EUROPEAN RESPIRATORY *journal*

FLAGSHIP SCIENTIFIC JOURNAL OF ERS

Early View

Research letter

Awake Prone Positioning for Non-intubated Oxygen Dependent COVID-19 Pneumonia Patients

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Please cite this article as: Ng Z, Tay WC, Ho CHB. Awake Prone Positioning for Non-intubated Oxygen Dependent COVID-19 Pneumonia Patients. *Eur Respir J* 2020; in press (https://doi.org/10.1183/13993003.01198-2020).

This manuscript has recently been accepted for publication in the *European Respiratory Journal*. It is published here in its accepted form prior to copyediting and typesetting by our production team. After these production processes are complete and the authors have approved the resulting proofs, the article will move to the latest issue of the ERJ online.

Title:
Awake Prone Positioning for Non-intubated Oxygen Dependent COVID-19 Pneumonia Patients

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Introduction

Oxygenation failure recalcitrant to increasing positive end-expiratory pressure is a feature of severe coronavirus disease 2019 (COVID-19) pneumonia [1]. A Chinese group [2] used prone positioning to improve oxygenation for intubated patients with severe COVID-19 pneumonia. However, prone positioning in unconscious patients is labour-intensive and is associated with various complications [3, 4]. As the incidence of severe COVID-19 pneumonia worldwide increases rapidly, many countries are also facing the problem of diminishing intensive care resources.

Prone positioning ventilation is most used today in intensive care units (ICU) for patients with acute respiratory distress syndrome (ARDS) [5–7] and for prevention of ventilator-induced lung injury [8, 9]. Many mechanisms have been proposed, including relieving the dependent lung regions from the compressive force of the heart's weight [10] or increasing aeration in the originally-dorsal lung regions [11]. The overall lung ventilation from dorsal to ventral areas is more homogeneous in the prone position than in the supine position. Prone positioning thus improves oxygenation whilst the other variable, perfusion, remains almost constant in both postures.

The physiological basis behind prone ventilation in an intubated patient with COVID-19 infection should apply to patients breathing spontaneously. However, the literature for prone positioning of non-intubated patients is less available [12], usually described in post-lung transplantation cases [13, 14].

Moreover, the treatment of COVID-19 has mainly been supportive thus far. Trials are still ongoing to validate the use of antiviral and immunomodulatory therapies against this disease, but the use has been limited by the associated adverse events [15]. With the global pandemic putting a strain on many countries' resources, there is an urgency to find a low-risk, low-cost manoeuvre for non-intubated patients that halts disease progression, especially when this has the potential to reduce the need for labour-intensive care and prone ventilation in the ICU.

In our case series, we describe ten patients with COVID-19 pneumonia requiring oxygen supplementation who underwent awake prone positioning therapy, describing the manoeuvre's effects on patients' oxygenation and outcomes.

Methods

Collection of clinical data from infected patients was approved by the Ministry of Health, Singapore, with waiver of written informed consent under the Infectious Disease Act of Singapore. We recruited patients who were admitted to the National Centre for Infectious Diseases (NCID) since the introduction of this therapy in March 2020. All suitable patients with COVID-19 pneumonia who required oxygen supplementation were started on the protocol. We chose the first ten patients that were notified to the study team for this series as they were part of the internal audit of the therapy's effectiveness.

The protocol was initiated in a general ward setting. Patients were required to adopt the prone position for one hour each session, five sessions a day, each spaced three hours apart during awake hours. A patient information sheet was provided to illustrate the possible prone variations. Arms could either be positioned at the side or abducted to less than 90 degrees at the shoulder and flexed at the elbow ("prone superman" posture). The patient's face could be placed on either side and patients were allowed to adjust their position for comfort. Haemodynamics and oxygen saturation were charted at 0, 30 and 60 minutes from the start of each session.

This protocol was disseminated to all attending physicians caring for patients with COVID-19 pneumonia. All patients without contraindications were started on this protocol. Contraindications included patients who were drowsy or uncooperative, or those with ophthalmic (e.g. glaucoma), cervical (e.g. spondylosis) or abdominal pathologies (including pregnancy). Patients who were haemodynamically unstable or required oxygen more than a fraction of inspired oxygen (FiO_2) of 50% were instead referred to the ICU team. This protocol was suggested to be terminated once the patient has been weaned to room air for at least 24 hours.

Decision to start or terminate awake prone positioning protocol was dictated by the attending physician. The study team was not involved in patient care decision for all the recruited patients.

Results

The mean age of the patients was 60 years old and protocol was initiated on median day 11 from illness onset (Fig. 1). The patients underwent the protocol for a cumulative median of 21 hours, with 9 patients successfully weaning off oxygen, requiring a median of 8 days. All 10 patients were able to tolerate the protocol as described, allowing for adjustments for comfort.

Three patients were transferred to ICU due to increasing oxygen requirements, where one patient was intubated and subsequently died from severe ARDS. For the remaining two patients, the prone protocol was continued in ICU and they did not require intubation. Both patients were successfully weaned off oxygen, although one required interim support with high flow nasal cannula oxygenation.

