

Does reduced dose volume impact inhaled mass with a novel low residual volume nebulizer?

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INTRODUCTION

Standard jet and ultrasonic nebulizers leave residual drug volumes in their medication reservoirs ranging from 0.8 to 2.0 mL at the end of therapy. (Hess et al., Chest 1998). These nebulizers have been shown to be more efficient as drug volume placed in the medication reservoir is increased.

Aerogen has a second generation mobile nebulizer system in development (Aeroneb[®] Go Nebulizer), incorporating Aerogen's OnQ[™] Aerosol Generator.

The OnQ Aerosol Generator is an electronic micropump (Figure 1) with a residual drug volume as low as 1 microliter. Because of the high efficiency of the aerosolization mechanism, and placement of the solution to be nebulized directly in contact with the aerosol generator, the medication cup residual in the nebulizer is also low (approximately 0.1 mL).

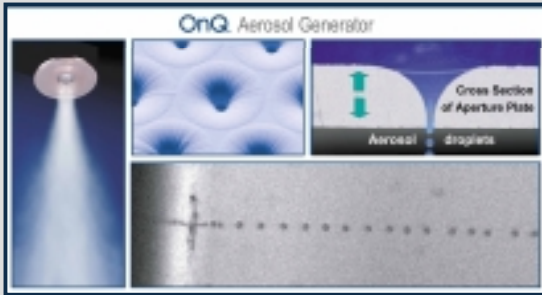


FIGURE 1: THE AERGEN ONQ[™] AEROSOL GENERATOR (LEFT) WITH A MICROSCOPIC VIEW OF TAPERED APERTURES (UPPER MIDDLE), AND CROSS SECTION OF APERTURES (UPPER RIGHT), HIGH SPEED MICROSCOPIC PHOTOGRAPH OF AEROSOL GENERATED FROM A SINGLE APERTURE (LOWER RIGHT).

OBJECTIVE

We wanted to determine the effect of initial drug volume on inhaled mass and time of administration with this low residual volume nebulizer.

MATERIALS AND METHODS

A prototype nebulizer was used to aerosolize 2500 µg of albuterol sulfate (salbutamol) solution in volumes of 3.0 mL (0.083% solution) and 0.5 mL (0.5% solution).

Aerosol was delivered to an absolute filter placed between the mouthpiece of the nebulizer and a breath simulator (Hans Rudolph) set to adult breathing parameters (tidal volume 500 mL, rate 15 b/min and inhalation time 35%). (Figure 3).

Drug was eluted from the filter, assayed by HPLC, and expressed as percent of total dose (mean ± SD, n=3).

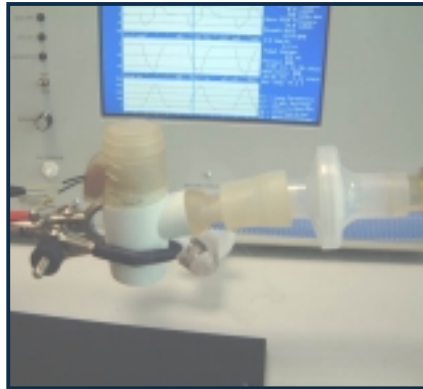


FIGURE 3: MODEL USED FOR MEASURING AEROSOL DELIVERY WITH SIMULATED ADULT BREATHING PATTERN

RESULTS

The inhaled mass and treatment time for administration of an initial dose of 3.0 mL 0.083% solution, and 0.5 mL of 0.5% albuterol sulfate are shown in Table 1. Inhaled mass is expressed as the actual amount of drug deposited on the filter and as the percentage of initial dose. All reported values are mean ± SD, n=3.

Dose Volume	Inhaled Mass µg	Inhaled Mass % of Dose	Treatment Time Mean
3.0 mL	1084±94 µg	43±4%	6 min 22 (±28) s
0.5 mL	1123±42 µg	45±1%	1 min 20 (±8) s

TABLE 1: TESTING RESULTS FOR THE NEBULIZER WITH THE SAME DOSE (2.5 MG) OF ALBUTEROL SULFATE (SALBUTAMOL) ADMINISTERED IN DOSE VOLUMES OF 3.0 ML AND 0.5 ML. DATA ARE MEAN ± SD.

SUMMARY

While we found no difference in inhaled mass between the two dose volumes, the treatment time was substantially longer with the greater 3.0 mL dose volume.

In treatment of acute exacerbation of asthma or COPD, reduced treatment time would be desirable.

Although comparable inhaled mass is achieved with shorter treatment time, it is unclear whether the characteristics of 0.083% and 0.5% make a difference in airway response.

CONCLUSION

When using the nebulizer system, with its low residual volume aerosol generator and medication cup, there is no significant difference in inhaled mass of salbutamol between 3.0 and 0.5 mL doses containing the same drug content. This contrasts with the changes in efficiency with changing dose volumes reported for other small volume nebulizers. With the configuration of the nebulizer as envisaged for the Aeroneb Go, there was a four fold decrease in the administration time required for the smaller dose volume.