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Project Title:

Incidence and Characteristics of Patient-Ventilator Dyssynchrony during Non-Invasive Ventilation with Transport Ventilators: A Bench Study

Executive Summary

The project, "Incidence and Characteristics of Patient-Ventilator Dyssynchrony during Non-Invasive Ventilation with Transport Ventilators: A Bench Study," was supported by the American Respiratory Care Foundation under the Parker B. Francis Research Grant. This study aimed to identify the rate and characteristics of patient-ventilator dyssynchrony during non-invasive ventilation (NIV) when using transport-specific ventilators that offer both invasive and non-invasive capabilities.

A controlled bench study was conducted using the IngMar ASL 5000® lung simulator to replicate spontaneous breathing efforts across varying respiratory drive intensities, pressurization parameters, and an obstructive pathophysiological profile. Multiple transport ventilators were evaluated under standardized conditions. Patient-ventilator dyssynchrony was identified through detailed waveform analysis and standardized dyssynchrony indices. Leaks were introduced via a custom water seal apparatus to replicate the non-linear leak behavior typical of oronasal masks during inspiratory and expiratory phases.

We observed an increased incidence of patient-ventilator dyssynchrony associated with higher leak levels and extremes of inspiratory efforts within and among the ventilators tested. Compared to a commonly used, NIV-specific ventilator (Philips Respironics V60), all transport-specific ventilators exhibited delayed pressurization during inhalation and variable performance during end-inspiratory cycling and expiratory phases. Significant variability was noted among ventilators in their ability to compensate for leak and synchronize with patient effort. Design differences, including exhalation valve configurations, mechanisms of PEEP control, and manufacturer “background” settings such as Ti-max, may have also contributed to performance variability.

The findings of this study aim to inform clinical decision-making regarding the selection and setup of transport ventilators for non-invasive ventilation. By highlighting variability in ventilator performance and susceptibility to dyssynchrony under conditions common in real-world transport, this research supports efforts to optimize patient-ventilator interaction, reduce NIV failure rates, and ultimately improve patient safety during transport.

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