EFFECT OF HME ON AEROSOL DRUG DELIVERY AND AIRWAY RESISTANCE IN SIMULATED VENTILATOR DEPENDENT ADULTS USING JET AND MESH NEBULIZERS

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Background & Purpose

Placement of a heat moisture exchanger (HME) between aerosol generator and patient has been associated with greatly reduced drug delivery and increased resistance of gas passing through the HME increasing work of breathing.

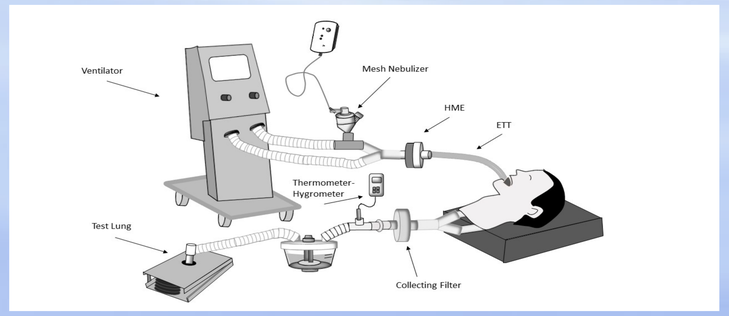
The purpose of this study was to evaluate the effect of a specific HME placed between nebulizer and patient on aerosol deposition and airway resistance (Raw) in simulated ventilator dependent adults.

Methods

Lung Model: An in vitro lung model was developed to simulate a mechanically ventilated adult (Vt 500 ml, RR 15/min, PEEP 5 cmH2O and I:E ratio: 1:2) using an endotracheal tube (8 mmID).

The mainstem bronchi of the manikin was connected to a Y adapter through a collecting filter (Respirgard II) attached to a test lung through a heated cascade humidifier (37ºC producing 100% relative humidity) to simulate exhaled humidity.

Experimental Set-up of the Study



Methods

Data Collection: For treatment conditions, an HME (ThermoFlo™ 6070, ARC Medical) was placed between the ventilator circuit at the ETT and allowed to acclimate to the exhaled heat and humidity for 30 min prior to aerosol administration.

The values on airway resistance ($cmH_20/l/s$) was taken from the display on the ventilator monitor (Hamilton Galileo) at 0, 10, 20 and 30 min after HME placement and after each of 4 treatments.

Albuterol sulfate (2.5 mg/ 3mL) was administered with jet (MistyMax10, Airlife) and mesh (Aerogen Solo, Aerogen) nebulizers positioned in the inspiratory limb 6 in from the Y adaptor and at the Y, respectively. Control consisted of nebulization with no HME. Drug was eluted from filter at the end of the trachea and measured using spectrophotometry.

Results

The table shows mean±SD percent dose delivered and Raw. Greater than 60% of the control dose was delivered through the ThermoFlo™. No significant difference was found between the first four treatments given by the jet (p=0.825) and the mesh (p=0.753) nebulizer.

AEROSOL DEPOSITION

	TREATMENT GROUPS (WITH HME)		CONTROL GROUPS (WITHOUT HME)	
	Jet Neb	**Mesh Neb**	**Jet Neb**	**Mesh Neb**
1st Treatment	3.47±0.40	6.61±0.34	5.44±0.17*	10.64±0.53*
2nd Treatment	3.56±0.52	6.54±0.71		
3rd Treatment	3.38±0.41	6.57±0.84		
4th Treatment	3.64±0.44	6.40±0.86		

Results

After placement of the HME for 30 min, there was a small but significant increase in Raw that was similar with jet (p=0.023) and mesh (p=0.024) nebulizers test groups. However, Raw did not increase with individual aerosol treatments or cumulative with all 4 treatments with either jet (p=0.99) or mesh (p=0.25).

Raw Before Treatment	Jet Nebulizer	Mesh Nebulizer	p value
0 min	15.50±0.57	13.75±0.50	*0.035*
10 min	16.25±0.95	14.75±1.25	*0.182*
20 min	16.50±0.57	15.75±2.06	*0.423*
30 min	17.00±0.81	16.00±1.63	*0.375*
p value	*0.23*	*0.24*	
Raw After Treatment			
1st treatment	17.50±1.00	16.00±2.16	*0.547*
2nd treatment	17.50±0.57	16.50±1.91	*0.353*
3rd treatment	17.50±0.57	16.25±2.21	*0.312*
4th treatment	17.50±0.57	16.75±1.70	*0.444*
p value	*0.99*	*0.25*	

Conclusion

The ThermoFlo™ HME effectively passed the majority of aerosol on to the airway. Increases in Raw would likely not be outside of a tolerable range in ventilated patients. Further research with other HMEs and materials is warranted.

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