The effect of awake prone position in non-intubated patients with COVID-19: A feasibility randomized controlled trial

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Abstract

Background: The duration of discomfort and clinical benefits of lying prone in Indonesian clinical settings remain unknown, with the accumulation of prone hours potentially impacting results.
Purpose: The study aimed to test the effect of awake prone position in non-intubated patients with covid-19.
Methods: This study used a feasibility randomized control trial. The research was conducted at two general hospitals in Jakarta, Indonesia. This study used a computerized random number generator was used to assign patients to intervention and control groups. The sample is adult patients who admitted to the hospital with hypoxic respiratory failure due to a positive COVID-19 test. A total of 70 patients were randomly assigned to each group, with 35 individuals being included in the analysis. The intervention involved bedside nurses encouraging patients to lie prone for at least 6 hours daily, with additional pillows provided for comfort. Significant prone position sessions were recorded if they lasted more than 30 minutes in both arms, lasting for 7 days.
Results: The intervention group of patients achieved 65.7% adherence to the intervention protocol. After 2 hours, the P/F ratio was significantly different across the groups, but no significant different between intervention and control group, in term of respiratory escalation, length of stay, or mortality. However, 5.7% of patients in intervention group and 11.4% of patients in control group died due to respiratory failure.
Conclusion: Clinical trial conditions have shown that non-intubated patients can be placed in an awake prone position without harm, and this information could be used to help design protocols for future large randomized controlled trials.

Keywords: COVID-19; prone position; oxygen saturation

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Introduction

COVID-19 infections have led to an increase in admissions for hypoxemic and breathing problems requiring non-invasive ventilation (Franco et al., 2020; Grasselli, Tonetti, et al., 2020). The high demand for ventilatory assistance has had a negative influence on the ICU's ability to respond to surge capacity (Grasselli, Pesenti, et al., 2020; Winck & Ambrosino, 2020). Acute respiratory distress syndrome (ARDS) is a common complication of COVID-19 with prevalence rate of 20%–41% (Cammarota et al., 2020; Grasselli, Pesenti, et al., 2020). Prone positioning has been proven to increase oxygenation and reduce mortality among ARDS patients (Guérin et al., 2013). Prone positioning considered as a cornerstone of treatment for COVID-19-related ARDS (Scaravilli et al., 2015; Valter et al., 2003; Yang et al., 2020). There are many types of prone positioning, including awake prone positioning (APP) aimed to decrease the need for invasive mechanical ventilation and enhance patient outcomes (Cammarota et al., 2016). The APP ensures uniform lung perfusion, shifts ventilation to well-perfused lung segments, and recruits dependent atelectatic regions of the lung (Guérin et al., 2013, 2020; Sartini et al., 2020). More gas-exchange effective regions can be recruited in the dorsal areas because the abdominal cavity and mediastinum are no longer constricting them (Jagan et al., 2020;

Sartini et al., 2020) APP is workable and associated with better oxygenation in non-incubated individuals (Broccard et al., 1997; Cornejo et al., 2013; Valenza et al., 2005; Yang et al., 2020).

A few researchers have documented the practice of putting a patient in a prone position while they are receiving routine oxygen therapy, CPAP, or noninvasive ventilation (Ding et al., 2020; Scaravilli et al., 2015; Valter et al., 2003). Prone positionings appear to promote oxygenation and reduce breathing effort, which may be advantageous to patients at risk of self-induced lung injury. As a result, this position may allow for the deferral or avoidance of tracheal intubation and its associated dangers. In resource-constrained settings, a reduction in the requirement for intubation and subsequent admission to the intensive care unit (ICU) may also be helpful. At the same time, this approach may introduce various risks associated with position change (e.g., vomiting, thrombosis) or delayed intubation. Later studies have reported prone positioning in awake COVID-19 patients (Coppo et al., 2020; Guérin et al., 2020; Ng et al., 2020; Sartini et al., 2020). The use of APP in non-intubated or hypoxemic patients with COVID-19 is now commonplace in overburdened health care systems (Grasselli, Tonetti, et al., 2020; Raoof et al., 2020; Winck & Ambrosino, 2020). A cohort of ten patients reported that the prone position resulted in a significant improvement in oxygen saturation within one hour (Elharrar et al., 2020). Another study indicated that compared to supine position, APP was related to decreased fatality (20.0%) and intubation rate (23.6%) (Guérin et al., 2020).

