

Movilización temprana en pacientes con ventilación mecánica contagiados por COVID-19

Early mobilization in patients with mechanical ventilation infected by COVID-19

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Palabras

Claves: Covid-19, medicina de terapia intensiva, ventilación mecánica, insuficiencia respiratoria, insuficiencia respiratoria.

Keywords:

covid-19, intensive care medicine, mechanical ventilation, respiratory failure, respiratory failure.

Resumen

Los pacientes contagiados con enfermedad COVID-19 que requieren ventilación mecánica tienen una alta mortalidad y utilización de recursos. La capacidad de predecir y emitir criterios clínicos en qué pacientes pueden requerir ventilación mecánica permitirá una mayor agudeza de la atención e intervención específicas para mitigar potencialmente el deterioro de su fisiología. **Objetivo:** Examinar mediante la revisión de la literatura científica sobre la movilización temprana en pacientes con ventilación mecánica contagiados con COVID-19. **Metodología:** Se realizó un análisis bibliográfico de la literatura en diferentes revistas científicas como SCOPUS, WEB OF SCIENCE y PUBMED bajo un enfoque de síntesis narrativo, interpretativo y conceptual. Por lo consiguiente, se empleó términos clave en inglés y español como: “patients infected with COVID-19”, “infected mechanically ventilated patients”, “critical care medicine”, “mechanical ventilation”. Las fuentes bibliográficas se establecieron desde el 2019 al 2021. **Resultados:** Se demuestra la existencia de desafíos médicos, logísticos y de protección del personal médico para proporcionar apoyo respiratorio en pacientes contagiados con COVID-19, desde la epidemiología hasta las características clínicas, y el desarrollo de tratamientos farmacológicos que mejoran la mortalidad y la recuperación. **Conclusión:** Es esencial un enfoque terapéutico integrado para mitigar los efectos adversos para la salud física y mental de la neumonía por COVID-19.

Abstract

Patients infected with COVID-19 disease who require mechanical ventilation have a high mortality and use of resources. The ability to predict and issue clinical criteria in which patients may require mechanical ventilation will allow greater acuity of targeted care and intervention to potentially mitigate deterioration of their physiology. **Objective:** To examine through the review of the scientific literature on early mobilization in patients with mechanical ventilation infected with COVID-19. **Methodology:** A bibliographical analysis of the literature in different scientific journals such as SCOPUS, WEB OF SCIENCE and PUBMED was conducted under a narrative, interpretive and conceptual synthesis approach. Therefore, key terms in English and Spanish were used,

such as: "patients infected with covid-19", "infected mechanically ventilated patients", "critical care medicine", "mechanical ventilation". The bibliographic sources were established from 2019 to 2021. **Results:** The existence of medical, logistical and protection challenges for medical personnel to provide respiratory support in patients infected with COVID-19 is demonstrated, from epidemiology to clinical characteristics, and the development of pharmacological treatments that improve mortality and survival. **Conclusion:** An integrated therapeutic approach is essential to mitigate the adverse physical and mental health effects of COVID-19 pneumonia.

Introduction

In December 2019, a cluster of pneumonias caused by an unknown pathogen was first reported in Wuhan, a city within the central part of China, linked to a large market offering varied species of live seafood and wild animals. The pneumonia-causing agent was later identified as a new coronavirus and named severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) (Rushforth et al., 2021).

Genetic analysis of whole genome sequences revealed that SARS-CoV-2 is most closely related to a bat coronavirus named Bat-CoV-RaTG13, explaining bats as the likely origin, which suggested the high possibility of animal-to-human transmission (Reyes et al., 2021; Rushforth et al., 2021). Subsequently, person-to-person transmission was confirmed in 15 health care professionals, all infected by a patient with the new coronavirus infection.

The identification of the pathogen and the transmission pattern have led to the implementation of high-level preventive and control measures by the Chinese government and the World Health Organization (WHO), which consequently declared coronavirus disease (COVID-19) a public health emergency of international concern (Reyes et al., 2021; Rushforth et al., 2021).

