Influence of Polymeric Particles Internalization on Mesenchymal Stem Cell Differentiation

11029017, 姜朋飞, 毛峥伟*, 高长有*

Introduction

Stem cell differentiation can be influenced by many kinds of signals such as soluble factors, substrate stiffness and geometry [1]. Internalization of particles can have significant impact on cell functions such as adhesion, proliferation and migration [2, 3]. However, the impact of particles inside cells on the fate of stem cells has not been thoroughly studied. In this study, we investigated the uptake of PLGA-BSA particles and the subsequent influence on the differentiation of rat mesenchymal stem cells.

Experiment and Result

PLGA-BSA particles (~300nm in diameter) were prepared using an O/W emulsion-solvent evaporation method [2]. The cellular uptake of Nile red labeled PLGA particles were followed by confocal laser scanning microscopy (CLSM) (Figure 1) and flow cytometry.

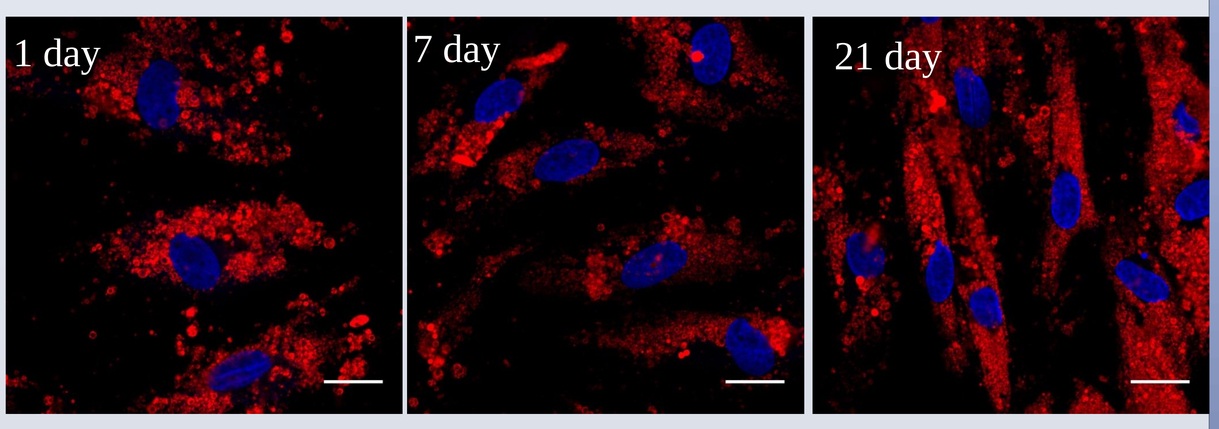

Figure 1: CLSM image of MSCs cultured with 50μg/mL Nile Red labeled PLGA-BSA particles for 1, 7, 21 days

The impact of PLGA particles on osteogenic differentiation of MSCs were studied in terms of alkaline phosphatase (ALP) activity, calcium deposition.

