch)
Perisplenic recess
BLAD PROST
sens 82%, spec 99%
diagnose blunt force trauma
Rectovesicular space
Nishijima Ann Int Med 2012

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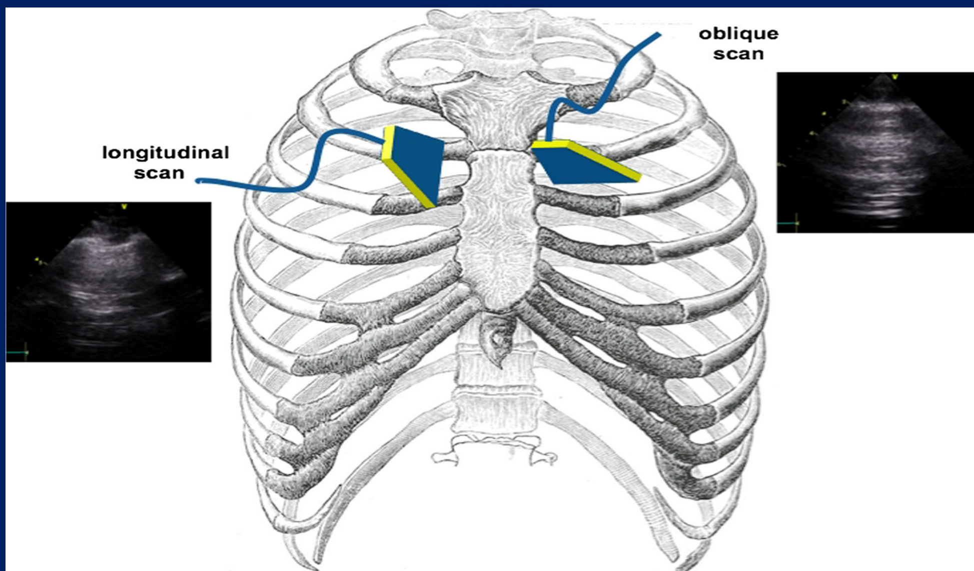
Scanning Technique



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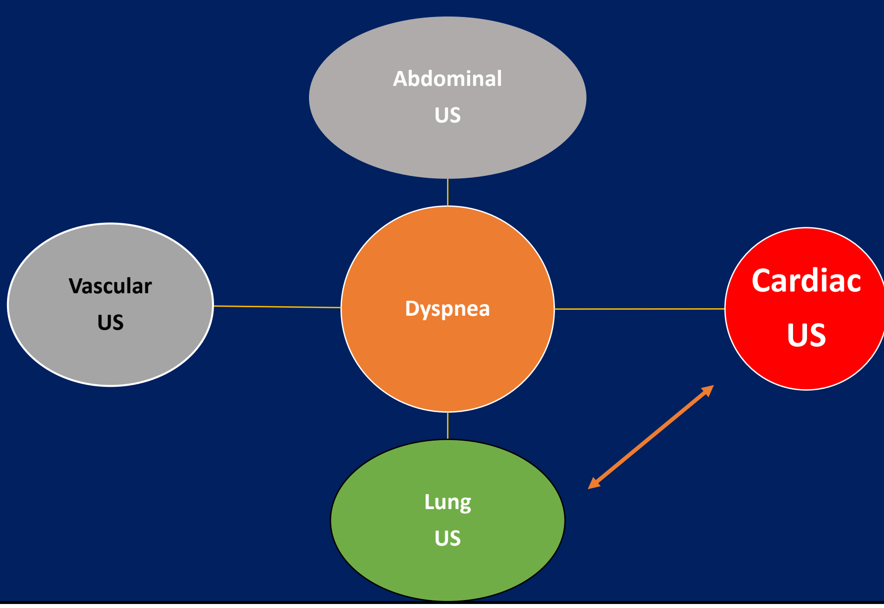
POCUS: Goal Directed Holistic Bedside Ultrasound Evaluation