COVID-19 has now become a global pandemic that seriously endangers human health. Among patients with COVID-19, 31% of them progressed to ARDS (Acute Respiratory Distress Syndrome), and some cases were even complex by severe refractory development of ARDS to mechanical ventilation (MV) with an average mortality rate (Shima et al., 2020). Due to the improved efficacy achieved by ECMO (Extracorporeal Membrane Oxygenation) during the H1N1 influenza crisis (Swine Flu) in 2009, it was successfully applied for the treatment of H7N9 (Avian Influenza A Virus) and SARS-CoV-2 (Tang et al., 2021).

Studies of invasive mechanical ventilation to treat respiratory failure for COVID-19 have shown a mortality rate greater than 85%. Although limited information is available on which patients admitted to hospitals or clinics not requiring mechanical ventilation will progress to mechanical ventilation and what clinical factors are associated with such progression (Sasidharan et al., 2021).

Recent studies have shown that the mortality rate of patients with COVID-19 treated with ECMO remains high. At present, there are no case reports on successful treatment of COVID-19 patients complicated with ARDS by ECMO. However, there are clinical cases that were successfully treated by combining early MV with ECMO, providing experience for treatment in critically ill COVID-19 patients (Mellow et al., 2020; Zhong et al., 2020).

It should be taken into account that better identification of patients likely to require mechanical ventilation will allow closer monitoring of signs of clinical deterioration and optimize the allocation of resources such as ventilators and intensive care beds (Hill et al., 2020; Zhong et al., 2020). New analytical techniques could also reveal previously unrecognized indicators of a worsening respiratory trajectory. This could guide treatment decisions (e.g., medications such as anticoagulants or corticosteroids, tighter hemodynamic regulation, or supplemental oxygen titration) that may mitigate progression to respiratory failure (Zhong et al., 2020).

Therefore, this study lies in the purpose of exposing as main objective: To review in the scientific literature on early mobilization in mechanically ventilated patients infected by COVID-19.

At the same time, it explores the definitions and impact of the problematic that exists in the development of treatment strategies for early mechanical ventilation, performing a detailed analysis of the types of pathogens and risk factors, providing specific objectives oriented to; Contrast on the scientific evidence on the coronavirus (COVID-19) caused by the SARS-CoV-2 virus; To explore the definitions of early mobilization in mechanically ventilated patients infected with COVID-19; To examine the scientific literature on the types of activities in early mobilization in mechanically ventilated patients infected with COVID-19. To expose a reliable basis for the possible choice of clinical experiences in the management of patients with COVID-19.

Methodology

The type of research was based on the bibliographic analysis of the literature in different scientific journals under a narrative, interpretative, conceptual, and iterative synthesis approach that emphasized the importance of developing a critique based on the relevance, credibility, and contribution of the evidence rather than on methodological considerations

rigidly determined in analysis and synthesis under the recommendations of the PRISMA statement.

In the literature search strategy, the SCOPUS, WEB OF SCIENCE and PUBMED databases were used as sources of bibliographic data oriented to this review of the exposed objectives. It should be noted that, publications were selected between the years 2019 to 2021, with the following descriptors in Spanish and English: "patients infected with covid-19", "covid-19", "infected mechanically ventilated patients", "critical care medicine", "mechanical ventilation", "predictive models respiratory", "respiratory insufficiency", "respiratory failure".

The inclusion criteria for the study were selected based on the following characteristics:

- Studies involving clinical trials in mechanically ventilated patients infected with COVID-19.
- Systematic and narrative reviews with thematic approach.
- Qualitative studies from the best indexed scientific journals.
- Studies with publication year between 2019 to 2021.

This review included studies considered as standard references for the subject, as well as studies describing the consequences and rehabilitation of patients with COVID-19.

Similarly, exclusion criteria include:

- Animal studies.
- Research that did not address the relationship of mechanically ventilated patients infected with COVID-19.
- Research referring to: technical reports, undergraduate, graduate, and doctoral theses.
- Scientific publications of low relevance to the proposed topic.

Accordingly, the first phase of the literary research procedure focuses on the set of research questions: What is the theoretical knowledge of the coronavirus (COVID-19), what are the definitions or clinical criteria for early mobilization in mechanically ventilated patients, what are the types of activities in early mobilization in mechanically ventilated patients infected by COVID-19, and what are the types of activities in early mobilization in mechanically ventilated patients infected by COVID-19, and what are the types of activities in early mobilization in mechanically ventilated patients infected by COVID-19, and what are the types of activities in early mobilization in mechanically ventilated patients infected by COVID-19?

