CASE STUDY

Tripod Position as A Novel Adjunct Clinical Management of Moderate to Severe ARDS in COVID-19 Patients: A Case Series and Review

Ryan T. Uy, RN, CCN[1*], **Gerard Vincent A. Aguas**, MD, MN, RN[1], **Portia Ann M. Aquino**, MSN, RN[1]
Rhada E. Mendoza, RN, CCN[1] and **Rey Benedict Raniaga**, MSN, RN, MSN[1]

Abstract

Objective: The World Health Organization (WHO) recommends prone positioning for mechanically ventilated COVID-19 patients with Acute Respiratory Distress Syndrome (ARDS) to improve oxygenation. Subsequently, researchers facilitated the position to non-intubated COVID-19 patients as early management which showed significant improvement but with discerned limitations. Tripod position is explored as an alternative exhibiting promising results. This present study describes a case series of four COVID-19 patients with moderate to severe ARDS who demonstrated considerable breakthrough.

Methods: Four COVID-19 cases of moderate to severe ARDS were instructed to do tripod positioning as long as they can tolerate while under close supervision.

Results: An hour after assuming tripod position, all four patients presented a decrease in respiratory rate, increase in peripheral oxygen saturation, and increase in partial oxygen saturation in arterial blood gas. The assumed position was maintained by four patients without discomfort and was maintained with a mean of 12 - 20 hours per day.

Conclusions: Our findings confirmed that tripod position is advantageous to non-intubated COVID-19 patients with moderate to severe ARDS and may delay or prevent invasive mechanical ventilation. The position also manifested tolerance to extended duration which permitted time for the medical team to focus on managing their disease in its entirety. Nevertheless, certain aspects such as contraindication, side effects, and other adverse events that may occur have yet to be sufficiently clarified and investigated.

Keywords: *tripod position, prone position, acute respiratory distress syndrome, covid-19, dyspnea-relieving position*

Introduction

COVID-19, a novel virus in its sense continuously inflicts detrimental effects on human health throughout the world and it is spreading exponentially. This unprecedented virus has been exhausting health resources all over the globe.

Locally, the current burden of the disease is enormous. The Department of Health reports a total of 404,713 total cases of Covid-19, 83.9%- mild; 0.12%- moderate; 0.12% - severe; 4.3%- critical; and 1.92% died (DOH COVID-19 Casetracker, n.d.).

COVID-19 Pneumonia, in its severe form, can cause Acute Respiratory Distress Syndrome (ARDS) therefore may necessitate intubation and invasive mechanical ventilation in those patients who are critically ill. Intubation should not be delayed if the patient acutely deteriorates or does not improve (World Health Organization, 2020). This intervention conveys risk to both patients and healthcare workers who are directly managing their disease. This could also cause a strain on the hospital's resources during a pandemic where mechanical ventilators are inadequate. That is why researchers worldwide are delving into simple, safe yet effective interventions that can be utilized to avert critical deterioration.

In current studies, positioning is one of the management that are presently explored as an adjunct intervention to improve patients' oxygenation although clinicians must be aware that there is a

[1] Central Luzon Doctors' Hospital
[*] Corresponding author email: uyryanrn@gmail.com

small evidence base for this intervention at present. Prone position has been revealed to have a beneficial effect on patients who are experiencing ARDS in awake Covid-19 patients but with assumed limitations like tolerance especially to awake patients that is why clinical trials are still being executed.

Another position that is used for patients with ARDS is the Tripod position. It is done when the patient is sitting and leaning forward posture with their outstretched hands on their knees or arms propped forward a bedside table. The forward-leaning position improves dyspnea by several mechanisms. This stance has been studied as an effective dyspnea-relieving position on patients with COPD (Sarkar M. et al., 2019). However, there are no published trials or experiments that investigated the efficacy of this position in connection with COVID-19 patients suffering from moderate to severe ARDS at present.

The objective of the study was to describe the effectiveness of tripod position in a case series of four patients with moderate to severe ARDS in Covid-19 who showed significant improvement, particularly to their oxygen saturation after assuming tripod position.

