

Comparison of Valved Holding Chambers (VHCs) and Combination of VHCs with Coaching Whistles: Is our Understanding of Airflow Signals when Addressing Human Factors Correct?

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Introduction

- VHCs used with pMDIs are a beneficial combination.
- Patients are, however, given confusing advice about how to breathe when using their VHC.
- It is unclear to what extent training on VHCs with audible coaching whistles is correctly understood.

Questions

- Do VHC-whistles offer counter-intuitive training stimuli to achieve 'slow and steady breathing' ?
- Are VHC-integral whistles actually helpful ?

Our research

Study 1 — determine if a problem exists

Ventolin® HFA (GSK) activation flow rates of 3 VHCs (Able Spacer® [=Easivent®], CCI; AeroChamber Plus®, Trudell; and Optichamber Diamond®, Philips Healthcare), all with integral whistles.

Study 2 — establish comparability of *in vitro* delivery

Ventolin® HFA (albuterol) 8-Stage Andersen Cascade Impactor data: alone, and through A2A Spacer® VHC, CCI (no whistle) and AeroChamber Plus VHC.

Study 3 — whistle activation rates with 2 drug pMDIs

Ventolin® and ProAir® HFAs (Teva) through Aero Chamber Plus, Optichamber Diamond and Easivent, Dey Pharma VHCs (all integral whistles), and A2A Spacer plus additional external dual whistle (Figure 1)

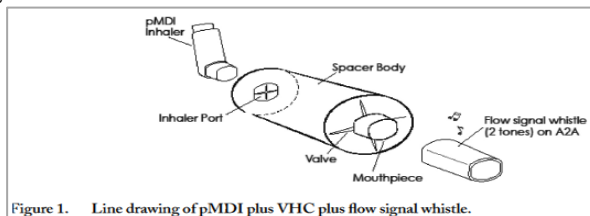


Figure 1. Line drawing of pMDI plus VHC plus flow signal whistle.

Study 1

Able Spacer	AeroChamber	Optichamber
activation flow rate L/min n=3 (mean)		
96/78/78 (84)	96/102/96 (98)	78/75/75 (76)

Whistle first activates at a flow rate in excess of that considered acceptable to promote effective drug deposition.

A problem exists.

Study 2

Albuterol pMDI plus (n=3)	Total dose emitted	Respirable fraction	Fine fraction
% ex-valve, mean ± SD			
A2A	45.6 ± 5.0	39.5 ± 4.7	40.9 ± 4.6
AeroChamber	46.9 ± 5.2	41.9 ± 5.4	43.4 ± 5.4
pMDI alone	96.1 ± 0.9	39.1 ± 3.8	44.5 ± 2.5

No differences (based on 95% CI) in any aerosol characteristic between VHCs and pMDI (except total dose).

Ventolin HFA comparability established.

Study 3

VHC (n=3)	Ventolin pMDI	ProAir pMDI	
	activation flow rate L/min, mean		
AeroChamber	98 ± 2.8	109 ± 3.7	
Easivent	84 ± 8.5	87 ± 2.5	
Optichamber	76 ± 1.4	80 ± 2.8	
A2A + whistle	1 st signal	17.3 ± 0.5	17.3 ± 0.5
	2 nd signal	30.7 ± 0.5	31.3 ± 0.5

Clinically significant differences between VHC-pMDI combinations for whistle-activation inspiratory flow rates. Integral-whistle VHCs first sound at undesirably high flow rates compared with A2A plus whistle.

If patients think that inhalation is proceeding correctly absent the whistle sound, these integral-whistle VHCs are being used sub-optimally.

Acknowledgements:

Whistle activation flow rates measurement: a calibrated waveform generator (Pulmonary Waveform Generator System, MH Custom Design & Mfg L.C., Utah, USA) created a standardized vacuum force similar to a human inhalation, repeatable in 1 L/min increments, with whistle-sounding agreed by two observers.

Study 1 part-data reproduced from: Sanders MJ, Bruin R. Are we misleading users of respiratory spacer devices? Primary Care Respiratory Journal 2013; 22 (4): 466-467.