Developing a solution for nasal and olfactory transport of nanomaterials_Dataset

Introduction

Nanotechnology is one of the most rapidly developing areas of the economy and involves the study and control of matter in the nanoscale. The nanoscale is the size range from 1 to 100 nm. Recently, some nanomaterials have demonstrated the ability to enter the brain through the olfactory pathway from the nose to the brain. This pathway can potentially enable inhaled nanomaterials to enter the brain. Inhalation exposures are technically difficult and expensive. Intranasal instillation is a potential screening tool for evaluating nose to brain transport. However, particles in aqueous media tend to agglomerate and agglomerated particles often act like larger particles in terms of surface area, toxicity, and size thresholds for transport pathways. For neuronal transport within the brain, the upper size limit is estimated to be approximately 100 nm. Therefore, nanomaterials must be adequately dispersed in the vehicle used for instillation in order to evaluate their potential for transport from the nose to the brain.

Because 100 nm is the upper size limit estimated for transport within the central nervous system, components of dispersion media may need to be different from dispersion media used to evaluate toxicity in other tissues. For example, albumin, a protein which is useful in dispersion media developed for the lung, can interact with nanomaterials and increase their size. In addition, neurons transport sodium out of the cell, suggesting that a dispersion medium to evaluate nose-to-brain transport should avoid high sodium concentrations. To overcome issues with the size of albumin and other proteins as well as the potential effects of sodium and phosphate, we hypothesized that free amino acids, a balanced electrolyte solution, and a mixture of phospholipids could produce a solution that both dispersed nanomaterials and was compatible with neuronal transport. This study describes and characterizes a solution for nasal and olfactory transport (SNOT) that can disperse nanomaterials and dyes with nanoscale dimensions, enabling intranasal instillation so that potential nose-to-brain transport can be evaluated.

Methods Collection

- The SNOT is composed of 1 mg/mL DPPC (as 10 µL of a 1:10 dilution of DPPC in 200 proof ethanol), 0.25 mg/mL DMPC (as 25 µL of a 1:100 dilution of DPPC in 200 proof ethanol), 959 µL/mL LRS and 6 µL/mL TrophAmine®.
- DLS measurements (ZetaSizer Nano ZS, Model Zen3600, Malvern,) were used to determine particle hydrodynamic diameter (dH) of SNOT and hexagonal boron nitride nanoparticles (HBN) in SNOT after varying sonication procedures
- B6;129P2-*Omp*^{tm3Mom}/MomJ heterozygous (OMP-GFP) mice were obtained from Jackson Laboratory (Stock #006667)
- OMP-GFP mice display intense green fluorescence in olfactory neurons from the nose to their axonal terminus in glomeruli of the olfactory bulb
- Rhodamine dextran (tetramethylrhodamine 3000 MW anionic lysine fixable dextran) and anionic NIR dextran in SNOT (Alexa Fluor 680; 3,000 MW, Anionic) were used to track the movement of dextran in SNOT in the nasal cavity and olfactory bulb using stereomicroscopy and epifluorescence
- Plastic sections and fluorescence microscopy were used to demonstrate the presence of rhodamine dextran in the neuroepithelium of the nose
- Hematoxylin and eosin-stained sections of lung and nose were evaluated by a board-certified veterinary pathologist for potential morphologic alterations in those tissues

Citations:

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