Case series

A total of 8 Covid-19 patients with moderate to severe ARDS were instructed to do a tripod position at our hospital for the duration of the study. The researchers described four cases in which the assumed position was utilized because of its dyspnea-relieving mechanism.

1.1 Case A

A 43-year old female with a history of type 2 diabetes mellitus, with a sudden onset of difficulty of breathing presented to the hospital, and with 3 days of dry cough and fever. She was admitted to the critical Covid-19 unit with severe ARDS. Her vital signs upon admission were as follows: Temperature 38.2 ºC, blood pressure (BP) 140/90 mmHg, heart rate (HR) 118 beats per minute (bpm), respiratory rate (RR) 45 breaths per minute, Peripheral oxygen saturation (Sp02) 72% at room air, while on 15L per minute (LPM) oxygenation with a non-rebreather mask the saturation increase to 88%. The arterial blood gas (ABG) analysis showed the following: pH: 7.373, pCO2: 39.7, p02: 48, HC03: 22.1 B.E.: -2.4, 02 saturation: 83.9%. Chest X-Ray demonstrated bilateral, peripheral consolidations. Other blood tests were initiated such as D-dimer, Procalcitonin, Ferritin, CBC, and Electrolytes. The patient was instructed to do proning but was unable to do so due to intolerance. She was then placed on a high backrest. After an hour of monitoring, the patient's oxygen saturation decreased and an immediate referral and assessment were relayed to the resident doctor. Consecutively, the patient assumed a self-forward-leaning position on the side of her bed

then a sudden increase of oxygen saturation from 88% to 99% was noted and a decrease of RR 32. After five hours of monitoring, the patient stayed on the assumed position and a repeat ABG was utilized and results were as follows: pH: 7.573, pC02: 35.9, p02: 95.5, HC03: 29.3, B.E: 5.3, O2 saturation: 97.9%. On the following days of her confinement, she continued to assume a tripod position (for a mean duration of 16 hours a day) and gradually decreased her need for oxygen supplementation. After 6 days, she was weaned off from a non-rebreather mask to nasal cannula at 5LPM, placed back to her bed on semi- fowler's position, and transferred to a step-down department for further care.

Figure 1. *Tripod position to ARDS Covid-19 patients. Patient was placed in a tripod position sitting on the side of the bed leaning forward with the arm extended on a surface of a table supporting her head with a pillow. (see figure and charts document).*

1.2 Case B

A 63-year old female with type 2 uncontrolled diabetes mellitus and hypertension was rushed to the emergency department due to difficulty breathing with initial vital signs as follows: BP 150/90mmHg, HR 102, RR 35, temperature 36.6 ºC, Sp02 89% at room air. She was hooked to a non-rebreather mask at 10LPM and her oxygen saturation increased to 92%. Laboratory exam confirmed positive RT-PCR test result and Chest X-ray showed bilateral pneumonia, ABG results were as follows: pH: 7.441, pC02: 31.4, pO2: 64.7, HCO3: 22.6, B.E: -2.1, O2 saturation: 93.6%. She was placed in tripod position by providing a simple table and placed at the side of the bed and do forward-leaning with arms extension supporting her head with a pillow and an improved oxygenation level was noted. The O2 saturation increased to 97%, RR decreased to 25, HR decreased to 60, and she verbalized relief on dyspnea. She continued assuming the position until tolerated (mean duration of 18hours a day) and was weaned off from oxygen support and transferred to the step-down department for further care.

1.3 Case C

A 34-year old female with no known comorbidity was admitted due to severe DOB with the following vital signs: BP 110/90mmHg, RR 53, HR 126bpm, temperature 36.7 ºC, and SpO2 90% at room air. ABG was ordered with the following results: pH: 7.376, pC02: 32.9, p02: 71.1, HC03: 20.1, B.E: -5.3, O2 saturation: 92.93%. She was given oxygen therapy via a non-rebreather mask at 10 LPM and Sp02 rose to 94%. Upon history taking, the patient was known to be the daughter of patient B and was exposed to her. The patient is confirmed positive to RT-PCR swab test and Chest X-ray showed bilateral infiltration. After placing the patient on a tripod position, an improved oxygenation level was noted. A repeat ABG was ordered after 6hours with the following results: pH: 7.442, pC02: 33.1, pO2: 89.2, HC03: 23.4, B.E: -1.3, O2 saturation: 97.2%. The patient also verbalized a relief on breathing difficulty and with an RR of 30. She continued assuming the said position (mean duration of 12hours a day). Three days later, she was transferred to the step-down unit for further care.

