

Pilot study into the causes of airway drying during continuous positive air pressure breathing

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ABSTRACT

The airway surface liquid (ASL) lining the upper respiratory tract has an essential role in heat and moisture exchange, as well as having an important role in airway defense. Continuous positive air pressure (CPAP) users frequently report troublesome symptoms of airway dryness and nasal congestion. Clinical investigations have demonstrated that supplementary humidification reduces these symptoms but the reason for their occurrence remains unexplained. Previously, symptoms of nasal drying have been attributed to unidirectional airflow created by mouth leaks; however these still occur when leaks are absent. Tidal breathing stresses have previously been shown to regulate epithelial cell ionic fluid secretion and reabsorption into the ASL [1]. The purpose of this study was to determine whether augmented air pressures change overall mucosal ASL water supply and, if so, the extent of this effect. It is hypothesized that the low-level positive airway pressures used in CPAP therapy could reduce the ability of respiratory mucosa to humidify inhaled air as a result of reduced ASL supply from the airway mucosa.

In an original *in vitro* experimental process, maximal bovine tracheal ASL supply was determined experimentally over a range of pressures. During simulated ambient pressure breathing, the maximal supply of ASL was found to compare well to previously published data (31.2 μ l/cm².hr). However, CPAP pressures from 5 cm H₂O above ambient were found to reduce ASL supply by 22% as shown by Figure 1. Statistical analysis (n=8) showed a significant difference existed between the ambient and CPAP results ($p < 0.0001$), and that there was no significant variation between all pressurized results ($p = 0.716$). Although the actual mechanism by which this occurs is unclear, these findings provide tracheal mucosa water flux data over the range of augmented pressures normally applied during CPAP therapy. It also provides a potential explanation for the troublesome airway drying symptoms associated with CPAP therapy and justifies the use of supplementary humidification during

CPAP treatment. This work is an aspect of a larger program aimed at understanding and modeling the nasal breathing cycle with respect to CPAP conditions.

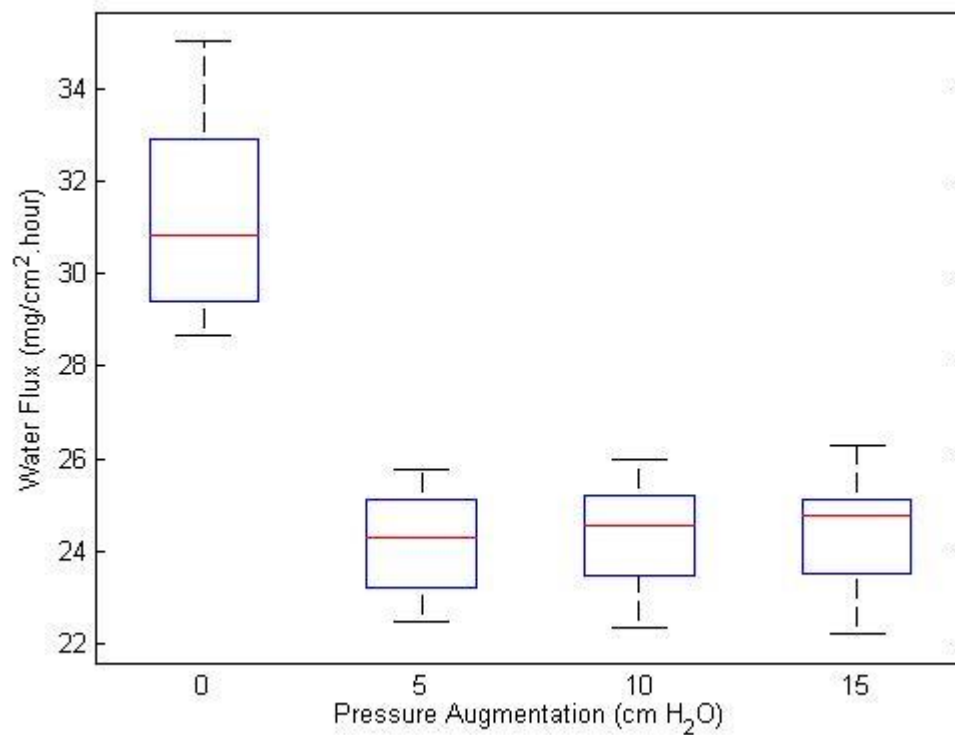


Figure 1 - Trachea maximal water flux during simulated breathing at ambient and augmented air pressure.

Median values (shown by bold line) demonstrate a 22% reduction in maximal water flux from CPAP pressures of 5 cm H₂O.

KEYWORDS: Continuous positive air-pressure, heated humidification, airway surface liquid, mucosal water flux, airway drying, upper airway.

REFERENCE

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