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Cell surface engineering with polyelectrolyte-stabilized magnetic nanoparticles: A facile approach for fabrication of artificial multicellular tissue-mimicking clusters

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Abstract

© 2015, Tsinghua University Press and Springer-Verlag Berlin Heidelberg. Regenerative medicine requires new ways to assemble and manipulate cells for fabrication of tissue-like constructs. Here we report a novel approach for cell surface engineering of human cells using polymer-stabilized magnetic nanoparticles (MNPs). Cationic polyelectrolyte-coated MNPs are directly deposited onto cellular membranes, producing a mesoporous semi-permeable layer and rendering cells magnetically responsive. Deposition of MNPs can be completed within minutes, under cell-friendly conditions (room temperature and physiologic media). Microscopy (TEM, SEM, AFM, and enhanced dark-field imaging) revealed the intercalation of nanoparticles into the cellular microvilli network. A detailed viability investigation was performed and suggested that MNPs do not inhibit membrane integrity, enzymatic activity, adhesion, proliferation, or cytoskeleton formation, and do not induce apoptosis in either cancer or primary cells. Finally, magnetically functionalized cells were employed to fabricate viable layered planar (two-cell layers) cell sheets and 3D multicellular spheroids. [Figure not available: see fulltext.]

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Keywords

artificial multicellular clusters, magnetic modification, magnetic nanoparticles