Superparamagnetic iron oxide nanoparticles for multiple biomedical applications

Superparamagnetic nanoparticles (SPION) were prepared by alkaline co-precipitation of ferric and ferrous chlorides in aqueous solution. The obtained particles were mixed at various ratios with different polymer solutions to obtain either SPION coated with polyvinyl alcohol (Mowiol® 3-83), (PVA-SPION) or SPION coated with PVA modified by functional groups (amino-SPION, carboxy-SPION, and thiol-SPION). Studying human melanoma cells by these different functionalized SPION preparations, only the amino-PVA SPION demonstrated the capacity to be uptaken by, and not being cytotoxic to these cells. This uptake by melanoma cells was dependent on the amino-PVA to iron oxide ratio, as an active mechanism, and all cells in a culture internalized these SPION. Depending on the size and of the surface charge of the coated and derivatized particles, the uptake rate can be optimized. Best results are shown with a positive surface charge and a hydrodynamic size of 50 to 80 nm. Static as well as dynamic magnetic forces increase significantly the uptake rate. It could also shown that these particles are useful tools in
transfection as alternative to the viral vectors. Interestingly is to note, that the same particles generate heat, which can be used e.g. for local hyperthermic treatment of tumor cells. Therefore, a multitasking including transport, transfection, heating and imaging with these superparamagnetic particles will be possible. Applications like magnetically target drug delivery, magnetofection and hyperthermic treatment will be discussed in detail.

Stichworte:
Drug delivery; Iron oxide; Nanoparticle; Superparamagnetic; Transfection

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