# Mechanical power ratio in spontaneously breathing COVID-19 pneumonia: a prospective observational study

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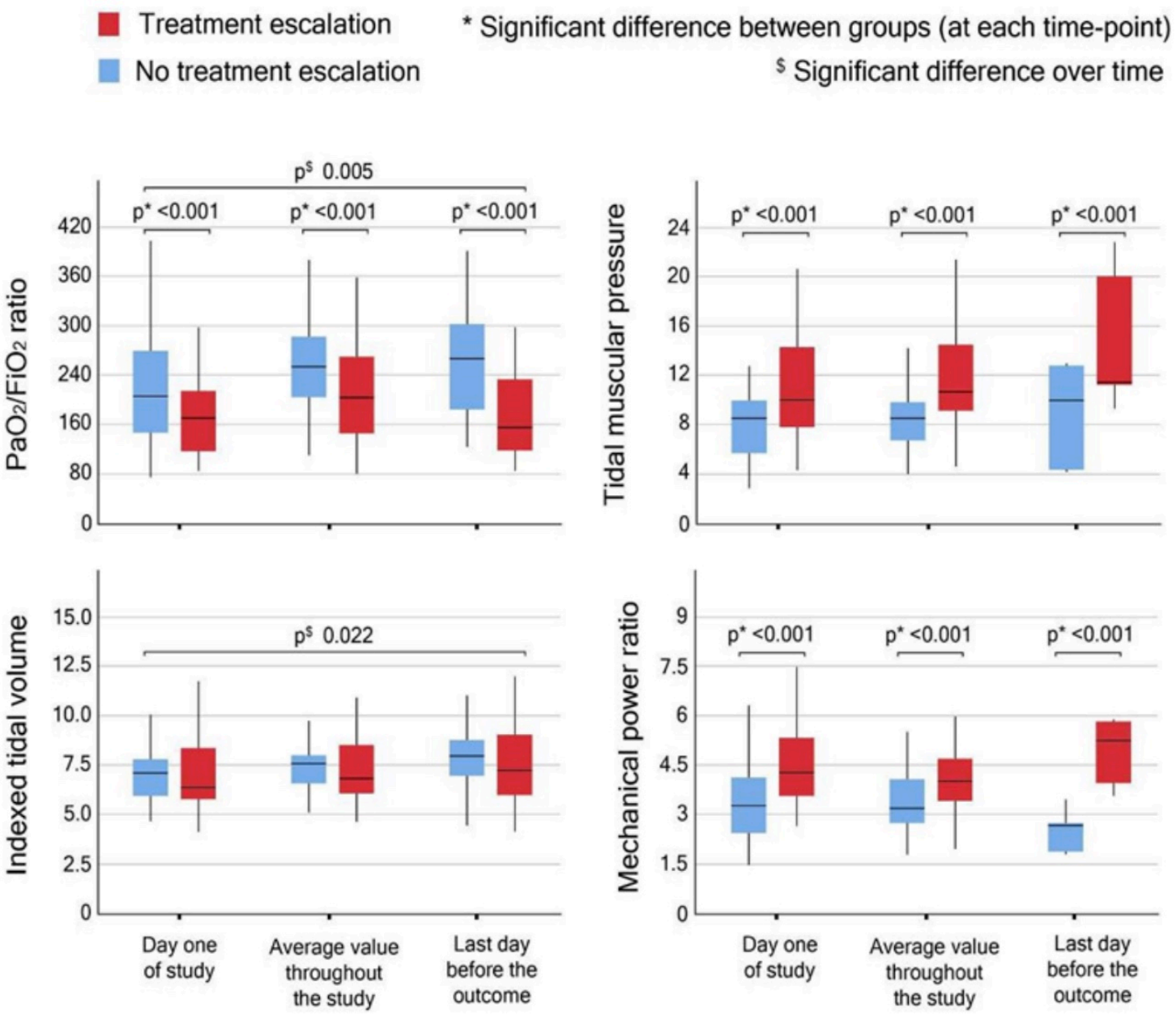
**Background:** In an era of personalized medicine, a tailored approach is achievable only through a careful use of clinical monitoring. This study aimed to apply an extended clinical monitoring system with low invasiveness in non-intubated patient with COVID-19 pneumonia in order to: 1) describe their physiological characteristics; 2) compare the lung mechanics between patients who received respiratory treatment escalation and those who did not; 3) derive a diagnostic model to predict treatment escalation.

**Methods:** Prospective observational study enrolling 111 consecutives spontaneously breathing adults receiving continuous positive airway pressure. Lung CT scan was performed on admission and esophageal pressure, tidal volume and respiratory rate were continuously monitored throughout the study. A new variable, the mechanical power ratio, was computed as the ratio between the measured mechanical power and the expected baseline mechanical power. Patients were grouped according to the outcome: 1) no-treatment escalation (patient supported in C-PAP until improvement and discharge); 2) treatment escalation (escalation of the respiratory support to non-invasive or invasive mechanical ventilation).

**Results:** Baseline quantitative CT scan was similar between groups (non-aerated, poorly-aerated and well-aerated fractions). At day 1, spontaneous tidal volume (7.1±1.9 vs 7.1±1.4 mL; p=0.990) was similar between patients undergoing treatment escalation and patients who did not. In contrast, higher respiratory rate (20±5 vs 18±5 bpm; p=0.028), minute ventilation (9.2±3.0 vs 7.9±2.4 L/min; p=0.011), tidal pleural pressure (8.1±3.7 vs 6.0±3.1 $cmH_2O$; p=0.003), tidal muscular pressure (11.8±5.2 vs 8.5±4.3 cmH2O; p=0.001), mechanical power (9.9±6.0 vs 6.7±4.3 J/min; p=0.003), mechanical power ratio (2.4±1.4 vs 1.7±1.5; p=0.042) and lower PaO2/FiO2 (174±64 vs 220±95; p=0.007) were observed in patients who underwent treatment escalation (see Figure 1). Mechanical power (AUROC 0.738 [95%CI;0.636-0.839] p<0.001) and mechanical power ratio (AUROC 0.734 [95%CI0.625-0.844] p <0.001) showed the highest accuracy for outcome prediction.

**Conclusions:** In this COVID-19 cohort, among all assessed variables, mechanical power and its ratio showed the most accurate variables for outcome prediction. Furthermore, the present study underlines the importance of respiratory rate and tidal pleural pressure, which are usually ignored when lung protective strategy is applied, in modifying outcomes.


Treatment escalation
No treatment escalation
* Significant difference between groups (at each time-point)
$ Significant difference over time
PaO2/FiO2 ratio
p$ 0.005
p* <0.001
p* <0.001
p* <0.001
420
360
300
240
160
80
0
Tidal muscular pressure
p* <0.001
p* <0.001
p* <0.001
24
20
16
12
8
4
0
Indexed tidal volume
p$ 0.022
15.0
12.5
10.0
7.5
5.0
2.5
0
Mechanical power ratio
p* <0.001
p* <0.001
p* <0.001
9
7.5
6
4.5
3
1.5
0
Day one of study
Average value throughout the study
Last day before the outcome