The question of whether APP is beneficial for non-incubated hypoxic COVID-19 patients has increased interest in the conduct of randomized controlled trials (RCTs) (Bouadma et al., 2020; Elharrar et al., 2020; Valter et al., 2003). Moreover, in Indonesian clinical contexts, many questions remain unanswered, such as how long can a patient comfortably lie prone for, how long is clinically beneficial, and whether the accumulation of prone hours affects results. Therefore, we conducted a feasibility study of prone positioning in non-intubated COVID-19 patients requiring additional oxygen.

Materials and Methods

Design

This study followed the guidelines of the 1964 Helsinki Declaration, Good Clinical Practice, and the Consolidated Standards of Reporting Trials (CONSORT) for conducting a feasibility randomized control trial. The study was conducted at two general hospitals in Jakarta, Indonesia, from January to March 2021, with a 7-day follow-up completed on April 10. COVID-19 patients were treated in designated areas of the hospital. Those requiring more than 4 liters of oxygen a minute were administered in areas capable of providing a high level of intensive care. The Affiliated University Ethical Review Authority (STIKes Abdi Nusantara) granted ethical approval (2020-02743) on November 10, 2020. All subjects provided written informed consent.

Randomization

Patients randomized to either intervention and control group. A computerized random number generator was used to assign patients in groups of two randomly. The allocation was hidden by utilizing sealed opaque envelopes. Block sizes were unknown to the sites. The participants and treating professionals were not blinded because of the nature of the intervention.

Sample

Adults admitted to the hospital with hypoxic respiratory failure due to a positive COVID-19 test were assessed for study eligibility. Patients over the age of 18 who require more than four LPM of supplemental oxygen to maintain a SpO2 of 92 percent were considered for inclusion in the study. It was decided that the study would not be conducted on pregnant women, patients in hemodynamic shock who required norepinephrine 0.1 mcg/kg/min, GCS of 15 or less, emergency intubation patients, or those who were unable to lie prone due to absolute or relative contraindications.

The feasibility study involved enrolling 70 patients due to limited event rate data, as the results will aid in determining sample sizes for a definitive trial, as the trial was designed with limited data (Jayakumar et al., 2021).

Intervention procedure

Intervention was done by nurse who have experienced working in Intensive Care Unit for more than 5 years and have taking care for COVID-19 patients at least 6 months. The duration of the interevntion was 7 days. The nurses advised the study group to maintain a supine position for a minimum of six hours each day (in total). The inclusion of more cushions facilitated assuming the prone posture and enhanced overall comfort. In the control group, patients were permitted to make postural modifications as necessary. If they preferred assuming a prone position, they were free to do so. The nurses and healthcare providers in this group will not support or endorse the use of prone positioning. Extended periods of lying face down for over 30 minutes were observed and documented in both groups. Patients received timed intervals for eating and resting while in a recumbent position. The oxygen flow and fraction of inspired oxygen (FiO2) were adjusted to ensure a consistent saturation level of 92% in both arms.

Outcome Measurements

The primary outcome was the proportion of patients in each group who completed their treatment regimen as intended. Secondarily, we looked at the percentage of patients who needed escalation of respiratory assistance and how long patients could spend in the prone position in 24 hours.

Table 1. Baseline characteristics between intervention and control group (n=70)

Characteristics	Intervention group (n=35)	Control group (n=35)	p-value
Age in years	43.3 ± 11.9	44.8 ± 11.6	0.345
Sex			
Men	13 (37.1%)	17 (48.6)	0.198
Women	22 (61.9%)	18 (51.4)	
BMI	25.9 ± 3.4	26.1 ± 4.1	0.076
APACHE II Score	9.2 ± 3.7	9.8 ± 3.3	0.515
Comorbidity (yes)	16 (45.7%)	15 (42.9%)	0.113
Initial oxygen delivery device			0.275
Face Mask	18 (51.4%)	17 (48.6)	
Non-Rebreather Mask	17 (48.6)	18 (51.4%)	
Initiation oxygen saturation	92.45± 1.3	93.12± 2.5	0.164
Initial FiO2	50.2 ± 20.8	48.2 ± 18.6	0.214
Initial P/F ratio	185.6 ± 126.1	201.4 ± 118.8	0.387

