Use of a Non-invasive Open Ventilation (NIOV) System to Assist Mobilization: A Case Study

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Overview

Neuromuscular weakness often occurs as a consequence of the immobility associated with prolonged hospitalization and especially during intensive care treatment, where its negative effects can be persistent and severe. Clinical studies have shown that exercise and early mobilization is beneficial in altering the downward spiral associated with immobility, and in improving muscle strength and physical function.[1] Recently, early mobility studies in the ICU have demonstrated that doing so can be accomplished safely, with reductions in short-term physical impairment.[2-3] However, accomplishing early mobility often requires significant changes in ICU practices, including reduction of sedation, teamwork, and the availability of portable devices.

A portable device that augments ventilation, while supplying supplemental oxygen could improve patient mobility, enhance rehabilitation, and offset some of the functional impairment associated with prolonged immobility and neuromuscular weakness. In this regard, a wearable, non-invasive open ventilation (NIOV) system that delivers oxygen therapy while augmenting ventilation has been developed by Breathe Technologies, Inc. and cleared for use by the FDA. The ventilator is light enough (1 lb) to be carried by patients, and uses a proprietary "open" nasal pillow interface (Figure 1). Because of its portability and comfortable nasal interface, the NIOV System is uniquely positioned to provide patients with a means of receiving truly ambulatory augmented ventilation plus supplemental oxygen.

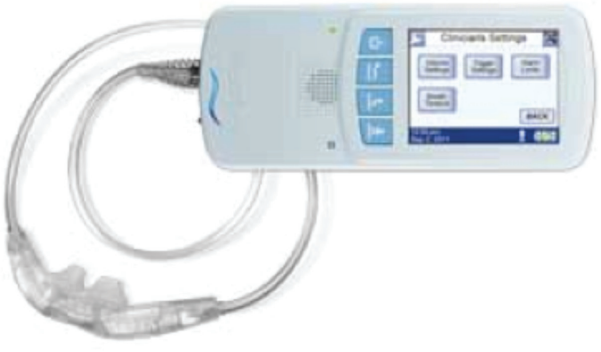

Figure 1. The portable Breathe Technologies NIOV System.

This article was provided by Breathe Technologies.

Potential Benefits of the Breathe NIOV System include:

- A portable method for augmenting ventilation and oxygenation, allowing patients to move from a sedentary situation, build strength and stamina, enhance mobility, and reduce neuromuscular weakness.
- Establishes a foundation of effective ventilation and oxygenation that allows patients to perform basic activities and functions with the intent upon improving cardiopulmonary function.

Patient Case Study

The NIOV System was evaluated in a 71-year-old, male patient chosen by the pulmonary staff with an admitting diagnosis of Waldenström macroglobulinemia (WM). WM is a rare, slow-growing, non-Hodgkin lymphoma. Approximately 18 days prior to the NIOV evaluation, the patient had been directly admitted into the intensive care unit due to failure to thrive. Initially, the patient was placed on a high-flow nasal cannula. Earlier in the week, the ICU staff was able to successfully wean his supplemental oxygen requirement down to a standard nasal cannula at 4-6 lpm. The patient's current chest radiographs revealed moderate bilateral pleural effusions and auscultation revealed coarse crackles bilaterally. The patient complained of moderate-to-severe weakness and fatigue. After conferring with the patient's physician and obtaining a prescription, evaluation of the NIOV System was undertaken to determine whether the patient could benefit from the device.

Summary of Results

Day 1: The patient found the NIOV nasal pillow interface to be comfortable, and he was able to immediately breathe in synchrony with the ventilator. Initial acclimation and titration to the NIOV System resulted in volume augmentation settings of 90 mL, 150 mL, and 180 mL on the low, medium, and high volume settings, respectively. The patient was slowly progressed out of bed, and throughout his first walk using the ventilator, volume augmentation was titrated up three times, with final settings of 180 mL, 200 mL, and 230 mL. During the entire trial session, the patient maintained SpO2 >95% with a maximum respiratory rate of 28/min and maximum heart rate of 91/min. The patient walked a total distance of approximately 70 ft. During the walk, the patient complained of weakness in the legs, and felt that this was the greater limiting factor versus dyspnea in his decision to terminate the walk. The patient commented that the NIOV pillow interface was "more comfortable than all previous nasal [interfaces]" he had been placed on.

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If clinicians are able to keep the ETT cuffs inflated to the therapeutic range, not only would it prevent damage to the mucosa, but would certainly help to prevent microaspiration shown to cause VAP. One way to do this is to have continuous ETT cuff pressure monitoring and control. Nseir and colleagues[1] showed in their study that continuous cuff pressure monitoring and control resulted in reduced microaspiration and the rate of VAP. If automatic cuff controllers could be used with every patient it is likely that we would see a reduction in VAP as a direct consequence of the reduction in microaspiration of subglottic secretions. One such automatic cuff controller just cleared by the FDA is INTELLiCUFF, which is an option on Hamilton G5 ventilators.

Today, we must be vigilant in the effort to continue to reduce VAP. Hospital costs skyrocket with each new case of VAP that is diagnosed. Knowing that we can reduce microaspiration in the ventilated patient is good news as it is directly linked to the incidence of VAP. Automatic ETT cuff controllers have been studied and have shown that they, in fact, reduce microaspiration. For the number of VAP cases that can be prevented by the continuous control of cuff pressure, it seems as though the cost of these devices is well worth it.

References

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Day 2: The patient was re-evaluated on the NIOV System with no changes made to the ventilator settings from the previous day. During this trial, the patient was able to increase his total distance walked to 125 ft, while maintaining stable vital signs comparable to Day 1. During both evaluation walks, the patient used a special arm rest walker and was encumbered with a Foley catheter, two intravenous lines, and an arterial line. The NIOV System was on only during activity and the patient was returned to his standard oxygen cannula afterwards.

Discussion

This limited evaluation of the NIOV System is part of an ongoing effort to explore the applications of a unique product. The use of a portable non-invasive open ventilation system in the acute care setting may allow patients with neuromuscular weakness to more easily accomplish early mobilization. If so, this might ultimately result in a reduction in morbidity and complications associated with neuromuscular weakness and immobility. This case study, along with prior clinical trials[4,5] using the NIOV System, support the premise that a truly portable ventilator can provide utility in improving mobility and exercise tolerance. Further clinical evaluations and trials are required to better define NIOV's applications, benefits, and its expected outcomes.

References

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