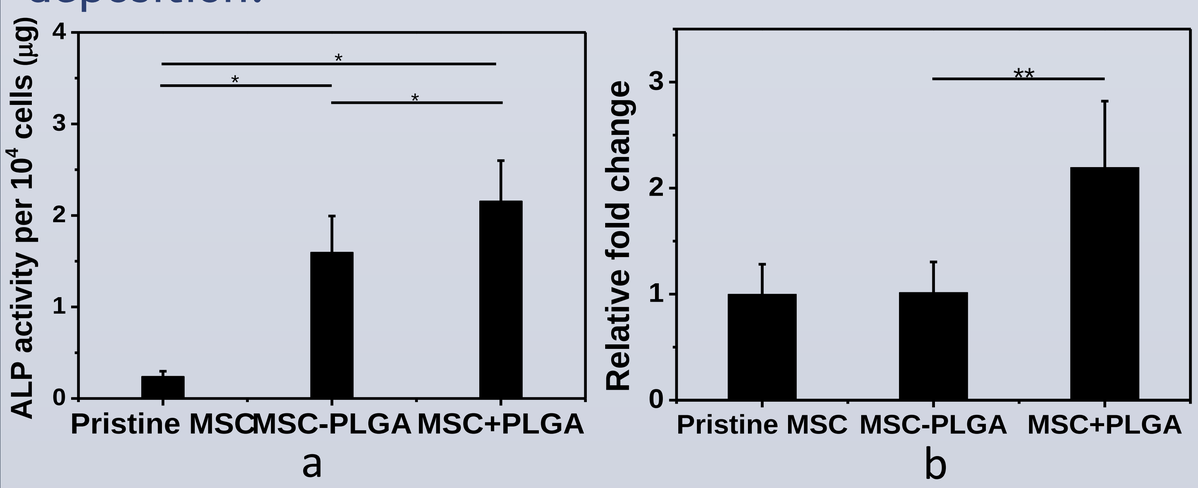

Figure 2: (a)Effects of PLGA-BSA particles on ALP activity of MSCs cultured for 7 days; (b)Relative calcium content per ten thousand cells were calculated.(t-test, ∗P<0.05)

The results (Figure 2) showed that both ALP activity and calcium deposition increased with the uptake of PLGA-BSA particles. Besides, several differentiation markers such as osteocalcin (OCN), collagen type I (COL I), peroxisome proliferator-activated receptor-gamma (PPAR-γ) and lipoprotein lipase (LPL) were quantified at both mRNA and protein levels by quantitative real-time polymerase chain reaction (qRT-PCR) analysis and western blotting (WB) assay. The results showed that PLGA-BSA particles internalized by MSCs significantly promote osteogenesis and inhibit adipogenesis.

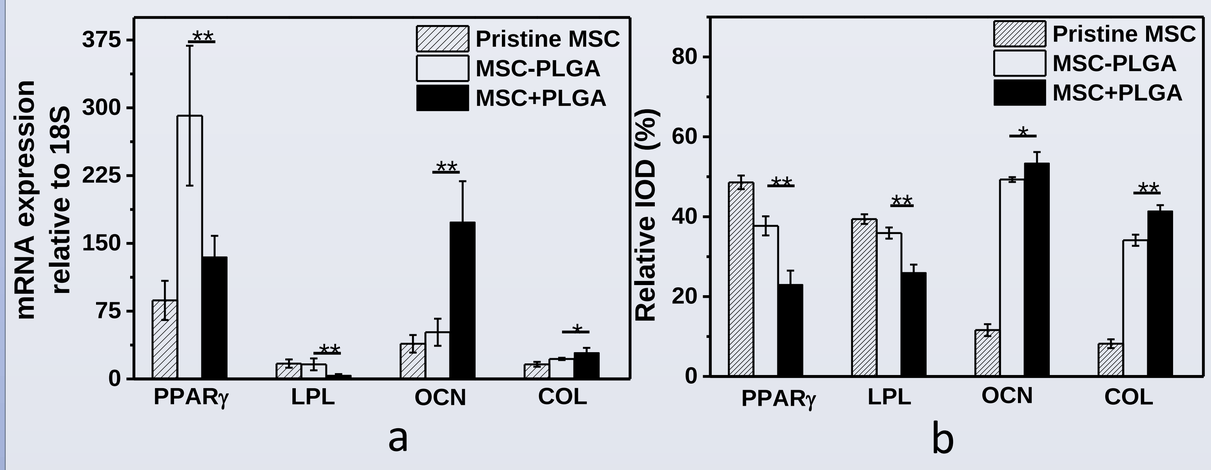

Figure 3: RT-PCR and WB characterization of MSCs afters cultured with (MSC+PLGA) or without(MSC-PLGA) PLGA particles for 21 days

Conclusions

In this study, we investigated effects of PLGA-BSA particles on MSCs function including cell morphology, viability and differentiation. PLGA-BSA showed no obvious cell toxicity, and it was proved that internalization of PLGA-BSA particles was able to promote osteogenesis of mesenchymal stem cells and inhibit adipogenesis. This study shows that PLGA-BSA particles are potential candidates for applications in stem cell therapy.

References

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