Comparing Aerosol Characteristic of Vibrating-Mesh and Jet Nebulizers when Delivering Inhaled Antibiotics and Corticosteroids

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Introduction

Aerosol therapy of antibiotics and corticosteroids has become an emergent trend in clinical practice. However, studies have shown that a large variation exists in medication delivery efficiency among different nebulization systems[1-4]. Herein we compared the functional performance of two vibrating-mesh and a jet nebulizers when atomizing colistimethate sodium and budesonide.

Methods

■Drug: a unit-dose of budesonide (2.0 mg/2mL, AstraZeneca Corp.), and a vial of colistimethate sodium powder (colistin, 2 million IU, 66.8 mg/vial, TTY Biopharm Ltd.) was dissolved separately in 2 mL (high concentration colitsin) and 4 mL (normal concentration colitsin) of isotonic saline.

■Nebulizers: Table 1 showed particle size of three nebulizers, the Aerogen Solo (Aerogen Ltd.), the MICROVENT™ (MicroBase Tech. Corp.) and jet nebulizer JN (Galemed Corp.). Particle size of volumetric median diameter was tested by laser source 670 nm wavelength of Malvern Spraytec (Malvern Instruments Ltd.), expressed as volume median diameter (VMD).

■Measurement of nebulizers output: budesonide, high conc. colistin, and normal conc. colistin were placed separately into three nebulizers, nebulizer output was defined as emitted dose divided by nebulization time (min). Each experiment was independently conducted for 6 times (N=6).

Results

Table 1 and Figure 4 below showed that nebulizer output for MICROVENT™ was higher than Aerogen Solo and JN which was 0.37±0.06 ml/min (mean±SD), 0.09±0.01 ml/min and 0.15±0.03 ml/min respectively when atomizing normal conc. colistin. VMD of aerosol delivered by MICROVENT™ was in the range of 4.0-4.5 μm and VMD of Aerogen Solo and JN was 3.9-4.7 μm and 2.5-2.6 μm respectively when delivering inhaled antibiotics and corticosteroids.

Table 1. Nebulizers performance among three formulations (mean±SD)

Drug formulation	Budesonide	Colistin	High conc. Colistin	*P*
Nebulizer output (mL/min)				
MicroVENT™	0.28±0.04	0.37±0.06	0.31±0.05	0.025
Solo	0.35±0.03	0.09±0.01	0.08±0.004	<0.001
JN	0.17±0.02	0.15±0.03	0.22±0.03	0.002
VMD (μm)				
MicroVENT™	4.02±0.15	4.36±0.18	4.49±0.28	0.005
Solo	4.34±0.19	3.91±0.11	4.70±1.29	0.226
JN	2.63±0.08	2.52±0.16	2.50±0.15	0.206

Figure 1-3 indicated that nebulizer output (mg/min) of different nebulizers when atomizing three formulations. The nebulizer output for Aerogen Solo was significantly greater than others when atomizing budesonide. The output of Jet nebulizer was higher than others when atomizing high conc. colistin. The nebulizer output for MICROVENT™ was similar when normal conc. colistin and high conc. colistin were used (*p*=0.156).

Figure 1. MICROVENT™ outputs when 3 formulations were used individually.

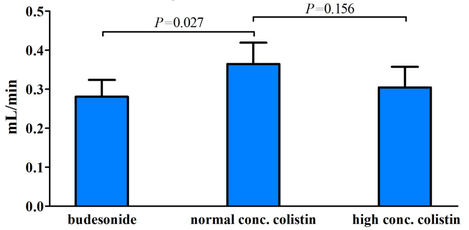


Figure 2. Aerogen Solo outputs when 3 formulations were used individually.

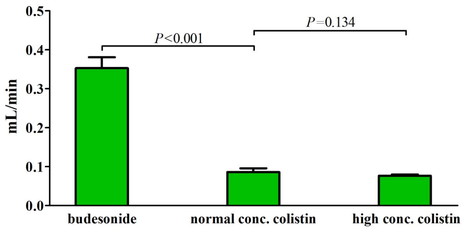


Figure 3. Jet nebulizer outputs when 3 formulations were used individually.

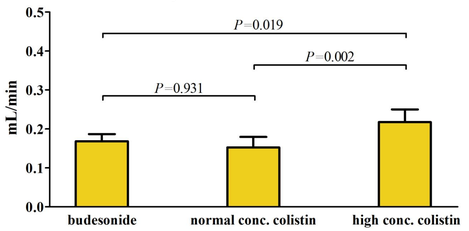
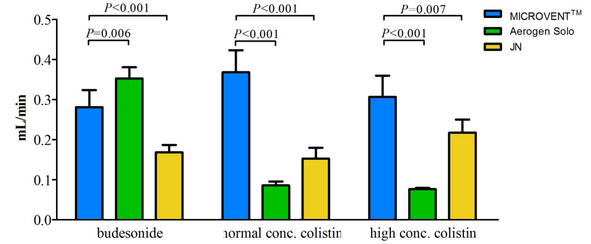


Figure 4. Comparison of nebulizer outputs with 3 formlations.



Conclusion

MICROVENT™ was able to deliver both corticosteroid (suspension based medication) and antibiotic successfully and efficiently. Our study suggested that vibrating-mesh nebulizers such as MICROVENT™ has the potential to better atomize antibiotic or corticosteroid medications alike within a ventilatory setting to achieve clinical efficacy and safety.

Reference

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