Point of Care Lung Ultrasound in the NICU: Clinical Applications and Research Potential

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Disclosures

- I have no financial disclosures.
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Objectives

1. Describe the utility of bedside lung ultrasound in the NICU.
2. Explain the basics of interpreting lung ultrasound findings.
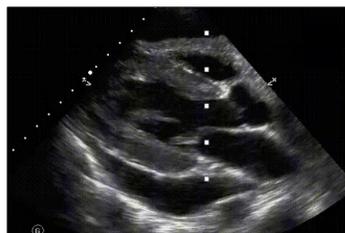3. Briefly list possible research applications for neonatal lung ultrasonography.

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?POCUS?

- **What?**
  - **P**oint **O**f **C**are **U**ltra**S**ound
- **Who?**
  - Many subspecialties
- **Where?**
  - U.S.A. lags behind other countries in neonatal POCUS
- **When?**
  - Exam, Transport, Code, Delivery Room
- **Why?**
  - Adjunct to clinical assessment
  - Answer *binary* clinical questions

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Pericardial Effusion?

https://www.showmethepocus.com/cardiac-tamponade

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Ascites?

Image courtesy of UltrasoundCases.info owned by SonoSkills

https://www.pocus.org/role-of-point-of-care-ultrasound-pocus-in-diagnosing-ascites/

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Lung Ultrasound: Pros and Cons

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Lung Field Scoring

- Semi-quantitative evaluation of lung fields using ultrasound
- "Score" assigned based on presence of different ultrasound artifacts
- Higher score → "Sicker" lungs
- Clinical applications?

Brat R, Yousef N, Klifa R, Reynaud S, Shankar Aguilera S, De Luca D. Lung Ultrasonography Score to Evaluate Oxygenation and Surfactant Need in Neonates Treated With Continuous Positive Airway Pressure. JAMA Pediatr. 2015;169(8):e151797. doi:10.1001/jamapediatrics.2015.1797
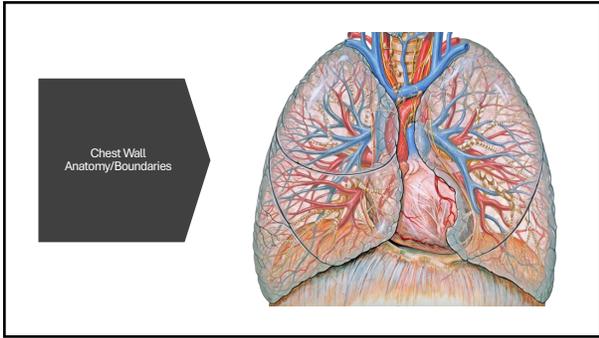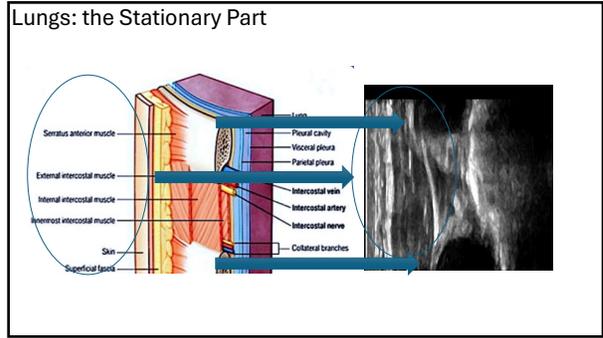
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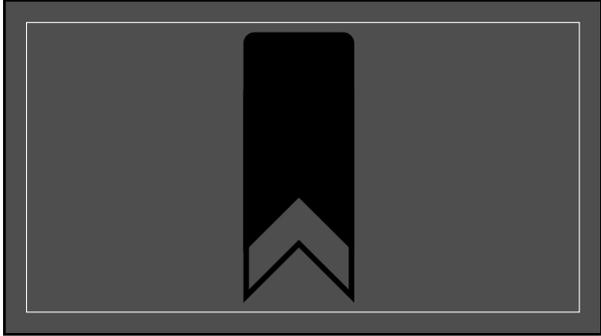
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2. Explain the basics of interpreting lung ultrasound findings
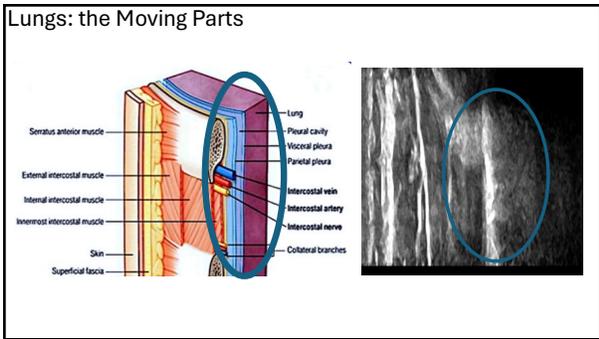
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Probe Choice: Depends on What You Have!

