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Review

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

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Abstract: 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. Objectives: To evaluate the effectiveness of the prone position in patients with acute respiratory distress syndrome as a consequence of the COVID-19 disease who are mechanically ventilated and admitted to the intensive care unit. To demonstrate the nursing care carried out and to identify the respiratory benefits of the prone position in this type of patient. Data sources, study eligibility criteria: The search for articles was carried out from January 2018 to June 2021, in five databases (Pubmed, Google Scholar, Scielo, Dialnet, and WOS), based on the clinical question, using the keywords derived from the DeCS and MeSH thesauri, combined with the Boolean operators "AND", "NOT", and "OR". The search was limited to publications from the last 6 years, in English. Results: After applying the selection criteria and evaluating the quality of the methodology, 12.14% (n = 21) of the 173 results were included with filters: 3 bibliographic reviews, 1 narrative review, 2 systematic review, 7 descriptive (4 series of cases and 3 of cross section), and 8 analytical (6 of cohorts and 2 of cases and controls). Conclusions and implications of key findings: The prone position in adults with acute respiratory distress syndrome improves oxygenation, in conjunction with invasive mechanical ventilation, from the second cycle and in prolonged pronation episodes. This technique improves oxygenation by increasing alveolar recruitment and inspiratory capacity in the dorsal pulmonary areas.

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

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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].

1.1. Acute Respiratory Distress Syndrome

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].

Its clinical manifestations are as follows: acute onset, severe hypoxemia, increased physiological dead space, decreased lung compliance (or compliance), and the appearance of diffuse bilateral infiltrates on chest radiography [3]. The Berlin definition defines ARDS as "a type of acute, diffuse, inflammatory lung injury, characterized by increased vascular permeability and loss of pulmonary aeration, the clinical characteristics of which are hypoxemia and bilateral opacities associated with increased pulmonary shunt and physiological dead space". The absence of a universally accepted definition over time has been an impediment to its diagnosis and research [2,4]. Currently, the diagnosis of ARDS is made based on the criteria established in the Berlin definition. It is very important to perform the differential diagnosis with other pathologies, such as cardiogenic pulmonary edema or cancer, as a large number of situations can cause a similar hypoxemic picture and lead to erroneous diagnoses [5]. The treatment of ARDS is aimed at early recognition and correction of the etiological cause, through interdisciplinary therapeutic strategies taught by the staff of the intensive care unit (ICU) [5]. The use of non-invasive mechanical ventilation (NIMV) has been suggested as part of the initial treatment of ARDS, despite the fact that most of these patients will end up requiring invasive mechanical ventilation (IMV). However, there is insufficient evidence for its recommendation and its application may worsen the patient's prognosis owing to delayed endotracheal intubation [3].

1.2. Prone Position

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 [6–8]. 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 [8–10]. 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].

1.3. Coronavirus

Coronaviruses (CoVs) constitute a broad family of enveloped viruses composed of non-segmented, positive-sense RNA strands. Like other RNA viruses and unlike DNA viruses, they have a great capacity for mutation and genetic recombination, which provides them with a remarkable capacity for adaptation and evasion of the immune response produced by the host [15]. The first four cause colds and rarely infections, and the last three are highly capable of causing lower respiratory tract infections, including severe atypical pneumonia, which can progress to respiratory failure and ARDS [15,16]. Structurally, coronaviruses consist of enveloped, polymorphic, or spherical virions, with a size that varies between 80 and 120 nm in diameter. The genome is composed of positive polarity, unsegmented, single-stranded RNA loaded with about 27 to 32 kb. These RNA base pairs encode at least 16 non-structural and 4 structural proteins [16]. Non-structural proteins perform different functions that determine various processes in the virus itself and in the host cell [17,18].

The clinical manifestations that develop present a wide spectrum that ranges from the total absence of symptoms or mild symptoms of general malaise (80%), to more serious

forms that require intensive hospital care and that have a high mortality rate (5%). The remaining 15% consist of moderate symptoms where, according to the "Report of the Center for the Coordination of Health Alerts and Emergencies of 4 April 2020", the most frequent symptoms found are the following: fever (68.7%), cough (68.1%), sore throat (24.1%), dyspnea (31%), chills (27%), diarrhea (14%), and vomiting (6%) [17,18]. The main strategies used for the diagnosis of the SARS-CoV-2 virus are reverse transcription polymerase chain reaction (RT-PCR), computerized axial tomography (CT), and certain hematological parameters [19].