1.4 Case D

A 56-year old male with stage 1 hypertension with a chief complaint of difficulty breathing presented in the facility. Baseline data were as follows: BP 140/80mmHg, RR 46, HR 98bpm, temperature: 37.0ºC, and Sp02 80%. ABG results were as follows: pH: 7.424, pC02: 38.6, pO2: 56.7, HCO3: 24.2, B.E: -2.3, Oxygen Saturation 78%. Oxygen delivery support was given to the patient via a non-rebreather mask at 15LPM with an increase of Sp02 of 90% and standby intubation was ordered. Chest X-ray and other laboratory tests were done with an initial impression of Covid-19 infection and the patient was then transferred to Covid-19 critical unit. Tripod position was instructed and he complied with the position. A sudden improvement in oxygenation level was noted after an hour of maintaining the position and intubation was prevented. Vital signs taken after an hour were as follows: BP 130/90, RR 19, HR 66bpm, Sp02 98%, and the patient expressed relief of dyspnea. A repeat ABG was ordered after 12 hours with the following results: pH: 7.313, pC02: 29.0, p02: 93.4, HCO3: 16.5, B.E: -10.2, Oxygen saturation: 97.7%. The patient tolerated the tripod position with a median of 20 hours a day. Five days later, he was weaned off to oxygen support and was transferred to the mild Covid-19 wing.

Discussion

Prone positioning is indicated in ARDS patients who fulfill the Berlin criteria (Fröhlich et al., 2012). The suggested mechanisms by which prone positioning improves these patient's oxygenation include recruitment of the non-aerated dorsal lung territories and a resultant improvement in ventilation-perfusion mismatches.

Figure 2. *Tripod position to ARDS Covid-19 patient. Patient was instructed to sit on a chair leaning forward on the side of the bed with arm extension supporting his head with a pillow. Peripheral oxygen saturation increases to 98 percent after an hour of tripod position. (see figure and charts document).*

The clinical relevance is based upon lung tissue distribution within the chest cavity. A substantially greater proportion of lung tissue is oriented toward the dorsum of the chest which is about 50%. In addition, the gravitational effects on pulmonary gas distribution are determined by spatial distribution in alveolar sizes at the commencement of inspiration. The combined effects of gravity and the greater tissue mass suspended from a larger dorsal chest wall area produce more equal stress distribution throughout the lung, resulting in a more uniform alveolar size (Kallet, 2015).

Early recognition and application of awake prone positioning together with high flow nasal cannula (HFNC) or non-invasive ventilation that may enable avoidance of endotracheal intubation was demonstrated (Ding et al., 2020).

Prone positioning is no doubt to be effective in lung recruitment maneuvers; however, this improvement was not maintained when patients were placed back in the supine position because of intolerance (Coppo et al., 2020). To address the issue of intolerance researchers used light sedation to achieve long hours of pronation (Taboada et al., 2020). With tripod position, it is being executed by sitting on a chair and leaning forward with arm extension to a side of the bed supporting the head. It is also being utilized by our body as a natural reaction to dyspnea to compensate with the oxygen demand using the accessory muscles by several mechanisms, thus, improves oxygen saturation (Bhatt et al., 2007; (Zuriati et al., 2020). Applying the principle behind prone position, tripod position was utilized. However, there is no related study in connection to Covid-19 with ARDS.