Table 2. The effect of awake prone position on primary and secondary outcome

	Intervention group (n = 35)	Control group (n = 35)	P value
Average Hours Awake Prone^			
0 hours	0	30 (85.7%)	
1-3 hours	0	5 (14.3%)	
4-6 hours	12 (34.3%)	0	
≥ 6 hours	23 (65.7%)	0	
P/F ratio after 2 hours	175.1 ± 87.2	198.7 ± 96.4	0.023a
Respiratory escalation	3 (8.6%)	4 (11.4%)	0.352b
Oxygen saturation	94.0± 3.7	93.5± 4.3	0.131a
Adverse events	0	0	–
Length of stay	13.21 ± 2.44	16.40 ± 5.11	0.046a
Dead	2 (5.7%)	4 (11.4%)	0.561b

a Independent t-test; bChi Square Test; ^over 7 days or duration of stay whichever is shorter; – No statistical test applicable due to zero variation or not relevant.

Data collection

In addition to the patient's demographics and APACHE II scores, comorbidities data were obtained. The position chart also recorded the total number of hours spent in the prone position during the day (cumulative), the number of prone sessions, and the length of each one. We followed this approach for seven days. This information was noted if the patient was unable to lie prone due to any of the issues listed above, as well as any adverse events such as pressure ulcers, vomit, or nerve compression that may have happened.

Data analysis

Means and standard deviations are used to report continuous variables and frequency for categorical data. Comparing demographic characteristics between intervention and control group was done using independent t test and Chi-Square test. The student t-test was used for comparing means and the chi-square was used for comparing proportions of studies outcome between intervention and control group. All two-tailed tests had a significance level of $p<0.05$. The analysis was done using Statistical Package for the Social Sciences (SPSS) version 23 (Chicago, SPSS In).

Results

Over five months, 110 patients were screened for eligibility, 70 of whom agreed to participate (Figure 1). Seventy patients were randomly assigned to each group, with 35 individuals being included in the analysis.

Table 1 shows the baseline characteristics that were comparable between the two groups. There were no significant different between intervention and control group in term of age, sex, BMI, APACHE

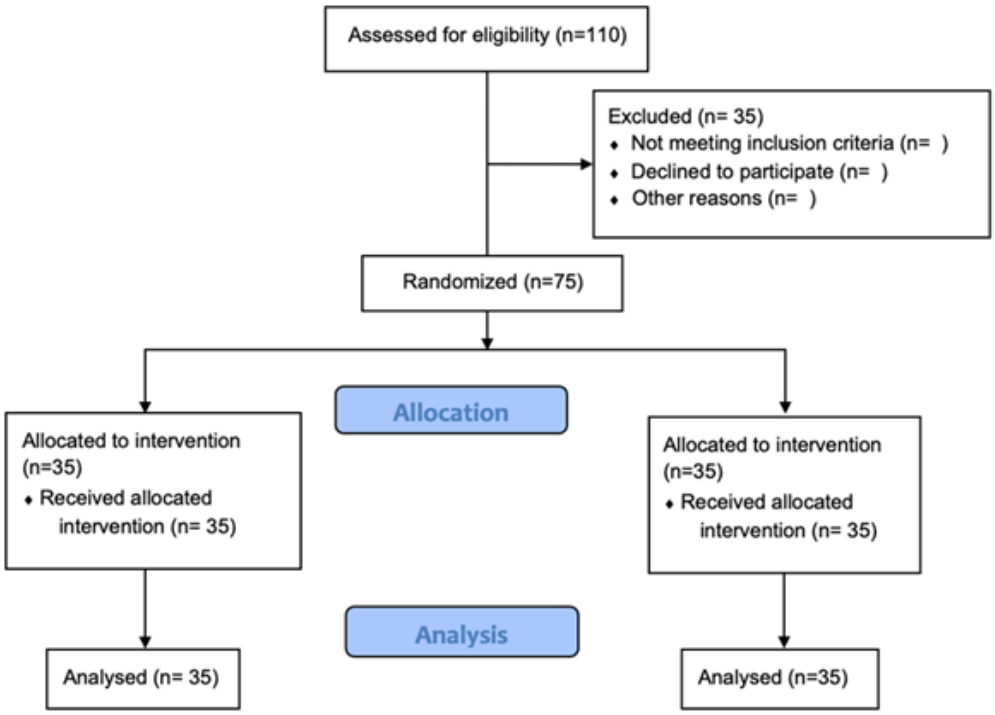

Figure 1. CONSORT 2010 Flow Diagram

II score, comorbidity, initial oxygen delivery device, initiation oxygen saturation, initial FiO2, and initial P/F ratio (p>0.05).