Carrying out a serological test for the detection of specific antibodies against SARS-CoV-2 is a technique for simple, rapid, and sensitive diagnosis of the virus. Immunoglobulins M (IgM) constitute the first line of defense during a viral infection, before the generation of the adaptive response by immunoglobulins G (IgG), which are responsible for long-term immunity [19,20].

The transmissibility between people of the COVID-19 disease is determined by the presence of the virus in the oropharynx with a high viral load, even before the onset of symptoms. Of course, this is associated with the mechanisms that favor the spread of the virus, such as coughing, sneezing, or expectoration, as well as direct contact with the hands or fomites of an infected person [20–22].

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. Materials and Methods

The preparation of this work was carried out through a systematic bibliographic review of the articles found by searching the following databases: Dialnet, Google Scholar, Pubmed, Scielo, and WOS. To find the best possible scientific evidence, a series of inclusion and exclusion criteria were applied.

The keywords for this review were as follows: Coronavirus, prone position, pneumonia, care, nursing, prevention, pediatrics, cancer, and physiotherapy. These were validated by DeCS and MeSH. Once selected, the corresponding Boolean operators were used: AND/NOT/OR, as well as the necessary parentheses and quotation marks. The criteria that were taken into account for the selection of the relevant studies are the following. Inclusion criteria: the period between January 2018 to June 2021; article type: article review and article research; field: health sciences; English language; sample in adult population; and studies that provide scientific evidence justified by the level of indexing of articles in journals according to the latest certainties. Exclusion criteria: articles prior to 2018; language: not English; studies in which the population were minors; and studies that do not provide scientific evidence justified by the level of indexing of articles in journals according to the latest certainties.

3. Results

The research question was constructed following the PICO format (population/patient, intervention, comparator, and outcomes/outcomes). It was detailed as, "adults with acute respiratory distress syndrome subject to invasive mechanical ventilation in an ICU (P), prone decubitus technique (I), not applicable (C), effectiveness, pressure ulcer care, changes in the patient's respiratory physiology, and recommended duration to achieve greater survival and effectiveness (0)" (Figure 1).

