

Point of Care Ultrasound in Congestive Heart Failure

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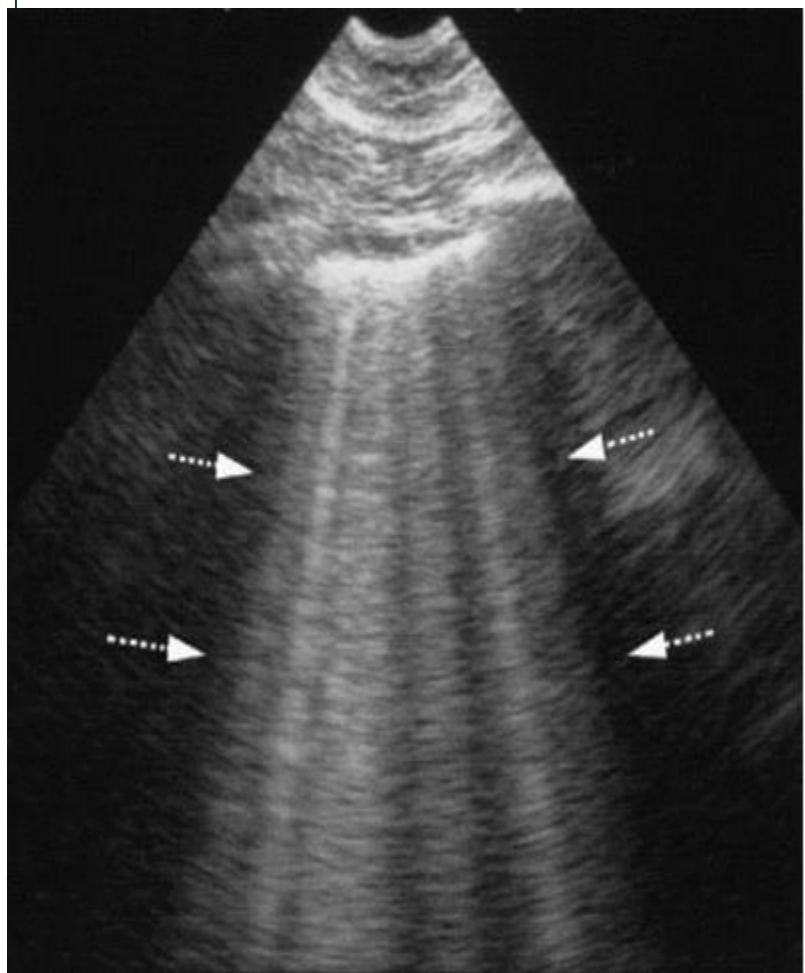
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Introduction

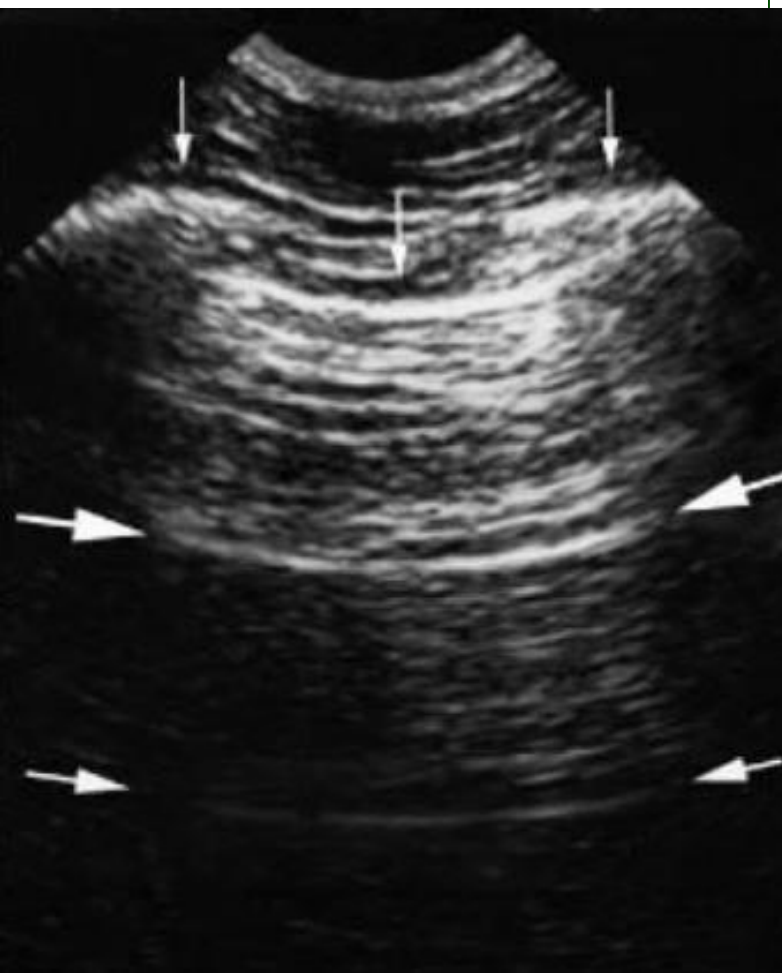
- Ultrasound is increasingly recognized as a low cost and high fidelity tool for the diagnosis of pulmonary edema (Sens - 97%, Spec – 95%).¹
- Little evidence exists regarding the utility of serial monitoring for hospitalized patients.
- Our study aims to characterize the evolution of ultrasonographic artifact (B-lines) on thoracic point of care ultrasound (POCUS) in patients admitted with acute heart failure.
- A further aim is to evaluate whether POCUS assessments for CHF can be taught and accurately employed by medical residents with limited prior ultrasound training.

