Inhalation therapy with jet nebulisers – conventional but not old fashioned!

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Introduction

Recent studies indicate that inhalation therapy with nebuliser systems is quite more than merely an alternative treatment for patients unable to coordinate medication delivery with MDIs: nebuliser treatment may increase quality of life [1, 2]. Furthermore lung deposition rate is improved [3] and novel nebuliser concepts have been developing indicating the progress in nebuliser systems.

The innovative PARI LC SPRINT® allows efficient treatment via three different nozzle inserts for selection of droplet size to meet patient’s individual needs and therapeutic objectives (either central or peripheral lung deposition) [4].

Furthermore the novel concept may improve patient’s compliance by additional product advantages like faster inhalation, simple assembly and easy cleaning.

This in-vitro assessment was carried out with 4 established asthma medications to compare the Respirable Drug Delivery Rate (RDDR) of the PARI LC SPRINT® nebuliser system with the PARI LC PLUS® and another commercially available reusable jet nebuliser configuration. The RDDR is an objective parameter that indicates the therapeutic usable amount of drug administered per minute and thus specifies the efficiency of a nebuliser system.

Materials and Methods

Aerosol performance and inhalation time of the PARI LC SPRINT® was compared with the PARI LC PLUS® (both powered by a PARI BOY SX compressor) and the MPV Truma MicroDrop Pro nebuliser compressor configuration (identical in construction to MEDEL Pro).

The following drug products were investigated: Pädiamol containing 1500 µg Salbutamol sulphate / 2,5 ml (Päidamol MicroDrop Pro, Germany), IsoCROM® 20 mg sodium cromoglicate / 2 ml (PARI GmbH, Germany), Ipratropiumbromid-Stullen 500 µg (Ipratropiumbromid-Stullen 2ml (Pharma Stullen GmbH, Germany) and Pulmicort® 500 µg Budesonide / 2 ml (AstraZeneca, Germany).

Droplet size was assessed at a flow rate of 20 l / min by laser diffraction utilising a Malvern MasterSizer X (Malvern Ltd). The delivered dose (DD) representing the drug collected on inspiratory filters was obtained by mimicking an adult breathing pattern (15 breaths / min of 500 ml inhalation: exhalation ratio = 1 : 1) via the PARI COMPAS® breath simulator. The drug was quantified by validated HPLC methods each from inspiratory and expiratory filters and the residue in the nebulisers.

The Respirable Drug Delivery Rate (RDDR) was calculated as follows: (Delivered Dose) x % droplets < 5 µm (Respirable Fraction) / min [µg/min], below expressed as RDDR in percent of filled drug amount [%/min].

Results

The Mass Median Diameters (MMD) of the PARI LC SPRINT® and PARI LC PLUS® are slightly smaller than the MMD of the MicroDrop Pro. With a range between 3.6 and 4.3 µm, the LC SPRINT® and LC PLUS® are suitable for more central lung deposition (Tab. 1).

Tab 1: Mass Median Diameter [µm] upon nebulisation of 2,5 ml Pädiamol (Salbutamol), 2 ml IsoCROM® (DSCG), 2 ml IPB-Stullen (Ipratropium bromide), 2 ml Pulmicort® (Budesonide) with different nebuliser/compressor systems.

<table>
<thead>
<tr>
<th>Drug</th>
<th>LC SPRINT / BOY SX</th>
<th>LC PLUS / BOY SX</th>
<th>MicroDrop Pro / MicroDrop Pro Com.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MMD [µm]</td>
<td>MMD [µm]</td>
<td>MMD [µm]</td>
</tr>
<tr>
<td>Salbutamol</td>
<td>3.8</td>
<td>3.9</td>
<td>4.4</td>
</tr>
<tr>
<td>DSCG</td>
<td>3.6</td>
<td>3.8</td>
<td>4.5</td>
</tr>
<tr>
<td>Ipratropium bromide</td>
<td>3.8</td>
<td>3.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Budesonide</td>
<td>4.1</td>
<td>4.3</td>
<td>4.5</td>
</tr>
</tbody>
</table>

The RDDR [%/min] of the PARI LC SPRINT® compared to the LC PLUS® and the MicroDrop Pro nebuliser is up to 1,4-fold and 1,8-fold higher, respectively (Tab. 2, Fig. 2).

Indicated by the higher RDDR [%/min] the PARI LC SPRINT® provides a higher drug delivery and respirable dose for all measured medications: Salbutamol, DSCG, Ipratropium bromide and Budesonide (Tab. 2).

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The LC SPRINT® enables further reduction in nebulisation time and offers 10 % to 24 % faster inhalation compared to the LC PLUS® and 33 % to 38 % more rapid nebulisation versus the MicroDrop Pro (MEDEL Pro).

Summary and Conclusions

Three different inhalation systems and four established asthma medications have been measured to emphasize the importance of the nebuliser type for efficient aerosol therapy and the advantages of the LC SPRINT® nebuliser.

The 1,8-fold higher RDDR value of the LC SPRINT® indicates that the delivery of the therapeutic usable amount of drug is approx. twice as fast compared to the MicroDrop Pro (Medel Pro) system. Additionally the inhalation time is up to 1,6-fold shorter.

The RDDR indicates efficient and fast inhalation therapy, both of which increase compliance. The LC SPRINT® fulfills the demands on efficiency and time-saving aspects and demonstrates the progress in the development of nebuliser systems.

References