

## Biomedical Science and Engineering: a new multidisciplinary journal dealing with modern regenerative medicine strategies

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### Biomedical science and engineering

Modern regenerative medicine strategies include both tissue engineering approaches as well as molecular medicine, drug release, cell and gene therapy with the final purpose to regenerate human tissue and organs. Particularly, tissue engineering is an interdisciplinary field born in the eighties with the purpose of applying the principles of life sciences and engineering toward the development of biological substitutes that restore, maintain, or improve the functions of tissues and organs.

The economic burden for the care of patients affected by severe diseases, such as cardiovascular, cancer and neurodegenerative diseases is tremendously increasing due to the progressive aging of the world population. The lack of effective therapies to counteract such severe diseases causes an increase of the healthcare costs. However, the conditions of life for many patients still remain unsatisfactory. Up to date, organ transplantation, tissue auto-, allo- and xeno-grafting, as well as implantation of artificial prostheses are the only available options to treat the loss of functionality of tissues and organs as caused by severe diseases or traumatic events.

Societal and economic data underline the needs for new research progresses aimed at increased knowledge on tissue regeneration mechanisms and the discovery of new effective therapies replacing or restoring tissue functionalities. Similar achievements require a strict collaboration among scientists with complementary competences, including materials, biomedical and chemical engineers, chemists, biologists, clinicians and research and development staff of biomedical industries. Ease exchange of information among the actors of research together with the formation of a multidisciplinary network of scientists may significantly strengthen the scientific research, leading to the development of effective advanced therapies and their easy translation from bench to bedside.

### Biomedical Science and Engineering journal

In this context, the recent achievements in the fields of biomedical science and engineering are the subject of this new open access journal, whose mission is the scientific dissemination among a wide population of scientists, with the final aim to reinforce scientific research collaboration. In particular, the *Biomedical Science and Engineering* journal will provide an insight into the newest findings of regenerative medicine with particular focus on emerging topics, such those described as follows.

#### *In vitro* tissue modeling

There is an increasing demand for *in vitro* 3D human tissue models, as they can provide several advantages respect to the traditional *in vivo* mouse and rat models, including high biomimicry, reproducibility, possibility for real-time monitoring, limited costs and lack of ethical constrains. Reliable organ-on-chips models are those of the new frontiers of the scientific research as they provide an effective means for the study of human tissue functions and for a preclinical screening of therapies.

#### Niche-mimicking substrates directing adult stem cell behavior

It is known that the regenerative potential of stem cells can be guided by various factors in their external environment, including the cell attachment substrate, the direct interaction with neighboring cells and the presence of soluble signaling factors in the culture medium, regulating cell-substrate, cell-cell, and cell-soluble factors interactions, respectively. The proper regulation of adult stem cell behavior may lead to effective autologous therapies and/or advanced personalized tissue engineered models.

#### Tissue engineering studies making use of induced pluripotent stem cells

Induced pluripotent stem cells (iPSCs) are pluripotent stem cells derived from somatic cells through genetic modifications. Nowadays, the main sources of iPSCs are blood and skin. Once obtained, they can be expanded *in vitro*, then differentiated into the desired phenotypes, offering the possibility to have an autologous source of cells for regenerating purposes. Currently, the first clinical trial using iPSCs is in progress. Some initiatives are also in progress for the obtainment of iPSCs banks. Such cells can be used in the field of regenerative medicine, including tissue engineering and cell therapies and they

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are also exploited in *in vitro* models for new drug discoveries.

#### Novel methods and biomaterials for cell bioprinting

One of the trends of tissue engineering is the design of cellularized scaffolds by printing a combination of cells and biomaterials with a tissue-biomimetic assembly, followed by tissue maturation (by *in vitro* static or dynamic culture). Many successful cell printing reports have been disseminated by the scientific literature, however *tissue printing* still represents an exciting challenge for the scientific community and deserves more efforts in the next future.

#### New biomimetic scaffolds for tissue engineering

The regeneration of tissues require an interplay between cells and biomaterials assembled into a 3D porous scaffold. Modern tissue engineering strategies make use of scaffolds recapitulating the compositional, mechanical and architectural properties of native extracellular matrix as to positively affect the development of tissues with biomimetic structure and functions.

#### Mini-invasive approaches for cell and drug delivery

Modern regenerative medicine therapies are required to be effective and minimally invasive for an easier translation from bench to bedside. To this purpose, injectable degradable hydrogels for cell and drug delivery are of great interest.

#### Novel drug carriers in the form of nanoparticles for targeting delivery

Targeted drug therapies are highly demanded to avoid the secondary effects of pharmaceuticals

such as the cytotoxicity of chemotherapeutics, and to increase drug therapy effectiveness. One demanding field is the treatment of diseases affecting the brain, including tumours, neurodegenerative diseases and stroke, as the blood-brain-barrier poses a limitation in the ability of the drugs to reach the brain. Drug embedding into nanoparticles decorated with antifouling moieties and targeted ligands offer the possibility to vehicle the drug to the desired cells.

### **Innovative biosensors for *in vitro* and/or *in vivo* validation of medical therapies**

Novel biosensors are required for the *in vivo* and *in vitro* preclinical validation of advanced regenerative medicine strategies, such as targeted drug therapy. They offer a tool for quantification and evaluation of therapy effectiveness.

### **Advanced strategies for effective gene therapy**

Gene therapy including the delivery of oligonucleotides is widely studied as it offers the possibility to modify a population of cells *in vitro* or to introduce a genetic modification in specific cells *in vivo*. Problems are related to the short half-life of oligonucleotides in the biological media, their negative charge being an obstacle to internalization by the cells and their need for a targeted therapy being addressed to specific cells to avoid unwanted effects. Gene therapy offers the potentiality to reverse the poor regenerative potential of organs such as the heart and the central nervous system, and to tune the host inflammatory response.

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### **Conclusions**

The Journal will disseminate the recent findings on such *hot topics* of modern regenerative medicine: it will deal with subjects that are new or just presented at national and international congresses and will disseminate the matter among scientists with complementary competences, providing a contribution to the sharing of scientific information aimed at the disclosure of effective therapies against human diseases. Finally, the peer-review system adopted will guarantee the high quality and scientific level of publications.

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