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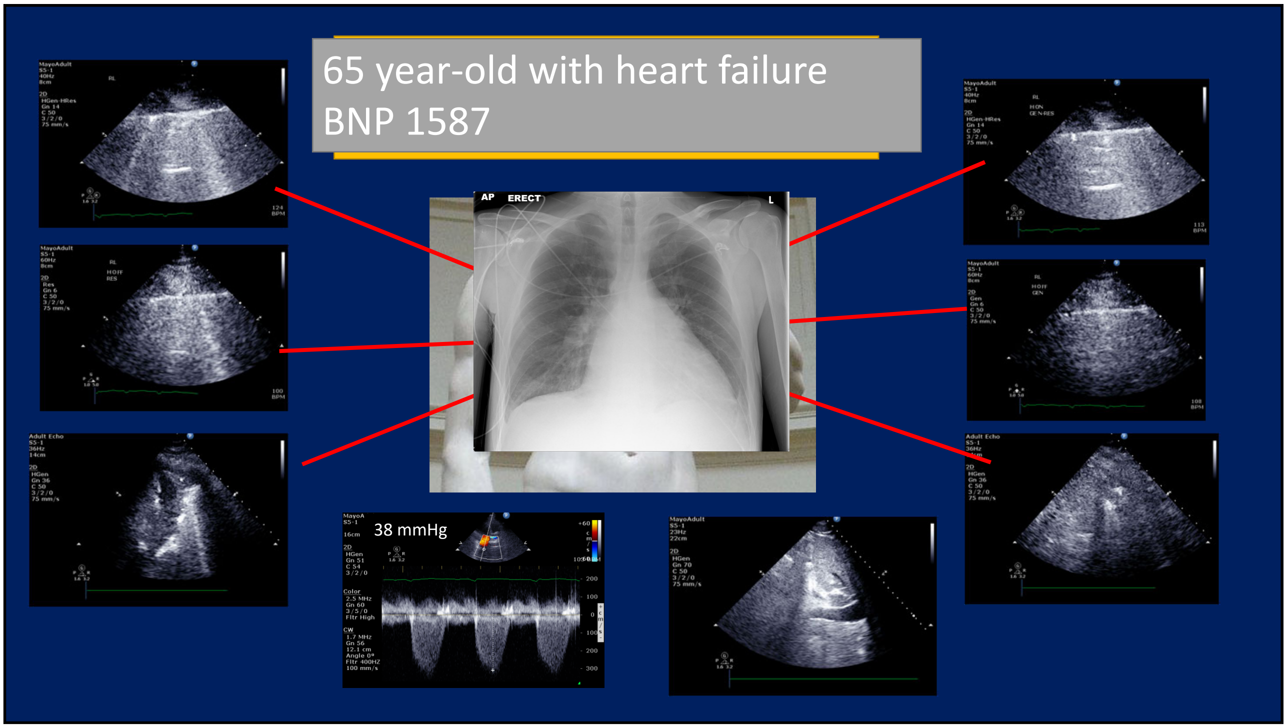

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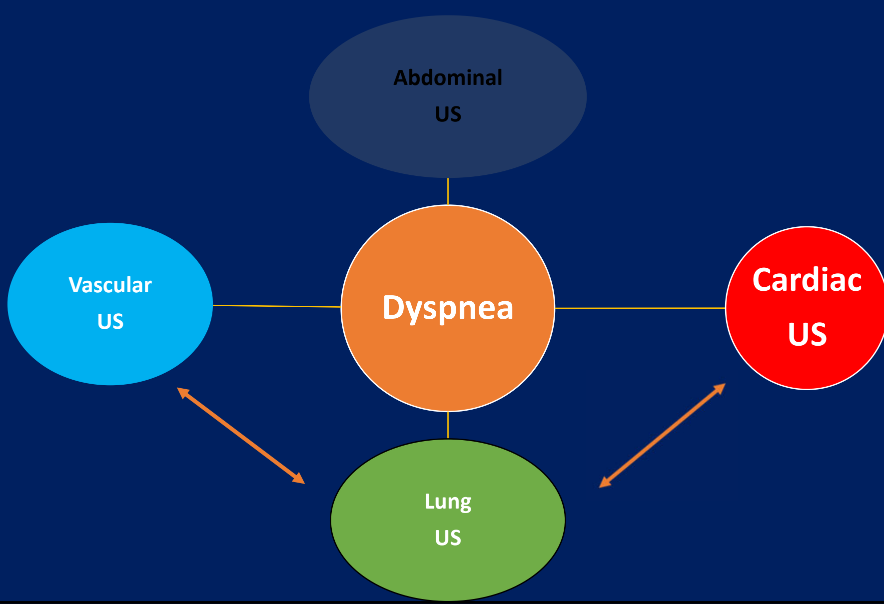
POCUS: Goal Directed Holistic Bedside Ultrasound Evaluation



