

Effects of lung ultrasound technique and pleural line depth on in vitro and in vivo measurements of pleural line thickness



Thomas H. Fox MD, Siraphob Chansangavej MD, Krystal Kirby PhD, Daniel Cho MD, Ricardo Rodriguez MD, Gautam Gare, Garrett Collins MD, John Galeotti PhD, Amita Krishnan MD, Bennett deBoisblanc MD

Introduction

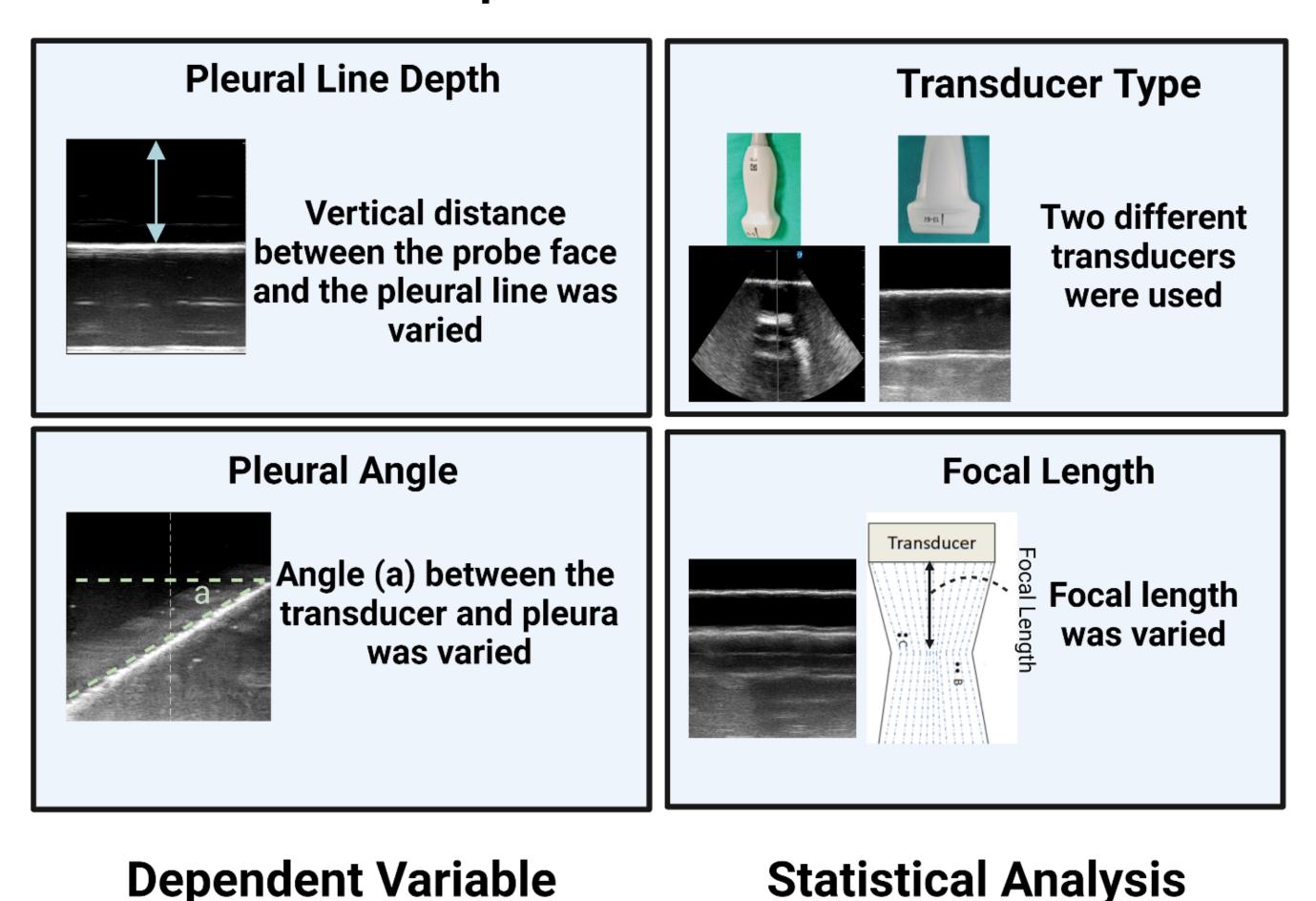
Thickened pleura seen on lung ultrasound has recently emerged as a marker of various lung diseases including acute respiratory distress syndrome, interstitial lung disease, and COVID-19 pneumonia. Patient and technical factors are influence other lung ultrasound findings, but the influence of these factors on pleural line thickness has never been evaluated.

