Hybrid Core-Shell Nanoparticles as Multifunctional Tools in Brain Cancer Theranostics

Hybrid Core-Shell Nanoparticles as Multifunctional Tools in Brain Cancer Theranostics

Brachi Giulia, Menichetti Luca, Mikheev Andrei, Ferrari Mauro, Mattu Clara, Ciardelli Gianluca

Introduction

Glioblastoma multiforme (GBM) is the most common primary brain tumor in adults. Because of its aggressive and infiltrative nature, efficient treatment with systemic chemotherapy remains a major challenge[1].

In this work, hybrid core-shell polymer nanoparticles (PNPs) for concomitant loading of multiple payloads and imaging agents were designed and characterized for the intracranial (i.c.) drug delivery in GBM.

Experimental Methods

PNPs were prepared via a nanoprecipitation/self-assembly method to obtain a hybrid structure composed of a cell membrane-friendly lipid outer shell for long circulation and ready conjugation with imaging agents and a polymer core of multi-block polyurethanes (PURs) to host multiple payloads.

PNPs labeled with an infra-red dye and loaded with a fluorescent molecule simulating a therapeutic payload, were i.c. administered in highly infiltrative GBM model[2] and their transport kinetics were investigated using different 2D/3D imaging techniques.

Results

PNPs showed high loading efficiency and remarkable imaging capabilities, showing high selectivity as MRI contrast agents as well as a high Contrast to Noise Ratio (CNR) in fluorescent/photoacustic imaging[3].

PURs PNPs demonstrated potential to combine imaging and therapy, high tissue penetration ability, long-term retention inside the brain, warranting further investigation as theranostic nanocarriers in GBM.

Acknowledgement

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 658665, and by the ''Fondazione Cassa di Risparmio di Pisa" through the project ''PREVISION".

References:

(1) Iacob, G.; Dinca, E. Current Data and Strategy in Glioblastoma Multiforme. *J. Med. Life* **2009**, *2* (4), 386–393.

(2) Wakimoto, H.; Kesari, S.; Farrell, C. J.; Jr, W. T. C.; Aghi, M.; Kuroda, T.; Stemmer-rachamimov, A.;

Shah, K.; Liu, C.; Jeyaretna, D. S.; et al. NIH Public Access. *Cancer Res.* **2010**, *69* (8), 3472–3481. https://doi.org/10.1158/0008-5472.CAN-08-3886.Human.

(3) Mattu, C.; Brachi, G.; Menichetti, L.; Flori, A.; Armanetti, P.; Ranzato, E.; Martinotti, S.; Nizzero, S.; Ferrari, M.; Ciardelli, G. Alternating Block Copolymer-Based Nanoparticles as Tools to Modulate the Loading of Multiple Chemotherapeutics and Imaging Probes. *Acta Biomater.* **2018**. https://doi.org/10.1016/j.actbio.2018.09.021.