

LETTER



Using the lung ultrasound score to monitor disease progression for COVID-19-associated ARDS

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Dear Editor,

The lung ultrasound (LUS) score identifies patients with coronavirus disease 2019 (COVID-19) and may guide triage [1]. Its monitoring and prognostic value in patients in intensive care unit (ICU) with acute respiratory distress syndrome (ARDS) needing ventilation support remains unknown.

During the first wave of the COVID-19 pandemic, we consecutively and prospectively followed 60 patients admitted for ARDS COVID-19 in our ICU. LUS score [2] was performed at admission, daily for the first-7 days and then on a 3-days' basis, since LUS examination is part of a routine monitoring of our patients. Computed tomography (CT) scan measurement of fibrosis and ground-glass opacities (GGOs) scores [3, 4] and their changes during the ICU stay were recorded. LUS score and CT scores were compared for patients who survived and with ICU stays ≤ 14 days (group 1, $n = 26$) and patients who died or with ICU stays > 14 days (group 2, $n = 34$). (Table 1).

The LUS score at admission is higher in group 2 (18 ± 6 vs 22 ± 5 , $p < 0.05$). Bedside applicability of a difference of four in patients with high LUS score remain limited. This was showed by a receiver operating characteristic (ROC) curve area of 0.72 ± 0.08 (confidence interval 0.56–0.87, $p = 0.012$) for the LUS score at admission to predict an

ICU stay > 14 days. However, LUS score at day 1 is correlated to the GGO score ($r = 0.56$, $p = 0.003$) and the GGOs score was significantly higher in group 2 (38 ± 21 vs 60 ± 25 ; $p = 0.001$) (Table 1). No fibrosis was found in group 1, in contrast to group 2 (fibrosis score: median = 0 with IQR = [0–10]; $p = 0.006$).

At day 7, LUS score remained high and was not significantly different between the both groups (19 ± 6 vs 22 ± 3 , $p = 0.055$). Twelve (35%) patients died in group 2 after a median of 9 days (IQR: 13.5). Patients in group 1 left the ICU after a median stay of 7.5 days [2.3–11.8] despite the persistence of a high LUS. This underlines the discrepancy between absence of image resolution and clinical improvement. Increase of fibrosis scores can be detected using LUS only if GGOs decrease. It seems that LUS detection of fibrosis could be improved by adding quantification of pleura changes. This was recently showed in a histopathological study correlating fibroproliferative changes with a modified LUS, including a study of pleural change [5].

To summarize, our study, further clarifies the prognostic value and place of the LUS in ARDS COVID-19 patients admitted for ventilation in ICU. LUS scores is correlated with the GGO score at Day 1. However, a discrepancy between persistent high LUS score and clinical improvement was observed. Moreover, in some patients, we observed a decrease in the LUS score associated with fibroproliferative change. The severity of the included patients, may explain this discrepancy from previous triage studies [1].

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Table 1 Main parameters

	Overall (n = 60)	Group 1 (n = 26)	Group 2 (n = 34)	P value
Age (years)	62.1 (11)	58.6 (11.9)	64.7 (9.63)	0.037
Gender (male)	35 (58.3)	15 (57.7)	20 (58.8)	1.000
BMI (m/kg ²)	29.3 (5.5)	30 (4.9)	28.8 (5.9)	0.390
Arterial blood gas at admission				
PaCO ₂ (mmHg)	37.6 [32.8; 45]	36.5 [32.2; 40.4]	39 [35.9; 50.6]	0.096
P/F ratio	152 [121; 200]	180 [133; 288]	142 [120; 171]	0.015
Invasive mechanical ventilation parameters at day 1 of ventilation				
Number of patients	49 (81.7%)	16 (61.5%)	33 (97.1%)	0.001
FiO ₂ (%)	60 [50; 80]	60 [40; 63.8]	70 [60; 80]	0.002
PEEP(cmH ₂ O)	12 [10.8; 13.2]	12 [12; 12.2]	12 [10; 14]	0.991
Pplat (cmH ₂ O)	23.7 (3.4)	23.9 (2.9)	23.5 (3.7)	0.731
Tidal volume (ml)	386 (67.5)	388 (40.6)	384 (80.2)	0.853
Norepinephrine	36 (60)	10 (38.5)	26 (76.5)	0.007
Dose (µg/kg/min)	0.04 [0; 0.17]	0 [0; 0.09]	0.1 [0.01; 0.25]	0.003
LUS score at day 1	20 ± 5	18 ± 6	22 ± 5	0.013
LUS score at day 7	21 ± 5	19 ± 6	22 ± 3	0.14
CT scan at admission				
Ground-glass opacity score	60 [30; 70]	40 [20; 60]	65 [33; 80]	0.002
Fibrosis score	0 [0; 0]	0 [0; 0]	0 [0; 10]	0.006
Outcome				
ICU stay (days)	15 [6.8; 26.2]	7.5 [2.3; 11.8]	23.5 [19; 32.8]	<0.001
Duration of mechanical ventilation (days)	13.5 [4.8; 23]	3.5 [0; 8.8]	21.5 [16.2; 28.5]	<0.001

Numbers are given as mean (± SD), median [IQR], number (%). Group 1: surviving patients with an ICU stay ≤ 14 days; group 2: deceased patients or patients with an ICU stay > 14 days. Comparisons between groups were made using the Mann–Whitney *U* and Chi-squared tests for continuous and categorical variables. *P/F* PaO₂/FiO₂ ratio, *PEEP* positive end expiratory pressure, *Pplat* plateau pressure. CT scan at admission were available in 21 (81%) patients of group 1 and 29 (82%) patients for group 2

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1007/s00134-021-06515-x>.

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Author contributions

BB, MN and P-GG contributed to the study concept and design; performed the data collection and analysis, and drafted the manuscript. GG performed the data collection. All the members of the study contributed in data collection, analysis and/or revising the manuscript.

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Declarations

Conflicts of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval

In accordance with the law on personal data protection of 6 January 1978 (number 78-17), our study was submitted to the National Commission of Data Protection (CNIL) via the hospital's personal data protection correspondent (declaration number 2013053v0).

Informed consent

Observational study for whom written consent was waived according to French law (Law 88-1138 of 20 December 1988, modified on 9 August 2004, on biomedical research). Patients received an information concerning study, their right to refuse to participate in the study and their right to withdraw at any time.

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