

Prone Positioning and COVID-19-Related Acute Respiratory Distress

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The prone position is a non-invasive technique resulting from the mobilization of the patient, where the person is lying horizontally face down. This technique has been used since the 1970s, but it has gained great relevance in the last year owing to the COVID-19 pandemic with the use of invasive mechanical ventilation.

Keywords: acute respiratory distress syndrome ; prone position ; intensive care unit ; pressure ulcers

1. Introduction

The current outbreak of pneumonia caused by a new coronavirus, so-called SARS-CoV-2, is the subject of numerous investigations owing to its great impact on global public health, as well as its economic and social repercussions. Because it is an emerging virus, little is known about it, although, after being declared a pandemic on 11 March 2020, many professionals and subject matter experts from around the world immediately went to work to find the greatest amount of information in this regard and in the shortest possible time ^[1].

Acute respiratory distress syndrome (ARDS) is a clinical picture characterized by inflammation and increased permeability in the alveolocapillary membrane that causes, as a consequence, an acute and severe injury, of both the lung structure and function. In addition, it leads to the appearance of pulmonary edema of non-cardiogenic origin, as a result of increased alveolar vascular permeability, causing acute respiratory failure ^{[2][3]}.

Supportive strategies include prone ventilation (PP), neuromuscular blockade and sedation, fluid management, and nutritional support. Even so, patients often do not respond correctly to these measures and show progressive clinical deterioration ^{[4][5]}. The PP is an anatomical position resulting from the mobilization of the patient, involving the person lying horizontally face down, resting on his chest and abdomen on a surface, with the neck in a neutral or to one side, and with arms and legs extended ^{[6][7][8]}. The first studies focusing on the management of patients with IMV in the prone position appeared in the 1970s, which demonstrated the potential benefits of this position on oxygenation and pulmonary mechanics in ARDS ^{[9][10]}. It is a non-invasive and complex application procedure, characterized by placing the patient face down, with the neck in a neutral position or slightly flexed to one side, the upper limbs (MMSS) glued to the trunk with the palms of the hands down, and the lower extremities (MMII) stretched out, with the feet in neutral flexion and fingertips down ^{[10][11]}. The procedure is increasingly used in the ICU, as the patient usually encounters IMV and requires qualified personnel to perform it ^[12]. The PP technique is validated in patients with ARDS COVID-19, both in patients with spontaneous respiration as well as with non-invasive ventilation and invasive mechanical ventilation ^{[13][14]}.

The general objective of this work is to determine if the prone position is effective in the treatment of COVID-19 disease in critical patients in the ICU, as well as to identify the respiratory physiological benefits of the position in patients with acute respiratory distress syndrome subject to invasive mechanical ventilation (MV).

2. Effectiveness of Prone Positioning in Patients with COVID-19 Related Acute Respiratory Distress Syndrome Undergoing Invasive Mechanical Ventilation

The determination of the effectiveness of the PP in the treatment of COVID-19 disease in critical patients in the ICU is consistent by all authors ^{[15][16][17]}, as long as the patient is found with IMV and moderate to severe ARDS ^[17], with a prolonged duration of each pronation cycle 18 and from the second or third cycle of each episode ^[18]. In contrast, this strategy showed little or no ventilatory benefit in those patients who ended up requiring ECMO therapy or who died ^[19]. In addition, some of the studies found that the pronation procedure, in addition to improving the oxygenation status of the patients, increased the survival rate ^[20] and decreased the mortality rate ^[21], provided that a prolonged duration of posture

and was established early (less than 48 h from the onset of the disease) [22]. The relative limitations for performing the PP technique are the presence of medical devices on the face, as well as increased tissue moisture and facial edema [20][21][22]. However, the bibliographic review carried out by Campello C, et al., in 2015, reports that there was insufficient evidence to demonstrate that the prone position decreased the mortality rate in patients with ARDS, regardless of the pathological origin of said syndrome [23].

