

Distribution of lipid nanocapsules in different cochlear cell populations after round window membrane permeation

Submitted by Emmanuel Lemoine on Fri, 07/18/2014 - 13:56

Titre	Distribution of lipid nanocapsules in different cochlear cell populations after round window membrane permeation
Type de publication	Article de revue
Auteur	Zou, Jing [1], Saulnier, Patrick [2], Perrier, T. [3], Zhang, Ya [4], Manninen, T. [5], Toppila, E. [6], Pyykko, I. [7]
Editeur	Wiley
Type	Article scientifique dans une revue à comité de lecture
Année	2008
Langue	Anglais
Date	10/2008
Numéro	1
Pagination	10-8
Volume	87
Titre de la revue	Journal of Biomedical Materials Research Part B: Applied Biomaterials
ISSN	1552-4981

Résumé en anglais

Hearing loss is a major public health problem, and its treatment with traditional therapy strategies is often unsuccessful due to limited drug access deep in the temporal bone. Multifunctional nanoparticles that are targeted to specified cell populations, biodegradable, traceable in vivo, and equipped with controlled drug/gene release may resolve this problem. We developed lipid core nanocapsules (LNCs) with sizes below 50 nm. The aim of the present study is to evaluate the ability of the LNCs to pass through the round window membrane and reach inner ear targets. FITC was incorporated as a tag for the LNCs and Nile Red was encapsulated inside the oily core to assess the integrity of the LNCs. The capability of LNCs to pass through the round window membrane and the distribution of the LNCs inside the inner ear were evaluated in rats via confocal microscopy in combination with image analysis using ImageJ. After round window membrane administration, LNCs reached the spiral ganglion cells, nerve fibers, and spiral ligament fibrocytes within 30 min. The paracellular pathway was the main approach for LNC penetration of the round window membrane. LNCs can also reach the vestibule, middle ear mucosa, and the adjacent artery. Nuclear localization was detected in the spiral ganglion, though infrequently. These results suggest that LNCs are potential vectors for drug delivery into the spiral ganglion cells, nerve fibers, hair cells, and spiral ligament.

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