

MAGNETIC GLYCONANOPARTICLES AS CONTRAST AGENTS FOR BRAIN TUMOR TARGETING BY MRI

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Magnetic nanoparticles offer exciting new opportunities including improving the quality of magnetic resonance imaging (MRI), hyperthermic treatment for malignant cells and site-specific drug delivery. The development of functional magnetic nanoparticles is mainly based on proteins and nucleic acids. However, as far as we know, magnetic nanoparticles conjugated to biologically relevant oligosaccharides for specific cell targeting have not yet been prepared. Our laboratory has recently been successful in preparing gold nanoclusters and semiconductor nanocrystals functionalized with carbohydrate antigens (glyconanoparticles) [1]. These glyconanoparticles have been shown to be excellent platforms for basic studies of carbohydrate interactions and potential tools for biotechnological and biomedical applications.

We also explored the potential of these tools for cell labelling and imaging of carbohydrate-mediated biological processes. To this end, we propose the use of magnetic glyconanoparticles as potential MRI agents. Therefore, in this study, magnetic gold-iron nanoparticles (MGNPs) coated with different saccharides (glucose, maltose and lactose) [2] and hybrid DOTA-Gd³⁺/saccharides (glucose and lactose) have been prepared using straightforward and economical methodologies. The influence of these nanoparticles on human dermal fibroblasts in vitro has been assessed in terms of cytotoxicity, light microscopy and scanning electron microscopy (SEM). From the results, we observed that, although maltose-MGNP presents an extremely high cytotoxicity, lactose and glucose are innocuous. We have also observed that lactose and maltose- MGNPs are able to internalize the cell membrane via endocytosis, but this effect was not detected for gluco-MGNPs.

To confirm their application as MRI contrast agents, the longitudinal and transversal relaxation times (T₁ and T₂) of our GNPs were measured. All the MGNPs showed similar relaxivities and they have an acceptable value, in spite of the low content in iron in all of them. However, DOTA-Gd³⁺-GNPs showed very good relaxivities values, even better than commercial available contrast agents. In vivo experiments have also been carried out with gluco-GNPs and lacto-GNPs to demonstrate their utility as contrast agents for tumoral processes. Only gluco-GNPs could reach brain tumours and accumulate there, allowing their visualization by MRI and indicating a different role in the carbohydrate activity in the process.

References:

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