To demonstrate the nursing care performed on the patient in the prone position as a result of COVID-19, aimed at the prevention and treatment of pressure ulcers, it is revealed that, even applying the usual preventive measures, pressure ulcers have appeared in all cases and are considered serious [24]. However, most of the selected studies emphasize the importance of carrying out correct prevention by controlling the areas exposed to pressure to avoid it [25][26][27], being the best treatment for them [28]. One of the aspects that has generated the most controversy is the lack of consensus between the most appropriate dressing in the treatment of these injuries. While one advises the use of only paraffin or alginate gauze, if the wound is highly exudative [29], others use multilayer silicone dressings [17][30], and others use hydrocolloid dressings [30]. In addition, one of the studies advises against surgical treatment [31]. On the other hand, two studies advise the use of specific padded devices for the management of pressure in the head [31][32], and two others highlight the importance of providing good nutritional intake for the prevention and treatment of pressure ulcers [18][32]. The rest of the articles found related to the care of pressure ulcers name different recommendations that neither contradict nor are specified in more than one of them. These recommendations are the occlusion of the eyes with occlusive dressings for the prevention of corneal ulcers, changing the position of the head two to three times in each session [32] and the use of clonaphenicol in the eyes to avoid infections [33].

In the same way, it has been shown that this therapeutic technique promotes the drainage of secretions, as there is an improvement in the redistribution of pressure and volumes of those lung areas with an imbalance in ventilation/perfusion, which contributes to the prevention or decreased pulmonary edema [34][35].

Among the limitations of the research, it is necessary to mention that, although the methodology allows to achieve the main objective, allowing a direct explanation of the effectiveness of the PP in patients with ARDS related to COVID-19 subjected to IMV, as a source for the plans of health care, some questions of interest would require complementary treatment, as this study is considered as a first approximation that requires greater depth.

3. Conclusions

The prone position is an effective strategy in the management of COVID-19 patients, demonstrated by adequate support with IMV, in ARDS classified from moderate to severe, from the second or third pronation cycle and performing prolonged cycles. This position reduces mortality and increases survival in this type of patient.

References

1. Ministry of Health, Government of Spain. Spanish Agency for Medicines and Health Products (AEMPS) Recommends the Authorization of the First Vaccine against COVID-19. 2020. Available online: <https://www.aemps.gob.es/informa/notasinformativas/laaemps/2020-laaemps/la-ema-recomienda-la-autorizacion-de-la-primera-vacuna-frente-a-la-covid-19/> (accessed on 21 July 2021).
2. Sweeney, R.M.; McAuley, D.F. Acute respiratory distress syndrome. *Lancet* 2016, 388, 2416–2430.
3. Luis, N.; Sánchez, I.; Bengoetxea, U.X.; Rodrigo, M.P.; García, J.M.; Aguilera, L. Síndrome de distrés respiratorio agudo: Revisión a propósito de la definición de Berlín. *Rev. Española de Anestesiología y Reanimación* 2014, 61, 319–327.
4. Cardinal-Fernández, P.; Correger, E.; Villanueva, J.; Rios, F. Distrés respiratorio agudo: Del síndrome a la enfermedad. *Med. Intensiva* 2016, 40, 169–175.
5. Rodríguez, R.D.; Ordoñez, S.A.; Gómez, J.L.; Camargo, M.E. Decúbito prono en el Síndrome de Dificultad Respiratoria Aguda, de la fisiología a la práctica clínica. *Rev. Méd. UIS* 2016, 29, 81–101.
6. Mitchell, D.A.; Seckel, M.A. Acute respiratory distress syndrome and prone positioning. *AACN Adv. Crit. Care* 2018, 29, 415–425.
7. Pham, T.; Rubenfeld, G.D. The epidemiology of Acute Respiratory Distress Syndrome. A 50th Birthday Review. *Am. J. Respir. Adn Crit. Care Med.* 2017, 195, 860–870.
8. García, J.; Piqueras, J.; Ortiz, M.C.; Martínez, M.C.; Carrilero, C.; Torralba, M.; Cebrian, E.; Cuesta, M.C.; Murcia, I. Protocolo maniobra de decúbito prono en el servicio de medicina intensiva. Castilla la Mancha (SESCAM). 2018.