Methods

- An educational program consisting of one didactic lecture followed by several hands-on teaching sessions was designed and presented to residents with the intent of enabling them to identify B-lines in their CHF patients.
- A modified BLUE protocol was taught using six thoracic points of ultrasound interrogation.¹
- Residents recorded daily POCUS results within the patient chart.
- B-line evolution on POCUS was then compared to the “gold standard” of treatment response (supplemental oxygen requirements) as well as other clinical metrics (daily weights, chest radiograph, subjective dyspnea).
- Scans were recorded and reviewed independently by an expert ultrasonographer for validation.

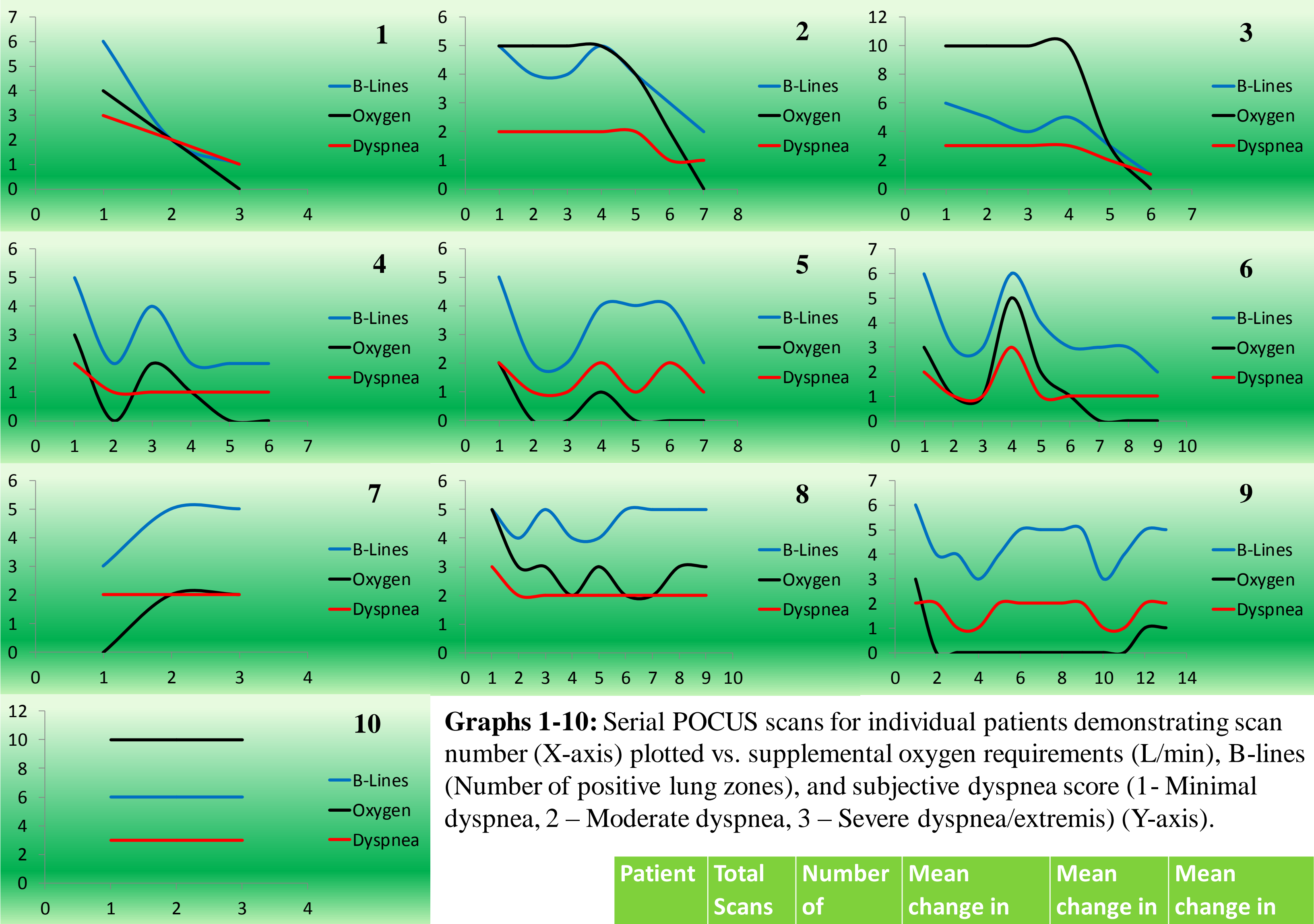


B - Lines



Normal Lung (A – Lines)

Results



Graphs 1-10: Serial POCUS scans for individual patients demonstrating scan number (X-axis) plotted vs. supplemental oxygen requirements (L/min), B-lines (Number of positive lung zones), and subjective dyspnea score (1- Minimal dyspnea, 2 – Moderate dyspnea, 3 – Severe dyspnea/extremis) (Y-axis).

Expert Review

	A-Lines	B-Lines	Pleural Fluid	Total
A-Lines	8	0	0	8
B-Lines	0	9	0	9
Pleural Effusion	0	0	3	3
Total	8	9	3	20

Table 1: Number of observed agreements: 20 (100.00% of the observations)

Number of agreements expected by chance: 7.7 (38.50% of the observations) Kappa= 1.000

Patient	Total Scans	Number of changes	Mean change in positive lung zones	Mean change in oxygen	Mean change in dyspnea rating
1	3	2	-2	-2	-1
2	7	6	0	-0.83	-0.17
3	2	1	-1	-1	-1
4	9	8	-0.5	-0.38	-0.13
5	7	6	-0.17	-0.33	-0.17
6	13	12	-0.09	-0.17	0
7	6	5	-1	-3	-0.4
