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by Arif Setyo Upoyo

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The Effect of Prone Position on Breathing State in Covid-19 Patients with Breathing Disorders: a systematic review

Anisa Fatma, Arif Setyo Upoyo*

[1]Nurse Profession Student Nursing Department, Faculty of Health Sciences, General Sudirman University
[2]Lecturer in the Department of Nursing, Faculty of Health Sciences, Jenderal Soedirman University Purwokerto, Indonesia
Jl. Dr. Soerparno, Karangwangkal, Purwokerto Utara 53123 Tel (0281) 642838

Corresponding author: Arif Setyo upoyo; email: afkarfadholi@gmail.com

Abstract

Background: The world is facing a pandemic COVID-19. The spread of COVID-19 is very fast, Indonesia is one of the countries affected by COVID-19 transmission with confirmed cases up to June 24, 2020 totaling 49,009 positive cases, 20,658 cases recovered and 2,573 cases died. Most cases of death are caused by respiratory disorders such as acute respiratory distress syndrome (ARDS).

Objective: This paper aims to review some of the literature on the effect of prone position on respiratory status in COVID-19 patients with respiratory disorders.

Methods: The article search was conducted electronically using several databases namely PubMed, Science Direct, The Lancet and Jama Network. The keywords used are "COVID-19", "prone position" and "respiratory state" or "respiratory rate" or "saturation" or "ventilation" or "non ventilation" or "intubation" so that we get 5 research articles in the last 2 years for review.

Results: The prone position in COVID-19 patients with respiratory disorders was considered to have an effect on respiratory status by increasing oxygen saturation, stabilizing the frequency of breathing, comfort, shortening the duration of hospitalization and reducing dependence on the use of breathing aids and intubation. Increased oxygenation occurs because the prone position can reduce lung compression in the back region and increase pulmonary perfusion.

Conclusion: The application of prone position to COVID-19 patients with respiratory disorders affects the respiratory status with an increase in oxygenation

Keywords: *COVID-19, Prone Position and Respiratory State*

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Introduction

The world is facing a pandemic caused by a viral infection Sars-CoV-2. The virus is a trigger for a disease called Coronavirus Disease 2019 (COVID-19).This disease is a new type of disease that has never been identified before in humans. The Sars-CoV-2 virus is zoonotic which means it is transmitted between animals and humans. Individuals who are most at risk of contracting this disease are people who have direct contact with COVID-19 patients, including those who treat COVID-19 patients because this virus can be transmitted from human to human via droplets. COVID-19 cases first occurred in Wuhan City, Hubei Province, China at the end of 2019. The spread of COVID-19 is very fast until June 24, 2020 has occurred in many countries in the world, around 216 countries with a confirmed number of cases 9,071,475 positive cases and 472,075 cases died.[1]

Indonesia is one of the countries affected by COVID-19 transmission. The first COVID-19 case was reported in Indonesia on March 2, 2020 which consisted of 2 cases. Data on June 24, 2020 shows that confirmed cases in Indonesia amounted to 49,009 positive cases, 19,658 cases were cured and 2,573 cases died.[2] The COVID-19 case was also an outbreak on March 13, 2020, in one of the cities in Central Java Province, Solo. Based on data from the Central Java Provincial Health Office, the current number of confirmed cases (June 24, 2020) is 3,352 positive cases consisting of 1,639 treated, 1,455 cured and 258 dead.

The main cause of death in COVID-19 patients is acute respiratory distress syndrome (ARDS), especially one of the clinical symptoms of COVID-19 is respiratory disorders such as pneumonia.[3] The results of a study conducted by Shang et al (2020) showed that the majority of COVID-19 patients, around 67%, had ARDS.[4] COVID-19 patients can experience ARDS due to an uncontrolled inflammatory response due to the release of large amounts of proinflammatory cytokines and chemokines. In addition, ARDS experienced by COVID-19 patients can also trigger right ventricular disorders and sepsis. This condition can increase the need for intensive care and the use of a ventilator.