9. Mora-Arteaga, J.A.; Bernal-Ramírez, O.J.; Rodríguez, S.J. Efecto de la ventilación mecánica en posición prona en pacientes con síndrome de dificultad respiratoria aguda. Una revisión sistemática y metanálisis. *Med. Intensiva* 2015, 39, 352–365.
10. Campello, C.; Vidal, A.; Del Saz, M.I.; Tomás, A.; Villaescusa, M.C. La terapia decúbito prono desde la perspectiva de la enfermera de UCI: Una revisión integrativa. *Rev. Científica De Enfermería* 2015, 12, 1–16.
11. Xu, Y.; Deng, X.; Han, Y.; Zhou, L.; He, W.; Chen, S.; Nong, L.; Huang, H.; Zhang, Y.; Yu, T.; et al. A multicenter retrospective review of prone position ventilation in treatment of severe human H7N9 Avian Flu. *J. Pone* 2015, 10, e0136520.
12. Jové, E.; Villarrasa, A.; Ortiz, D. Análisis de las complicaciones del decúbito prono en el síndrome de distrés respiratorio agudo: Estándar de calidad, incidencia y factores relacionados. *Enf. Intensiva* 2017, 28, 125–134.
13. Huerta, Y.; Valencia, A.L. Cuidados de Enfermería durante la posición en decúbito prono al paciente con síndrome de dificultad respiratoria. *Rev. Mex. Enf.* 2020, 8, 70–75.
14. González, C.A.; Rentería, F.J.; Martínez, R.; Wilfrido, U. Impacto del decúbito prono en el síndrome de insuficiencia respiratoria aguda en pacientes con COVID-19 bajo ventilación mecánica invasiva. *Med. Crit.* 2020, 34, 326–329.
15. Kim, W.; Kang, B.; Chung, C.; Park, S.; Oh, J.; Park, S.; Cho, W.H.; Sim, Y.S.; Cho, Y.-J.; Park, S.; et al. Prone positioning before extracorporeal membrane oxygenation for severe acute respiratory distress syndrome: A retrospective multicenter study. *Med. Intensiva* 2018, 43, 402–409.
16. Guérin, C.; Albert, R.K.; Beitler, J.; Gattinoni, L.; Jaber, S.; Marini, J.J.; Munshi, L.; Papazian, L.; Pesenti, A.; Vieillard-Baron, A.; et al. Prone position in ARDS patients: Why, when, how and for whom. *Intensive Care Med.* 2020, 46, 2385–2396.
17. Weiss, T.T.; Cerda, F.; Scott, J.B.; Kaur, R.; Sungurlu, S.; Mirza, S.H.; Alolaiwat, A.A.; Kaur, R.; Augustynovich, A.E.; Li, J. Prone positioning for patients intubated for severe acute respiratory distress syndrome (ARDS) secondary to COVID-19: A retrospective observational cohort study. *Br. J. Anaesth.* 2020, 126, 48–55.
18. Peko, L.; Barakat-Johnson, M.; Gefen, A. Protenting prone positioned patients from facial pressure lacerations using prophylactic dressing: A timely biomechanical analysis in the context of the COVID-19 pandemic. *Int. Wound J.* 2020, 17, 1595–1606.
19. Ibarra, G.; Rivera, A.; Fernandez-Ibarburu, B.; Lorca-García Gacia-Ruano, A. Prone position pressure sores in the COVID-19 pandemic: The Madrid experience. *J. Plast. Reconstr. Aesthetic Surg.* 2020, 79, 2141–2148.
20. Martel, T.; Orgill, D.P. Medical Device- Related Pressure Injuries During the COVID-19 Pandemic. *J. Wound Cont. Nurse* 2020, 47, 430–434.
21. Perrillat, A.; Foletti, J.M.; Lacagne, A.S.; Guyot, L.; Graillon, N. Facial pressure ulcers in COVID-19 patients undergoing prone positioning: How to prevent an underestimated epidemic. *J. Stomatol. Oral Maxillofac. Surg.* 2020, 121, 442–444.
22. Sleiwah, A.; Nair, G.; Mughal, M.; Lancaster, K.; Ahmad, I. Perioral pressure ulcers in patients with COVID-19 requiring invasive mechanical ventilation. *Eur. J. Plast. Surg.* 2020, 15, 1–6.
23. Singh, C.; Tay, J.; Shoqirat, N. Skin and Mucosal Damage in Patients Diagnosed With COVID-19. *J Wound Ostomy Cont. Nurs* 2020, 47, 425–438.
24. Carrillo, R.; Mejía, L.; Monares, E.; Chavarría, U.; Díaz, A.; Ayala, M.; Zamora, S.; Sánchez, J.S.; Lomelí, M.; Briones, J.C.; et al. Hemodynamic and mechanical ventilation approach in patients with COVID-19. *Cir. y Ciruj.* 2020, 88, 805–817.
25. Concha, P.; Treso-Geira, M.; Esteve-Sala, C. Invasive mechanical ventilation and prolonged prone position during the COVID-19 pandemic. *Med. Int.* 2020, 65, 221–226.
26. Chen, Y.; Zhang, J.; Feng, H.; Wan, F.; Zhang, Y.; Tan, L. Prone positioning in intubated and mechanically ventilated patients with SARS-CoV-2. *J. Clin. Anest.* 2021, 10, 1–9.
27. Coppo, A.; Bellani, G.; Winterton, D.; Di Pierro, M.; Soria, A.; Faverio, P.; Cairo, M.; Mori, S.; Messinesi, G.; Contro, E.; et al. 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. *Lancet Respir. Med.* 2020, 8, 765–774.
28. Pierucci, P.; Ambrosino, N.; Di Lecce, V.; Dimitri, M.; Battaglia, S.; Boniello, E.; Portacci, A.; Resta, O.; Carpagano, G.E. Prolonged Active Prone Positioning in Spontaneously Breathing Non-intubated Patients With COVID-19-

