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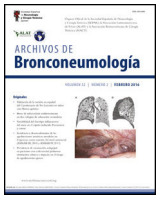

Scientific Letter

Impact of Early Mobilization Added to Respiratory Physiotherapy Postextubation on Weaning Success

To the Director,

A significant number of patients with severe acute respiratory syndrome Coronavirus-2 (SARS-CoV-2) disease developed acute respiratory distress syndrome (ARDS)[1] and invasive mechanical ventilation (IMV) is cornerstone in its supportive treatment. Within this pandemic situation with a focus on critical patients over those on mechanical ventilation, we considered how to improve the hospital stay. Clinicians face several challenges when taking care of COVID-19 patients,[2] and intensive care unit (ICU) acquired weakness (AW) – (ICU-AW) –[3] is historically one of those specially in IMV patient.

Chest physiotherapy (CPT) in the mechanically ventilated patient has been recognized as an essential component of respiratory care within the ICU. The main goal of CPT includes airway clearance that helps reduce airway resistance and improve lung compliance.[4,5] The benefits of CPT are reflected in a reduced incidence of ventilator associated pneumonia (VAP), reduced duration of ICU stay and greater success of liberation from mechanical ventilation. Moreover, ICU acquired weakness (ICU-AW) is a potential risk factor for extubation failure and prolonged weaning, increasing patient mortality and morbidity by up to 25%.[6,7] The integration of early mobilization (EM) protocols in ICUs has been recognized as a preventative strategy against the incidence of ICU-AW with strong recommendations (Grade 2+) supporting their use for extubation success.[8,9] However, there is no evidence that promotes the combination of EM with early CPT following extubation to increase weaning success. During the COVID-19 pandemic, there has been a high incidence of ICU-AW and prolonged weaning from invasive mechanical ventilation (IMV), which may consequently prolong ICU and hospital length of stay.[10,11] Therefore, the aim of our study is to determine whether early CPT following extubation reduces the risk of reintubation with in 24–72 h, in addition to an EM protocol in a COVID-19 population.

An observational study was completed at the ICU of Vall d' Hebron Hospital. Adult patients admitted to ICU with severe SARS-CoV-2 pneumonia for IMV care were studied. Severe respiratory illness was defined as acute respiratory distress syndrome (ARDS) in accordance with the Berlin criteria.[12] Only patients who received intubation via an endotracheal tube were studied, where tracheostomized patients and prolonged weaning cases were excluded. Prolonged weaning is defined as failure of 3 spontaneous breathing trials (SBT) or ongoing need for IMV 7 days after the first SBT.[13] The weaning protocol included daily screening for weaning readiness according to general criteria and extubation failure, which was defined as the need for reintubation within 48 h of tube removal.[3] Spontaneous breathing trials were performed, varying between T-piece and pressure support ventilation.[14]

All patients received CPT during mechanical ventilation, however not all patients received CPT within two hours of IMV withdrawal. This situation occurred in cases when extubation took place outside of physiotherapy service hours and when extubation took place during weekend hours where the on-call physiotherapist was not informed. CPT sessions following extubation included treatments such as airway clearance techniques, assisted cough using mechanical in-exsufflation devices, manual hyperinflation, rib cage compressions, positive expiratory pressure devices and inspiratory muscle training. In addition, an EM protocol was followed for all patients within the first 24 h of initiating IMV, with the sole exception of cases with hemodynamic instability or pulmonary thromboembolism. Deep sedation or neuromuscular blockade was not an absolute contraindication to EM. In cases where patients were proned, EM was not implemented until they were supinated. The EM interventions included active, assisted or passive limb mobilization, cycle-ergometry, transfers to sitting and standing. The duration of EM sessions was a total of 1 h/day/patient (30 min, twice daily). The outcome measures included extubation success, days of IMV, length of ICU stay and hospital survival. The study was approved by the local Clinical Research Ethics Committee (PR(ATR)164/2021).

