IN VITRO PERFORMANCE OF HFA FLUTICASONE PROPIONATE (FP) IN TWO VALVED HOLDING CHAMBERS (SPACERS) TESTED WITH FACEMASKS ATTACHED AT LOW INSPIRATORY FLOW RATES AND EXTENDED DELAY TIMES

Jolyon P. Mitchell[1], Heather Mackay[1], Mark W. Nagel[1], Kimberly J. Wiersema[1], Alan L. Cripps[2], Sylvine M. Pischel[2] and William R. Lincourt[3]

[1] Trudell Medical International, London, Ontario, Canada, [2] GlaxoSmithKline, Ware, United Kingdom, [3] GlaxoSmithKline, RTP North Carolina USA,

OBJECTIVE

- Valved Holding Chambers (VHCs) are an important adjunct in delivery of medication particularly to infants and young children
- These devices are recommended for use with facemasks in patients who may experience difficulty in using a mouthpiece efficiently[1]
- The aim of the current *in vitro* study was to evaluate the performance of VHCs with facemasks under clinically realistic conditions of reduced flow rate and extended delay time, which simulate conditions potentially experienced with young patients

MATERIALS AND METHODS

- Two different VHCs each with either a small or medium facemask (manufactured by Monaghan Medical Corp. Plattsburgh, NY):
  - ***AeroChamber Plus**** VHC
    - conditioned to manufacturer instructions

Small Facemask

Medium Facemask

  - ***AeroChamber Plus**** VHC with ***Z-STAT****
    - non-electrostatic devices, so tested out-of-package without conditioning

Small Facemask

Medium Facemask

- Evaluated with a widely prescribed anti-inflammatory corticosteroid for paediatric use:
  - Flovent†-44 HFA (GSK Inc.)
  - 44 µg/actuation fluticasone propionate ex actuator

- Emitted Mass (Dose) ex VHC (ED):
  - Filter collection of aerosol at mouthpiece of model face (oral breather)
  - 2-actuations/measurement
  - n = 5 VHCs/group
- Aerodynamic Particle Size Distribution for Fine Particle Fraction (FPF):
  - Low flow Marple-Miller impactor
  - 10-actuations/measurement
  - 4.9 L/min (tests with small mask)
  - 12.0 L/min (tests with medium mask)
  - n = 3 VHCs/group

STUDY DESIGN

VHC Type	*AeroChamber Plus** VHC		*AeroChamber Plus** with *Z-STAT** VHC	
Delay (s)	Small	Medium	Small	Medium
0	Each device tested at 4.9, 8.0** and 12.0 L/min			
2				
5**				
10				

** Omitted for the APSD measurements

MODEL FACES

Infant Face Model‡

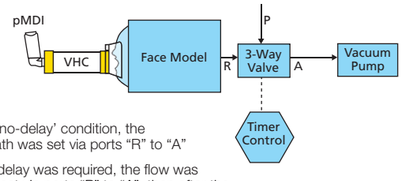
Small Child Face Model‡

- The soft tissues surrounding the oral cavity were simulated so that the facemask dead volume is realistic when applied to the face with a clinically appropriate force of 1.6 kg[2]

VHC SUPPORT CRADLE

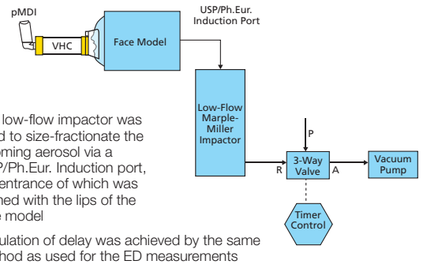
- The VHC/facemask was retained in a purpose-built cradle‡ during each measurement, so that the positioning and sealing of the facemask on the face could be accurately reproduced, as an effective seal is critical for effective delivery of medication[3]

MEASUREMENT OF ED



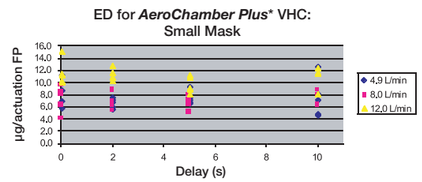
- In the 'no-delay' condition, the flow path was set via ports "R" to "A"
- When delay was required, the flow was initially set via ports "P" to "A", then after the prescribed interval the solenoid actuated to switch flow via ports "R" to "A"

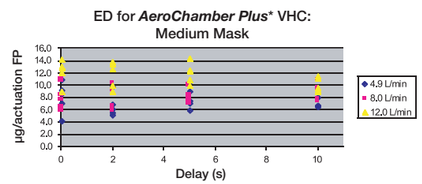
MEASUREMENT OF APSD

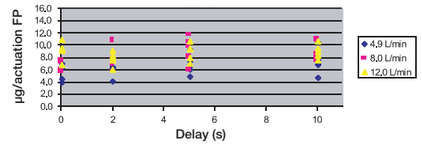


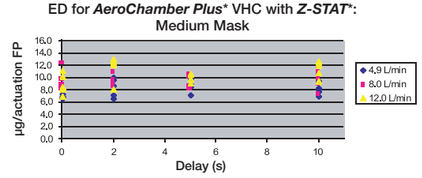
- The low-flow impactor was used to size-fractionate the incoming aerosol via a USP/Ph.Eur. Induction port, the entrance of which was aligned with the lips of the face model
- Simulation of delay was achieved by the same method as used for the ED measurements

RESULTS – INDIVIDUAL ED VALUES









RESULTS – MEAN FPF (%)

VHC Type	*AeroChamber Plus** VHC		*AeroChamber Plus** with *Z-STAT** VHC	
Delay (s)	Small	Medium	Small	Medium
0	73.0	78.2	69.5	76.7
2	73.3	77.7	73.2	78.2
10	76.4	81.9	75.9	84.1

SUMMARY

- Although the delivered dose of FP through each VHC/facemask combination was reduced under all conditions compared with label claim (44 µg), fine particle fraction (FPF) was increased as a percentage of ED, consistent with deposition of the coarser fraction in the VHC:
  - $FPF_{0.77\text{-}4.7}$ µm - measurements at 4.9 L/min
  - $FPF_{0.44\text{-}4.7}$ µm - measurements at 12.0 L/min
- At the lowest flow rate (4.9 L/min) and longest delay time (10 s) with either VHC type (10 s), mean ED ranged between 5.7 to 8.3 µg/actuation, while $FPF_{0.77\text{-}4.7}$ µm was close to 76% of ED compared to approximately 50% for the pMDI alone at the standard flow rate of 28.3 L/min

CONCLUSIONS

- The findings from this *in vitro* study on Flovent-44 HFA have shown that even at low flow rates and extended delay times potentially experienced in real-life situations with young children, drug remains available at the patient interface from either VHC/facemask combination

REFERENCES

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[2] Shah, S.A., Berlinski A.B. and Rubin B.K. Respir. Care. 2006;51:140-144

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