Therefore, in the second research phase, a theoretical-conceptual framework was developed based on reviews of scientific journals with the following descriptors in

Spanish and English: "patients infected with covid-19", "covid-19", "infected mechanically ventilated patients", "critical care medicine", "mechanical ventilation", "predictive respiratory models", "respiratory insufficiency", "respiratory failure".

Likewise, in the third research phase, we present the respective inclusion criteria of the literature review, leading to the explicit collection of information from 1 year with the serious health crisis due to COVID-19 describing consequences and rehabilitation of patients, to present reliable and quality information.

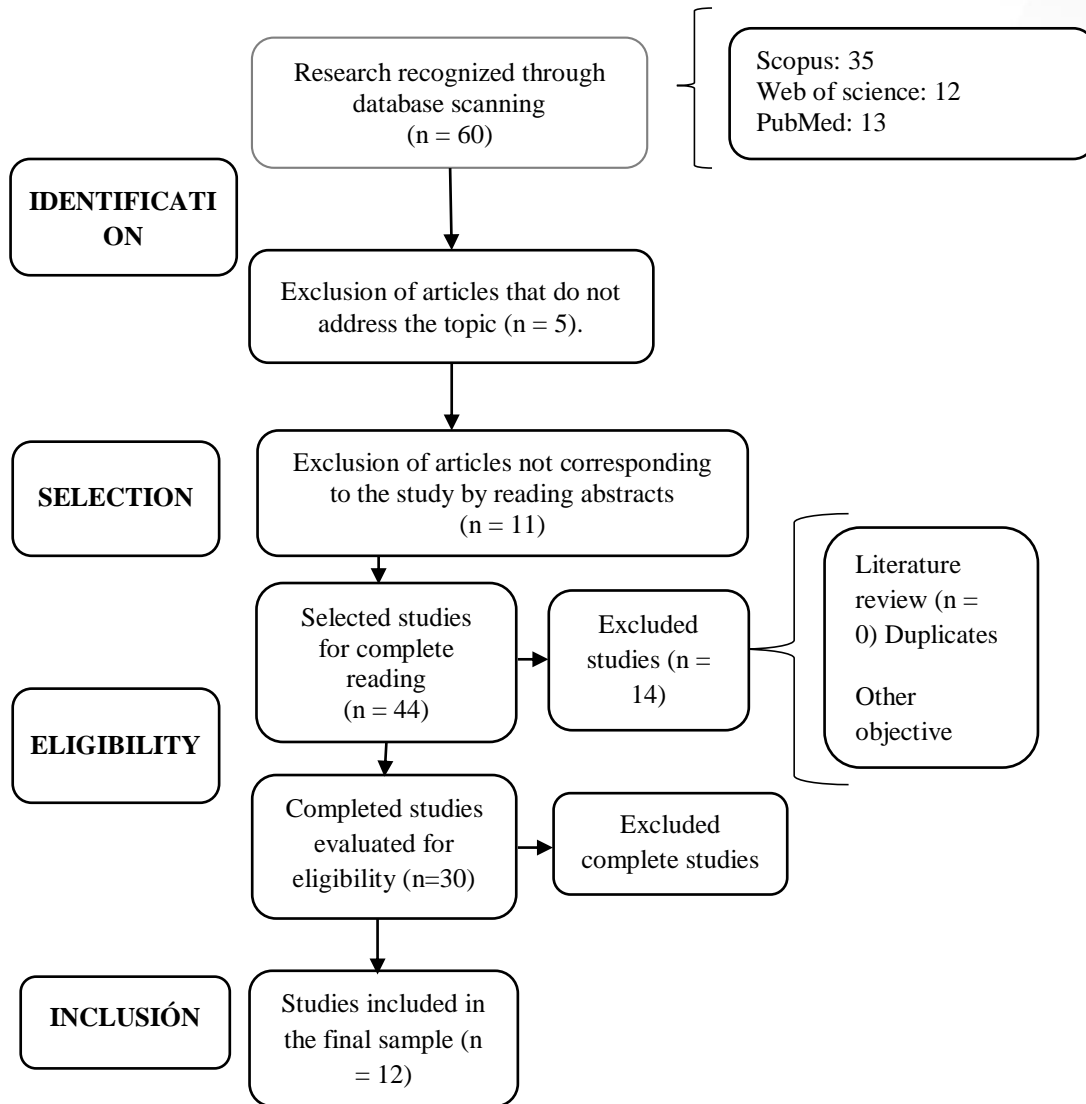
It can be inferred that, explicitly, the exclusion criterion in the fourth research phase was strictly developed to reduce contradictory information or information not intrinsically related to the research topic.

