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Cell/biomaterials interaction

The cell/material interaction is a complex, dynamic process in which the cell and the material synergistically influence the fate of the cell. Indeed, both materials intrinsic (i.e. topography, charge, ζ-potential, and contact angle) and extrinsic properties (i.e. surface functionalization, crystallinity, etc.) played a pivotal role in dictating the type and strength of the biological responses (Figure 1). Furthermore, the ability of biomaterials to release bioactive molecules (i.e. resveratrol, fluoride, etc.) expands the possibilities to control cell-cell interactions and/or intracellular signal transduction. Our recent research demonstrated a functional role of charged polymers in altering or supporting the osteogenic differentiation of mesenchymal stem cells (MSCs) through the modulation of the ephrinB2/EphB4 interaction. Indeed, cell-cell signaling pathways that lead to efficient differentiation of stem cells include the interaction of Ephrin ligands (ephrinB2) with Eph receptors (EphB4). For the first time we have shown that high charged polymers can affect the Eph/ephrin interaction between neighboring cells inhibiting the MSCs osteogenic differentiation via the perturbation of the bidirectional signaling. In contrast, low charged polymers modulate the differentiation of MSCs into an osteocyte lineage via cell-cell ephrinB2/EphB4 signaling.

Moreover, we demonstrated that electrospun PCL and PLA nanofibers loaded with resveratrol (RSV) differently modulate DPSCs osteoblast differentiation and inhibit osteoclastogenesis depending on their RSV release kinetics. Our results indicate that the slow and continuous RSV release from PLA was able to modulate both osteoblast and osteoclast differentiation representing a promising material for the preservation of post-extraction integrity of alveolar socket. Taking together, our results highlight that rationally designed materials can give rise to biomaterials able to modulate functional aspects of biological signaling. Furthermore, understanding the mechanisms by which cells respond to external stimuli could be a successful strategy i.e. in cancer therapy, regenerative medicine, etc.

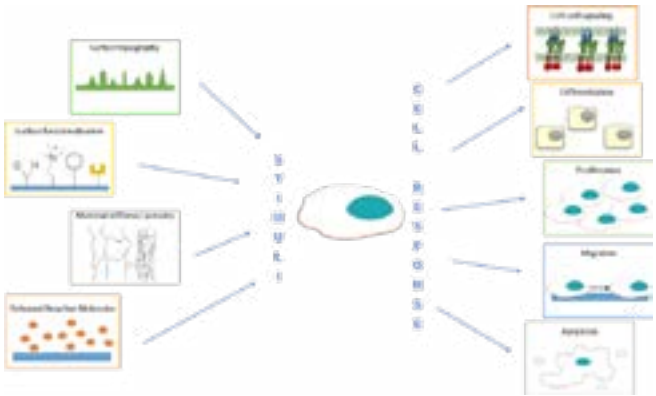

Figure 1: Schematic illustration of cell/biomaterials interaction. Intrinsic and extrinsic materials properties could affect cell fate and tissue development inducing a cell response.

Recent Publications

1. Pannico M, Calarco A, Peluso G, Musto P. Functionalized Gold Nanoparticles as Biosensors for Monitoring Cellular Uptake and Localization in Normal and Tumor Prostatic Cells. Biosensors. 2018 Oct 4;8(4).
2. Riccitiello F, De Luise A, Conte R, D'Aniello S, Vittoria V, Di Salle A, Calarco A, Peluso G. Effect of resveratrol release kinetic from electrospun nanofibers on osteoblast and osteoclast differentiation. Europ Polym J. 2018 Feb 99 289-297.
3. Squillaro T, Cimini A, Peluso G, Giordano A, Melone MAB. Nano-delivery systems for encapsulation of dietary polyphenols: An experimental approach for neurodegenerative diseases and brain tumors. Biochem Pharmacol. 2018 Aug;154:303-317.
4. Conte R, Marturano V, Peluso G, Calarco A, Cerruti P. Recent Advances in Nanoparticle-Mediated Delivery of Anti-Inflammatory Phytocompounds. Int J Mol Sci. 2017 Mar 28;18(4).
5. De Luca I, Di Salle A, Alessio N, Margarucci S, Simeone M, Galderisi U, Calarco A, Peluso G. Positively charged polymers modulate the fate of human mesenchymal stromal cells via ephrinB2/EphB4 signaling. Stem Cell Res. 2016 Sep;17(2):248-255.
6. Calarco A, Di Salle A, Tammaro L, De Luca I, Mucerino S, Petillo O, Riccitiello F, Vittoria V, Peluso G. Long-Term Fluoride Release from Dental Resins Affects STRO-1+ Cell Behavior. J Dent Res. 2015 Aug;94(8):1099-105.

Biography

Prof. Gianfranco Peluso graduated magna cum laude and special mention in Medicine at the University of Naples, Italy. He has been Director of the Department of Experimental Oncology at the National Cancer Institute. Currently, he is Research Director at Italian National Research Council. His scientific activity and areas of interest include: nanoscience and nanotechnology applied to biomedicine, life science and food security, for: a) development of nanostructured polymers as novel delivery platform to minimize drug degradation upon administration, prevent undesirable side effects, and sustain and/or increase drug's bioavailability in a targeted area, and b) synthesis of biodegradable polymers for innovative food packaging to improve shelf life, microbiological safety and sensory properties of foods without affecting their organoleptic and nutritional characteristics.

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