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Magnetoelectric nanoparticles as a new drug delivery system

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Statement of the Problem: In the recent years, pharmaceutical sciences have been quickly developed, so it´s easy to forget that no many years ago there weren´t available, effective and safety treatments for common diseases. Despite the advances in the pharmaceutical sciences, nowadays there are still inefficiently treated diseases that remain a challenge, therefore the development of new systems is crucial for the improvement of current therapies. The magnetoelectric nanocarriers are nanoparticles composed by magnetoelectric materials, a subgroup of multiferroic compound that exhibit the magnetoelectric effect, a phenomenon in which a magnetic field can induce an electrical polarization or vice versa. The coating of magnetoelectric nanoparticles with materials that respond dynamically to stimuli in the cellular environment provides a way to control the release of the drug inside the target cells. The aim of this study is to design, elaborate and characterize magnetoelectric core-shell nanoparticles coated with a thermoresponsive polymer for their application in drug release and cellular nanoelectroporation.

Methodology & Theoretical Orientation: The coprecipitation method was used to the synthesis of the magnetic core of the nanoparticles, which then were coated with a ferroelectric material by sol gel method. Finally, the magnetoelectric nanoparticles were coated with PNIPAm via radical polymerization. The nanoparticles where characterized by several method as X-ray, electronic microscopy, IR, DSC, among others.

Findings: The methodology employed in this study allowed the synthesis of the core-shell nanoparticles which now are subject of *in vitro* release studies.

Conclusion & Significance: This new nanocarriers promises to improve the treatment of diseases which remain a cause of premature death. In the case of cancer, they promise to overcome one of the main challenges, the delivery and specifically release of drugs into tumoral cells without effecting healthy cells.

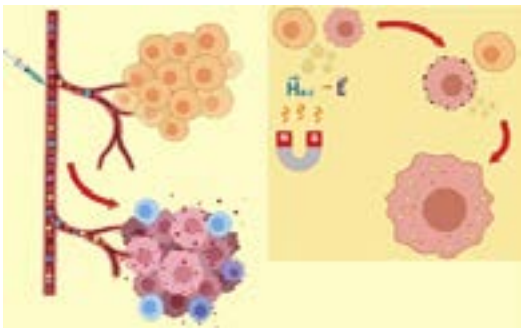

Figure 1: Delivery mechanism of magnetoelectric nanoparticles. Due to their composition the nanoparticles can be localized in a target site, where they generate an electric field that induces electronanoporation of certain cells based on their cell membrane potential value by the application of an external magnetic field. The electronanoporation allows the selective entry and accumulation of nanocarrier into the cells, where finally the drug is release.

Recent Publications

1. Guduru, R., Liang, P., Runowicz, C., Nair, M., Atluri, V., & Khizroev, S. (2013). Magneto-electric nanoparticles to enable field-controlled high-specificity drug delivery to eradicate ovarian cancer cells. Scientific reports, 3, 2953.
2. Kaushik, A., Jayant, R. D., Nikkhah-Moshaie, R., Bhardwaj, V., Roy, U., Huang, Z., ... & Khalili, K. (2016). Magnetically guided central nervous system delivery and toxicity evaluation of magneto-electric nanocarriers. Scientific reports, 6, 25309.
3. Kaushik, A., Jayant, R. D., Nikkhah-Moshaie, R., Bhardwaj, V., Roy, U., Huang, Z., ... & Khalili, K. (2016). Magnetically guided central nervous system delivery and toxicity evaluation of magneto-electric nanocarriers. Scientific reports, 6, 25309.
4. Corral-Flores, V., Bueno-Baques, D., & Ziolo, R. F. (2010). Synthesis and characterization of novel CoFe2O4–BaTiO3 multiferroic core–shell-type nanostructures. Acta Materialia, 58(3), 764-769.
5. El Azim, H. A. (2017). Magneto-electric nanocarriers for drug delivery: An overview. Journal of Drug Delivery Science and Technology, 37, 46-50.

Biography

Sofía N. Casillas-Popova studied a Bachelor of Chemical Pharmaceutical Biology in the National Autonomous University of Mexico, now she is a master student in the Chemical Sciences Program of the National Autonomous University of Mexico. During the bachelor she studied the influence of gene transcription and protein translation in the prefrontal cortex and hippocampus in forgetting during consolidation and recovery of information in animals trained in the autoshaping task, through pharmacological manipulation. Now she is working on her master´s project, which involved the synthesis of magnetoelectric nanoparticles as new nanocarriers for the treatment of cancer.

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