

The Impact of a Unique Airway Clearance System on Airway Mechanics in Ventilated Patients

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Abstract

Background: The adherence of secretions along the endotracheal tube (ETT) lumen in mechanically ventilated (MV) patients' results in airway narrowing and concomitantly may increase patients' work of breathing. Biofilm accumulation may also promote the development of ventilator-associated pneumonia. Routine suctioning does not address the potential risks associated with secretions and biofilm that collect within the ETT lumen. A unique mucus shaver system (endOclear[®]) facilitates removal of secretions and biofilm. The purpose of this study is to determine the effectiveness of reducing peak airway pressures and resistance in ventilated patients who have their ETT cleared with a mucus shaver system. The hypothesis is: Application of a mucus shaver system in addition to routine suctioning prior to spontaneous breathing trials (SBTs) lowers both peak airway pressures and airway resistance.

Methods: This study retrospectively identified all subjects having their ETTs cleared at a single institution prior to beginning a SBT between Jan 2012-Jul 2013. All subjects had received at least 24 hrs of MV prior to the SBT, and all underwent routine suctioning with a closed in-line system prior to use of the mucus shaver. Peak airway pressures before and after the additional use of the mucus shaver along with changes in airway resistance served as our co-primary endpoints. The study also compared changes in these variables as function of the ETT lumen size.

Results: The median peak airway pressure measured 29 cmH₂O before use of the mucus clearance system and fell to 23 cm H₂O (p<0.001). There was a similar decline in the median airway resistance (27 cm H₂O/Lps to 15 cm H₂O/Lps, p < 0.001). The average percent decline in peak airway pressure equaled 17.6±13.3% while the mean drop in airway resistance was greater, 33.3±18.9%. Seventy-five percent of subjects experienced a greater than 10% and 19% fall in peak airway pressure and airway resistance, respectively. Differences in ETT lumen size did not alter the magnitude of the fall seen in either of the co-primary endpoints.

Conclusions: The addition of a unique mucus shaving and tube cleaning system to routine suction prior to an SBT significantly reduces both peak airway pressure and airway resistance in persons undergoing SBTs.

Introduction

- Current standard of care closed suction systems do not completely clean the inside of the endotracheal tube.^{1,3,4, 5}
- Secretions and biofilm accumulation may lead to decreased liberation from the ventilator^{7,8} and increased ventilator associated pneumonia (VAP).⁶
- Recent protocol use of an endotracheal tube cleaning device prior to spontaneous breathing trials at one center was associated with improved patient outcome (decreased length of intubation and decreased length of ICU and hospital stay) and decreased hospital cost.²
- Physiologic implications of this new secretion management tool have not yet been described

Study Objective

To describe the effect of routine, protocolized use of endOclear[®] device on physiologic measures of airway resistance and peak pressures during efforts to liberate patients from the ventilator

Methods

Design: Prospective, observational quality assurance study, January 2012 through July 2013

Setting: Community hospital mixed medical-surgical ICU

Subjects: Mechanically ventilated patients on the ventilator over 24 hours

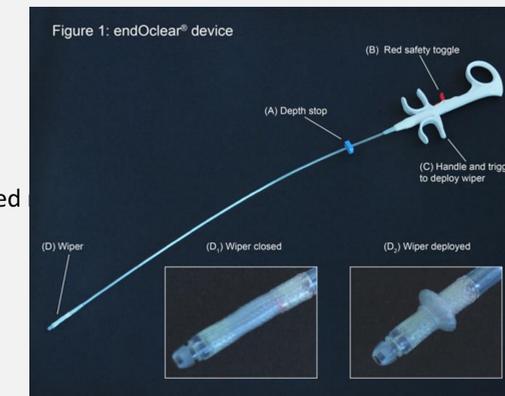
Protocol:

- Prior to SBT, the patient undergoes standard closed suctioning
- peak-airway-pressure (PAP) and resistance are measured while the patient is still on the vent in ventilated
- endOclear[®] (Figure 1) is used and measurements on the same settings are repeated
- patient undergoes SBT

Endpoints: PAP and airway resistance

Statistics:

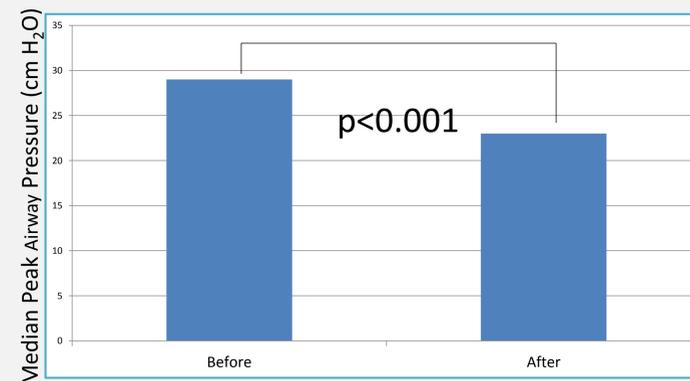
- Endpoints from before and after period compared with either Student's t test (paired)
- p < 0.05 assumed to represent statistical significance



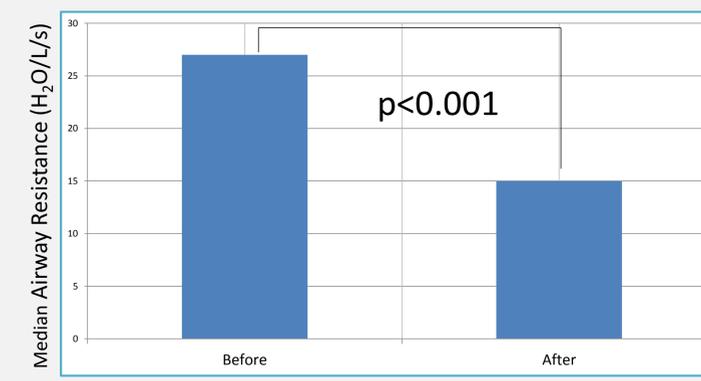
Results

- Cohort
 - n = 109 patients, 18 bed mixed surgical / medical ICU
 - In 2011, prior to use of endOclear[®] the mean duration of MV was 4.3 days
 - Mean duration of MV in current population 3.4 days
- Median airway resistance declined from 27 cm H₂O/Lps to 15 cm H₂O/Lps (p < 0.001).
- The average percent decline in peak airway pressure equaled 17.6±13.3%
- The mean drop in airway resistance was greater, 33.3±18.9%.
- Seventy-five percent of subjects experienced a greater than 10% and 19% fall in peak airway pressure and airway resistance, respectively.
- Differences in ETT lumen size (e.g., whether 8.0 mm vs. smaller) did not alter the magnitude of the fall seen in either of the co-primary endpoints

Results: Impact on Peak Airway Pressure



Results: Effect on Airway Resistance



Conclusions

- Addition of a unique mucus shaving and tube cleaning system (endOclear[®]) to routine suctioning prior to an SBT significantly reduces both peak airway pressure and airway resistance
- Our findings provide a physiologic rationale to explain the impact of this system on duration of MV noted in other reports

References

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