Prognostic Role of Lung Ultrasound in Cardiogenic Shock Patients

A Prospective Registry Study

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Background

Lung ultrasound (LUS) is an established parameter to evaluate **pulmonary congestion** in acute heart failure (AHF) and myocardial infarction (AMI). Its usefulness in the cardiogenic shock (CS) population has never been prospectively evaluated.

Our **aim** is to **evaluate the prognostic role of the LUS and its relation to outcome** in a contemporary, Nationwide prospective multicenter observational registry including allcomers CS patients (ALT-SHOCK).

METHODS

LUS included 4 zones scan protocol using dichotomous assessment of lung congestion severity as by the detection of lung field occupied by : < 50% (mild-moderate) or ≥ 50% (severe).

STATISTICAL ANALYSIS

Categorical variables are shown as counts and percentages. Differences in the clinical characteristics were evaluated using Pearson's chi-square test. The associations between changes in B-lines over 24 hours and survival were evaluated using univariable Cox regression; survival probability was estimated using KM curves.

RESULTS

Population

Among 550 patients enrolled from March 2020 to November 30th, 2023, 75 had monitored LUS during the hospitalization. 52 patients (69.3%) presented at admission with ≥ 50% of B-lines of whom 25 (33.3%) improved or completely resolved at 24 hours. At presentation, 28 (37,3%) also had moderate/severe MR. Respiratory support was used in 68 patients (90.7%; respectively NIV 44.3% and iMV 45%). MCS was used in 70.7%. [Table 1]

At admission B-lines were significantly associated with moderate/severe MR ($p < 0.01$). There was a significant correlation between the ≥ 50% B-lines and SCAI stage ($p < 0.001$), NT-pro BNP (p 0.045), PaO2/FiO2, lactate and pH ($p < 0.001$ for all).

Outcome

In the Cox regression analysis, SCAI was associated with mortality while the level of pulmonary congestion at admission was not, even when adjusted for the presence of either mechanical circulatory or respiratory support. However, the change in B-lines over the first 24 hours was significantly associated with survival (p 0.008 – HR 0.381 – 95% CI [0.178 - 774]) even when adjusted for respiratory and circulatory support (Figure 1).

Baseline characteristics

	Overall	<50% B lines	≥ 50% B lines
N (%)	**75**	**23 (30.7)**	**52 (69.3)**
Male, yes (%)	59 (78.7)	18 (78.3)	41 (78.8)
Aetiology, yes (%)			
- AMI	37 (49.3)	10 (43.5)	27 (51.9)
- HF-CS	29 (38.7)	11 (47.8)	18 (34.6)
- Myocarditis	1 (1.3)	1 (4.3)	0 (-)
- Other	8 (10.7)	1 (4.3)	7 (13.5)
SCAI at admission, yes (%)			
- A	3 (4)	2 (8.7)	1 (1.9)
- B	10 (13.3)	4 (17.4)	6 (11.5)
- C	35 (46.7)	12 (52.2)	23 (44.2)
- D	16 (21.3)	2 (8.7)	14 (26.9)
- E	9 (12)	1 (4.3)	8 (15.4)
SCAI at worst, yes (%)			
- A	2 (2.7)	1 (4.3)	1 (1.9)
- B	4 (5.3)	1 (4.3)	3 (5.8)
- C	24 (32)	8 (34.8)	16 (30.8)
- D	7 (9.3)	3 (13)	4 (7.7)
- E	9 (12)	1 (4.3)	8 (15.4)
Echo parameters at ad, yes (%)			
- Bilateral B-lines	69 (92)	18 (78.3)	51 (98)
- Pleural effusion	26 (34.7)	8 (34.8)	18 (34.6)
- MR ≥ 3	28 (37.3)	10 (43.5)	18 (34.6)
- AR ≥ 3	4 (5.3)	1 (4.3)	3 (5.8)
Respiratory support, yes (%)	68 (90.7)	16 (69.6)	44 (84.6)
- NIV	33 (44)	10 (43.5)	23 (44.2)
- iMV	34 (45.3)	7 (30.4)	27 (51.9)
Mechanical support, yes (%)	53 (70.7)	16 (69.6)	37 (71.2)
- IABP	40 (53.3)	15 (65.2)	25 (48)
- VA ECMO	11 (14.7)	3 (13)	8 (15.4)
- Impella	14 (18.7)	2 (8.7)	12 (23)

Table 1 - Comparison of baseline characteristics between groups.