Twenty-eight patients were included in this study. The main characteristics of our population, such as age, gender and comorbidities, are presented in Table 1. Proned ventilation and neuromuscular blockade was used in 57% and 82% of the population, respectively. The main complication during IMV was VAP [20 (71%)]. All patients required high-flow nasal cannula (HFNC) post-extubation [28 (100%)], where 7% required additional support from non-invasive ventilation (NIV). As there were no contraindications in our sample, EM protocol was implemented for all patients and no patient was denied EM treatment [28 (100%)]. CPT within two hours of extubation was provided to 32% of our study population. This study shows that only two patients (7%) required reintubation and eventual need for a tracheostomy.

Our study is the first to investigate how the combination of early CPT within 2 h of extubation and an EM protocol may imply a decrease in extubation failure rate. In a similar approach to ours, a randomized controlled study in Taiwan observed that EM and CPT during IMV significantly reduced the reintubation rate by half (8% vs 16%).[15] However, unlike our research, this study considers the benefits of CPT during IMV and not immediately after extubation. On the whole, research regarding physiotherapy in weaning from IMV mainly focuses on EM protocols. The benefits of EM in the ICU were first studied in 2008 for their association with a decreased length of ICU stay when compared to standard care.[16] However, unlike in our study where EM began within 24 h, this study began EM within 48 h of initiating IMV. A more recent study considered a

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Table 1
Patient demographic data and supportive related therapies. The lowest PaO_2/F_IO_2 and highest PEEP values were documented. We define early mobilization as the one performed within the first 24 h after initiation of IMV. ARDS: acute respiratory distress syndrome; CPT: chest physiotherapy; SOFA: sequential organ failure assessment; APACHE II: Acute Physiology and Chronic Health disease Classification System II; COPD: chronic obstructive pulmonary disease; HBP: high blood pressure; ICU: intensive care unit; IMV: invasive mechanical ventilation; HFNC: high flow nasal cannula; NIMV: non-invasive mechanical ventilation; PF: PaO2/FiO2 ratio; PEEP: positive end expiratory pressure; AKI: acute kidney injury; CRRT: continuous renal replacement therapy; LMWH: low-molecular-weight heparin; VAP: ventilator associated pneumonia.

Variable	Result ($n = 28$)
Age (years)	59 ± 12
Gender (n, %) (male)	15/28 (53%)
Comorbidities	
HBP (*n*, %)	13/28 (46%)
COPD (*n*, %)	1/28 (3%)
Asthma (*n*, %)	2/28 (7%)
Chronic renal failure (*n*, %)	1/28 (3%)
Chronic heart failure (*n*, %)	1/28 (3%)
Diabetes mellitus (*n*, %)	4/28 (14%)
BMI > 30 kg/m^2	5/28 (18%)
SOFA	4 ± 1
APACHE II	14 ± 8
Early mobilization	28/28 (100%)
Chest physiotherapy (CPT) within 2 h after extubation	9/28 (32%)
HFNC post-extubation	28/28 (100%)
ARDS related variables	
PaO_2/F_IO_2 (mmHg)	129 ± 37
PEEP (cmH_2O)	14 ± 2
Prone position during ICU course (*n*, %)	16/28 (57%)
VAP (*n*, %)	20/28 (71%)
Delirium during weaning course (n, %)	12/28 (42%)
Sedation strategies	
Neuromuscular blockade during ICU course (*n*, %)	23/28 (82%)
Respiratory support after extubation	
HFNC (*n*, %)	28/28 (100%)
NIMV (*n*, %)	2/28 (6%)
Renal failure	
AKI (*n*, %)	1/28 (3%)
AKI I (*n*, %)	1/1 (100%)
CRRT (*n*, %)	0/28
Results/Outcomes	
IMV duration (days)	7 ± 4
Successful extubation (*n*, %)	26/28 (92%)
Reintubation (*n*, %)	2/28 (7%)
Need for tracheostomy (*n*, %)	2/28 (7%)
Prolonged weaning (*n*,%)	2/28 (7%)
Length of ICU stay (days)	17 ± 11
Outcome Hospital (survived) (*n*, %)	28/28 (100%)