Based on cases that occurred in Wuhan, of the 99 COVID-19 patients about 93% needed oxygen therapy, non-invasive ventilation, mechanical ventilation and even intubation. The duration of treatment with non-invasive ventilation is 4-22 days and mechanical ventilation is 3-20 days. Meanwhile, the availability of beds in the intensive care unit (ICU) and ventilators that can be used to treat COVID-19 patients is very limited so this can risk increasing mortality. Therefore, there is an alternative in the management of respiratory status to reduce the need for intensive care.4

One effort that can be done to minimize the use of breathing aids and accelerate the duration of treatment of patients with respiratory disorders is to regulate body position. 5 Prone position or prone position is one position that can help overcome respiratory problems. A study showed that of 170 ARDS patients, 98 (58%) experienced an increase in oxygenation after prone positioning. The effect of the prone position is that the anterior thoracic wall will be fixed and reduced compliance so as to reduce pleural pressure and increase posterior lung ventilation.6 Other than that, prone position is considered to reduce dependence on the use of breathing aids or the use of ventilators and accelerate the healing process.7 Based on this explanation the authors are interested in compiling a literature review the effect of the prone position on respiratory status in COVID-19 patients with respiratory disorders.

Methods

After searching electronically using several databases, including PubMed, Science Direct, The Lancet and Jama Network with the keywords "COVID-19", "prone position" and "respiratory state" or "respiratory rate" or "saturation" or "ventilation" or "non ventilation" or "intubation", the author has obtained 371 articles (Pubmed N: 31, Science Direct N: 304, The Lancet N: 16 and Jama Network N: 20). Fulltext articles obtained were analyzed using frame work in the form of PICO analysis (patient, intervention, comparison, outcome). Therefore, it can be explained P: COVID-19 patients with respiratory disorders, I: prone position, C: the articles examined do not use a control or comparison group, O: respiratory status. Inclusion criteria in the selection of articles includes research journals in the past 2 years, free full text, the topic is in accordance with the theme, randomized controlled trials while the exclusion criteria in the selection of this article are research journals about giving prone positions but not COVID-19 patients and review articles. Then 371 articles obtained were identified based on the title in accordance with the theme so that 37 articles

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were obtained. Subsequently 37 articles were selected again by adjusting eligibility and RCT so that 12 articles were obtained while article reviews and those that were not relevant to the subject were excluded. However, from 12 articles there were 7 duplicate articles so that the total articles that met the criteria were 5 articles (figure 1).

