Functionalization of T-cells with microwave synthesized magnetic nanoparticles for their magnetic retention

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Abstract

Introduction

Adoptive T-cell transfer (ATC) therapy, despite being promising against cancer, has a big drawback: the low proportion of T cells that reach the tumour. To tackle this problem, approaches that localize T lymphocytes in target regions are being tested, such as those based on magnetic nanoparticles (MNPs) [1, 2]. This work evaluates if human and mouse T-cells, functionalized with innovative microwave synthesized MNPs without disrupting their biology, could be retained by an external magnetic field (EMF, magnet).

Methodology

MNPs of different sizes were obtained by microwave-assisted synthesis and coated with aminopropylsilane (APS) and aminodextran. After physicochemical characterization, the biocompatibility between human (Jurkat) or mouse (primary $CD8^+$) T-cells and MNPs were analysed by different experimental approaches: citotoxicity (PrestoBlue assay), iron-association kinetics (ICP-OES), cell localization (confocal microscopy) and the cell surface phenotype (flow cytometry). Finally, magnetic retention of T-cells was studied *in vitro* using a flow chamber system in presence of EMFs.

Results

All microwave synthesized MNPs showed low toxicity and greater iron association to T-cells at 2-4 hours. Also, MNP treatment did not affect the cell surface phenotype of T-cells, and, regarding their localization, confocal microscopy showed that MNPs were present on cell membrane. Among different microwave synthesized MNPs, only APS coated 30 nm particles showed a magnetic retention capacity similar to coprecipitation MNPs of around 10 nm. Together, these data suggest the implications of coating and size in magnetic targeting.

Conclusions

Microwave synthesized MNPs are biocompatible with human and mouse T-cells. Further, when applying an EMF, cell magnetic retention is shown preferentially with a microwave synthesized ~ 30 nm MNP coated with APS (MW1-APS) similarly to coprecipitation ~ 12 nm COP-APS. Although microwave and coprecipitation synthesis methods showed similar results, microwave-assisted synthesis is a more feasible and reproducible procedure and, thus, a more suitable method to be used in clinical practice.

References

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