multimodal rehabilitation program for IMV patients however this was provided to a prolonged weaning group, with IMV for greater than 14 days.[17] It does not consider early CPT post extubation in simple weaning and first attempt extubation. Moreover, the general evidence suggests that there is a 10–20% of reintubation rates following planned extubation in ICUs.[18] However, in a more recent study, where the use of CPT and EM was not considered, the extubation failure rate was 38% as opposed to our study's 7%[19]; thus highlighting the importance of our findings. It is key to mention than in our study, extubation success may have also been supported by using HFNC for all of our patients. Hernandez et al described a reintubation rate of 22.8% with the use of HFNC post extubation, however this was not a study that included the use of CPT post extubation and EM protocols, alongside HFNC.[20]

We recognize that our study has several limitations. This study is a single-center study and the typology of patients only includes those affected by SARS-CoV-2 pneumonia, creating a homogenous sample. There is limited evidence available for comparison with regards to weaning success in the COVID-19 population, particularly in the context of early post-extubation CPT and EM. Furthermore, the small sample size is another limiting factor, making it difficult to compare it with the aforementioned studies. This will be addressed by conducting this study as a multicenter study to expand the sample size and make it heterogenous, to aid generalizability of its findings. The decision to publish these preliminary results is relevant, as we have implemented early CPT following extubation and EM protocols, achieving important results in weaning success despite our limitations. Moreover, a randomized controlled trial was not considered for this research due to the ethical implications of depriving control group patients from health benefitting treatments, such as CPT and EM. These widely recognized benefits include reducing muscle atrophy, duration of IMV, length of hospital stay and increasing functional capacity.[21] Finally, the lack of information regarding the premorbid functional status of our population and absence of a mobility assessment scale may have hindered the interpretation of our results in the context of EM. We were unable to achieve baseline mobility measurements for each patient due to the requirement of deep sedation in the majority of our study population. We aim to include these measurements as an outcome measure in future studies. In fact, we are in the process of analyzing our results in a more powerful study format such as cases – retrospective controls. However, the early mobilization program has worked within our care organization with very good results and acceptance, and in addition, we have obtained these preliminary results that we consider very good, with a reintubation rate of only 7% in a population with severe ARDS, so we considered its publicity relevant.

In conclusion, we are the first to describe a lower than usual extubation failure with physiotherapy interventions that include CPT within 2 h of extubation and EM protocols before and after extubation. We want to highlight that these interventions may imply a decreased in extubation failure rate. The future completion of a multicenter study will include a multivariate analysis with a larger sample size to give us more generalizable results in the future.

Statement of ethics

We complied with the guidelines for human studies and our research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. Information revealing the subject's identity is to be avoided. The study was approved by the local Clinical Research Ethics Committee (PR(ATR)164/2021) with exemption from informed consent

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Author contributions

We were all involved in providing care for the patient. We were all involved in writing and reviewing the manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

The study was approved by the local Clinical Research Ethics Committee (PR(AG)270/2020) with exemption from informed consent.

Conflict of interest

The authors have no conflicts of interest to declare.

