Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Medical Hypotheses 146 (2021) 110443

Contents lists available at ScienceDirect

Medical Hypotheses

journal homepage: www.elsevier.com/locate/mehy

Hypothesis: A wearable device may help COVID-19 patients improve lung function

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ARTICLE INFO

Keywords:
COVID-19
Proning
Wearable technology
Hospital transmission
Personal protective equipment

ABSTRACT

Managing respiratory status of patients with COVID-19 is a high resource, high risk healthcare challenge. Interventions that decrease need for invasive respiratory support and utilization of bedside staff would benefit patients and healthcare personnel alike. Proning has been established as optimal positioning that may reduce the need for escalation of respiratory support. We propose a new application of a wearable device to decrease supine positioning and ameliorate these risks.

Introduction

The COVID-19 pandemic has resulted in significantly increased incidence of acute respiratory distress syndrome (ARDS), which historically has had a high mortality of 25–40%, even with improvement in supportive therapies and protocol-based application of lung protective mechanical ventilation [1]. One study suggests that around two-thirds of severely ill COVID-19 patients meet criteria for ARDS, and more than half of those require intubation [2]. This has led to close examination of respiratory support approaches to determine best outcomes. Prone positioning is considered one of the most effective strategies for patients with severe ARDS [3], and may even stave off intubation in selected severely ill COVID patients [4]. A major drawback is maintaining the position, even in patients utilizing high flow nasal cannula (HFNC) or noninvasive positive pressure ventilation (NIPPV), a strategy which requires frequent involvement of healthcare personnel and concomitant transmission risk.

Hypothesis

Three axis accelerometry has been utilized in multiple medical interventions. One such intervention is utilization of accelerometry to determine supine positioning in pregnancy, a risk factor for small for gestational age fetuses, preeclampsia, and even intrauterine death [5,6]. A small IRB-approved feasibility trial of the PregnancyCoach wearable device (Smart Human Dynamics, California) at Mayo Clinic demonstrated an 80% decrease in supine sleep time utilizing a vibrating device to signal pregnant patients to reorient during sleep (84% vs 21%; unpublished, IRB #16-006414). A 500-patient clinical trial at the University of Michigan is now being conducted with continued evidence of an average decrease in supine time of approximately 80% (data forthcoming). Extensive use of the device in non-trial subjects also demonstrates that this platform is effective at altering body position without disrupting sleep.

These data suggest a novel approach to treatment of moderately severe respiratory distress secondary to COVID-19. A modification of the device, the MiniProner body positioner, helps patients consistently maintain prone and lateral positions. Real-time data can also be remotely monitored to support compliance. We propose several benefits to utilizing this simple technology:

1) Improve patient outcomes

Most people change positions frequently throughout the night. The real-time 24-hour-per-day monitoring from the MiniProner device may significantly increase the amount of time patients spend in the prone position. This increased position compliance may reduce the need for intubation and mechanical ventilation, reduce the time spent in the hospital, and reduce the mortality rate.

2) Reduce COVID-19 exposure to clinicians

Nurses typically check patient position in intensive care settings frequently, and recommendations for minor repositioning in prone patients are for every 30–120 min [7]. While patients requiring sedation and invasive ventilation cannot reposition themselves, patients

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https://doi.org/10.1016/j.mehy.2020.110443
Received 20 November 2020; Accepted 29 November 2020
Available online 4 December 2020

tolerating HFNC or NIPPV may be able to do so without staff assist utilizing prompting from the Mini-Proner device. This could significantly reduce care providers' exposure.

3) Reduce costs to the healthcare system

Each time caregivers come in close contact with a highly infectious patient, they must discard and replace their exposed personal protective equipment (PPE). These costs add up very quickly when a dozen or more sets of PPE are used every day. Secondly, nurses who contract COVID-19 must quarantine, generating staffing and systems costs. Finally, potentially shorter hospitalization reduces payor, system, and patient costs.

4) Research augmentation

Most studies of prone positioning in COVID patients rely on nurse reports of body position, which may be sparse or imprecise. MiniProner captures real-time continuous data and stores it securely. In addition, it captures the exact body position (to less than 1 degree of angle precision), so researchers can further investigate optimal positioning. The number of position changes, sleep quality, longest average supine time intervals each night, and dozens of other position and sleep data sets are auto generated, thus improving the power and robustness of the data set.

Authors declare no funding for current paper; S. Dugan is the founder and CEO or Smart Human Dynamics, manufacturer of MiniProner

Conclusion

The challenges in COVID-19 care are many, and novel interventions that reduce clinician exposure and improve outcomes are few. Utilization of a simple accelerometry-based device to prompt non-supine positioning may benefit healthcare systems and patients during this crisis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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