29. Bastoni, D.; Poggiali, E.; Vercelli, A.; Demichele, E.; Tinelli, V.; Iannicelli, T.; Magnacavallo, A. Prone positioning in patients treated with non-invasive ventilation for COVID-19 pneumonia in an Italian emergency department. *Emerg. Med. J.* 2020, 37, 565–566.
30. Qadri, S.K.; Ng, P.; Toh, T.S.W.; Loh, S.W.; Tan, H.L.; Lin, C.B.; Fan, E.; Lee, J.H. Critically Ill Patients with COVID-19: A Narrative Review on Prone Position. *Pulm. Ther.* 2020, 6, 233–246.
31. Langer, T.; Brioni, M.; Guzzardella, A.; Carlesso, E.; Cabrini, L.; Castelli, G.; Dalla Corte, F.; De Robertis, E.; Favarato, M.; Forastieri, A.; et al. Prone position in intubated, mechanically ventilated patients with COVID-19: A multi-centric study of more than 1000 patients. *Crit. Care* 2021, 25, 128.
32. Vollenberg, R.; Matern, P.; Nowacki, T.; Fuhrmann, V.; Padberg, J.S.; Ochs, K.; Schütte-Nütgen, K.; Strauß, M.; Schmidt, H.; Tepasse, P.R. Prone Position in Mechanically Ventilated COVID-19 Patients: A Multicenter Study. *J. Clin. Med.* 2021, 10, 1046.
33. Lucchini, A.; Bambi, S.; Mattiussi, E.; Elli, S.; Villa, L.; Bondi, H.; Rona, R.; Fumagalli, R.; Foti, G. Prone Position in Acute Respiratory Distress Syndrome Patients: A Retrospective Analysis of Complications. *Dimens. Crit. Care Nurs.* 2020, 39, 39–46.
34. Ng, J.A.; Miccile, L.A.; Iracheta, C.; Berndt, C.; Detwiller, M.; Yuse, C.; Tolland, J. Prone Positioning of Patients With Acute Respiratory Distress Syndrome Related to COVID-19: A Rehabilitation-Based Prone Team. *Phys. Ther.* 2020, 100, 1737–1745.
35. Araújo, M.S.; Santos, M.M.P.D.; Silva, C.J.A.; Menezes, R.M.P.; Feijão, A.R.; Medeiros, S.M. Prone positioning as an emerging tool in the care provided to patients infected with COVID-19: A scoping review. *Rev. Lat. Am. Enfermagem.* 2021, 29, e3397.