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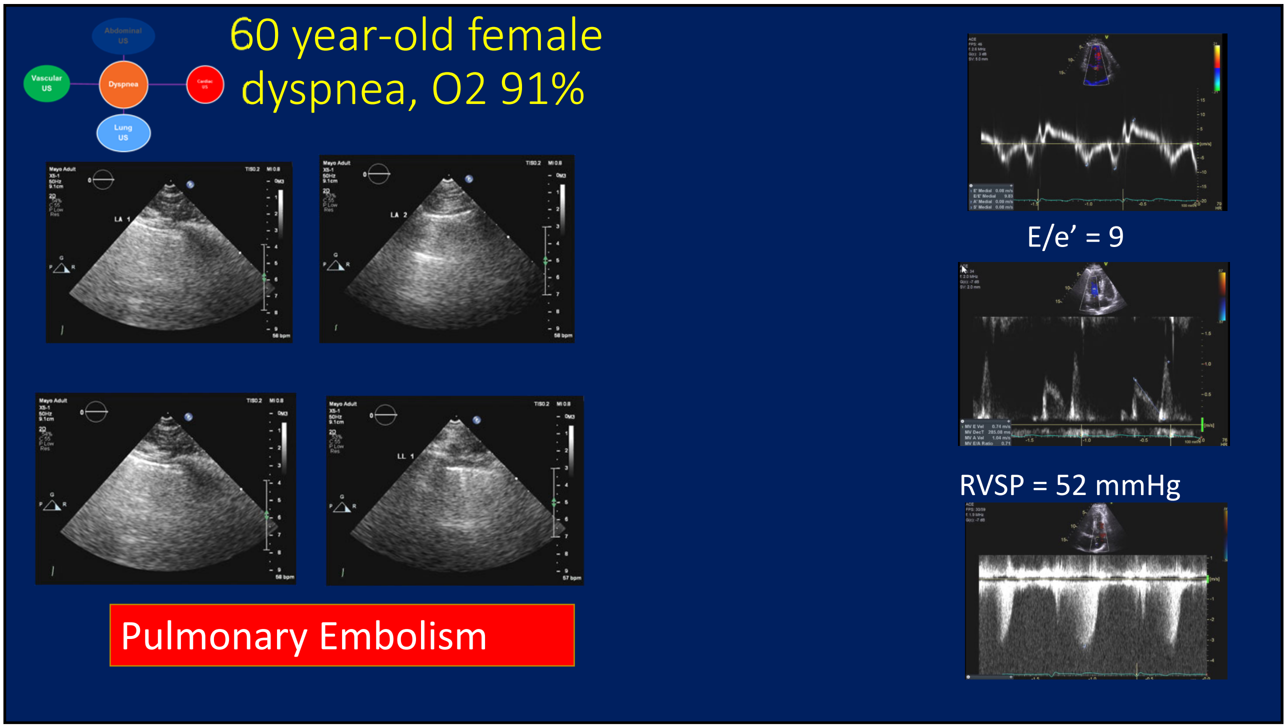
Abdominal US
Vascular US
Dyspnea
Cardiac US
Lung US
60 year-old female
dyspnea, O2 91%
LA 1
LA 2
LL 1
E/e' = 9
RVSP = 52 mmHg
Pulmonary Embolism

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