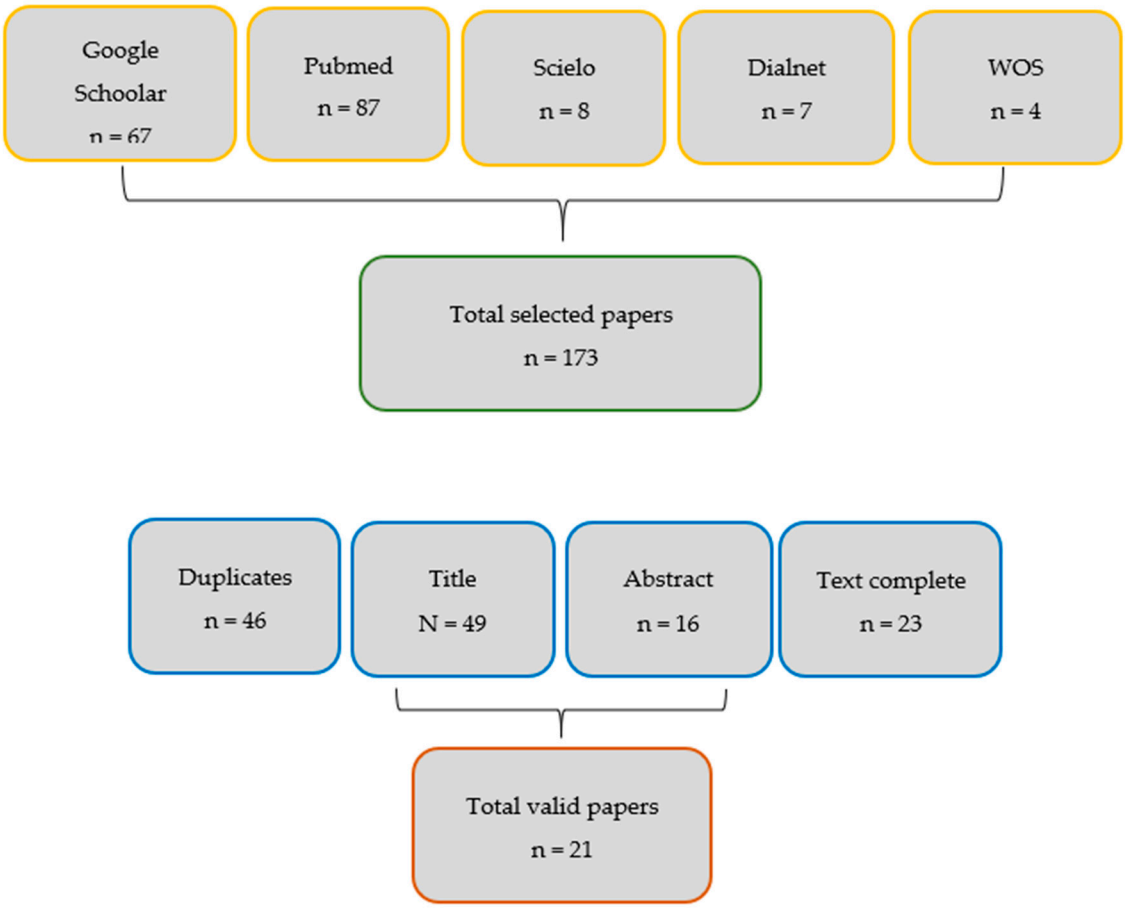


Figure 1. Flow diagram.

Below is a table that shows the search strategy used to select 21 articles (Table 1). The total number of valid articles is summarized in the Appendix A (Table A1).

Table 1. Databases consulted.

Item Criteria	Google Scholar	Medline/ Pubmed	Scielo	Dialnet	WOS	Total
Identified	67	87	8	7	4	173
Duplicates	17	23	4	4	1	46
Title	19	22	5	2	1	49
Abstract	4	9	1	1	1	16
Text complete	6	12	3	1	1	23
Valid	6	12	2	1	1	21

To determine if the PP position is effective in treating patients with ARDS due to COVID-19 disease, it is observed how PP is a strategy in ARDS, owing to the absolute conformity in the studies found in this regard [23–25]. This effectiveness is achieved in conjunction with IMV, in moderate to severe ARDS, from the second or third pronation cycle and performing prolonged cycles (about two continuous days) [25–27]. Mortality and survival are also two parameters that increase, even though there was a study carried out in 2015 that does not support the first index reviewed [27,28]. This may be because of the fact that this procedure has never been so needed for patients with respiratory disease until the COVID-19 pandemic, which has led to its massive use and has prompted the conducting of numerous investigations in this regard [29,30]. In those patients who ended up dying or needing alternative therapies (ECMO), PP has not been effective [31,32]. This may be because of the fact that there are cases of ARDS that present an unchangeable or

barely modifiable prognosis with such therapy [33,34]. It would be advisable to carry out studies in this regard to identify which cases do not respond to this strategy in order to implement it or find another strategy that is effective in order to avoid death [35,36].

Regarding the nursing care carried out in the critical patient prone by COVID-19, it is observed that the appearance of pressure ulcers is inevitable in patients prone due to the COVID-19 disease. The risk and severity of this type of injury in pronated patients seem higher than patients in other body positions. This secondary pathology is due to the severity of the disease and the workload to which ICU personnel are subjected [37]. These professionals during the pandemic have been overwhelmed and have not had the same time to apply preventive care for pressure ulcers in these patients [38,39]. A patient immobilized for a long time in any body position, without receiving sufficient attention, would have the same risk and severity of pressure ulcers as those obtained in these patients [40]. The rest of the articles show heterogeneous recommendations regarding the treatment of pressure ulcers, as has happened so far with pressure ulcers that appear from other body positions [40,41]. It is concluded that there is a lack of studies that determine standardized measures of care for the development and treatment of pressure ulcers in the prone patient [42].