Patients who participated in the intervention group were found to be 65.7% adherent to the protocol (23 patients completed an average of 6 hours a day in prone position), and 24.3% of the patients were able to lie prone for 4 to 6 hours per day (Table 2). In the control group, 85.7% (30 of 35) of participants were supine, and 14.3% spent around 1 to 3 hours per day in the prone position.

After 2 hours, the P/F ratio was significantly different across the groups, but not respiratory escalation, length of stay, or mortality (Table 2). About 5.7% (n=2) patients in intervention and 11.4% (n=4) in control group were dead due to respiratory failure. All patients assigned to the intervention group were able to lie prone with no difficulty. There were no negative side effects associated with the positional treatment.

Discussion

This study indicated that prone positioning was safe and practical in most patients and increased P/F ratio after two hours showed a significant difference between groups. Valter and colleagues reported that who awake prone position enhanced oxygenation immediately and prevented the need for intubation. Feltracco and colleagues reported five successful awake prone positioning with noninvasive breathing for refractory hypoxemia. Munshi and colleagues suggest that numerous factors influence acceptance of a pandemic intervention, including the perception of therapeutic benefits and risks, situational factors including the convenience of use, and physician characteristics (early or late adopters). Although prone positioning may seem like a mild method, it's likely that the temporary improvements in oxygenation give a false sense of security and postpone the need for an increase in respiratory support. As a result, even in the face of pandemic desperation, the threshold for considering experimental interventions must remain high.

The majority of patients in the treatment group met or exceeded the six-hour daily APP target. In a previous study, the prone group spent 10.54 hours per day compared to 1.54 hours in the supine group. According to a prior study (Longhini et al., 2020), treatment adherence is one of the most significant limitations of APP. When participants were placed in a prone position, researchers expected to see a decrease in static adherence because of the lack of lung recruitment, but they did not. We know that being in the prone position has a negative effect on chest wall compliance (Guérin et al., 2020), this must imply that lung compliance increased during prone stance. While this is not a typical outcome, it is seen in "classic" ARDS when total compliance does not improve (Guérin et al., 2020). Two of three prone

patients were found to have recruited dorsal lung areas via serial electrical impedance tomography (EIT) measurements.

Following a period of two hours, there was no significant difference in respiratory escalation, duration of stay, or mortality between the intervention group (which was getting APP) and the control group. Due to the fact that APP in non-intubated patients failed to enhance oxygenation, the degree of respiratory escalation did not considerably improve. This was notably true in patients who were experiencing hypoxemic respiratory failure as a result of COVID-19 pneumonia. However, the translation of physiological improvement into clinically meaningful results has not been confirmed by studies conducted on ARDS (Ferrando et al., 2020). Furthermore, there is still a vacuum in the existing understanding about the use of APP (Albert et al., 2014; Padrão et al., 2020; Coopersmith et al., 2021). A randomized clinical study has not yet been conducted to investigate the impact that APP has on the percentage of patients who do not need intubation while they are suffering from hypoxemic respiratory failure. The APP did not substantially lower the duration of stay or the mortality rate, which is another point of interest. According to the findings of a multicenter observational research that investigated a cohort of 199 patients with COVID-19, there was no difference in the frequencies of intubation between patients who had administered APP for more than 16 hours per day and those who had administered APP for a shorter length (Hallifax et al., 2020). When compared with our inquiry, they showed comparable baseline characteristics, levels of respiratory failure, and death rates; however, they reported greater intubation rates (41% in the control group and 40% in the prone group at the time of the study).

Considering the study's limited scope, the results cannot be relied upon to change current procedures. It's important to note that 65.7% of people got in a prone position for at least six hours every day. Although, there were no significant different between intervention and control group in term of age, sex, BMI, APACHE II score, comorbidity, initial oxygen delivery device, initiation oxygen saturation, initial FiO2, and initial P/F ratio, adherence may have been affected by a variety of factors, such as changes in nurse-to-patient ratios, the need for isolation, and cohorts, which restrict access to trial personnel. It is uncertain whether positional aides, such as mattresses, will permit prolonged prone positioning. Five of the thirty-five supine participants flipped over to rest on their stomachs. No rules were violated, as no one remained in a prone position for more than six hours, despite the substantial number of participants who switched roles.

