

RESEARCH LETTER

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Prone positioning combined with high-flow nasal or conventional oxygen therapy in severe Covid-19 patients



Cyrielle Despres¹, Yannick Brunin¹, Francis Berthier¹, Sebastien Pili-Floury^{1,2} and Guillaume Besch^{1,2*} 

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-PCT) from nasal and pharyngeal swabs. ARDS was defined according to the Berlin definition, with a ratio of P_aO_2 to F_iO_2 (P_aO_2/F_iO_2) ≤ 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 ≥ 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_aO_2/F_iO_2 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_aO_2/F_iO_2 ratio improvement after PP appeared to be higher with HFNO compared to conventional oxygen therapy, suggesting 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_aO_2/F_iO_2 ratio and the rate of intubation avoided in these 2 studies were very

* Correspondence: gbesch@chu-besancon.fr

¹Department of Anesthesiology and Intensive Care Medicine, University Hospital of Besancon, University of Franche-Comte, Besancon, France
²EA 3920, University of Franche-Comte, 3 bvd Alexander Fleming, 25000 Besancon, France



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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)	P _a O ₂ /F _i O ₂ before prone position	P _a O ₂ /F _i O ₂ 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	1	129	156	No
				HFNO 50 L/min		16	126	194	
4	Male	66	37	COT 5 L/min	31	4	150	242	Yes
				COT 3 L/min		2	193	124	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
				COT 3 L/min		2	193	124	

F_iO₂ with COT was calculated using the following formula: F_iO₂ = 21 + (4 × oxygen flow rate in L min⁻¹)

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

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

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References

- Guérin C, Reigner J, Richard J-C, Beuret P, Gacouin A, Boulain T, et al. Prone positioning in severe acute respiratory distress syndrome. *N Engl J Med*. 2013;368:2159–68.
- Ding L, Wang L, Ma W, He H. Efficacy and safety of early prone positioning combined with HFNC or NIV in moderate to severe ARDS: a multi-center prospective cohort study. *Crit Care*. 2020;24:28.
- Pérez-Nieto OR, Guerrero-Gutiérrez MA, Deloya-Tomas E, Namendys-Silva SA. Prone positioning combined with high-flow nasal cannula in severe noninfectious ARDS. *Crit Care*. 2020;24:114.

- Pan C, Chen L, Lu C, Zhang W, Xia J-A, Sklar MC, et al. Lung recruitability in SARS-CoV-2 associated acute respiratory distress syndrome: a single-center, observational study. *Am J Respir Crit Care Med*. 2020;201(10):1294–297.
- Roca O, Caralt B, Messika J, Samper M, Sztrymf B, Hernández G, et al. An index combining respiratory rate and oxygenation to predict outcome of nasal high-flow therapy. *Am J Respir Crit Care Med*. 2019;199:1368–76.
- Scaramuzza G, Ball L, Pino F, Ricci L, Larsson A, Guérin C, et al. Influence of positive end-expiratory pressure titration on the effects of pronation in acute respiratory distress syndrome: a comprehensive experimental study. *Front Physiol*. 2020;11:179.

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