Hypothesis

Measurements of pleural line thickness will be impacted by pleural depth, transducer type, pleural line angle relative the transducer, and focal length.

Methods

Independent Variables

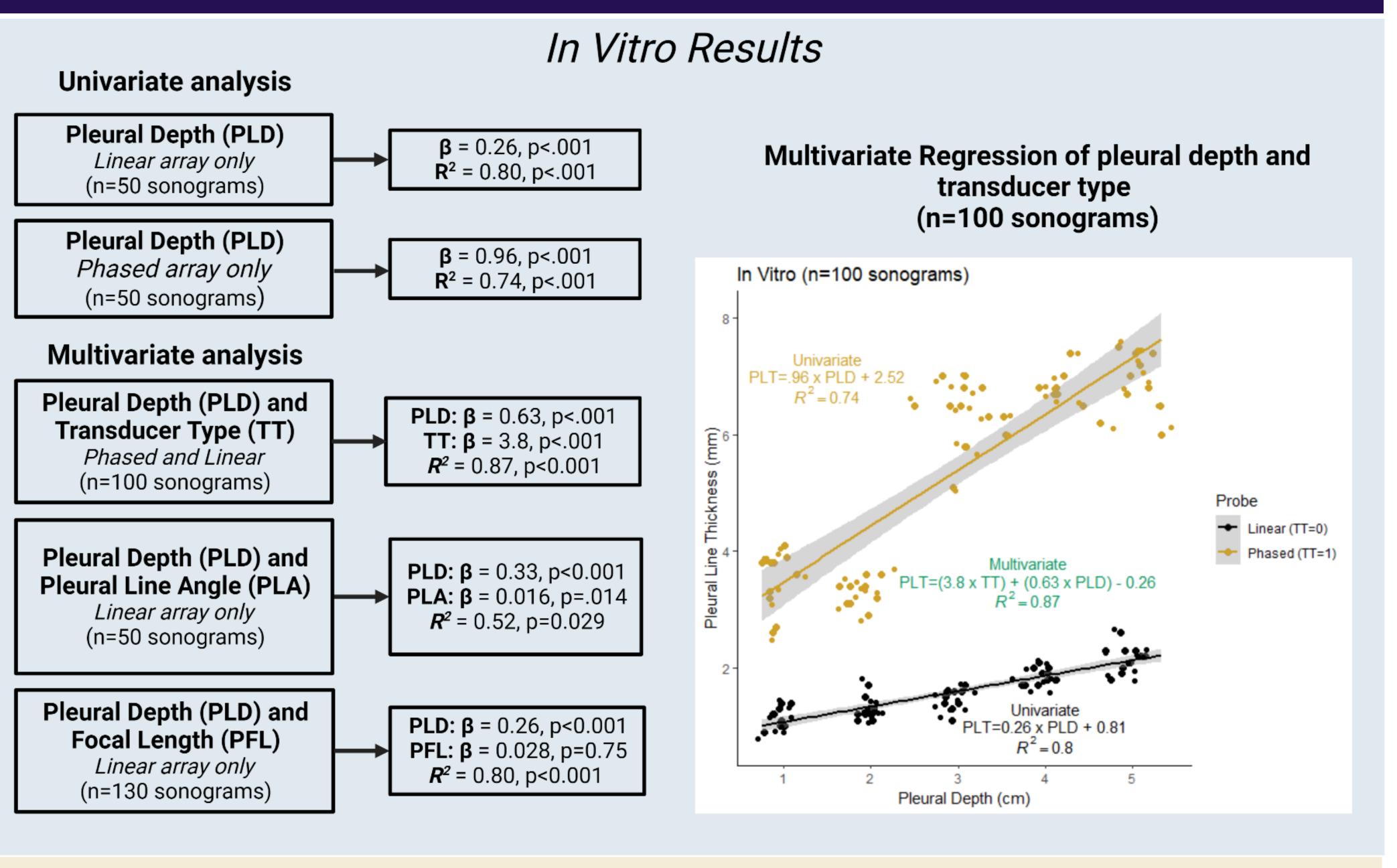


Dependent Variable

Pleural Line Thickness Thickness of the pleural line was measured using calipers.