Furthermore, to be included in this study, one did not have to show signs of illness. They may have been sick for a longer period of time than other patients. It is possible that this had an impact on the overall efficacy of the intervention. However, this study provides crucial data for designing larger definitive studies in terms of feasibility, incident rates, and safety. This research was done in hospitals and clinics at the height of the epidemic, when clinical trial infrastructure was still in its infancy or nonexistent. One of the major benefits is that it can be implemented in healthcare systems and countries with limited resources, which are typically left out of similar studies.

Conclusion

Clinical trials in awake prone patients who have not been intubated, as demonstrated in this study, show that this position is feasible and safe. For future large randomized controlled trials, the findings could be useful. Future studies may apply cross-over and increasing prone positioning compliance should be the focus of future studies.

Declaration of Interest

The author declares no conflict of interest.

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Data Availability

None

References

Albert, H. (2014). Treatise on critical reason. http://digital.casalini.it/9781400854929

Bouadma, L., Lescure, F.-X., Lucet, J.-C., Yazdanpanah, Y., & Timsit, J.-F. (2020). Severe SARS-CoV-2 infections: Practical considerations and management strategy for intensivists. *Intensive Care Medicine, 46*(4), 579–582. https://doi.org/10.1007/s00134-020-05967-x

Broccard, A. F., Shapiro, R. S., Schmitz, L. L., Ravenscraft, S. A., & Marini, J. J. (1997). Influence of prone position on the extent and distribution of lung injury in a high tidal volume oleic acid model of acute respiratory distress syndrome. *Critical Care Medicine, 25*(1), 16–27. https://doi.org/10.1097/00003246-199701000-00007

Cammarota, G., Longhini, F., Perucca, R., Ronco, C., Colombo, D., Messina, A., Vaschetto, R., & Navalesi, P. (2016). New setting of neurally adjusted ventilatory assist during noninvasive ventilation through a helmet. *Anesthesiology, 125*(6), 1181–1189. https://doi.org/10.1097/ALN.0000000000001354

Cammarota, G., Ragazzoni, L., Capuzzi, F., Pulvirenti, S., De Vita, N., Santangelo, E., Verdina, F., Grossi, F., Vaschetto, R., & Della Corte, F. (2020). Critical care surge capacity

to respond to the COVID-19 pandemic in Italy: A rapid and affordable solution in the Novara hospital. *Prehospital and Disaster Medicine, 35*(4), 431–433.

Coelho, C. C., Padrão, T., Costa, L., Pinto, M. T., Costa, P. C., Domingues, V. F., Quadros, P. A., Monteiro, F. J., & Sousa, S. R. (2020). The antibacterial and angiogenic effect of magnesium oxide in a hydroxyapatite bone substitute. *Scientific Reports, 10*(1), 19098.

Coppo, A., Bellani, G., Winterton, D., Pierro, M., Soria, A., Faverio, P., Cairo, M., Mori, S., Messinesi, G., Contro, E., Bonfanti, P., Benini, A., Valsecchi, M., Antolini, L., & Foti, G. (2020). Feasibility and physiological effects of prone positioning in non-intubated patients with acute respiratory failure due to COVID-19 (PRON-COVID): A prospective cohort study. *The Lancet Respiratory Medicine, 8.* https://doi.org/10.1016/S2213-2600(20)30268-X

Cornejo, R. A., Díaz, J. C., Tobar, E. A., Bruhn, A. R., Ramos, C. A., González, R. A., Repetto, C. A., Romero, C. M., Gálvez, L. R., Llanos, O., Arellano, D. H., Neira, W. R., Díaz, G. A., Zamorano, A. J., & Pereira, G. L. (2013). Effects of prone positioning on lung protection in patients with acute respiratory distress syndrome. *American Journal of Respiratory and Critical Care Medicine, 188*(4), 440–448. https://doi.org/10.1164/rccm.201207-1279OC

Ding, L., Wang, L., Ma, W., & He, H. (2020). Efficacy and safety of early prone positioning combined with HFNC or NIV in moderate to severe ARDS: a multi-center prospective cohort study. *Critical Care (London, England), 24*(1), 28. https://doi.org/10.1186/s13054-020-2738-5

