Dear Editor,

A massive outbreak of coronavirus disease 2019 (Covid-19) occurred in France in March and April 2020. About 20% of Covid-19 patients develop acute respiratory distress syndrome (ARDS), with mortality ranging from 20 to 50%. Since the publication of the PROSEVA study [1], prone positioning (PP) has become a cornerstone of management of mechanically ventilated severe ARDS patients.

Recently, PP was reported to enhance oxygenation when combined with high-flow nasal cannula in severe non-Covid-19 ARDS [2, 3] and to improve lung recruitability when combined with non-invasive ventilation in severe Covid-19 ARDS [4].

We report the case of 6 severe Covid-19 patients admitted to our critical care unit between March and April 2020, who had PP combined with either high-flow nasal oxygen (HFNO) or conventional oxygen therapy (COT). All patients had laboratory-confirmed SARS-CoV-2 infection, defined as a positive result of real-time reverse transcriptase-polymerase chain reaction (RT-PCR) from nasal and pharyngeal swabs. ARDS was defined according to the Berlin definition, with a ratio of P aO2 to F iO2 (PaO2/FiO2) \( \leq 300 \) mmHg. All patients presented rapid worsening of dyspnea and oxygenation, defined as \( S_pO_2 \leq 92\% \) despite increasing oxygen supply to more than \( \geq 5 \) L/min. All patients were spontaneously ventilated, and no patient had criteria that indicated the need for emergency intubation. All patients had predominant posterior lung condensation documented either on lung ultrasound or CT-scan.

HFNO or COT was prescribed to reach \( S_pO_2 \geq 94\% \). The clinical course of ARDS was closely followed using the ROX index [5]. PP was proposed to patients who presented clinical worsening, as persistent hypoxia despite increasing oxygen delivery, or a decrease in the ROX index. PP was maintained depending on patient clinical tolerance and could be repeated if necessary.

Relevant clinical, laboratory data and HFNO or COT settings were obtained from medical records and are presented in Table 1.

A total of 9 PP sessions was performed in 6 patients. PP was combined with HFNO in 4 sessions and to COT in 5 sessions. The P aO2/FiO2 ratio improved after 4 sessions, including 3 sessions combined with HFNO and 1 session combined with COT. Intubation was avoided in 3 patients.

This is the first report of PP combined with either HFNO or COT in severe Covid-19 pneumonia. The proportion of patients with P aO2/FiO2 ratio improvement after PP appeared to be higher with HFNO compared to conventional oxygen therapy, suggesting then the need for a high flow of oxygen to provide a significant oxygen response [6]. All patients described subjective enhancement of dyspnea after prone positioning, but this data was not quantified. The efficacy of PP combined with HFNO therapy or non-invasive ventilation was recently reported in small cohorts of non-infectious and infectious non-Covid-19 ARDS patients [2, 3]. Interestingly, the proportion of patients with an improvement in P aO2/FiO2 ratio and the rate of intubation avoided in these 2 studies were very
close to that observed in the present series of 6 severe Covid-19 patients.

Considering these observations, PP combined with either HFNO or COT could be proposed in spontaneously breathing, severe Covid-19 patients to avoid intubation. The indication for PP in non-intubated Covid-19 pneumonia needs to be addressed in further studies.

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Authors’ contributions
Cyrielle Despres, Yannick Brunin, Francis Berthier, Sebastien Pili-Floury, and Guillaume Besch had substantial contributions to conception and design of the study, acquisition and interpretation of data, and drafting of the article manuscript. The author(s) read and approved the final manuscript.

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Table 1 Clinical characteristics and outcomes of patients

| Case no. | Gender | Age (years) | SAPS II score at admission | Ventilatory support | BMI (kg.m⁻²) | Duration of prone positioning (hours) | PₐO₂/FₐO₂ before prone position | PₐO₂/FₐO₂ after prone position | Intubation |
|----------|--------|-------------|---------------------------|--------------------|-------------|-----------------------------|-----------------------------|-----------------------------|-----------|
| 1        | Male   | 60          | 27                        | HFNO 50 L/min      | 27          | 7                           | 144                         | 254                         | Yes       |
| 2        | Male   | 54          | 32                        | COT 6 L/min        | 27          | 1                           | 215                         | 147                         | No        |
| 3        | Male   | 55          | 26                        | HFNO 50 L/min      | 26          | 16                          | 126                         | 194                         | No        |
| 4        | Male   | 66          | 37                        | COT 5 L/min        | 31          | 4                           | 150                         | 242                         | Yes       |
| 5        | Male   | 61          | 28                        | COT 3 L/min        | 21          | 1                           | 274                         | 225                         | Yes       |
| 6        | Male   | 64          | 36                        | COT 5 L/min        | 27          | 2                           | 212                         | 168                         | No        |

FₐO₂ with COT was calculated using the following formula: FₐO₂ = 21 + (4 x oxygen flow rate in L min⁻¹)

BMI body mass index, HFNO high-flow nasal oxygen, COT conventional oxygen therapy

Table 1

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