Figure 3. *Summary of Oxygen Saturation monitoring to Patient A, B C and D from baseline with oxygen support via Non rebreathing mask and after on Tripod position*
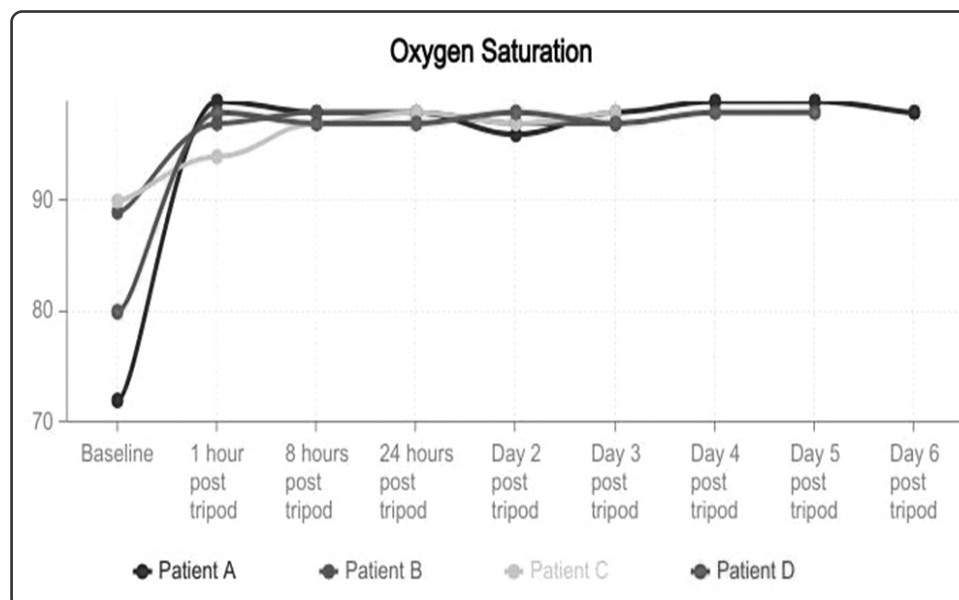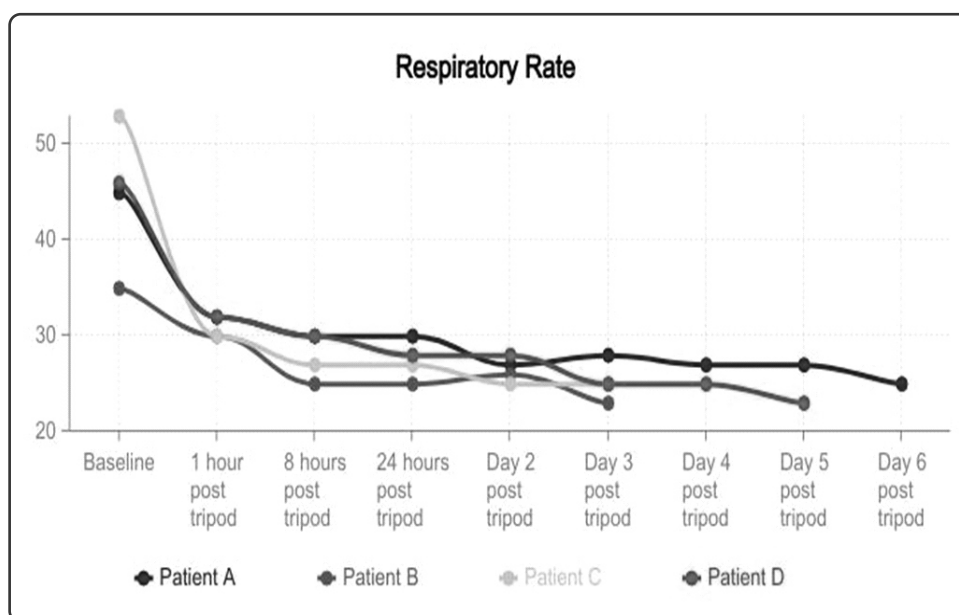

Figure 4. *Summary of Respiratory rate (breath per minute) monitoring to Patient A, B, C and D from baseline data and after on Tripod position*

Data shows baseline partial oxygen saturation on ABG of Patient A = (72); B = (89); C= (90) and D = (80) that were already receiving oxygen support. Patients were instructed to assume a tripod position as much as they can tolerate. Continuous peripheral oxygen saturation monitoring was made and the record showed a remarkable increase in oxygen saturation [Patients A = (99%); B = (97%); C = (94%); and D = (98%)] after an hour of the assumed position. Patients' oxygen saturation was maintained after 8 hours up to several days on tripod position and were able to be weaned off from oxygen support via non-rebreather mask to nasal cannula and transferred to the step-down unit for further monitoring.