Eight patients were initiated on COVID-19 specific therapies such as lopinavir/ritonavir (Fig. 1). None of the patients were initiated on anticoagulation for venous thrombosis prophylaxis. There was no incident of the patients developing any venous thrombosis. One patient was started on anticoagulation for newly diagnosed atrial fibrillation.

Discussion

Our series shows promising data for early prone positioning in non-intubated patients. We compared our findings with our own centre's data for the first 100 patients diagnosed with COVID-19 pneumonia: 12 out of 20 (60%) patients who required supplemental oxygen were eventually intubated. Our series suggests that only 1 out of 10 patients required intubation.

Most patients also reported an improvement in symptoms but some patients experienced mild side effects like musculoskeletal discomfort, nausea or vomiting. For patients unable to tolerate prone positioning, we advocated lying in left and right decubitus position for 30 minutes each, in view of the bilateral nature of COVID-19 pneumonia. The timings of the prone positioning were also planned at least one hour after meal times to minimise gastrointestinal side effects. We did not monitor the ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen (PaO_2/FiO_2 ratio) in our series as the majority of our patients were in the general ward setting who did not have an intra-arterial line for frequent arterial blood gas measurements. We are also cognizant that other COVID-19 specific therapies could have modified the disease course as well.

Being a low-risk and logistically easy-to-execute intervention in cooperative patients, this therapy has a high potential for reducing ICU workload burden. In addition, it is especially useful when other COVID-19 specific therapies are either unavailable or precluded by the patient's pre-existing conditions (e.g. liver dysfunction, thrombocytopenia). There was also no increase in adverse events in our series. The risk of complications as seen in ARDS ventilation [3] or prolonged spine surgeries [4] was also lower as the patients were conscious and could vary their positions for comfort.

Conclusion

With critical care teams globally facing resource depletion, we share preliminary evidence that awake prone positioning can be a low-risk, low-cost manoeuvre which can help patients with COVID-19 pneumonia delay or reduce the need for intensive care. This will offload the resource and manpower burden on healthcare as the number of critically ill patients with COVID-19 pneumonia is expected to increase. Further studies are warranted to confirm our results and to evaluate its clinical relevance, including benefits of extending each awake prone positioning session beyond one hour if the patient is able to tolerate.

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Fig 1. Overview of Patients who underwent Awake Prone Positioning Therapy

Biographic Data			Initiation of Oxygen Therapy			Awake Prone Positioning Therapy		Other Interventions (Day of illness)						Outcome Measures					
Patient Number	Age (years)	Gender	Day of Illness	Room Air SpO2 (%)	Oxygen Supplementation Required (L/min)	Day of illness	Cumulative Duration of Therapy (Hours)	COVID-19 Specific Therapies	Lopinavir/ Ritonavir	Tocilizumab	Inferferon Beta-1b	Remdesivir	Anti-coagulation	Duration of Oxygen Supplementation (days)	Maximum oxygen requirement	Intubation Required	Reason for Termination of Therapy	Venous Thrombosis	Outcome
Patient 1	59	M	13	95	2	13	2	-	-	-	-	-	No	2	NC 2L/min	No	Room air	No	Discharged
Patient 2	66	F	7	88	2	7	32	Yes	D12 - D19	D11	-	-	No	7	HFNC 60L/min FiO2 60%	No	Room air	No	Discharged
Patient 3	73	M	9	91	3	9	58	Yes	D9 - D11	-	D10	-	No	17	NC 4L/min	No	Room air	No	Discharged
Patient 4	68	M	7	90	3	8	10	Yes	-	-	-	D6 - D10	No	10	Intubated, FiO2 100%	Yes	Deceased	No	Deceased
Patient 5	57	F	10	94	1	12	20	Yes	-	-	-	D14 - D23*	No	8	Venturi Mask, FiO2 50%	No	Room air	No	Discharged
Patient 6	59	M	6	94	2	6	31	Yes	-	-	-	D5 - D14	No	8	NC 2L/min	No	Room air	No	Discharged
Patient 7	55	M	9	92	2	10	40	Yes	-	-	-	D10 - D19*	No	9	NC 4L/min	No	Room air	No	Discharged
Patient 8	44	M	13	91	2	13	15	-	-	-	-	-	No	5	NC 4L/min	No	Room air	No	Discharged
Patient 9	72	M	9	93	2	24	20	Yes	D9 - D22	-	D11 - 22	-	No	19	Venturi Mask, FiO2 50%	No	Room air	No	Discharged
Patient 10	53	M	16	91	3	16	22	Yes	D10 - D14	-	-	-	Yes^	4	NC 3L/min	No	Room air	No	Discharged
Mean / Median*	**60.0**	-	**9***	**91.5***	**2***	**11***	**21***	-	-	-	-	-	-	**8***	-	-	-	-	-

Legend: D - D = Duration of Therapy from Day of Illness, NC = Nasal cannula, HFNC = High Flow Nasal Cannula, VM = Venturi Mask, FiO2 = Fraction of Inspired Oxygen

* These 2 patients were enrolled in a randomized remdesivir versus placebo trial, with a 50% chance of receiving remdesivir.

^ For newly diagnosed atrial fibrillation. The patient was started initially started on enoxaparin and later bridged to apixaban.