Results and Discussion

A flow chart was designed based on the compilation of scientific articles where a literary research procedure is presented with the objective of selecting studies according to the relationship of the subject, based on the characteristics of the variables of interest such as: patients infected with COVID-19, COVID-19, mechanically ventilated infected patients, intensive care medicine, mechanical ventilation, respiratory predictive models, respiratory failure, respiratory failure.

In the studies collected, international studies were selected from the most prestigious journals and scientific databases for subsequent presentation of their literature.

Figure 1



The findings obtained in the present study were based on the analysis of the literature review in relation to early mobilization in mechanically ventilated patients infected with COVID-19, focusing on procedures, risks, criteria for treatment comparison, medical assistance, adequate pulmonary rehabilitation, and other pulmonary disorders.

For this reason, it was considered to expose studies of different research authors in relation to the topic of study.

Table 1

Early mobilization in mechanically ventilated patients infected with COVID-19

No	Base	Magazine	Title	Autor	Year	Objective	Results
1	Scopus	American Society of Health-System Pharmacists	An examination of sedation requirements and practices for mechanically ventilated critically ill patients with COVID-19 (Balakrishna et al., 2021).	Balakrishna et al	2021	To examine the use of sedatives in critically ill patients with coronavirus disease 2019 (COVID-19) infection requiring mechanical ventilation within the intensive care units (ICUs) of a large academic medical center.	In the study cohort, Propofol and hydromorphone were the most common initial drug combination, and these drugs were used on a given day in up to 100% and 88% of patients, respectively. Doses of sedative and analgesic infusions increased for patients during the first 10 days, reaching or exceeding the upper limits of published dosing guidelines for Propofol (48% of patients), dexmedetomidine (29%), midazolam (7.7%), ketamine (32%), and hydromorphone (38%). The number of sedative and analgesic agents administered simultaneously increased over time for each patient, with more than 50% of patients requiring 3 or more agents at day 2. Compared with patients requiring 3 or fewer agents, as a group patients requiring more than 3 agents were younger, had an increased body mass index, increased serum ferritin and lactate

					dehydrogenase concentrations, developing more likely to receive neuromuscular blockade.
2	Web of Science	JAMA Internal Medicine	Risk Factors Associated with Mortality Among Patients With COVID-19 in Intensive Care Units in Lombardy, Italy (Grasselli et al., 2020).	Giacomo Grasselli, Massimiliano Greco, Alberto Zanella, Giovanni Albano, Massimo Antonelli, Giacomo Bellani.	In critically ill patients with laboratory-confirmed SARS-CoV-2 infection admitted to an ICU during the first 2 months of the COVID-19 outbreak in Lombardy, Italy, the estimated in-hospital, and ICU mortality rates were 27 and 12 per 1000 patient-days, respectively.
				To evaluate independent risk factors associated with mortality in patients with COVID-19 requiring ICU treatment in the Lombardy region of Italy.	Independent risk factors associated with mortality included older age, male sex, high inspired oxygen fraction (FiO ₂), positive end-expiratory pressure or low ratio on ICU admission, and history of chronic obstructive pulmonary disease, hypercholesterolemia, and type 2 diabetes. No medication was independently associated with mortality (angiotensin-converting enzyme inhibitors, angiotensin receptor blockers).

3 PubMed

Paediatric
Respiratory
Reviews

COVID-19
and
respiratory
support
devices
-
Los
dispositivos de
asistencia
respiratoria y
el COVID-19
(Pons-Òdena
et al., 2020).

Marti Pons-
Òdena,
Arnau Valls,
Jordi Grifols,
Ramon Farré,
Francico Jose
Cambra
Lasosa,
Bruce K.
Rubin.

2020

Reevaluate the
management of
respiratory failure
with affordable and
simple devices to
provide
noninvasive and
invasive support.

