Lung ultrasound in acute heart failure: prevalence of pulmonary congestion and associated short- and long-term outcomes

Authors:
E Platz¹, R Campbell², B Claggett¹, E Lewis¹, J Groarke¹, K Docherty², M Lee², A Merz¹, M Silverman¹, V Swamy¹, M Proplesch¹, J Rivero¹, S Solomon¹, J McMurray¹, ¹Brigham and Women's Hospital - Boston - United States of America, ²Cardiovascular Research Centre of Glasgow - Glasgow - United Kingdom of Great Britain & Northern Ireland,

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Background: Pulmonary congestion in acute heart failure (AHF) is both a common and important finding. However, current methods for its detection, such as auscultation and chest x-ray, are insensitive.

Purpose: To assess the prevalence and prognostic importance of pulmonary congestion, with a simplified lung ultrasound (LUS) method, and examine changes of LUS findings (‘B-lines’) with treatment for AHF.

Methods: In a two-site, prospective, observational study 4-zone LUS was performed early during hospitalization for AHF (LUS1) and at discharge (LUS2). B-lines were quantified offline, blinded to clinical findings and outcomes by a core laboratory.

Results: Among 349 AHF patients (median age 75, 59% men, mean EF 39%) the sum of B-lines in 4 zones ranged from 0 to 18 (median 6) (LUS1). The risk of an adverse in-hospital event increased with rising B-line number on LUS1: odds ratio for each B-line tertile 1.82 (95% CI 1.14-2.88, P=0.011). B-line count decreased from a median of 6 on LUS1 to 4 on LUS2; P<0.001) over a median of 6 days. In 132 patients with LUS2 images, the risk of HF hospitalization or all-cause death increased with increasing B-line number at discharge (LUS2). This relationship was stronger closer to hospital discharge: unadjusted HR comparing the first to the third B-line tertile for the first 90 days: 2.94, 1.46-5.93, P=0.003; for 180 days: 2.01, 1.11-3.64, P=0.021 (Figure). The association between B-line number and short and long-term outcomes persisted after adjusting for other important clinical variables, including NT-proBNP.

Conclusion: Pulmonary congestion using a simplified 4-zone lung ultrasound method was found to be common in AHF and improved with therapy. A higher number of B-lines at baseline and discharge identified patients at increased risk for adverse in-hospital and longer-term events.
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![Cumulative incidence of events over days for different B-line categories](image)