8	9	8	-.13	-0.38	-0.12
9	2	1	1	1	-1
10	3	2	0	0	0
11	6	5	-0.6	-0.6	-0.2
12	3	2	1	1.5	0

Table 2: Mean changes in B-line positive lung zones relative to supplemental oxygen and subjective dyspnea rating by patient.

Discussion

- Thoracic POCUS is easily taught, with strong agreement demonstrated between novice ultrasonographers and experts when interpreting scans done at the bedside (kappa=1.00).
- Using linear regression, an association could be seen between the average change in affected zones and the oxygen flow rate, with the number of zones increasing on average by 0.5 for every 1L increase in oxygen (95% CI = 0.2, 0.9, p=0.02). The association between mean change in clinical assessment score and the number of involved zones was not significant (p=0.23)
- On average, daily fluctuations in B-line score were concordant with clinical changes (oxygenation) 65% of the time.
- A number of discrete events were recorded wherein a sudden increase in the number of B-line positive zones preceded a significant clinical deterioration in a patient’s respiratory status.

Conclusion

- Although limited by small sample size, this study demonstrates that point of care ultrasound is a readily taught skill which correlates well with clinical markers of CHF severity and treatment response.
- Further study will be required to evaluate the possible role of this technology in guiding CHF management.

Acknowledgments

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References

1. Lichtenstein, D. A., & Mezière, G. A. (2008). Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*: The BLUE Protocol. *Chest*,134(1), 117-125. doi:10.1378/chest.07-2800