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ORIGINAL RESEARCH

An in Vitro Study on Tissue Repair: Impact of Unloading on Cells Involved in the Remodelling Phase

Monica Monici· Francesca Cialdai Giovanni Romano·Franco Fusi · Marcel Egli · Silvia Pezzatini ·Lucia Morbidelli

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Abstract The number of astronauts involved in long-lasting missions and extra-vehicular activities is going to increase in the future. Consequently, the chance ofinjury due to traumatic events or unexpected emergency surgery will also increase and medical evacuation times to earth will be prolonged. Hence, the need to address requirements for surgery and trauma care in non terrestrial environments will be a priority. Tissue repair in weightlessness should therefore be regarded as a major issue not enough studied to date. Wound healing is a complex multi-step process, crucial to the survival of the organism. It starts with an inflammatory phase followed by a remodelling phase. During repair, the extracellular matrix (ECM) is sequentially remodelled by the concerted action of different cell types, in order to rebuild a functional tissue. The available literature concerning wound healing with mechanical unloading presents controversial results. However, many studies indicate impairment of the healing processes. Here we present a study on the behaviour of cells involved in the remodelling phase of repair, e.g. fibroblasts and endothelial cells, in response to microgravity (µg). In particular, their adhesion/migration, cytoskeleton organization, production of ECM molecules and receptors have been investigated. Cell response to pulsed Nd:YAG laser irradiation has also been investigated in order to evaluate the possibility to use laser irradiation for counteracting the effect of µg on wound healing. In µg, we observed alterations in production/assembling of ECM molecules. Increased fibronectin (FN) and laminin (LM) could be the cause for impaired ECM rebuilding and altered cell adhesion/migration. Treatment with Nd:YAG laser pulses induced organized fibrillogenesis and favoured endothelial cell spreading and monolayer formation. These findings open the way for a better understanding of tissue repair mechanisms in space and future clinical applications on earth.

Keywords Tissue repair and regeneration · Wound healing · Microgravity · Extracellular matrix

M. Monici
ASAcampus Joint Laboratory, ASA Research Division,
Department of Clinical Physiopathology,
University of Florence, Viale Pieraccini 6,
50139, Florence, Italy
e-mail: monica.monici@unifi.it

F. Cialdai · G. Romano · F. Fusi
Department of Clinical Physiopathology,
University of Florence, Florence, Italy

M. Egli
Space Biology Group, ETH-Technopark,
Zurich, Switzerland

S. Pezzatini · L. Morbidelli
Section of Pharmacology, Department of Molecular Biology,
University of Siena, Siena, Italy