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Chest Wall Anatomy/Boundaries

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Slide 14

Lungs: the Stationary Part

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Slide 15

Lungs: the Moving Parts

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Skin and subcutaneous tissue
Muscle
Rib
Rib Shadow
Pleura
Lung field artifacts

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Slide 17

Artifacts: As easy as "A-B-C"

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A-Lines

- A = Aerated
- Pleura:
  - Bright
  - Reflective
  - Two apposing components
- Reverberation artifact
- Same distance as skin to pleura
- Equal distance from each other
- Fade with depth
- Doesn't always mean healthy lung

Pleura
A-Line

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B-Line it to the Bottom

- B Lines = Bad or Baby
- Blow through A lines
- Touch Bottom of field
- US through **not air**

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Lots of B-Lines = Really Bad

Supine

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Comet Tail

- Look similar to B-lines
- Do **not** touch bottom
- Do **not** obliterate A-lines
- Reverberation artifact
- Two strong reflectors

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Consolidation

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Consolidation

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Case Presentation:

A 36-week male neonate was delivered via C-section for maternal indications.
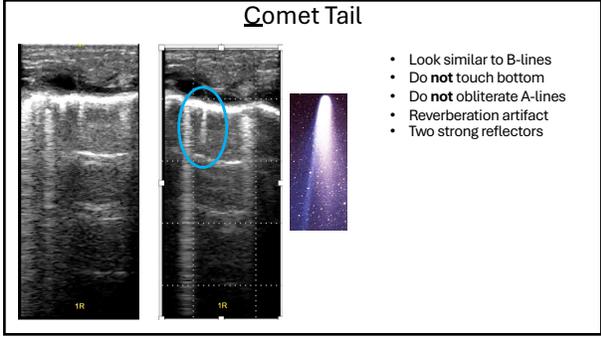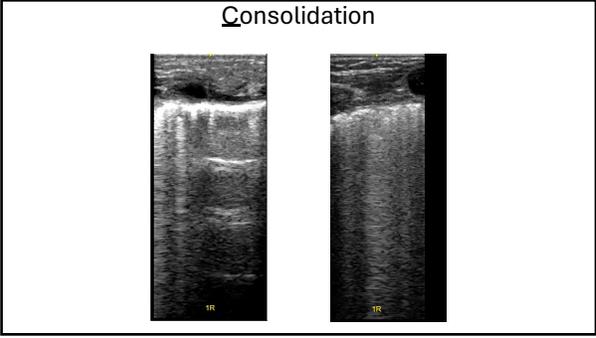
He received PPV in the delivery room, then started on CPAP.

Transport requested given need for higher level of service.

Developed increased work of breathing while in transport.

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Ultrasound Findings

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Get to the Point!
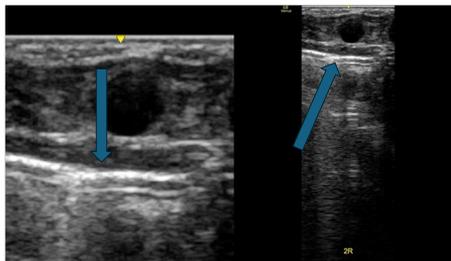
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Make the Point for POCUS
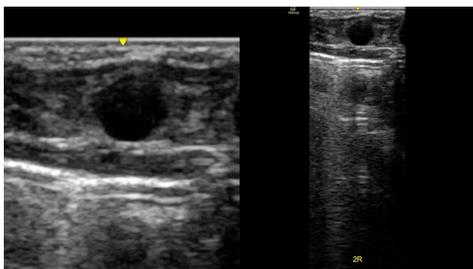
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A Day at the Beach ☺
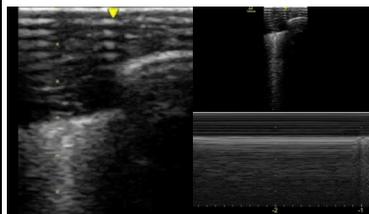
- M-Mode
- Captures motion
- Time (x-axis)
- Depth (y-axis)

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A Day at the Beach ☺
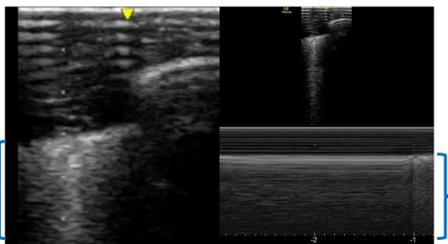
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Seashore Sign

