

# **In Vitro Testing of a New Non-Electrostatic Holding Chamber (the Vortex™) with Hydrofluoralkane Salbutamol and Beclomethasone Inhalers**

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**PURPOSE:** To examine the in vitro performance of a new non-electrostatic holding chamber (the Vortex™) for metered dose inhaler (MDI) aerosol delivery.

**METHODS:** The particle size distribution and amount of aerosol delivered by the Vortex was measured either during simulated pediatric tidal breathing (tidal volume 230 mL, 11 L/min, three sinusoidal breaths, similar to that of a 4 year old) or at a constant flow rate of 28.3 l/min by an Andersen cascade impactor. Tests were performed with two brands of hydrofluoralkane (HFA) inhalers (salbutamol sulphate: Airomir™, 100 µg equivalent; beclomethasone dipropionate: QVAR™, 100 µg). Similar data was obtained for Aerochamber Plus™ holding chambers and Inspirease™ holding chambers. Total “inhaled” drug delivered onto a filter at 28.3 l/min was measured for HFA beclomethasone inhalers (QVAR) after three time delays (0 s, 5 s and 15 s) between actuation and “inhalation” from the three holding chambers above.

**RESULTS:** In all tests, particle sizes with the Vortex did not differ significantly from those with the Aerochamber Plus ( $p > 0.05$ ), with both devices giving a mass median aerodynamic diameter of  $1.3 \pm 0.1 \mu\text{g}$  for QVAR and  $2.5 \pm 0.1 \mu\text{g}$  for Airomir. For a constant inhalation flow rate of 28.3 l/min and no pause between actuation and inhalation, the Vortex delivers 18-20% more beclomethasone than the Aerochamber Plus or Inspirease. With a delay of 5 sec., this increases to approximately 40% more drug delivered by the Vortex. For simulated pediatric inhalation and QVAR, the Vortex delivers 56% more drug in 3 breaths than the Aerochamber Plus delivers with 3 breaths, while the Vortex delivers 27% more drug in 3 breaths than the Aerochamber Plus delivers in 6 breaths. With Airomir, the Vortex with 3 breaths delivers 29% more drug than the Aerochamber Plus with either 3 or 6 breaths. All the above differences are significant ( $p < 0.01$ ). After a pause of 15 sec. the three devices do not deliver significantly different amounts of QVAR. In addition, for Airomir inhaled at 28.3 l/min, no significant differences are found in total drug delivery between the Vortex and Aerochamber Plus.

**CONCLUSIONS:** In vitro, the Vortex holding chamber delivers significantly more drug in most cases than the two other holding chambers tested, while yielding an inhaled particle size distribution that is the same as the Aerochamber Plus.

**CLINICAL IMPLICATIONS:** Our in vitro tests indicate that the Vortex holding chamber is a suitable alternative holding chamber that in most cases is expected to deliver a higher fraction of drug to the patient for the inhalers tested.

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