Inhaled nanomedicines using a vibrating-mesh nebuliser: Particle size considerations

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BACKGROUND

Nebulisers transform liquid formulations into fine inhalable aerosol droplets that can travel deep into the respiratory tract.

Vibrating-mesh nebulisers are preferred over jet-nebulisers as they are low shear and gentler to formulations as well as portable. For example:

> **FOX® nebuliser** is a breath activated, hand-held device that is optimised to deliver formulations to the lung periphery.

The membrane is a critical aerosol generating component of a vibrating-mesh nebuliser. There are thousands of micron size pores in a membrane that, upon oscillation in the 80-120 kHz range, convert a liquid into an inhalable aerosol.

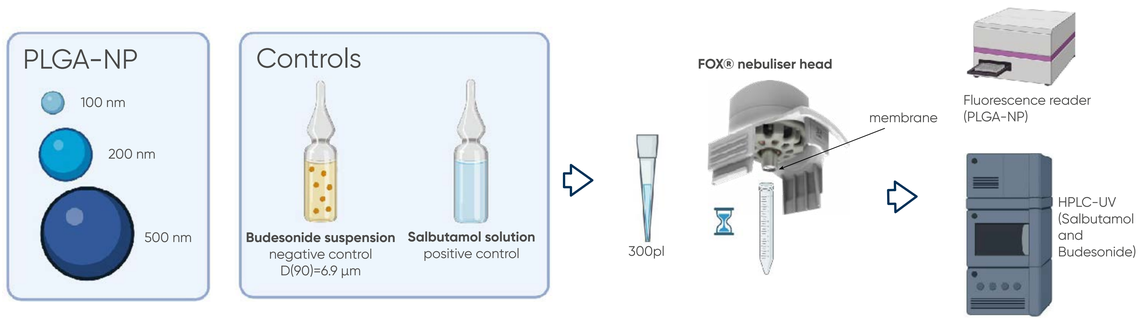
QUESTION

Due to the small diameter of the pores in the membrane, they have the potential to become blocked by unoptimized nanomedicines.

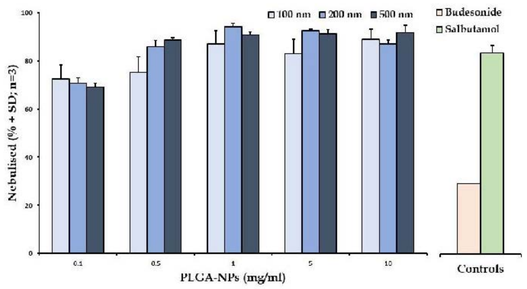
What if the effect of different solid particle sizes on nebulisation efficiency?

With special interest in establishing critical success factors for inhaled nanomedicines such as vaccines or nanoparticles.

METHODS



RESULTS



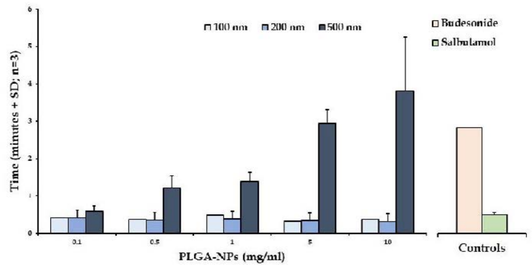
Time to nebulise 300 µl of formulation in a continuous mode as a function of particle size and particle concentration:

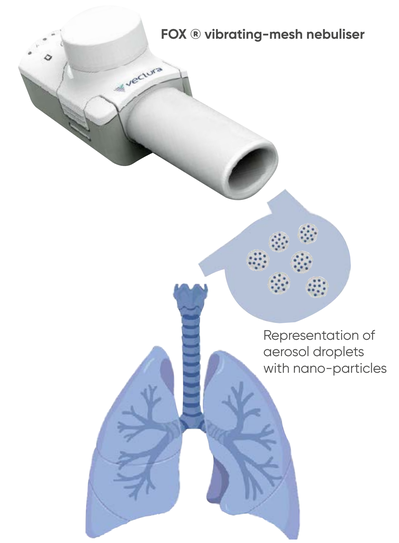
Particle size of 100 nm and 200 nm nebulised at a consistent speed independent of the concentration of the formulation.

Larger particles of 500 nm were not successfully nebulised with the mesh-nebuliser and may result in blockage of the micron-sized pores.

Percentage of PLGA-NPs nebulised depending on concentration and particle size:

All PLGA-NPs went through the vibrating-mesh of the FOX® at a percentage comparable to salbutamol solution (positive control).





CONCLUSIONS

Nanomedicines can be successfully nebulised using a vibrating-mesh nebuliser such as the FOX®.

The particle size of the nanomedicine is critical to achieve successful delivery of the formulations with particles of 200 nm or lower being successfully nebulised.

Thus, it is feasible to use mesh nebulisation as a mechanism to deliver nanomedicines to the lungs for either local effect or delivery to the systemic circulation via the pulmonary route.

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