Relationships between the independent variables and pleural line thickness were quantified using linear regressions

Results



In Vivo Results

Pleural Depth (PLD) Multivariate Regression of pleural depth and β = 0.25, p<.001 Linear array only transducer type $\mathbf{R}^2 = 0.68$, p<.001 (n=80 sonograms) (n=160 sonograms) Pleural Depth (PLD)

 β = 0.96, p<.001

 \mathbf{R}^2 = 0.64, p<.001

PLD: β = 0.24, p<0.001

PLA: $\beta = 0.009$, p=.003

 $R^2 = 0.59$, p<0.001

Multivariate analysis

Phased array only

(n=80 sonograms)

Univariate analysis

Pleural Depth (PLD) and **PLD:** β = 0.46, p<.001 Transducer Type (TT) **TT:** β = 2.56, p<.001 Phased and Linear $R^2 = 0.93$, p<0.001 (n=160 sonograms)

Pleural Depth (PLD) and Pleural Line Angle (PLA) Linear array only (n=80 sonograms)

Univariate PLT=0.67 x PLD + 1.6 → Linear (TT=0) Phased (TT=1)

Pleural Depth (cm)

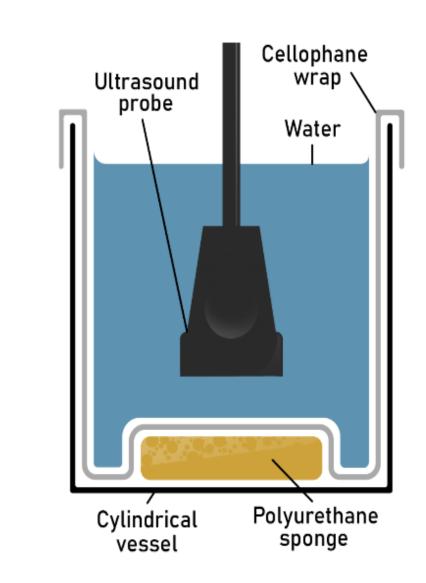
Previous publications using pleural line thickness

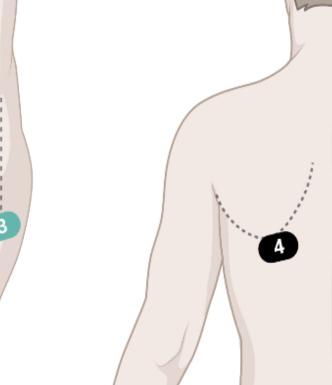
Critical Care Medicine The Clinical Respiratory Journa Findings of lung ultrasonography of novel corona virus pneumonia during the 2019–2020

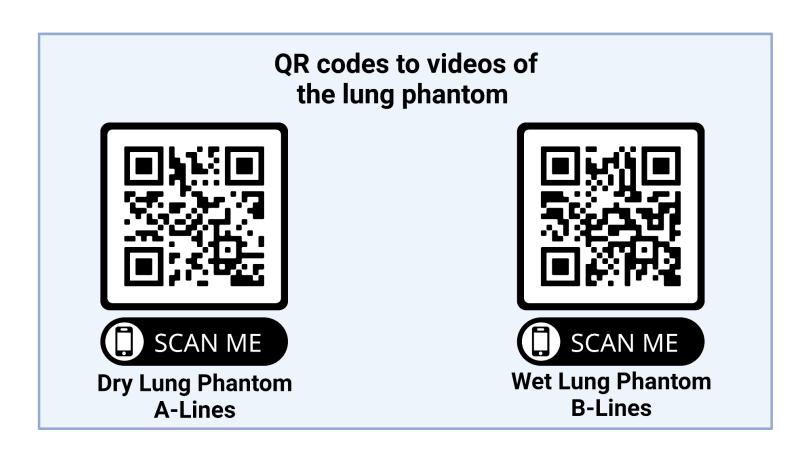
Cardiovascular Ultrasound

Methods Cont.

Scanning Approach







Discussion/Conclusion

We demonstrate that transducer type and pleural line depth, but not pleural angle or focal length, affect pleural line thickness. Future studies that use pleural line thickness as a disease marker must account for these confounders. Caution should be translating results of previous studies from research to the clinical arena.