The baseline data for respiratory rate of the patients (A=45 breaths per minute; B=35 breaths per minute; C=53 breaths per minute; and D=46 breaths per minute) significantly improved after an hour of tripod position (A= 32 breaths per minute; B= 30 breaths per minute; C= 30 breaths per minute; D= 32 breaths per minute) and this was sustained throughout the entire period of assuming the said position.

Conclusion and Recommendation

Based on the researchers' experience, exemplified in the cases herein, tripod position can be used as an alternative intervention with oxygen support via a non-rebreathing mask to moderate to severe Covid-19 with ARDS in improving their oxygenation with toleration to long hours of application and able to recover from severe hypoxemia.

Cases A, B, C, and D data showed that they were able to tolerate long hours on assumed position with mean hours of 16, 18, 12, and 20 hours per day, respectively.

Tripod position shows its efficacy in increasing oxygen saturation to the body. Its convenience and lesser limitations allow patients to maintain their posture for a prolonged duration. Relatively with the dyspnea-relief position discussed by Bhatt et.al (2009), respiratory effort decreased and stabilized back to above normal on succeeding days of utilizing the tripod position.

In addition, the researchers ascertained that this position can potentially be applied as early management that can delay or impede invasive mechanical ventilation.

It is recommended that further study on the application of the tripod position be conducted on future Covid-19 patients.   As of this time, the researchers are currently in the process of establishing the effectiveness of implementing the tripod position versus prone to patients in moderate to severe ARDS of Covid-19, thereby, strengthening the conclusions made by this study.

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ABOUT THE AUTHORS

Ryan T. Uy. RN, CCN, obtained his baccalaureate degree at Central Luzon Doctors Hospital Educational Institution (CLDH-EI), batch 2009. He completed his Critical Care Nurse course at Philippine Heart Center last 2020. He currently holds the position of staff Nurse in COVID-19 Critical Care Unit. He is also currently taking up a Masters of Science in Nursing Major in Nursing Administration at CLDH-EI. His primary research interest is for COVID-19 nursing management.

Gerard Vincent A. Aguas, MD, MN, RN, Internal Medicine specialist. A graduate of BS Nursing, Master in Nursing and Doctor of Medicine at Angeles University Foundation. He has completed his research on Empathy and Stress Levels of Medicine Students and Residents in Training.

Portia Ann M. Aquino, MSN, RN currently works as the Assistant Chief Nurse for Education, Training and Research at Central Luzon Doctors' Hospital in Tarlac City. She gained her Bachelor of Science in Nursing at the CLDH – Educational Institution, as well as her post graduate degree as Master of Science in Nursing, majoring in Nursing Administration and garnering both Loyalty and Meritus awards. Her professional interest is geared towards specialization in Quality Management, Critical Care and Resuscitation, and licensed as an American Heart Association Provider and Instructor for Basic and Advanced Cardiovascular Life Support disciplines. Her Quality Improvement paper entitled "Strengthening Leadership Influence to Reinforce Ritual Practice of Hand Hygiene" has been accepted for storyboard presentation during the Institute for Healthcare Improvement Patient Safety Congress in Orlando, Florida last year.

Rhada E. Mendoza, RN, CCN acquired her BSN diploma at Ecumenical Christian College in 2010 and is currently completing her Masters of Science in Nursing Major in Nursing Administration at Central Luzon Doctors' Hospital-EI. She commenced her Critical Care Nursing Course at the Philippine Heart Center last 2019. At present, she is assigned as the Continuing Nursing Education Officer under the Division of Education, Training and Research of CLDH focusing on nursing systems improvement and innovation, staff training and development, and critical care nursing management.

Rey Benedict Raniaga, MSN, RN earned his Bachelor of Science in Nursing at Central Luzon Doctors' Hospital-Educational Institution in 2005. He also obtained his Master of Science in Nursing, Major in Nursing Administration at the same institution in 2013. He is currently the Chief Nursing Officer of Central Luzon Doctors' Hospital and a Professional Lecturer for the graduate school-MSN program of CLDH-EI. His research interests are clinical practice, advanced nursing practice and nursing management.