There are logistical challenges to providing respiratory support devices beyond simple oxygen flow; hospital facilities often run out of supplies or do not have such devices, such as in low-resource settings. At the height of the COVID-19 crisis, it was extremely difficult to import medical equipment and supplies because most countries prohibited the medical industry from selling outside their own countries. As a result, engineering teams from around the world volunteered to develop emergency devices, and medical experts in mechanical ventilation helped guide the design and evaluation of prototypes. Although regulations vary between countries, given the emergency, some regulatory agencies facilitated expedited procedures. However, testing in animal and laboratory models is crucial to minimize the potential risk to patients when treated with a device that may worsen clinical outcome. if it is poorly designed or poorly used.

4	Scopus	Annals of Physical and Rehabilitation Medicine	Early mobilization in hospitalized patients with COVID-19 Early mobilization in hospitalized patients with COVID-19 (Valenzuela et al., 2020).	Pedro L. Valenzuela, Michel Joyner, Alejandro Lucia 2020	Contrast the condition motivating hospitalization in COVID-19 infected patients in the so-called hospital-induced disability.	<p>In this context, a stressful, but often forgotten, factor for the body's functional reserves, especially in elderly patients, is not only severe infections or other acute conditions per se, but also enforced inactivity. The latter can severely impair so-called intrinsic capacity (the combination of mental and physical function), which, according to the World Health Organization, is an important determinant of health in our increasingly aging society.</p> <p>For people who cannot perform volitional exercise, such as intubated patients, an alternative is neuromuscular electrical stimulation: the generation of involuntary contractions by applying intermittent electrical stimuli to skeletal muscles. This approach, studied for decades in physiology laboratories around the world, can attenuate muscle atrophy in critically ill patients.</p>
5	Scopus	American academy of	Factors Associated with Intubation and	Kevin Hur, Caroline P. E. Price, Elizabeth L. Gray, Reeti	To identify risk factors associated with intubation and extubating time in hospitalized	Severe disease is characterized by hypoxic respiratory failure requiring prolonged

Otolaryngology – Head and Neck Surgery	Prolonged Intubation in Hospitalized Patients With COVID-19 - Factores asociados a la intubación e intubación prolongada en pacientes hospitalizados con COVID-19 (Hur et al., 2020).	K. Gulati, Matthew Maksimoski, Samuel D. Racette, Alexander L. Schneider, and Ashoke R. Khanwalkar 2020	patients with coronavirus disease 2019 (COVID-19).	supportive care often including intubation and invasive mechanical ventilation.	
6	Scopus Revista del Nacional (Itauguá)	Feasibility and Efficacy of the Pulmonary Rehabilitation Program in a Rehabilitation Center Case report of a young patient developing severe covid-19 acute respiratory distress syndrome Feasibility and Effectiveness of the Pulmonary Rehabilitation Program in a Rehabilitation Center - Case	Simone Pancera, Silvia Galeri, Roberto Porta, Irene Pietta, Luca Nicola Cesare Bianchi, Maria Chiara Carrozza, Jorge Hugo Villafañe 2020	Prevent the development of permanent disabilities in previously healthy subjects, favoring the complete functional recovery of a young patient with COVID-19.	As a result of immobilization and prolonged MV, recovery of respiratory and physical functions may take a long time after the patient's discharge from the ICU, or sometimes only partial recovery is achieved, leading to reduced quality of life. ICU-acquired weakness affects both peripheral and respiratory skeletal muscles in critically ill patients and represents one of the gravest consequences of prolonged immobilization, delaying weaning

	<p>clinical case of a young patient who develops serious acute respiratory difficulty syndrome by covid-19 (Pancera et al., 2020).</p>		<p>from MV and lengthening hospital stay.</p> <p>The relevance of a respiratory rehabilitation program (RRP) in improving the clinical course of critically ill patients and recovering their functional capacities is well documented; however, rehabilitation programs must cope with the organizational problems and risks related to the emergence of COVID-19.</p>
<p>7 Web of Science Oxford University Press for the Infectious Diseases Society of America.</p>	<p>Tocilizumab, for treatment of mechanically ventilated patients with COVID-19 - Tocilizumab, para el tratamiento de pacientes mecánicamente con COVID-19 (Beer et al., 2019).</p>	<p>Emily C Somers, Gregory A Eschenauer, Jonathan P Troost Jonathan L Golob, Tejal N Gandhi, Lu Wang, Nina Zhou, Lindsay A Petty, Ji Hoon Baang, Nicholas Dillman, David Frame, Kevin S Gregg, Dan R Kaul, Jerod Nagel, Twisha S Patel, Shiwei Zhou, Adam S Lauring,</p> <p>To evaluate the effectiveness and safety of IL-6 blockade with tocilizumab in a cohort of patients with COVID-19 from one center requiring mechanical ventilation.</p>	<p>The primary endpoint was the probability of survival after intubation; secondary analyses included an ordinal disease severity scale integrating superinfections.</p> <p>Outcomes in patients who received tocilizumab compared with tocilizumab-untreated controls were assessed using multivariable Cox inverse probability propensity score weighted (IPTW) multivariable regression.</p> <p>Patients receiving tocilizumab were more than twice as likely to develop a superinfection as</p>