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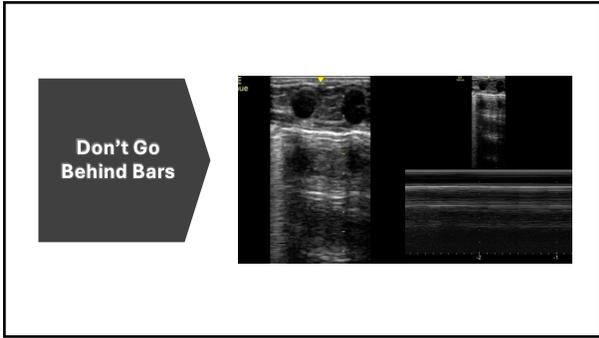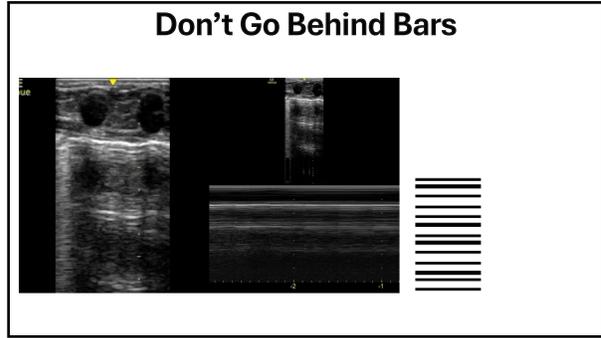
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Don't Go Behind Bars

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Slide 32
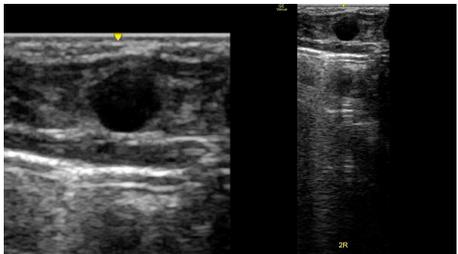
Don't Go Behind Bars

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Getting A's isn't Always Good...

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Chest X-ray before and after Needle Decompression

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Slide 35
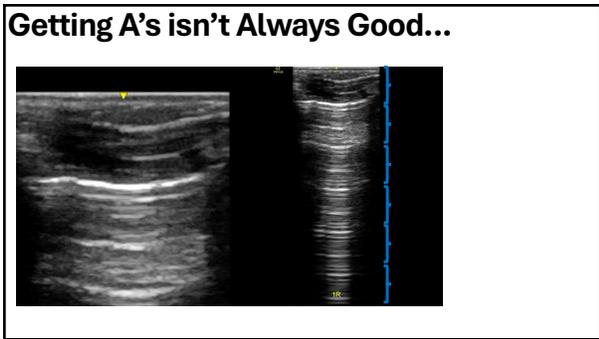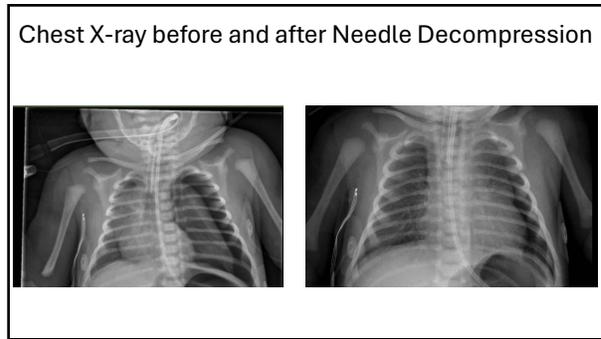
3. Briefly list possible research applications for neonatal lung ultrasonography.

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Slide 37
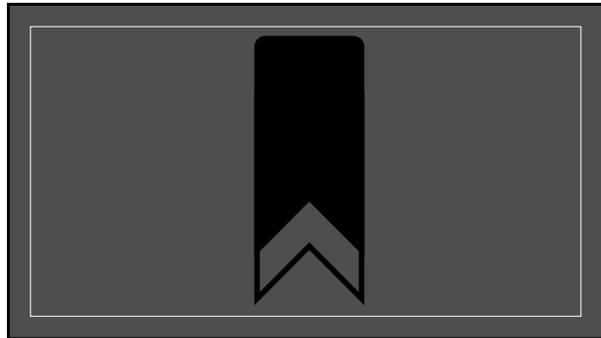
Semiquantitative Lung Field Scores

Provides a scoring system based on the presence of artifacts:
- **0**: A-pattern, defined by the presence of the only A-lines
- **1**: B-pattern, defined as the presence of ≥ 3 well-spaced B-lines
- **2**: Severe B-pattern, crowded and coalescent B-lines. May have consolidations limited to the subpleural space.
- **3**: Consolidations extending down into lung parenchyma.

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Lung Exam: Zones to Scan

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August 3, 2015

Lung Ultrasonography Score to Evaluate Oxygenation and Surfactant Need in Neonates Treated With Continuous Positive Airway Pressure

Roselyne Brat, MD[1]; Nadya Yousef, MD[1]; Roman Klifa, MD[1]; et al

Conclusion: The LUS score is well correlated with oxygenation status in both term and preterm neonates, and it shows good reliability to predict surfactant administration in preterm babies with a GA less than 34 weeks under continuous positive airway pressure.