To identify the physiological benefits of the PP position [43,44], it can be concluded that the main respiratory benefit achieved with the prone position is the improvement of blood oxygenation [44]. This occurs by improving or re-establishing gas exchange, which is determined by the Kirby index (PaO_2/FiO_2) [45,46]. This index improves owing to the increase in alveolar recruitment in dorsal areas, by reducing the pressure caused by the supine position, the improvement of the pulmonary adaptation to the thoracic cavity, and the reduction of the cardiac compression caused by the lungs [46]. In addition, this position carries other benefits, such as promoting the elimination of pulmonary secretions that can cause pulmonary edema [45,46].

4. Discussion

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 [23–25], as long as the patient is found with IMV and moderate to severe ARDS [25], with a prolonged duration of each pronation cycle 18 and from the second or third cycle of each episode [26]. In contrast, this strategy showed little or no ventilatory benefit in those patients who ended up requiring ECMO therapy or who died [27]. 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 [28] and decreased the mortality rate [29], provided that a prolonged duration of posture and was established early (less than 48 h from the onset of the disease) [30]. 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 [28–30]. 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 [31].

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 [32]. However, most of the selected studies emphasize the importance of carrying out correct prevention by controlling the areas exposed to pressure to avoid it [33–35], being the best treatment for them [36]. 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 [37], others use multilayer silicone dressings [25,38], and others use hydrocolloid dressings [38]. In addition, one of the studies advises against surgical treatment [39]. On the other hand, two studies advise the use of specific padded devices for the management of pressure in the head [39,40], and two

others highlight the importance of providing good nutritional intake for the prevention and treatment of pressure ulcers [26,40]. 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 [40] and the use of clonaphenicol in the eyes to avoid infections [41].

In the identification of the respiratory physiological benefits of the prone position in patients with ARDS due to COVID-19 disease subject to IMV and admitted to ICU, the position of patients with ARDS in PP has shown an improvement in oxygenation pulmonary, determined by the increase in the PaO_2/FiO_2 ratio [26–28,40,41]. This event is by improvements in ventilation/perfusion adaptation, as there is an increase in the adaptation of the lungs to the thoracic cavity and the reduction of cardiac compression by the lungs [42–44], and the volume current is distributed more homogeneously towards the dorsal pulmonary areas [44]. In this way, stress and strain is homogenized, as there is a better dilation of the thoracic cage, promoting alveolar recruitment [36–38,43,44] and, consequently, producing a re-establishment of gas exchange [44,45].

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 [45,46].

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.

5. 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.

Author Contributions: Conceptualization, M.d.R.S.-S.; methodology, Á.A.-P.; software, M.d.R.S.-S.; validation, M.d.R.S.-S. and Á.A.-P. formal analysis, Á.A.-P. investigation, M.d.R.S.-S. and Á.A.-P.; resources, M.d.R.S.-S.; data curation, M.d.R.S.-S.; writing—original draft preparation, Á.A.-P.; writing—review and editing, Á.A.-P.; visualization, M.d.R.S.-S.; supervision, Á.A.-P.; project administration, Á.A.-P. All authors have read and agreed to the published version of the manuscript.

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Abbreviations

PP	Prone position
ECMO	Extracorporeal oxygenation membrane
MMSS	Upper limbs
MMII	Lower limbs
PaO_2	Partial pressure of oxygen in arterial blood

$PaCO_2$	Partial pressure of carbon dioxide in arterial blood
ARDS	Acute respiratory distress syndrome
ICU	Intensive care unit
MV	Mechanical ventilation
IMV	Invasive mechanical ventilation
NIMV	Non-invasive mechanical ventilation

Appendix A

Table A1. Selected scientific articles table.

