A Comparison of Dissolv*It* Dissolution Profiles of Particles Deposited with a New Generation Impactor or with a PreciseInhale Aerosol Generator

Maria Malmlöf[1,2], B. Noriega[3,4], M. Nowenwik[2], M.L. Corvo[4], E. Costa[3] and P. Gerde[1,2]

[1] Karolinska Institutet, Sweden, [2] Inhalation Sciences, Sweden, [3] Hovione FarmaCiencia SA, Portugal, [4] iMed.Ulisboa, Portugal

Conclusions

The aerosol deposition pattern of inhalation drugs obtained prior to dissolution testing is an important factor that may significantly influence the resulting drug dissolution profiles

Introduction

The dissolution methods used today for testing dry powder drug particles aimed for the inhalation route are paddle over disc, Franz cell, flow through cell, transwell and the Dissolv*It*.

The proposed methods include different methods of depositing the powder on the test surface such as using a spatula, cascade impactors (next generation impactor (NGI), Andersen cascade impactor (ACI) or modified ACI) or the PreciseInhale (PI).

Aim

The aim of this study was to investigate the influence on dissolution rates by using either the nozzle-enhanced particle deposition pattern of the NGI or the more even deposition pattern of the PI.

Methods

The test formulation used was Pulmicort Flexhaler, dry powder inhaler (DPI, AstraZeneca), 180 µg budesonide (BUD)/dose. Dissolution testing was performed in triplicates by using the Dissolv*It* apparatus. For using Dissolv*It*, the particles need to be deposited on glass cover slips (GCS) 13 mm in diameter.

The doses deposited on the glasses used for dissolution testing were 264±17 ng (NGI deposition) and 218±12 ng (PI deposition).

Particle deposition with NGI

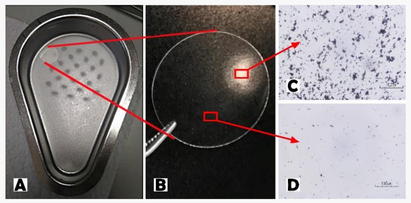

Figure 1. A. BUD deposition on a GCS in an NGI. B. Close-up of the non-uniform drug deposition of the GCS. The powder deposition pattern was dense below a nozzle jet (C) and much more sparse on the rest of the glass (D).

One GCS was placed in the NGI cup at stage 3 (Fig 1A), collecting powder from the same nozzle (Fig 1C) and its surroundings (Fig 1D) during one actuation cycle (inhalation flow rate 60 L/min and actuation time 4s). No pre-separator was coupled to the inductor port.

The cut-off for stage 3 at 60 L/min is 2.82 µm.

Particle deposition with PI

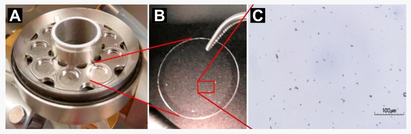

Figure 2. A. BUD deposition on 9 GCS placed in the Dissolv*It* aerosol coating chamber of the PI. B. Close-up of the coated glass cover slip with the deposited drug. C. A light microscope image of the more even drug deposition pattern obtained on the GCS.

Firstly, with a pre-separator present, aerosol was generated from the inhaler into the PI deposition chamber using an actuation flow rate of 40 L/min and an actuation time of 1 000 ms. Secondly, the aerosol was deposited on the cover slip glasses using an airflow of 400 mL/min and an exposure time of 180 seconds. Three actuations were used.

Mass median aerodynamic diameter (MMAD) was 3.33±0.04 µm (measured previously using a Marple cascade impactor).

Results

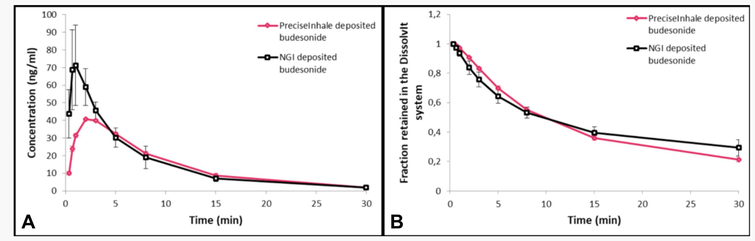

Figure 3. BUD dissolution profiles (n=3 ± SD) A. Concentration in the perfusate over time. B. Fraction of the deposited dose of BUD retained undissolved and/or unabsorbed in the dissolution chamber over time.

BUD particles deposited with an NGI had higher C_{max} (71±23 ng/mL) and shorter t_{max} (1±0 min) compared to particles deposited with the PI (C_{max}: 41±1 ng/mL and t_{max}: 2±0 min) (Fig 3A). This could be a consequence of the smaller particles deposited at the NGI stage 3 compared to the slightly larger particles deposited with the PI.

The error bars in Fig 3A indicates that the PI deposition method generates Dissolv*It* dissolution data with less variability. At 10 min, fraction retained curves in Fig 3B cross each other. One possible explanation is that initially, the scattered particles of the NGI method (Fig 1D) dissolved more quickly, leaving the densely deposited particles below the impactor nozzle to be dissolved more slowly (Fig 1C). In contrast, dissolution of the more evenly deposited particles from the PI proceeds more uniformly.

Inhalation Sciences

COI: MN and PG have stocks in Inhalation Sciences.

Inhalation Sciences
Director of Projects and *in vitro* Specialist
Hälsovägen 7-9
141 57 Huddinge, Sweden
maria.malmlof@inhalation.se
www.inhalation.se

Karolinska Institutet
Institute of Environmental Medicine
PhD student
Box 210
171 71 Solna, Sweden
www.ki.se/imm

Karolinska Institutet