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Editorial

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Special Issue on Regenerative Medicine: Unfolding the Nanoworld of Stem Cells towards a Self-Healing Potential – Introduction

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Progress in understanding stem cell biology is holding promise for a novel perspective in the cure of diseases that cannot be currently approached even by the most advanced pharmacological or surgical interventions. The emerging chance for a *Regenerative Medicine* tailored on patient-specific unmet clinical needs may prelude to the unprecedented opportunity for a *Precision Medicine*.

There is now increasing evidence that cells are also governed by physical energies and that cell biology entails circadian rhythms that are fashioned at multiple interconnected levels, involving the generation of cellular electric (and most likely electromagnetic) fields, mechanical oscillations, and electromagnetic radiation (light). Biomolecular recognition patterning not only occurs through lock/key interactions but it is based upon resonance modes and synchronization of vibrational patterns at molecular and supramolecular level.

Cell sensitivity to physical energies is forming the underpinning to exploit the diffusive feature of such energies to target and reprogram our stem cells where they already are, in all tissues of the human body, resuming our inherent ability for self-healing. Seeing (stem) cell biology with the eyes of Physics may therefore promote a new paradigm for a Regenerative Medicine developed without the needs for cell or tissue transplantation.

We are becoming aware that inter-cellular communication is mainly executed through the release and exchange of signaling molecules packaged inside a network of nanovescicles, embedding small peptides, microRNA, long-chain RNA and probably DNA. Rather than communicating through the secretion of naked molecules, cells and stem cells adopt the exchange of pockets of information, even through the establishment of an intercellular nanotube network.

Stem cells are not simply "sitting" in our tissues, but they live within the context of a very specialized architecture, the *niche*. The stem cell *niche* is a pro-active environment defined at the nano-scale level, a nanotopography encrypting both chemical and physical cues essential to exploit the regenerative potential of stem cells. Preserving such nanotopography (i.e. the integrity of stem cell *niche*) in tissues transplantable for regenerative purposes (i.e. bone marrow, fat) is currently regarded as a strategy to increase the chance for structural and functional recovery of damaged organs.

Accordingly, the identification of natural or the development of artificial scaffolds capable to mimic the *niche* is another major area of enquiry to optimize the outcome from stem cell transplantation and tissue engineering.

This Special Issue is focused on these novel, emerging paradigms in cell biology and tissue regeneration, discussing the current efforts to unfold the nanoworld of stem cells towards a self-healing potential.