WHITE PAPER

Performance of Thayer Valved Holding Chambers compared to Make-shift Spacers with Proventil® HFA pMDI

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SUMMARY

INTRODUCTION

Valved holding chambers (VHCs) are used to: (1) reduce the non-respirable portion of drug administered to a patient from a metered dose inhaler (MDI), and (2) allow for un-coordinated timing between actuation of the MDI and patient inhalation/exhalation. Non-respirable particles are larger in diameter and known to deposit in the mouth and throat which can cause undesirable side effects.

METHODS

Proventil® HFA, an albuterol sulfate MDI drug product marketed in the US, was used to demonstrate the difference in drug delivery between using the MDI alone and dosing the MDI through a VHC or make-shift spacer device. Proventil® HFA MDI canisters were purchased and tested for particle size distribution using an 8-stage Andersen Cascade Impactor (ACI) with a USP induction port and an airflow rate of 28.3 L/min. The test was repeated at least 4 and up to 12 times for each device type. In all cases, drug deposition on the ACI stages was measured using a validated HPLC assay with UV detection. Respirable doses and non-respirable doses were determined based on known stage cut-off sizes.

RESULTS

Figure 1 displays the results of the present study. Note the error bars represent 1 standard error about the mean. Without a VHC ("pMDI Alone" in the figure), the respirable dose (green bar) was found to be 57±1.5 µg, while the respirable doses (greens bars) with the Blue Corrugated Tubing, the Smooth-Flo® Corr-a-tube® Tubing, a disposable cardboard mouthpiece used for peak-flow measurement, the PrimeAire® and the LiteAire® were found to be 39±1 µg, 41±0.6 µg, 45±1 µg, 64±2 µg and 77±4 µg, respectively. The non-respirable doses (red bars) were all reduced from 53±4 µg with the MDI alone to 2±0.1 µg, 3±0.1 µg, 3±0.3 µg, 2±0.1 µg and 4±0.5 µg with Blue Corrugated Tubing, the Smooth-Flo® Corr-a-tube® Tubing, a disposable cardboard mouthpiece (peak-flow), the PrimeAire® and the LiteAire®, respectively.

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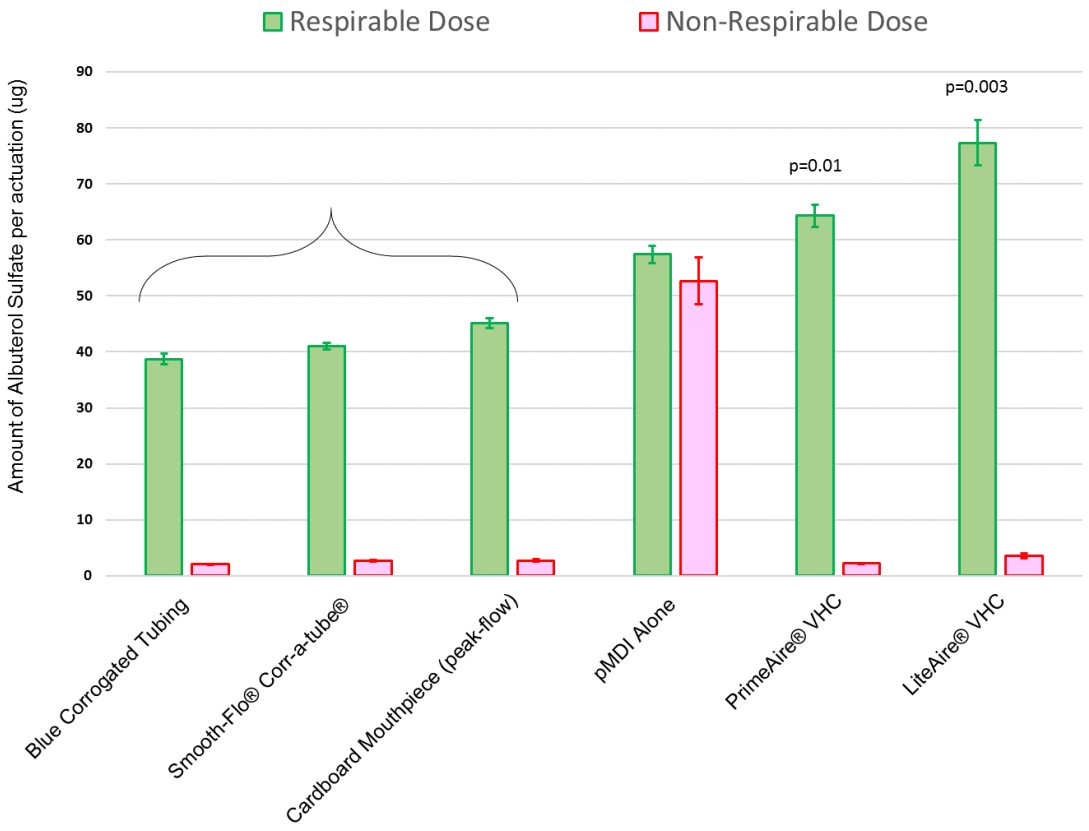

Figure 1. Simulated differences in doses of albuterol sulfate delivered to the patient via Proventil HFA when various make-shift spacers or VHC devices are used. The error bars represent the standard error of the mean. The reduction in non-respirable doses (red bars) are substantial and significant ($p<0.001$) with all 5 of the devices tested. Differences among devices are seen in the respirable doses. The respirable doses (green bars) are significantly reduced ($p<0.001$) with the make-shift spacers (Blue Corrugated Tubing, Smooth-Flo Corr-a-tube and a disposable cardboard mouthpiece (peak-flow)) but significantly increased with the VHCs [LiteAire® ($p=0.003$) and PrimeAire® ($p=0.01$)].

CONCLUSION

While all 5 devices reduced the non-respirable dose available to the patient ($p>0.001$), the LiteAire and PrimeAire were the only devices tested that did not also reduce the respirable dose available to the patient as compared to the MDI alone ($p>0.99$). In fact, the PrimeAire® ($p=0.01$) and LiteAire® ($p=0.003$) increased the respirable dose available to the patient as compared to dosing with Proventil® HFA alone.