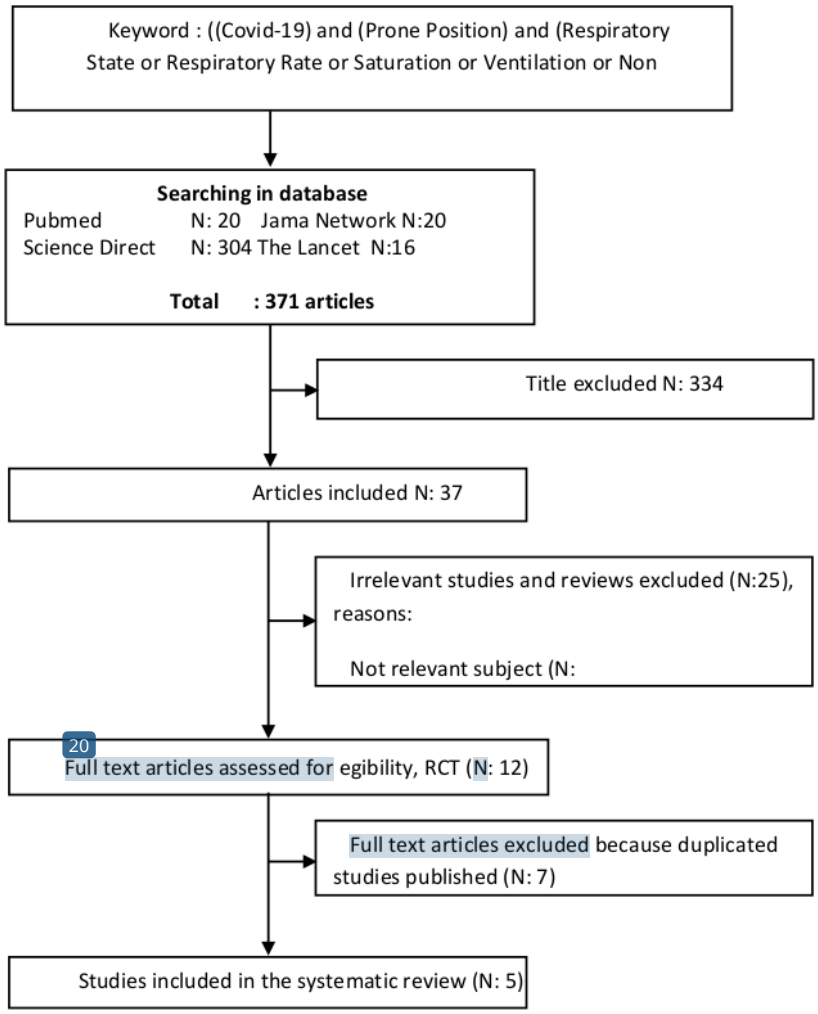

Figure 1. Selection articles processes

Results and Discussion

Five article selected from 371 articles were reviewed (table 1). Management of patients with respiratory disorders such as ARDS requires tracheal intubation and mechanical ventilation.[4] These actions aim to improve respiratory status with the hope that the patient can return to breathing spontaneously. The prone position can help the process weaning the use of breathing aids and reducing the need for intubation.[8,9] This is similar to the results of the study which explained that the position of prone contributed to avoid intubation in 11 of 20 patients.[10] The application of this prone position is combined with oxygen administration via high-flow nasal cannula and non-invasive ventilation.

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Table 1. Articles in study

Author	Title	Population	Intervention	Outcome
Chiara Sartini, Moreno Tresoldi, Paolo Scarpellini, Andrea Tettamanti, Francesco Carcò, Giovanni Landoni & Alberto Zangrillo (2020)	Respiratory Parameters in Patients With COVID-19 After Using Noninvasive Ventilation in the Prone Position Outside the Intensive Care Unit	COVID-19 patients with mild-moderate ARDS in the ICU and ward, San Raffaele Scientific Institute, Milan, Italy as many as 250 people. However, only 15 people met the criteria to be recruited as respondents	Prone position is carried out every day with a duration of 3 hours in 2 cycles for 14 days	After intervening for 14 days in 15 respondents, some respondents experienced an increase in oxygen saturation even though initially oxygen saturation in all respondents was less than 94%. A total of 9 respondents were sent home, 1 respondent experienced an increase and stopped the prone position, 3 respondents were still undergoing the prone position continued, 1 respondent was intubated and treated in the ICU and 1 respondent died. After being analyzed using STATA, the following results were obtained: Peripheral oxygen saturation (SpO2) P <0.001 between before and during pronation and P <0.004 between before and after pronation, partial arterial oxygen pressure (PaO2) for oxygen inspired fraction (FIO2) P < 0.001 between before and during pronation and P <0.004 between before and after pronation and respiration rate P <0,
Anna Coppo, Giacomo Bellani, Dario Winterton, Michela Di Pierro, Alessandro Soria, Paola Faverio, Matteo Cairo, Silvia Mori, Grazia Messinesi, Ernesto Contro, Paolo Bonfanti, Annalisa Benini, Maria Grazia Valsecchi, Laura Antolini, Giuseppe Foti (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	Patients aged 18-75 years who experienced COVID-19 with pneumonia in the Non-ICU Room, San Gerardo Hospital, Monza, Italy, were 46 respondents from a total population of about 667 people.	Prone positions are performed with a minimum duration of 3 hours per session. This study only measures one initial session and respondents are free to repeat the session.	Increased oxygenation substantially from the supine position to the prone position (p <0 · 001). However, after resupination this increase was not significant compared to before the prone position. The duration of hospitalization of respondents becomes shorter which is around 2-7 days. Although, 13 (28%) of the 46 respondents were finally intubated and 5 patients died during the follow-up due to the underlying disease, not related to the study procedure.

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Alison E. Thompson, Benjamin L. Ranard, YingWei & Sanja Jelic (2020)	Prone Positioning in Awake, Nonintubated Patients With COVID-19 Hypoxemic Respiratory Failure	A total of 88 COVID-19 patients treated at Columbia University step-down unit (intermediate care unit). Then selected according to inclusion and exclusion criteria so that 29 respondents were obtained, but only 25 people were willing to become respondents	The prone position is carried out for 24 hours every day, while doing the prone position the respondent can use a pillow placed under the hip / pelvis and rest in the lateral decubitus or supine position but later return to the prone position. Oxygen saturation assessment is done before and 1 hour after prone position	After analyzing using the Wilcoxon test, the increase in SpO2 from before and one hour after the prone position is around 1-34%. In addition, in the first hour the prone position did not change the level of oxygen therapy in all respondents. One hour after the prone position, 19 respondents had a SpO2 of 95% or greater and 7 respondents needed intubation. Furthermore, of the 6 respondents whose SpO2 remained less than 95% one hour after the prone position, 5 respondents were intubated. The average ratio between 95% SpO2 during prone position and SpO2 one hour after prone position is 46%. Then, from 12 respondents who needed intubation, 3 respondents died and from 13 respondents who did not need intubation, 9 respondents recovered and went home, 2 respondents were transferred to the medical ward, and 2 respondents remained in the step-down unit.
Qiancheng Xu, Tao Wang, Xuemei Qin, Yanli Jie, Lei Zha and Weihua Lu (2020)	Early awake prone position combined with high-flow nasal oxygen therapy in severe COVID-19: a case series	The study respondents were 10 COVID-19 patients with mild respiratory disorders, 10 of them taken from 3 hospitals in Wuhu City and Maanshan City, Anhui Province, China.	The prone position is combined with administration of oxygen therapy with high flow nasal cannula. This intervention was carried outmore than 16 hours per day	After the prone position, PaO2 / FiO2 (PF) increased significantly ($p < 0.001$) so that the respondent's condition did not worsen or require intubation.