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Less Than Nine? You will (probably) be fine

EDUCATION AND CLINICAL PRACTICE

Can a Lung Ultrasound Score (LUS) Predict the Need for Surfactant Replacement in Preterm Neonates?

STUDY DESIGN

- **Multicenter, pragmatic study** of preterm neonates (25⁵-33⁶ weeks) who underwent lung ultrasound at birth
- Infants given surfactant were also scanned within 24 hours from administration
- Clinical data and respiratory support variables were recorded

RESULTS

240 infants enrolled

108 received at least one dose of surfactant

ROC curve for LUS (cut-off = 9): AUC 0.86 (0.81-0.91)

ROC curve for LUS and SpO2/FiO2: AUC 0.93 (0.89-0.97)

Lung ultrasound score is a reliable predictor of the need for surfactant administration and its accuracy increases when combined with SpO2/FiO2, regardless of the degree of prematurity.

Raimondi F, et al. CHEST December 2021 | @Journal_CHEST | https://doi.org/10.1016/j.chest.2021.06.076

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Meta-Analysis › Ann Am Thorac Soc. 2022 Apr;19(4):659-667.
doi: 10.1513/AnnalsATS.202107-822OC.

Meta-Analysis of Lung Ultrasound Scores for Early Prediction of Bronchopulmonary Dysplasia

Lucilla Pezza[1], Almudena Alonso-Ojembarrena[2], Yasser Elsayed[3]

Meta-An Luca Vedovelli[4], Francesco Raimondi[5], Daniele De Luca[1][6]
Epub 2023 Jul 11.

Accuracy of lung ultrasound in predicting extubation failure in neonates: A systematic review and meta-analysis

Nada Mohsen[1], Gonzalo Solis-Garcia[2][3], Bonny Jasani[2][3], Nehad Nasef[3][4], Adel Mohamed[2][4]

› J Clin Ultrasound. 2022 Nov;50(9):1322-1327. doi: 10.1002/jcu.23207. Epub 2022 Mar 30.

Lung ultrasound in premature infants as an early predictor of bronchopulmonary dysplasia

Petya Radulova[1][2], Liliya Vakrilova[1][2], Stanislava Hitrova-Nikolova[1][2], Violeta Dimitrova[1][3]

Observational Study › Eur J Pediatr. 2023 Jan 17;184(2):144. doi: 10.1007/s00431-025-05977-1.

Predicting extubation failure in neonates: The role of lung ultrasound and corrected gestational age in safe weaning in the NICU

Bruna Schäfer Rojas[1], Renato Soibelmann Procianoy[1][2], Ana Carolina Menezes de Souza[3], Cristiane Cover Rigodanzo[3], Gabriela S Trindade[3], Silvana Piazza Furlan[3], Rita C Silveira[1][2]

› Chest. 2021 Sep;160(3):1006-1016. doi: 10.1016/j.chest.2021.02.066.

The Predictive Value of Lung Ultrasound Scores in Developing Bronchopulmonary Dysplasia: A Prospective Multicenter Diagnostic Accuracy Study

Almudena Alonso-Ojembarrena[1], Iker Serna-Guerediaga[2], Victoria Aldecoa-Bilbao[3], Rebeca Gregorio-Hernández[4], Paula Alonso-Quintela[5], Ana Concheiro-Guisán[6], Alicia Ramos-Rodríguez[7], Mónica de las Heras-Martín[8], Lorena Rodeño-Fernández[2], Ignacio Oulego-Erroz[5]

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Local Research Study

- **Research question**: Can serial lung field ultrasound scores and measurements of diaphragmatic excursion taken during a steroid taper predict successful liberation from invasive mechanical ventilation?
- **Inclusion criteria:** Birth GA <29 weeks starting on DART. CGA ≥ 36 weeks starting on prednisone.
- **Exclusion criteria:** Congenital lung/chest wall/diaphragm defects, air leaks, pleural effusions
- **Hypothesis:** Those infants who successfully extubate during a steroid course will have both lower baseline LUS and a greater difference between their baseline and post-extubation LUS's.

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Next Steps

- Ongoing enrollment!
- Multiple collaborators to over-read each lung ultrasound and provide their own score
  - Describe the inter-rater reliability of our scoring system
  - Provide a composite score
- Determination of interesting secondary findings
- Development of extubation readiness tool?

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References

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- Rojas BS, Procianoy RS, de Souza ACM, et al. Predicting extubation failure in neonates: The role of lung ultrasound and corrected gestational age in safe weaning in the NICU. *Eur J Pediatr*. 2025;184(2):144. Published 2025 Jan 17. doi:10.1007/s00431-025-05977-1

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Thank you!
Questions?

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