			David A Hanauer, Emily Martin, Pratima Sharma, Christopher M Fung, Jason M Pogue 2019.	untreated controls (54 % vs. 26 %; p<0.001), due to a significant increase in ventilator-associated pneumonia (45 % vs. 20 %; p<0.001).
		Incidence of Barotrauma in Patients With COVID-19 Pneumonia During Prolonged Invasive Mechanical Ventilation – A Case-Control Study	Josefina Udi, Corinna N. Lang, Viviane Zotzmann, Kirsten Krueger, Annabelle Fluegle, Fabian Bamberg, Christoph Bode, Daniel Duerschmied, Tobias Wengenmayer and Dawid L. Staudacher 2021.	SARS-CoV2 can cause pulmonary failure, requiring prolonged invasive mechanical ventilation (MV). Lung protective ventilation strategies are recommended to minimize ventilator-induced lung injury. Whether patients with COVID-19 have the same risk of complications, including barotrauma, remains unknown. Isolated cases of complications in general and barotrauma have previously been described in patients with COVID-19 pneumonia.
8	Web of Science	Journal of Intensive Care Medicine	Incidencia de barotrauma en pacientes con neumonía por COVID-19 durante la ventilación mecánica invasiva prolongada: un estudio de casos y controles (Udi et al., 2021).	To determine the incidence of barotrauma in a cohort of patients with COVID-19 pneumonia under invasive MV for at least 2 days (inclusion criteria). In this case report, the authors postulated diffuse alveolar damage in severe COVID-19 pneumonia and intense cough as probable predisposing factors for a sudden increase in alveolar pressure and

						consequently for alveolar rupture leading to air release into the lung parenchyma, mediastinum, and subcutaneous tissue.	
						The elderly and patients with underlying diseases are at increased risk of developing severe acute respiratory syndrome (SARS) requiring mechanical ventilation. Once intubated, mortality increases exponentially.	
						A number of drug regimens, including hydroxychloroquine -azithromycin, (with remdesevir) and anti-IL-6 agents (tocilizumab), were highlighted during the pandemic, depending on the potential of the therapy to interrupt the SARS-CoV-2 viral life cycle or prevent cytokine storm.	
9	Web of Science	Journal Of Wound Care	Of -	Hyperbaric oxygen therapy in the prevention of mechanical ventilation in patients with COVID-19: a retrospective case series (Thibodeaux et al., 2020).	Kerry Thibodeaux, Marcus Speyrer, Amer Raza, Raphael Yaakov, Thomas E Serena	2020	Examine in pharmacological therapies based on viral life cycle interruption or prevent cytokine storm and include hydroxychloroquin e-azithromycin, antiviral therapy, and anti-IL-6 agents.
						Although, most patients recover without the need for mechanical ventilation. After HBOT (hyperbaric oxygen therapy), oxygen saturation increased, tachypnea resolved, and inflammatory markers decreased.	

