The Impact of different Valved Holding Chambers (VHCs) on Lung Drug Delivery: Using Functional Respiratory Imaging (FRI) and a single Metered Dose Inhaler (MDI) type

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RATIONALE

• One of the most common MDI use errors is the failure to coordinate inhalation with actuation of the inhaler.
• Chambers are often prescribed to reduce the severity of this error.
• This FRI based study assessed a few different chambers, comparing their impact on modelled lung delivery, in addition to when the MDI was used alone.

METHODS

• 3D 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 was modelled using FRI with measured particle and plume characteristics with and without three VHCs.
• For the MDI alone, in addition to the ‘perfect coordination’ 0 second delay, a short inhalation delay of 0.5 second was evaluated. For the MDI/VHC systems, a typical 2 second delay was evaluated.

RESULTS

To view the FRI results video, click here: https://www.trudellmed.com/fri-results-videos

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• Chambers are often prescribed to reduce the severity of this error.
• This FRI based study assessed a few different chambers, comparing their impact on modelled lung delivery, in addition to when the MDI was used alone.

RESULTS

Deposition zone

<table>
<thead>
<tr>
<th></th>
<th>MDI alone (zero delay)</th>
<th>MDI alone (0.5s delay)</th>
<th>MDI/ACPlusFV (2.0s delay)</th>
<th>MDI/DD (2.0s delay)</th>
<th>MDI/CSCP (2.0s delay)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrathoracic</td>
<td>55.6</td>
<td>83.1</td>
<td>9.1</td>
<td>5.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Intrathoracic</td>
<td>25.4</td>
<td>0.3</td>
<td>28.7</td>
<td>13.4</td>
<td>14.1</td>
</tr>
<tr>
<td>Central Lung</td>
<td>9.7</td>
<td>0.1</td>
<td>13.1</td>
<td>7.2</td>
<td>6.6</td>
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<tr>
<td>Peripheral Lung</td>
<td>86.7</td>
<td>0.3</td>
<td>15.7</td>
<td>8.5</td>
<td>7.9</td>
</tr>
<tr>
<td>C/P ratio</td>
<td>0.32</td>
<td>0.36</td>
<td>0.83</td>
<td>0.85</td>
<td>0.83</td>
</tr>
</tbody>
</table>

• The FRI deposition profiles highlighted significant differences between the VHCs on test, with intrathoracic delivery for the AeroChamber Plus® Flow-Vue® VHC system being almost double that of the other two VHC systems and being similar to the MDI alone with perfect coordination.
• When a short 0.5 second inhalation delay with the MDI alone was modelled, the intrathoracic lung delivery decreased from 25.4 mcg to 0.3 mcg.
• These results highlight that the use of an appropriate VHC should be considered as general practice for all MDI patients other than those with a highly proficient inhaler technique and that VHCs should not be considered interchangeable.