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References

1. Murthy S, Gomersall C, Fowler R. Care for critically ill patients with COVID-19. JAMA. 2020, http://dx.doi.org/10.1001/jama.2020.3633.
2. Bouadma L, Lescure FX, Lucet JC, Yazdanpanah Y, Timsit JF. Severe SARS-CoV-2 infections: practical considerations and management strategy for intensivists. Intensive Care Med. 2020;46:579–82, http://dx.doi.org/10.1007/s00134-020-05967-x. Epub 2020 Feb 26. PMID: 32103284; PMCID: PMC7079839.
3. Vanhorebeek I, Latronico N, Van den Berghe G. ICU-acquired weakness. Intensive Care Med. 2020;46:637–53.
4. Ntoumenopoulos G, Presneil JJ, McElholum, Cade JF. Chest physiotherapy for the prevention of ventilator-associated pneumonia. Intensive Care Med. 2002;28:850–6, http://dx.doi.org/10.1007/s00134-002-1342-2. Epub 2002 May 24.
5. Stiller K. Physiotherapy in intensive care: an updated systematic review. Chest. 2013;144:825–47, http://dx.doi.org/10.1378/chest.12-2930.
6. Boles JM, Bion J, Connors A, Herridge M, Marsh B, Melot C, et al. Weaning from mechanical ventilation. Eur Respir J. 2007;29:1033–56.
7. Houzé MH, Deye N, Mateo J, Mégarbane B, Bizouard F, Baud FJ, et al. Predictors of extubation failure related to aspiration and/or excessive upper airway secretions. Respir Care. 2020;65:475–81.
8. Raurell-Torredà M, Regaira-Martínez EE, Planas-Pascual B, Ferrer-Roca R, Martí JD, Blazquez-Martínez E, et al. Early mobilisation algorithm for the critical patient. Expert recommendations. Enferm Intensiva. 2021. S1130-2399(21)00003-1.
9. Quintard H, l'Her E, Pottecher J, Adnet F, Constantin JM, De Jong A, et al. Intubation and extubation of the ICU patient. Anaesth Crit Care Pain Med. 2017;36:327–41.
10. Bouadma L, Lescure FX, Lucet JC, Yazdanpanah Y, Timsit JF. Severe SARS-CoV-2 infections: practical considerations and management strategy for intensivists. Intensive Care Med. 2020;46:579–82, http://dx.doi.org/10.1007/s00134-020-05967-x. Epub 2020 Feb 26. PMID: 32103284; PMCID: PMC7079839.
11. Van Aerde N, Van den Berghe G, Wilmer A, Gosselink R, Hermans G, Meersseman P, et al. Intensive care unit acquired muscle weakness in COVID-19 patients. Intensive Care Med. 2020;46:2083–5.
12. Ranieri V, Rubenfeld G, Thompson B, Ferguson N, Caldwell E, Fan E, et al. Acute respiratory distress syndrome: the Berlin definition. JAMA. 2012;307:2526–33.
13. Esteban A, Frutos F, Tobin MJ, Alía I, Solsona JF, Valverdú I, et al. A comparison of four methods of weaning patients from mechanical ventilation. Spanish Lung Failure Collaborative Group. N Engl J Med. 1995;332:345–50.
14. Pellegrini J, Moraes R, Maccari J, de Oliveira R, Savi A, Ribeiro R, et al. Spontaneous breathing trials with T-piece or pressure support ventilation. Respir Care. 2016;61:1693–703.
15. Wang T-H, Wu C-P, Wang L-Y. Chest physiotherapy with early mobilization may improve extubation outcome in critically ill patients in the intensive care units. Clin Respir J. 2018;12:2613–21.
16. Morris P, Goad A, Thompson C, Taylor K, Harry B, Passmore L, et al. Early intensive care unit mobility therapy in the treatment of acute respiratory failure. Crit Care Med. 2008;36:2238–43.
17. Verceles A, Vells C, Sorkin J, Terrin M, Beans J, Jenkins T, et al. A multimodal rehabilitation program for patients with ICU acquired weakness improves ventilation weaning and discharge home. J Crit Care. 2018;47:204–10.
18. Thille AW, Richard JCM, Brochard L. The decision to extubate in the intensive care unit. Am J Respir Crit Care Med. 2013;15:1294–302.
19. Whitmore D, Mahambray T. Reintubation following planned extubation: incidence, mortality and risk factors. Intensive Care Med Exp. 2015;3 Suppl. 1:A684.
20. Hernández G, Vaquero C, Colinas L, Cuena R, González P, Canabal A, et al. Effect of postextubation high-flow nasal cannula vs noninvasive ventilation on reintubation and postextubation respiratory failure in high-risk patients; a randomized clinical trial. JAMA. 2016;316:1565–74.
21. Alaparthi GK, Gatty A, Samuel SR, Amaravadi SK. Effectiveness, safety, and barriers to early mobilization in the intensive care unit. Crit Care Res Pract. 2020;2020, 7840743.

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