Elharrar, X., Trigui, Y., Dols, A.-M., Touchon, F., Martinez, S., Prud'homme, E., & Papazian, L. (2020). Use of prone positioning in nonintubated patients with COVID-19 and hypoxemic acute respiratory failure. *JAMA, 323*(22), 2336–2338. https://doi.org/10.1001/jama.2020.8255

Franco, C., Facciolongo, N., Tonelli, R., Dongilli, R., Vianello, A., Pisani, L., Scala, R., Malerba, M., Carlucci, A., Negri, E. A., Spoladore, G., Arcaro, G., Tillio, P. A., Lastoria, C., Schifino, G., Tabbì, L., Guidelli, L., Guaraldi, G., Ranieri, V. M., … Nava, S. (2020). Feasibility and clinical impact of out-of-ICU noninvasive respiratory support in patients with COVID-19-related pneumonia. *The European Respiratory Journal, 56*(5). https://doi.org/10.1183/13993003.02130-2020

Grasselli, G., Pesenti, A., & Cecconi, M. (2020). Critical care utilization for the COVID-19 outbreak in Lombardy, Italy: Early experience and forecast during an emergency response. *Jama, 323*(16), 1545–1546.

Grasselli, G., Tonetti, T., Protti, A., Langer, T., Girardis, M., Bellani, G., Laffey, J., Carrafiello, G., Carsana, L., Rizzuto, C., Zanella, A., Scaravilli, V., Pizzilli, G., Grieco, D. L., Di Meglio, L., de Pascale, G., Lanza, E., Monteduro, F., Zompatori, M., … Ranieri, V. M. (2020). Pathophysiology of COVID-19-associated acute respiratory distress syndrome: A multicentre prospective observational study. *The Lancet. Respiratory Medicine, 8*(12), 1201–1208. https://doi.org/10.1016/S2213-2600(20)30370-2

Guérin, C., Albert, R. K., Beitler, J., Gattinoni, L., Jaber, S., Marini, J. J., Munshi, L., Papazian, L., Pesenti, A., Vieillard-Baron, A., & Mancebo, J. (2020). Prone position in ARDS patients: Why, when, how and for whom. *Intensive Care Medicine, 46*(12), 2385–2396. https://doi.org/10.1007/s00134-020-06306-w

Guérin, C., Reignier, J., Richard, J.-C., Beuret, P., Gacouin, A., Boulain, T., Mercier, E., Badet, M., Mercat, A., Baudin, O., Clavel, M., Chatellier, D., Jaber, S., Rosselli, S., Mancebo, J., Sirodot, M., Hilbert, G., Bengler, C., Richecoeur, J., … Ayzac, L. (2013). Prone positioning in severe acute respiratory distress syndrome. *The New England Journal of Medicine, 368*(23), 2159–2168. https://doi.org/10.1056/NEJMoa1214103

Hallifax, R. J., Porter, B. M., Elder, P. J., Evans, S. B., Turnbull, C. D., Hynes, G., Lardner, R., Archer, K., Bettinson, H. V., Nickol, A. H., Flight, W. G., Chapman, S. J., Hardinge, M., Hoyles, R. K., Saunders, P., Sykes, A., Wrightson, J. M., Moore, A., Ho, L. P., Fraser, E., … Oxford Respiratory Group (2020). Successful awake proning is associated with improved clinical outcomes in patients with COVID-19: Single-centre high-dependency unit experience. *BMJ open respiratory research, 7*(1), e000678. https://doi.org/10.1136/bmjresp-2020-000678

Jagan, N., Morrow, L. E., Walters, R. W., Klein, L. P., Wallen, T. J., Chung, J., & Plambeck, R. W. (2020). The POSITIONED Study: Prone positioning in nonventilated coronavirus disease 2019 patients-a retrospective analysis. *Critical Care Explorations, 2*(10), e0229. https://doi.org/10.1097/CCE.0000000000000229

Jayakumar, D., Ramachandran Pratheema, D. N. B., Rabindrarajan Ebenezer, D. N. B., Vijayaraghavan Bharath Kumar Tirupakuzhi, M. D., Ramakrishnan Nagarajan, A. B., & Venkataraman Ramesh, A. B. (2021). Standard care versus awake prone position in adult nonintubated patients with acute hypoxemic respiratory failure secondary to COVID-19 infection—a multicenter feasibility randomized controlled trial. *Journal of Intensive Care Medicine, 36*(8), 918–924. https://doi.org/10.1177/08850666211014480

