Aerosol Deposition with Adult High Flow Nasal Cannula: a randomized trial with in vitro assessment

L. Alcoforado 1, A. Ari 2, J. de Melo Barcelar 1, S. C. S. Brandão 1, J. B Fink 2, A. Dornelas de Andrade 2

1Universidade Federal de Pernambuco, Department of Physical Therapy, 2Georgia State University; Department of Respiratory Therapy,
3Universidade Federal de Pernambuco, Department of Nuclear Medicine.

Introduction

High flow nasal cannula (HFNC) provides an opportunity to deliver aerosol to the lung, without interruption of oxygen and ventilatory support. While in vitro studies suggest that aerosol during HFNC may provide drug to the lung, the available evidence is not sufficient to support clinical practice.

Aim

To compare the effect of gas flow and heated humidity on the deposition and distribution of radiolabeled aerosol from a vibrating mesh nebulizer (VMN) during use of HFNC in healthy subjects (in vivo) and with an in vitro model.

Methods

In vivo study methods

Lung model: An in-vitro model was used to simulate a spontaneously breathing adult lung model with a tidal volume of 500 ml, 12 bpm and I:E ratio 1:2 at a temperature of 37 °C. A mask attached at the bronchi of the teaching mannequin was used to collect aerosol, eluted and measured using spectrophotometry at 276nm.

Methods

- In vivo study - Randomized and Crossover study.

Methods

Anthropometric measures and spirometry were performed

Inhaled an aerosol 99mTc – DTPA

VMN – total dose volume = 1.0 ml

The inlet of a heated humidifier (F&P 850™ System) attached to a high flow tubing and nasal cannula (HFNC; Optiflow™) for adult.

Radiation was counted with a scintillation camera
time= 300s; matrix= 256 x 256; view: posterior thorax, upper airway, and device components

Table 1. Distribution of aerosol across chambers at 10, 30 and 50 L/min under humidified conditions

<table>
<thead>
<tr>
<th>Flow Rate</th>
<th>Active Exhalation</th>
<th>Passive Exhalation</th>
<th>P value*</th>
<th>Active Exhalation</th>
<th>Passive Exhalation</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>10L/min</td>
<td>11.8±4.90</td>
<td>3.76±1.36</td>
<td>2.23±0.81**</td>
<td>0.0006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30L/min</td>
<td>36.46±10.49</td>
<td>42.46±14.43</td>
<td>46.72±8.58</td>
<td>0.213</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50L/min</td>
<td>0.25±0.10</td>
<td>0.69±0.75</td>
<td>0.23±0.32</td>
<td>0.118</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 In vitro deposition as aerosol % dosedelivered via HFNC with heated humidifier off and on using a model with active and passive heated exhalation at 10, 30 and 50 L/min.

Conclusions

Aerosol delivery through HFNC provided therapeutic levels of lung deposition in healthy subjects. In vitro models simulating active heated/humidified exhalation provided less overestimation of dose across conditions than models with passive unheated exhalation.

Sponsored Research- This study was funded by a grant CNPq-PVE-406801/2013-2

alcoforadoluiana@gmail.com - armelodelmas@yahoo.com