Valved Holding Chamber Angle Can Affect Pressurized Metered Dose Inhaler Medication Delivery Efficiency

Jason Suggett[1], Mark Nagel[1], Rubina Ali[1], Valentina Avvakoumova[1], and Jolyon Mitchell[2]

[1] Trudell Medical International, London, Canada. [2] Jolyon Mitchell Inhaler Consulting Services Inc., London, Canada

RATIONALE

- It is tacitly assumed that the patient inhaling their medication from a Pressurized Metered Dose Inhaler (pMDI) via a Valved Holding Chamber (VHC) align the long axis of the chamber perfectly with the horizontal axis of the mouthpiece component of the inhaler, such that the inhaler canister is upright[1]
- A commonly encountered error is to direct the pMDI-VHC combination towards the tongue or roof of the mouth, and this misalignment can often be achieved by displacing the chamber axis away from being aligned with the inhaler mouthpiece.
- This laboratory study evaluated 3 widely prescribed VHCs with their long axis inclined by 45° upwards and downwards, representing likely extremes in user orientation

Examples of real world use.
(Google images)

MATERIALS AND METHODS

- The following VHCs were evaluated (n=5/group)

AeroChamber Plus ***Flow-Vu**** VHC
Trudell Medical International

Volumatic† VHC
GlaxoSmithKline Inc.

Tipshaler† VHC
Laboratoire ProtecSom-OptimHal SAS

- A filter was located at the mouthpiece of the VHC to capture the emitted aerosol
- The filter was then coupled to a breathing simulator (ASL5000, IngMar Medical, Pittsburgh, PA, USA) to mimic the following tidal-breathing patient categories:

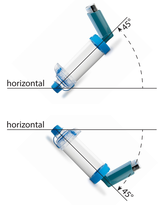
Small Child

- Tidal volume = 155-mL
- Number of breathing cycles/min = 25
- Inspiratory:expiratory ratio =1:2

Adult

- Tidal volume = 500-mL
- Number of breathing cycles/min = 13
- Inspiratory:expiratory ratio = 1:2

- In **Part 1** of the investigation, the long-axis of the VHC was initially orientated 45° upward from horizontal (inhaler raised)
- In **Part 2**, the long-axis was orientated 45° downward



- 5 doses of Salbutamol pMDI were delivered at 30-s intervals
  - Emitted Mass of Salbutamol recovered From the filter was determined using HPLC.

RESULTS

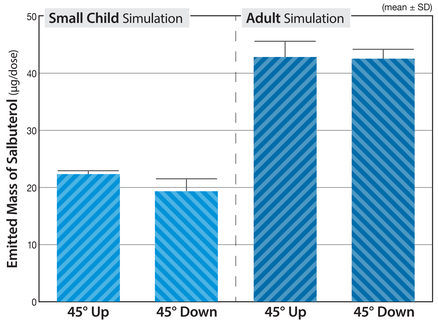
Small Child Simulation

- In the small child simulation, changes in Emitted Mass from 45° up to 45° down orientations were insignificant with both ***AeroChamber Plus**** ***Flow-Vu**** VHC (-13%, paired t-test, p=0.07) and Tipshaler† (-14%, p=0.51) VHCs.
- However, the decrease for the Volumatic† group was significant (-48%, p=0.004).

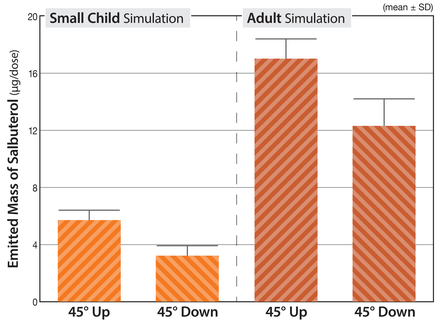
Adult Simulation

- There was no orientation effect in the adult simulation, with the ***AeroChamber Plus**** ***Flow-Vu**** VHCs (-0.7% p=0.77).
- However, the Emitted Mass changed significantly by +24% and -28% with the Tipshaler† (p=0.004) and Volumatic† (p=0.019) VHCs.

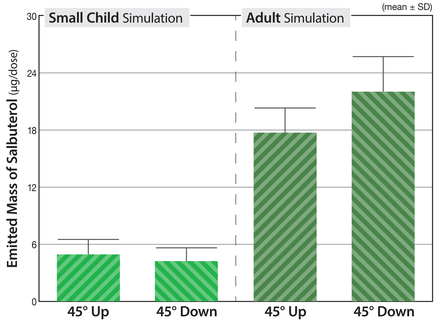
AeroChamber Plus* ***Flow-Vu**** VHC



Volumatic† VHC



Tipshaler† VHC



CONCLUSIONS

- The emitted mass from the ***AeroChamber Plus**** ***Flow-Vu**** VHC was consistent independent of VHC angle
- Clinicians should be aware that the output from some VHCs can change with VHC orientation, most likely due to the effect of gravity on less responsive mechanical inhalation valves

[1] Price D, Bosnic-Anticevich S, Briggs A, Chrystyn H, Rand C, Scheuch G, Bousquet J. Inhaler competence in asthma: Common errors, barriers to use and recommended solutions. *Respir Med.* 2013; 107(1): 37-46

ERS International Congress
Paris, France
September 15 – 19, 2018

Trudell Medical International®

Excellence By Design

MD-173A-0618. * trade-marks and registered trade-marks of Trudell Medical International. † trade-marks of their respective companies. Copyright © Trudell Medical International 2018.