

## The Impact of Inhalation Delay on Lung Drug Delivery: Using Functional Respiratory Imaging (FRI) to Compare Metered Dose Inhaler (MDI) and MDI/Valved Holding Chamber (VHC) Systems

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**RATIONALE:** Evaluations of inhaler use have demonstrated that mishandling of MDIs is commonplace. One of the most common errors is the failure to coordinate inhalation with actuation of the inhaler. One of the reasons why VHCs are often prescribed, is to reduce the severity of this error. This FRI based study assessed the likely severity of a short inhalation delay (from actuation) with an MDI alone and how it contrasted to the use with a VHC. **METHODS:** Three dimensional geometries of airways and lobes were extracted from a CT scan of a 67 year old male COPD Stage III patient. Drug delivery and airway deposition of MDI-delivered albuterol (Ventolin<sup>®</sup>-HFA, 100mcg) was modelled using FRI with measured particle and plume characteristics with and without an AeroChamber Plus<sup>®</sup> Flow-Vu<sup>®</sup> VHC. For the MDI alone, in addition to the 'perfect' 0-seconds delay, a short inhalation delay of 0.5 seconds was evaluated. For the MDI/VHC system, a typical 2 second delay was evaluated. **RESULTS:** See table at bottom of page. **CONCLUSIONS:** The FRI deposition profiles highlight the significant negative impact on lung deposition of even a relatively short 0.5 second delay between actuation and inhalation when an MDI is used alone. The intrathoracic lung delivery decreased from 25.4mcg to 0.3mcg. Extrathoracic delivery (related to oropharyngeal deposition) was consequently even higher. The MDI / AeroChamber Plus<sup>®</sup> Flow-Vu<sup>®</sup> VHC system with a 2 second delay delivered 28.7 mcg to the intrathoracic region with a greater central lung delivery than the MDI alone (perfect coordination) which might be suggestive of greater delivery to beta adrenoreceptors. These results further the message that the use of an appropriate VHC should be considered as general practice for all patients other than those with a highly proficient inhaler technique.

**RESULTS:** The deposition profile results are shown in table (mcg).

Deposition zone	MDI alone (zero delay)	MDI alone (0.5s delay)	MDI/VHC (2.0s delay)
Extrathoracic	59.6	83.1	9.1
Intrathoracic	25.4	0.3	28.7
Central Lung	8.7	0.1	13.1
Peripheral Lung	16.7	0.3	15.7
C/P ratio	0.52	0.36	0.83

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