

Respiratory Care Pharmacology/Quick Reference to Aerosolized Agents in Respiratory Care

Pediatric Pulmonology

Comparison of HFNC, Bubble CPAP and SiPAP on Aerosol Delivery in Neonates: An In-Vitro Study

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Summary. Aerosol drug delivery via high flow nasal cannula (HFNC), bubble continuous positive airway pressure (CPAP), and synchronized inspiratory positive airway pressure (SiPAP) has not been quantified in spontaneously breathing premature infants. Objectives: The purpose of this study was to compare aerosol delivery via HFNC, bubble CPAP and SiPAP in a model of a simulated spontaneously breathing preterm infant. Working hypothesis: The types of CPAP systems and nebulizer positions used during aerosol therapy will impact aerosol deposition in simulated spontaneously breathing infants. Study design: Quantitative, comparative, in-vitro study. Methodology: A breath simulator was set to preterm infant settings (V_T : 9 ml, RR: 50 bpm and T_I : 0.5 sec) and connected to the trachea of an anatomical upper airway model of a preterm infant via collecting filter distal to the trachea. The HFNC (Optiflow, Fisher & Paykel), Bubble CPAP (Fisher & Paykel), and SiPAP (Carefusion) were attached to the nares of the model via each device's proprietary nasal cannula and set to deliver a baseline of 5 cm H₂O pressure. Albuterol sulfate (2.5 mg/0.5 ml) was aerosolized with a mesh nebulizer (Aeroneb Solo) positioned proximal to the patient and prior to the humidifier ($n = 5$). The drug was eluted from the filter with 0.1 N HCl and analyzed via spectrophotometry (274 nm). Data were analyzed using descriptive statistics, t-tests, and one-way analysis of variance (ANOVA), with $P < 0.05$ significant. Results: At position 1, the trend of lower deposition (mean \pm SD%) across devices was not significant (0.90 ± 0.26 , 0.70 ± 0.16 and 0.59 ± 0.19 , respectively; $P = 0.098$); however, in position 2, drug delivery with SiPAP (0.79 ± 0.11) was lower compared to both HFNC (1.30 ± 0.17 ; $P = 0.003$) and bubble CPAP (1.24 ± 0.24 ; $p = 0.008$). Placement of the nebulizer prior to the humidifier increased deposition with all devices ($P < 0.05$). Conclusions: Aerosol can be delivered via all three devices used in this study. Device selection and nebulizer position impacted aerosol delivery in this simulated model of a spontaneously breathing preterm infant. **Pediatr Pulmonol.**

Key words: Aerosols; continuous positive airway pressure; nebulizer; neonate; high flow nasal cannula; bubble CPAP; SiPAP.

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Conflict of interest: None.

This study was conducted in the aerosol research lab at Georgia State University with no financial support received to conduct this study. A bubble CPAP system was supplied by Fisher & Paykel Healthcare, Inc. and a SiPAP device was borrowed from Carefusion. Dr. Fink discloses that he is a consultant to Aerogen, Bayer, Boehringer Ingelheim, Dance Biopharm, Novartis, ONY, Parson, Ardis, and the WHO. No company had input into the study design or execution. The findings of this paper were presented as a poster at the meeting of the 19th Conference of the International Society for Aerosols in Medicine (ISAM), that was held in Chapel Hill, NC, USA in April 6-10, 2013.

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