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Xavier Elharrar, Youssef Trigui, Anne-Marie Dols, François Touchon, Stéphanie Martinez, Eloi Prud'homme & Laurent Papazian (2020)	Use of Prone Positioning in Nonintubated Patients With COVID-19 and Hypoxemic Acute Respiratory Failure	This study was conducted in 24 patients with unincubated COVID-19 and acute hypoxemic respiratory failure. The patients were treated at Aix-en-Provence Hospital, France	Prone position is carried out for at least 3 hours per day for 10 days.	The application of prone positions in 24 respondents, 4 respondents (17%) cannot do prone positions for more than 1 hour, 5 respondents (21%) can maintain prone positions for 1-3 hours, and 15 respondents (63%) can do prone positions more than 3 hours. Patients who were able to survive for 3 hours or more experienced an increase in PaO2 from 73.6 mmHg before the prone position to 94.9 mmHg during prone (p = .006). Significant differences were found between PaO2 before the prone position and PaO2 after resupination (p =. 53). Some complaints experienced by respondents during the application of prone position, namely back pain were reported by 10 patients (42%). Then, on the 10th day, 5 respondents needed mechanical ventilation and 4 out of 5 were respondents who were unable to do prone positions for 1 hour or more and required intubation within 72 hours.

The use of breathing aids can be minimized due to an increase in oxygenation status after prone positioning. This is supported by research conducted which says that the position is prone proven to increase oxygenation and reduce mortality in ARDS that are not related to COVID-19.[11] Increased oxygenation occurs because the prone position can reduce lung compression in the back region and increase lung perfusion.[12]

Although the prone position affects the increase in oxygenation, the increase in oxygenation cannot be maintained in the long run.[13] This is in agreement with the study conducted in 15 non-intubating patients and reported a significant increase in PaO2 after the prone position compared to before doing the prone position, but PaO2 returned to the initial level (before the prone position) at 6 hours after repositioning.[14] This condition is influenced by the number of sessions per day and the respondent's compliance in conducting prone positions in each session. One of the things that can affect patient compliance in the application of prone positions in each session is comfort. Some respondents (42%) felt uncomfortable complaining of back pain.

In addition, respondents are also at risk of experiencing skin damage and edema of the face. Efforts to overcome this are by frequently repositioning every 2 hours, providing soft pads or layers and increasing nurse awareness in monitoring patient complaints. If comfort can be improved, respondents can apply the prone position according to the expected duration so that the effects of the intervention can be felt such as an increase in saturation, shorten the duration of hospitalization and stabilize the respiratory rate. [16, 17]

There was an increase in oxygen saturation from before the prone position of 94% to 98% one hour after prone positioning.[16] The average ratio between oxygen saturation during the prone position and one hour after the prone position is 46%. Respondents initially had oxygen saturation which is an average of 92% and received oxygen therapy of 1-3 L experienced an increase in oxygen saturation so that 9 out of 10 respondents managed to wean oxygen, can return to spontaneous breathing and does not require intubation.[8] Besides that, patients who experience increased oxygen saturation can also shorten the duration of hospitalization by about 2-7 days.

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Enhancement This oxygen saturation is influenced by the length of application of the prone position which is around 17-20 hours which is divided into 4 sessions per day.[12, 13] In addition to oxygen saturation, the prone position also influences the respiratory rate of COVID-19 patients with respiratory distress. This is consistent with the results of the study which says that there is a decrease in the average rate of breathing after prone positions from 31 x / min to 22 x / min.[15] This decrease in respiratory frequency occurs because the prone position can encourage secretion from the lungs to the airway and follow gravity so that the breathing muscles work lightly.[17]

Conclusion

Based on the description above, it can be concluded that the prone process can be an alternative management of respiratory status of COVID-19 patients. Prone position is considered to have an effect on respiratory status by increasing oxygen saturation, stabilizing respiratory frequency, comfort and shortening duration long of stay (LOS).

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