Authors; Year	Type of Study	Patients	Conclusion
Kim W, Kang B, Chung C, Park S, Oh J, Park S, et al., 2018	Analytical. Of Cohorts. Retrospective	62	PP position before ECMO was not associated with an increase in mortality in patients with severe ARDS. The group on PP had a lower mean maximum inspiratory pressure; similarly, the dynamic conduction pressure was also lower before ECMO.
Guérin C, Albert RK, Beitler J, Gattinoni L, Jaber S, Marini JJ, et al., 2020	Bibliographic review	34	The PP position has been shown to be effective in patients with moderate to severe ARDS who present IMV, showing a marked improvement in arterial blood gases. This improvement is due to an improvement in the ventilation/perfusion ratio. In non-intubated patients, this position has begun to be used, but studies are lacking to confirm its favorable impact. The main complications are pressure ulcers and facial edema.
Weiss TT, Cerda F, Scott JB, Kaur R, Sungurlu S, Mirza SH, et al., 2020	Analytical. Of Cohorts. Retrospective.	42	The prone position improves oxygenation in patients with ARDS secondary to COVID-19 who require IMV. This improvement occurred from the second and third cycles of prone decubitus in those surviving patients. This was not the case in those who ended up needing ECMO therapy or who died, who had little or no response to pronation cycles.
Peko L, Barakat-Johnson M, Gefen A.; 2020	Analytical. Cases and Controls.	1 case and 1 control	The application of prophylactic dressings of multiple layers of soft silicone foam on the forehead and chin in PP patients notably reduces the load on the soft facial tissues by more than 50%, in both sites, compared with not putting any type of protection. This study supports, for the first time, the nursing practice of this type of dressings in prone patients, both in the operating room and in the ICU.
Ibarra G, Rivera A, Fernandez-Ibarburu B, Lorca-García, Gacia-Ruano A; 2020	Analytical. Cases and Controls.	57 cases and 17 controls	The position of PP in ARDS has been shown to decrease mortality, but this position leads to the appearance of PUs. The most frequent location is the face (for medical devices, TET and NGS) and the pressure itself on the bony prominences. Within the face, the most frequent areas are as follows: cheek (18%), chin (16%), and forehead (8%). The frequency of these lesions was as follows: stage II (64%) and I (28%). Patients with grade IV PU ended up dying, so these lesions are considered preterm event markers. The best treatment for PUs is prevention.
Martel T, Orgill DP.; 2020	Narrative Review	30	The position of PP is related to higher survival rates in patients with SARS-CoV-2. However, this posture increases the risk of PU appearance by three times compared with the supine position. This because of the limitations in carrying out postural changes, the presence of medical devices on the face, and the increase in tissue moisture and facial edema. In addition to PP, COVID-19 produces a cytokine storm, with consequent endothelial dysfunction and ischemia, which further enhances the appearance of these types of lesions.

Table A1. *Cont.*

Authors; Year	Type of Study	Patients	Conclusion
Perrillat A, Foletti JM, Lacagne AS, Guyot L, Graillon N.; 2020	Descriptive. Number of cases.	2	PP facilitates recruitment of the dorsal lung regions, increases lung volume at the end of expiration, and reduces alveolar bypass. In the prevention of facial PUs, it is recommended to use a specific head cushion, gels, or silicone dressings; change the position of the head 2–3 times during each session; close the eyelids with occlusive dressings; and correct the systemic parameters that prevent healing (hypoxemia, anemia, or malnutrition). Treatment consists of debridement of the necrotic tissue and promoting its healing with dressings: vaseline (linitul) or alginate gauze if the wound is highly exudative.
Sleiwah A, Nair G, Mughal M, Lancaster K, Ahmad I.; 2020	Analytical. Cohorts. Retrospective.	60	PP is a strategy that increases arterial oxygenation and decreases the difference between perfusion and ventilation. Facial pressure ulcers are complications. These are prevented by replacing commercial ETT restraints with white cloth tape and treated with silicone foam dressings, paraffin gauze, or clonamphenicol (non-surgical).
Singh C, Tay J, Shoqirat N.; 2020	Descriptive. Cross-sectional.	4	All admitted patients were evaluated according to the Braden scale. Even applying preventive measures such as postural changes and pillows and other devices to relieve pressure areas, extensive ulcers appeared, so more extensive studies are needed to define the best way to prevent these injuries.
Carrillo R, Mejía L, Monares E, Chavarría U, Díaz A, Ayala M, et al., 2020	Bibliographic review	21	The prone position demonstrated a significant improvement in alveolar recruitment (PaO2/FiO2 ratio of 120 mmHg in the supine position to 182 mmHg in the prone position) in those patients with IMV in the supine position in the ICU.
Concha P, Treso-Geira M, Esteve-Sala C.; 2021	Descriptive. Number of cases. Retrospective	17	Prolonged pronation sessions, with an average of almost 48 h, showed greater efficacy in terms of mortality, in relation to those of 8 or 16 h a day that had been carried out. However, this increase in time increases the risk of the appearance of pressure ulcers, facial edema, and eye difficulties.
Chen Y, Zhang J, Feng H, Wan F, Zhang Y, Tan L.; 2021	Bibliographic review	40	The prone position for long periods of time is a feasible and safe treatment to prolong the survival time of patients with COVID-19 disease, who are in the ICU, intubated, and mechanically ventilated.
Qadri SK, Ng P, Toh TSW, Loh SW, Tan HL, Lin CB, Fan E, Lee JH.; 2020	Systematic review	1899	Based on the findings of our review, we recommend the prone position in patients with moderate to severe COVID-19 ARDS as per existing guidelines. A trial of the prone position should be considered for non-intubated COVID-19 patients with hypoxemic respiratory failure, as long as this does not result in a delay in intubation.
Langer T, Brioni M, Guzzardella A, Carlesso E, Cabrini L, Castelli G, Dalla Corte F, et al., 2021	Analytical. Of Cohorts. Retrospective.	1057	During the COVID-19 pandemic, the prone position has been widely adopted to treat mechanically ventilated patients with respiratory failure. The majority of patients improved their oxygenation during prone position, most likely owing to a better ventilation perfusion matching.
Vollenberg R, Matern P, Nowacki T, Fuhrmann V, Padberg JS, Ochs K, Schütte-Nütgen K, et al., 2021	Prospective bicentric study.	13	The PP significantly improves oxygenation in COVID-19 ARDS patients. The data suggest that they also benefit most from an early PP. A decrease in minute ventilation may result in fewer P_{aCO2} responders. LC may be a predictive outcome parameter in COVID-19 patients. Trial registration: retrospectively registered.