10	PubMed	Annals of the American Thoracic Society	<p>Rehabilitation Levels in COVID-19 Patients Admitted to Intensive Care Requiring Invasive Ventilation: An Observational Study - Niveles de rehabilitación en pacientes con COVID-19 ingresados en cuidados intensivos que requieren ventilación invasiva: un estudio observacional (McWilliams et al., 2021).</p>	David McWilliams, Jonathan Weblin, James Hodson, Tony Veenith, Tony Whitehouse, Catherin Snelson 2021.	To describe the demographics, clinical status, rehabilitation level, and mobility status at ICU discharge of patients with COVID-19.	<p>Patients with COVID-19 have complex pulmonary support needs over a prolonged period, resulting in a high incidence of neuromuscular weakness, loss of well-being, and delirium.</p> <p>This is predicted to create a "tsunami of rehabilitation needs" in both the short and long term, demonstrating that early, structured rehabilitation in intensive care is safe and, when implemented, is associated with significant improvements in physical and clinical outcomes.</p> <p>There is some feasibility of early mobilization in general intensive care to improve these outcomes, but, at present, no data are available to describe similar interventions and outcomes in COVID-19 populations admitted to the ICU.</p>
11	PubMed	Respiratory Physiology & Neurobiology	<p>Chest physiotherapy : An important adjuvant in critically ill mechanically ventilated patients with COVID-19</p>	Denise Battaglini, Chiara Robba, Salvatore Caiffa, Lorenzo Ball, Iole Brunetti, Maurizio Loconte, Daniele	Enunciate individualized ventilation strategies in those who become critically ill under chest physiotherapy to improve long-term respiratory physical function	<p>Conventional ARDS (acute respiratory distress syndrome) is characterized by diffuse damage of the alveolar capillary membrane, with edema and atelectasis in the</p>

			- Chest physiotherapy : an important adjuvant in critical mechanically ventilated patients with COVID-19 (Battaglini et al., 2020).	Roberto Giacobbe, Antonio Vena, Nicolo ` Patroniti a, Matteo Bassetti e, Antoni Torres, Patricia RM Rocco, Paolo Pelosi 2020.	among survivors. ICU dependent lung regions.	<p>The application of PEEP (Positive end-expiratory pressure) or prone position recruits collapsed lung regions associated with improved respiratory mechanics and gas exchange, while there is no notable change in regional pulmonary perfusion redistribution.</p> <p>In contrast, in COVID-19 lesions are compartmentalized with minor edema and pneumolysis, alveolar cell infiltration and necrosis. Application of PEEP or prone position results in perfusion redistribution, but not alveolar recruitment.</p> <p>In this sense, COVID-19 pneumonia is represented as primary ARDS with timely life-saving treatments.</p>
12	PubMe d	Journal Clinical Medicine	of Efficiency of Prolonged Prone Positioning for Mechanically Ventilated Patients Infected with COVID-19 - Efficiency of	Elizabeth M. Parker, Edward A. Bittner, Lorenzo Berra, and Richard M. Pino 2021.	To examine retrospective characteristics of prolonged, repeated, early versus delayed prone positioning (PP) in 20 patients with respiratory failure by COVID- 19.	In this study, prone positioning (PP) was performed in patients with a single etiology of ARDS, with no exclusions, and performed by a small, dedicated number of experienced physicians and

prolonged
prone
positioning for
mechanically
ventilated
patients
infected with
COVID-19
(Parker et al.,
2021).

nurses with similar
practice patterns.

During COVID-19,
augmentation
patients were treated
in intensive care
units and hospital
floors by caregivers
who were often not
trained in intensive
care medicine.

Given the
differences in
treatment, these
patients would not
have been valid for
inclusion either in
focus groups that
identified the
knowledge,
resources, and
culture of the team to
determine successful
prone positioning
procedures.

Conclusions

- SARS-CoV-2 infection is a complex multi-organ disease with peculiar and specific characteristics that requires invasive individualized treatment, especially in mechanically ventilated patients in the ICU.
- The mortality rate remains high among critically ill patients, although recent research has improved our understanding of the pathophysiology of COVID-19 and clarified the therapeutic role of specific medications and ventilation strategies, but questions remain about the optimal management of these patients.
- In this context, it is important to better understand the pathophysiology of SARS-CoV-2 induced pneumonia and damage to other organs, such as the best time to intubate patients, parameters to assess at the bedside and the ability to mitigate patient self-assessment, inflicted lung injury and ventilator-induced lung injury, as well as how to establish proper personal protective equipment in both supine and prone positions, and how to avoid lung fibrosis and strengthen the muscles involved in breathing in mechanically ventilated patients.
- Many questions are ongoing with the aim of clarifying not only mechanical ventilation strategies, but also new therapies such as immunomodulatory drugs,

the use of interferon, hydroxychloroquine, as well as adjuvant strategies such as the use of vitamin C.

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