

## Use of submicron vaterite particles serves as an effective delivery vehicle to the respiratory portion of the lung

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### Abstract

© 2018 Gusliakova, Atochina-Vasserman, Sindeeva, Sindeev, Pinyaev, Pyataev, Revin, Sukhorukov, Gorin and Gow. Nano- and microencapsulation has proven to be a useful technique for the construction of drug delivery vehicles for use in vascular medicine. However, the possibility of using these techniques within the lung as an inhalation delivery mechanism has not been previously considered. A critical element of particle delivery to the lung is the degree of penetrance that can be achieved with respect to the airway tree. In this study we examined the effectiveness of near infrared (NIR) dye (Cy7) labeled calcium carbonate (vaterite) particles of 3.15, 1.35, and 0.65  $\mu\text{m}$  diameter in reaching the respiratory portion of the lung. First of all, it was shown that, interaction vaterite particles and the components of the pulmonary surfactant occurs a very strong retardation of the recrystallization and dissolution of the particles, which can subsequently be used to create systems with a prolonging release of bioactive substances after the particles penetrate the distal sections of the lungs. Submicro- and microparticles, coated with Cy7 labeled albumin as a model compound, were delivered to mouse lungs via tracheostomy with subsequent imaging performed 24, 48, and 72 h after delivery by in vivo fluorescence. 20 min post administration particles of all three sizes were visible in the lung, with the deepest penetrance observed with 0.65  $\mu\text{m}$  particles. In vivo biodistribution was confirmed by fluorescence tomography imaging of excised organs post 72 h. Laser scanning confocal microscopy shows 0.65  $\mu\text{m}$  particles reaching the alveolar space. The delivery of fluorophore to the blood was assessed using Cy7 labeled 0.65  $\mu\text{m}$  particles. Cy7 labeled 0.65  $\mu\text{m}$  particles efficiently delivered fluorescent material to the blood with a peak 3 h after particle administration. The pharmacokinetics of NIR fluorescence dye will be shown. These studies establish that by using 0.65  $\mu\text{m}$  particles loaded with Cy7 we can efficiently access the respiratory portion of the lung, which represents a potentially efficient delivery mechanism for both the lung and the vasculature.

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### Keywords

Drug carriers, Prolonging release, Pulmonary drug delivery, Size-dependent biodistribution, Vaterite particles

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