Table A1. *Cont.*

Authors; Year	Type of Study	Patients	Conclusion
Lucchini A, Bambi S, Mattiussi E, Elli S, Villa L, Bondi H, Rona R, Fumagalli R, Foti G.; 2020	Single-center, retrospective, observational study	98	The onset rate of complications given by the use of prone position in ARDS patients is similar to data reported by previous literature. The implementation of a dedicated protocol in specialized centers and the involvement of five trained and skilled professionals while moving the patient in the prone position are recommended to prevent the occurrence of similar adverse events.
Gleissman H, Forsgren A, Andersson E, Lindqvist E, Lipka Falck A, Cronhjort M, Dahlberg M, Günther M.; 2021	Case series	44	Proning increased PaO_2/FiO_2, primarily in patients with PaO_2/FiO_2 of approximately <120 mm Hg, with a consistency over three sessions. No characteristic was associated with non-responding, which is why proning may be considered in most patients. Further study is required to evaluate mortality.
Shelhamer MC, Wesson PD, Solari IL, Jensen DL, Steele WA, Dimitrov VG, Kelly JD, Aziz S, et al., 2021	Cohort study	335	Prone positioning in patients with moderate to severe ARDS due to COVID-19 is associated with reduced mortality and improved physiologic parameters. One in-hospital death could be averted for every eight patients treated. Replicating results and scaling the intervention are important, but prone positioning may represent an additional therapeutic option in patients with ARDS due to COVID-19.
Binda F, Marelli F, Galazzi A, Pascuzzo R, Adamini I, Laquintana D.; 2021	Cohort study	86	Prone positioning is one strategy available for treating acute respiratory distress syndrome in patients with COVID-19. During this pandemic, prone positioning can be used extensively as rescue therapy, per a specific protocol, in ICU.
Ng JA, Miccile LA, Iracheta C, Berndt C, Detwiller M, Yuse C, Tolland J.; 2020	Case report	2	The description of the development, operations, evolution, and utilization of a rehabilitation therapist prone team acts as a guide for future development and implementation.
Araújo MS, Santos MMPD, Silva CJA, Menezes RMP, Feijão AR, Medeiros SM.; 2021	Systematic review	12	Positive outcomes outweighed complications. Various cycles of prone positioning are needed, which may cause potential work overload for the health staff. Therefore, an appropriate number of trained workers is necessary, in addition to specific institutional protocols to ensure patient safety in this context.

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