INFLUENCE OF NEBULIZER TYPE, POSITION AND BIAS FLOW ON AEROSOL DRUG DELIVERY IN A MODEL OF ADULT MECHANICAL VENTILATION.

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Background:

The effectiveness of aerosol drug delivery during adult mechanical ventilation varies due to aerosol generator type, position in the ventilator circuit and ventilator parameters. The purpose of this study was to determine the influence of position and bias flow using a jet (JN) and a vibrating mesh (VM) nebulizer on albuterol sulfate delivery in a model of adult mechanical ventilation.

Methods

Lung Model: Using a dual chamber test lung (Michigan Instruments, Grand Rapids, MI), an in-vitro lung model was constructed to simulate mechanically ventilated adult patients. A ventilator (Galileo, Hamilton Medical, Reno, NV) with a heated humidifier (Fisher & Paykel, Auckland, New Zealand) and heated wire circuit (Allegiance Healthcare Corporation, McGaw Park, IL) was connected to the test lung through 8 mm ID ETT. An absolute filter (Respirgard II bacterial/viral filter, No. 303; Vital Signs, Totowa, NJ) was placed distal the ETT and prior to the test-lung inlet.

Nebulizers: The types of nebulizers used in this study include:
1) Jet Nebulizer (JN): Misty FinityTM, Cardinal Health, and
2) Vibrating Mesh Nebulizer (VM): Aeroneb® Solo, Aerogen, Ltd.

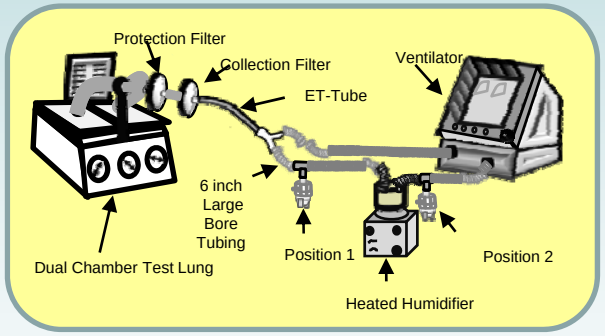
Methods

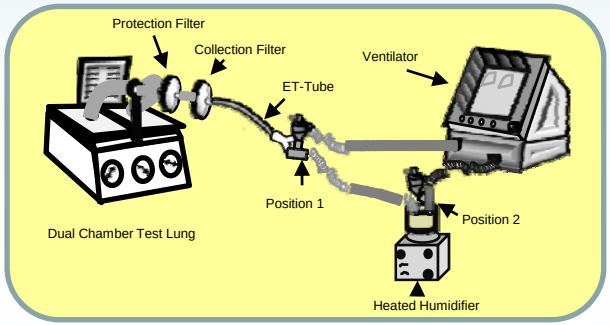
Positions: All nebulizers were operated at

Position 1: JN was placed 6 inches from the "Y" and VM was attached directly to the Y piece.

Position 2: JN was placed prior to the heated humidifier using 6 inches of large bore tubing and VM positioned at an inlet to the humidifier in the pediatric and adult lung models (See Figure 1).

Figure 1. Experimental set-up with JN and VM nebulizers.





Methods

Ventilator Settings: A ventilator with a heated humidifier and heated ventilator circuit delivered adult settings (Vt 500 mL, PEEP 5 cmH2O, RR 20/min, PIF 60L/min, Descending waveform) through an 8 mm ID ETT to an absolute filter attached to a test lung at a bias flow 2 and 5 lpm.

Data Collection & Analysis: Albuterol sulfate (2.5 mg) was nebulized in each condition (n=3), eluted from the filter and analyzed by spectrophometry (276nm). A 3-way factorial ANOVA was used ($p<0.05$).

Results

The percentage of inhaled dose (mean± SD) is presented in the table below. Increased bias flow reduced drug delivery. VM was more efficient than JN at both positions ($p<0.05$).

	Position 1: Placement at the Y				Position 2: Placement Pre-humidifier			
Bias flow	2 lpm		5 lpm		2 lpm		5 lpm	
JN	4.68	0.10	4.02	0.12	5.17	0.15	4.72	0.45
VM	13.44	1.10	9.73	0.60	23.82	1.02	21.43	0.43

Conclusion

Placement of the VM and JN at the pre-humidifier was more efficient than placement at the Y.