Longhini, F., Bruni, A., Garofalo, E., Navalesi, P., Grasselli, G., Cosentini, R., Foti, G., Mattei, A., Ippolito, M., Accurso, G., Vitale, F., Cortegiani, A., & Gregoretti, C. (2020). Helmet continuous positive airway pressure and prone positioning: A proposal for an

early management of COVID-19 patients. *Pulmonology, 26*(4), 186–191. https://doi.org/10.1016/j.pulmoe.2020.04.014

Ng, Z., Tay, W. C., & Ho, C. H. B. (2020). Awake prone positioning for non-intubated oxygen dependent COVID-19 pneumonia patients. *The European Respiratory Journal, 56*(1), 2001198. https://doi.org/10.1183/13993003.01198-2020

Nunnally, M. E., Ferrer, R., Martin, G. S., Martin-Loeches, I., Machado, F. R., De Backer, D., Coopersmith, C. M., Deutschman, C. S., & Levy, S. S. C. R. C. M. A. J. H. S. J. J. K. I. L. M. M. (2021). The Surviving Sepsis Campaign: research priorities for the administration, epidemiology, scoring and identification of sepsis. *Intensive Care Medicine Experimental, 9,* 1–26. https://doi.org/10.1186/s40635-021-00400-z

Raoof, S., Nava, S., Carpati, C., & Hill, N. S. (2020). High-flow, noninvasive ventilation and awake (nonintubation) proning in patients with coronavirus disease 2019 with respiratory failure. *Chest, 158*(5), 1992–2002. https://doi.org/10.1016/j.chest.2020.07.013

Sartini, C., Tresoldi, M., Scarpellini, P., Tettamanti, A., Carcò, F., Landoni, G., & Zangrillo, A. (2020). Respiratory parameters in patients with COVID-19 after using noninvasive ventilation in the prone position outside the intensive care unit. *JAMA, 323*(22), 2338–2340. https://doi.org/10.1001/jama.2020.7861

Scaravilli, V., Grasselli, G., Castagna, L., Zanella, A., Isgrò, S., Lucchini, A., Patroniti, N., Bellani, G., & Pesenti, A. (2015). Prone positioning improves oxygenation in spontaneously breathing nonintubated patients with hypoxemic acute respiratory failure: A retrospective study. *Journal of Critical Care, 30*(6), 1390–1394. https://doi.org/10.1016/j.jcrc.2015.07.008

Valenza, F., Guglielmi, M., Maffioletti, M., Tedesco, C., Maccagni, P., Fossali, T., Aletti, G., Porro, G. A., Irace, M., Carlesso, E., Carboni, N., Lazzerini, M., & Gattinoni, L. (2005). Prone position delays the progression of ventilator-induced lung injury in rats: does lung strain distribution play a role? *Critical Care Medicine, 33*(2), 361–367. https://doi.org/10.1097/01.ccm.0000150660.45376.7c

Valter, C., Christensen, A. M., Tollund, C., & Schønemann, N. K. (2003). Response to the prone position in spontaneously breathing patients with hypoxemic respiratory failure. *Acta Anaesthesiologica Scandinavica, 47*(4), 416–418. https://doi.org/10.1034/j.1399-6576.2003.00088.x

Villar, J., Ferrando, C., Martínez, D., Ambrós, A., Muñoz, T., Soler, J. A., Aguilar, G., Alba, F., González-Higueras, E., & Conesa, L. A. (2020). Dexamethasone treatment for the acute respiratory distress syndrome: a multicentre, randomised controlled trial. *The Lancet Respiratory Medicine, 8*(3), 267–276.

Winck, J. C., & Ambrosino, N. (2020). COVID-19 pandemic and non invasive respiratory management: Every Goliath needs a david. An evidence based evaluation of problems. *Pulmonology, 26*(4), 213–220. https://doi.org/10.1016/j.pulmoe.2020.04.013

Yang, X., Yu, Y., Xu, J., Shu, H., Xia, J., Liu, H., Wu, Y., Zhang, L., Yu, Z., Fang, M., Yu, T., Wang, Y., Pan, S., Zou, X., Yuan, S., & Shang, Y. (2020). Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. *The Lancet. Respiratory Medicine, 8*(5), 475–481. https://doi.org/10.1016/S2213-2600(20)30079-5