



DOES SLEEP QUALITY CHANGE BY MODE OF MECHANICAL VENTILATION?

by *Herbert Patrick MD*

The peer-reviewed research article selected to teach the scientific method in this column is: Belen Cabello MD, Arnaud W. Thille, MD, Xavier Drouot, MD, PhD, Fabrice Galia, Biomed Engineer Master, Jordi Mancebo, MD, Marie-Pia d'Ortho, MD, PhD, Laurent Brochard, MD: *Sleep Quality in Mechanically Ventilated patients: Comparison of Three Ventilator Modes* published in *Critical Care Medicine* 2008; Volume 36, Number 6, pages 1749-1755. The authors are from Creteil, France (BC, AWT, XD, FG, LB, MPdO), and Barcelona Spain (BC, JM).

The Background or Introduction of the research project explains interest in the topic and why the topic is significant. The authors state that patients requiring mechanical ventilation in intensive care units (ICUs) often have poor quality of sleep. They note that few studies have been performed to determine the extent of sleep abnormalities of patients in ICUs. Prior studies of

polysomnography performed on mechanically ventilated patients in ICUs showed several things. There is an increase in sleep fragmentation, a reduction of slow-wave sleep and rapid eye movement (REM) sleep, and an abnormal distribution of sleep. The authors sought to investigate the influence of different modes

of mechanical ventilation at night on sleep. Adjusting the pressure support ventilation (PSV) level at night could diminish the level of sleep fragmentation due to minimization of central apneas.

The Question being asked by the researchers was: Does the mode of nocturnal mechanical ventilation alter sleep quality for ICU patients? Note: The Question asked in a research project may have the possible answers: "yes" and "no" as in this study, or may be a numerical result. The preconceived answer by the researchers to the Question is called the Hypothesis. The researchers stated their hypothesis as setting the PSV level to the patient's ventilatory need would diminish sleep fragmentation when compared to assist control ventilation (ACV). Therefore, the hypothesis was yes, the mode of nocturnal ventilation will alter sleep quality for ICU patients.

The Methods for the research project describe the study design, setting and steps to answer the Question. The study was

approved by the Ethics Committee of the French Intensive Care Society and the patients or their surrogates gave informed consent. Three different modes of ventilation available to the authors in their ICUs were studied. The modes were ACV and two different types of PSV, clinically adjusted PSV (cPSV) and automatically adjusted PSV (aPSV). The authors' inclusion criteria were lack of sedation for 24 hours, lack of analgesia for 24 hours, FiO₂ below 60% and SpO₂ equal or above 90%. All patients were ventilated using a Dräger Evita 4 (Dräger Medical, Lübeck, Germany). The ACV mode was set for a tidal volume of 8 ml per kg of predicted body weight, a set rate of 10 breaths per minute and a square wave flow of 60 L/min. The cPSV titer was set to deliver a tidal volume between 6 and 8 ml per kg of predicted body weight. The clinician could modify the cPSV titer at anytime deemed necessary. The aPSV titer was programmed to maintain each patients' respiratory rate between 15 and 30 breaths/min, a tidal volume above a threshold of 300 ml, and an end-tidal CO₂ level below a threshold of 55 mmHg. To achieve these targets, the aPSV was automatically adapted by the Evita in steps of 2 - 4 cmH₂O. The clinician could modify the aPSV titer at anytime deemed necessary. These three different modes, *continued on next page*

Patients requiring mechanical ventilation in intensive care units often have poor quality of sleep



"Mom, Dad...I think it's time we go green on my allowance..."

ACV, cPSV and aPSV were delivered in a randomized order for each patient. The randomized order for each patient was determined using the closed-envelope technique to define the order. This technique has one of the possible random combinations for the three ventilator modes written on a slip of paper and placed in an envelope which is then sealed and numbered in order starting with #1. As each patient was enrolled, the next envelop was opened in order. The nocturnal polysomnography for each patient was performed using the N7000 EMBLA system (Embla ResMed, Denver, CO) with the Somnologica 3 software for data acquisition. Sleep recordings were scored by a physician blinded to the aspects of the study. The authors performed statistical analyses by entering their data into SPSS statistical analysis (SPSS Inc, Chicago, Illinois).

The Results section compiles the data to answer the Questions. A total of 15 patients completed the study. Their median total sleep time was 514 minutes. Median means half of the data is above and half of the data is below the median. Their median sleep efficiency was 43%. Their minute ventilation and tidal volume were similar for all three modes. Sleep fragmentation, sleep architecture and sleep duration were similar for all three ventilator modes as the difference between the modes for the 15 subjects were not statistically different.

The Discussion/Reflections/Future Research starts with a summary discussion of the research. In the Discussion, the authors proposed the reason for no differences by the ventilatory mode in levels of sleep fragmentation, sleep architecture, and sleep quantity. They noted that sleep was disorganized and of poor quality for all patients studied in the ICU. In Reflections, the authors noted that prior studies showed reduced sleep fragmentation during ACV compared to PSV, but the minute ventilation and tidal volume were not similar in the modes in that study. Future Research describes modifications to the project or new projects that would contribute to this research topic. The authors encourage others to conduct randomized trials of polysomnography on patients in ICUs using non-invasive methods.

The Conclusion is the final summary of the research project. This project demonstrated that sleep quality is markedly abnormal in conscious, non-sedated patients receiving assisted ventilation in ICUs. The ventilatory modes of ACV, cPSV and aPSV did not alter the quality of sleep. The ventilatory settings may be more important than the ventilatory mode. The answer to the Question was no, and the proposed hypothesis was incorrect.

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The Bibliography section includes references to support the research as included in the manuscript by reference number. For this research project, there were 33 references.

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