Magnetic Nanoparticles: A journey from the bench to high-grade glioma theranostics

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Cancer is a leading cause of death worldwide. Glioblastoma multiforme (GBM) is the most common and aggressive primary malignant brain tumor, with a median survival of only about 15 months. Current diagnostic protocols, based on medical imaging, present low specificity and fail to diagnose in the early stages. As for treatment, up to now, there are no effective therapies capable of significantly increasing life expectancy. Nanotechnology is a promising alternative to overcome these limitations. Thus, several nanoplatforms have been reported with promising features for tumor theranostics. However, a crucial aspect that remains unsolved in most cases is the ability of these nanoplatforms to reach and accumulate in the tumors efficiently, particularly in the case of metallic nanoparticles (MNPs). In this work, recent advances on the design of the metallic core of MNPs to optimize their capabilities as MRI contrast agents (CA) and to increase their magnetic field-to-heat transformation will be described. On the other hand, the functionalization of MNPs with polymer ligands is critical to avoid opsonization and thus prolong their blood residence time. Therefore, the structure, size and outermost surface charge of polymer ligands anchored to MNPs surface will be analyzed in deep. Finally, tumor targeting strategies will be exposed and discussed. Despite passive tumor targeting has long been recognized as the most competent mechanism for the accumulation of MNPs inside solid tumors, but there are limited experiments addressing it on GBM. Here, we present findings demonstrating that MNPs can barely penetrate GBM, leading to active targeting as the most plausible strategy for efficient GBM targeting. Thus, new approaches for active targeting of MNPs will be briefly discussed.

Keywords: Iron oxide nanoparticles, theranostics, MRI, magnetic hyperthermia, Glioblastoma Multiforme, tumor targeting.

Biography:

Dr. Carlos Caro began his PhD in 2006, focused on the development of metal nanoparticles for cell labeling. After his PhD, he obtained a postdoctoral position at the Universidade Nova de Lisboa (Portugal). In May 2015, he got a postdoctoral position at the Andalusian Centre for Molecular Biology and Regenerative Medicine (CABIMER) and the Institute of Chemical Research (IIQ). From January 2016, Dr. Caro joined as postdoctoral researcher in the group led by Dr. María Luisa García-Martín at the Andalusian Centre for Nanomedicine and Biotechnology (BIONAND). Overall, Dr. Caro has authored 27 articles (h-index=16), 3 book chapter; and 5 patents.