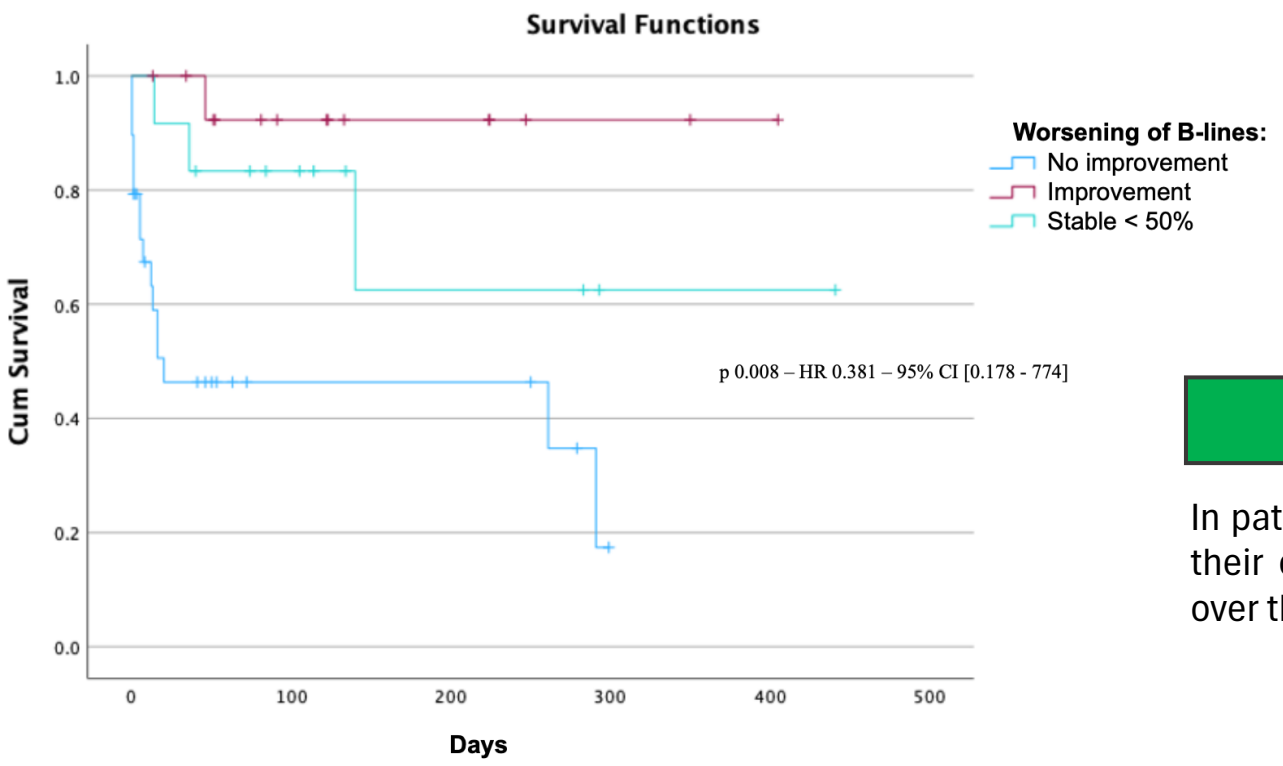

Figure 1 - Kaplan-Meier survival analysis comparing survival rates between patients with different changes in B-lines over the first 24 hours.

N (%)	At admission	After 24h
No B-lines, yes (%)	-	25 (33.3)
<50 % B-lines, yes (%)	23 (30.7)	24 (32)
≥ 50% B-lines, yes (%)	52 (69.3)	27 (36)
Bilateral B-lines, yes (%)	70 (93.3)	51 (68)
Pleural effusion, yes (%)	26 (34.7)	21 (28)

Table 2 – Comparison of parameters collected with lung ultrasound at the time of cardiogenic shock diagnosis and at 24 hours from diagnosis in the overall population (N=75)

CONCLUSION

In patients with CS, LUS findings are closely linked to the severity of their clinical condition. Moreover, improvement of lung congestion over the 24 hours seem to be predictive of patient outcomes.

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