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Satellite Meeting

Symposium

From Tissue Engineering to Alternatives: Research, Discovery and Development

A satellite symposium to the 7th World Congress on Alternatives and Animal Use in the Life Sciences, organised under the auspices of CELLTOX (Associazione Italiana di Tossicologia *in vitro*) and ESTIV (European Society of Toxicology *in Vitro*)

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Introduction

Research animals still serve as a model for man in biomedical research. There is a strong drive to limit animal experimentation for ethical, scientific, practical and economic reasons. *In vitro* models are widely developed and used to (partly) replace animal studies. Most *in vitro* models are based on single cell type 2D cultures, which lack the 3D structures of tissues under investigation and the interactions of the different cell types normally present *in vivo*. Tissue engineering promises to overcome some of these limitations.

Tissue engineering is an emerging multidisciplinary technique that involves the use of living, preferably human, cells to create tissues and organs *de novo*, either for therapeutic or diagnostic applications. Tissue engineering research includes different areas of application: biomaterials (e.g. scaffold), biomolecules (e.g. bone morphogenic proteins), engineering design aspects (e.g. 3D structure) and biomechanical aspects (e.g. safety and efficacy of engineered tissues).

3D culture systems, moving from “flat biology” of cell monolayers to a more realistic culture environment that maintains some aspects of the original tissue/organ characteristics and better preserves the differentiated cells’ phenotype, offer new opportunities for biomedical studies, becoming a bridge between *in vitro* and *in vivo* models.

3D reconstructed human skin equivalent (HSE) can be used for drug testing and for fundamental research purposes to better understand skin disease development in order to find appropriate therapies. Full thickness skin equivalents are therefore attractive for the study of cell-cell, cell-matrix and dermal-epidermal interactions and to mimic diseased skin disorders *in vitro* in order to test therapeutics. Studies with HSEs can therefore contribute to our knowledge of basic biochemical mechanisms underlying irritant reactions and can be used to understand the structural features of molecules that may be responsible for eliciting an irritant reaction. Reconstructed epidermal models used for screening of

potential skin irritants have recently been accepted by the European Union (EU) as alternative methods (EPIKIN™, SkinEthic RTE, EpiDerm™), while three-dimensional reconstructed tissue models of human cornea (EpiOcular™, SkinEthic) are regarded with great interest for the study of eye irritation.

Stem cell research is a promising approach for tissue therapy of neurodegenerative diseases, brain injury and cardiovascular disorders. Adult stem and progenitor cells, such as hNT neurons (derived from an embryonal human teratocarcinoma cell line), bone marrow and human umbilical cord blood (hUCB) derived cells are alternative cell sources compared to embryonic stem cells, the use of which is restricted in certain countries for ethical reasons. hUCB cells represent a non-controversial source of stem and progenitor cells appearing to have a multipotent capacity to differentiate into endothelial cells, neurons, glia and other cell types. They are easily obtained, provide repair through trophic and immunological mechanisms as shown in *in vitro* and *in vivo* studies and are associated with a low incidence of graft-versus-host (GVHD) diseases.

The development, use and opportunities of tissue engineering in different areas of application were discussed during a satellite symposium at the 7th World Congress on Alternatives and Animal Use in the Life Sciences organised under the auspices of CELLTOX and ESTIV on August 30, 2009 in Rome, Italy. The subsequent papers by A. E. Ghalbzouri, P. R. Sandberg and G. Mazzoleni follow this introduction.

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