

# Particle Size Characterization of Nebulized Albuterol Delivered by a Vibrating Mesh Nebulizer Through Pediatric Endotracheal Tubes

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## BACKGROUND

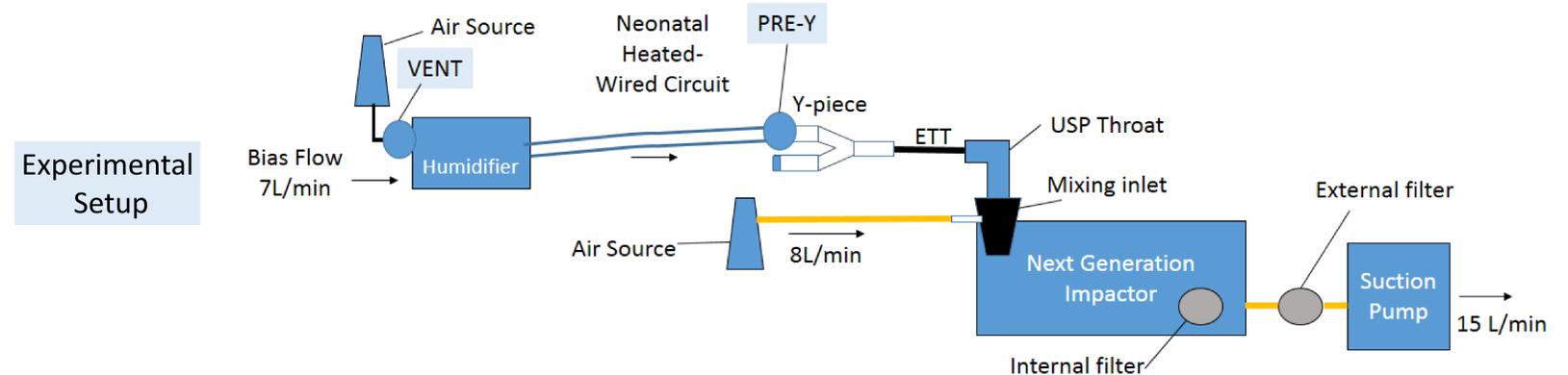
Vibrating mesh nebulizers (VMN) placed in different positions in the ventilator circuit are used to deliver albuterol to pediatric patients receiving mechanical ventilation. Size of endotracheal tube (ETT) could affect aerosol characteristics.

## OBJECTIVE

We aimed to evaluate the effect of VNM placement in a ventilator circuit and ETT size on aerosol characteristics of nebulized albuterol.

## MATERIALS AND METHODS

A model consisting of a neonatal ventilator heated-wired circuit and humidifier was connected to ETTs (3.5 and 5 mm internal diameter). Three units of a VMN (Aerogen Solo™, Aerogen, Galway, Ireland) loaded with albuterol sulfate solution (5mg/3.5ml) were tested inline in the ventilator circuit between the inspiratory limb and the Y-piece (PRE-Y) and on the dry side of the humidifier (VENT). The nebulizer was operated for 4 minutes with a bias flow of 7 L/min. The ETTs were connected to a cooled Next Generation Impactor (MSP Corporation, Shoreview, MN) to determine particle size characteristics. Albuterol mass was determined via spectrophotometry (276 nm). Total mass recovered was expressed as percentage of loading dose (% DELIV). Mass median aerodynamic diameter (MMAD), geometric standard deviation (GSD), and percentage of particles less than 5 μm (<5%) were calculated using CITDAS 3.1 software (Copley Scientific, Nottingham, UK).



## RESULTS (mean ± SD)

Position/ETT	VENT/3.5	VENT/5	P 3.5vs.5	PRE-Y/3.5	PRE-Y/5	P 3.5vs.5
MMAD (μm)	1.97(0.09) <sup>a</sup>	2.27(0.06) <sup>e</sup>	<b>0.009</b>	1.81(0.14)	2.53(0.05)	<b>0.001</b>
GSD	1.48(0.03) <sup>b</sup>	1.38(0.03) <sup>f</sup>	<b>0.02</b>	1.72(0.04)	1.68(0.03)	0.24
<5% (%)	88.3(3.3) <sup>c</sup>	99.3(0.6) <sup>g</sup>	<b>0.005</b>	21.4(3.4)	48.3(9.8)	<b>0.001</b>
% DELIV (%)	9.5(2.6) <sup>d</sup>	8.2(5.4) <sup>h</sup>	0.73	23.6(5.2)	22.1(6)	0.76

P values (T-test): VENT vs. PRE-Y for each ETT size: <sup>a</sup>p=0.07; <sup>b</sup>p=0.001; <sup>c</sup>p<0.0001; <sup>d</sup>p=0.01; <sup>e</sup>p=0.005; <sup>f</sup>p=0.0003; <sup>g</sup>p=0.008; <sup>h</sup>p=0.04.

Using a smaller ETT decreased MMAD and <5% but did not change % DELIV. Moving the nebulizer from VENT to PRE-Y decreased <5% and increased % DELIV, GSD, and MMAD (ETT size 5 mm only).

## CONCLUSIONS

Position of VMNs and ETT size affected aerosol characteristics of nebulized albuterol in a pediatric model of mechanical ventilation.

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