Deposition of aerosols delivered by nasal route with jet and mesh nebulizers


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Introduction ...

The FDA has released a draft for pharmaceutical companies emphasizing the importance to characterize the site of aerosol deposition to assess the efficiency of the treatment in terms of dose/response relationship. However, this demonstration is specifically difficult to achieve in the context of ENT infection treatments due to nasal delivery devices limitations such as nasal sprays (The drug fraction delivered beyond the nasal valve is low) and nasal nebulizers (a significant part of the aerosol is delivered into the lungs).

The aim of the present work was to compare a new nasal mesh nebulizer to a commercially nasal jet nebulizer in term of aerosol deposition into the different parts of the airways.

Materials and methods ...

Nebulization systems

Two nasal nebulizer systems were used:
- The Atomisor NL11® jet nebulizer with AQLH® box compressor generating an additional sound at 100Hz frequency. Figure 1.
- The Aeroneb Solo® mesh nebulizer (Aerogen, Galway, Ireland) connected to a special prototype compressor (Aerodrug, France) designed to avoid lung deposition. Particle size distribution of the aerosols produced by both nebulizer systems was measured (Spraytec, Malvern, UK).

Human volunteers

Seven non-smoking healthy male volunteers aged from 21 to 36 years with a mean weight 77 ± 10 kg and a mean height 1.81 ± 0.03 m were included in this single-center study.

Image acquisition and analysis

- In all volunteers, scintigraphies were performed with a planar single detector gamma camera (STARPORT 400 AC/T, GE, Horsholm, Denmark). Figure 2.
- 81mKr gas was continuously administered through the nostrils to measure nasal cavity, lung and maxillary regions of interest (ROIs).
- Both nebulizer systems were loaded with 3 ml of 99mTc-DTPA. The duration of nebulization was limited to 10 minutes with both nebulizers.
- Activity deposited in the airways was calculated by the activity balance method applying ROIs from 81mKr images. ROIs of ethmoid was defined as the half part of upper nasal airway.

![Image 1: Atomisor NL11 nasal jet nebulizer using a 100 Hz sound to improve drug deposition in the maxillary sinuses.](image1.png)

![Image 2: Nasal nebulizer and image acquisition.](image2.png)

Results ...

There was no statistical differences in terms of VMD (5.6 ± 0.5 µm vs. 5.6 ± 0.3 µm) and fraction of particles smaller than 5µm (44 ± 4 % vs. 45 ± 2 %) between both nebulizers (p>0.9, n=42).

Although the mesh nebulizer has the same particle size, it significantly improves peripheral aerosol deposition in the nasal cavity without deposition in the lungs.

This study validates a new prototype of nasal mesh nebulizer that could be used in clinical trials to test the efficiency of local drug delivery in accordance with FDA recommendations.