IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Life and Physical Sciences under reduced Gravity (7)

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PREPARATION OF THE "SUTURE IN SPACE" EXPERIMENT ON BOARD THE ISS

Abstract

Wound healing (WH) is a process strictly regulated and highly conserved throughout evolution because it is indispensable for surviving injuries. On Earth WH has been studied in depth, nevertheless the role of mechanical factors in regulating the process and the mechanisms that, in adult mammals, lead to scarring instead of tissue regeneration are not well understood. In weightlessness WH has been poorly studied, and the effect of loading/unloading on the healing mechanisms is quite completely unknown. Preliminary studies showed microgravity-induced alterations in mechanisms underlying tissue repair. The implementation of procedures and tools to manage emergency surgery, trauma, serious burns wounds and sutures is mandatory for future manned space exploration missions beyond Earth's orbit, at a distance incompatible with medical evacuation to Earth. Therefore, studies on WH in weightlessness are needed and they are an unique opportunity for understanding healing mechanisms still not completely known. The Suture in Space experiment, which will be performed on board the ISS in about a year, was selected by ESA (ESA-AO-ILSRA-2014) and supported by ASI in its preparation phase. It aims to study, in unloading conditions, the behavior and healing of ex vivo sutured wound models prepared from skin and blood vessel biopsies derived from plastic and vascular surgery in healthy subjects. The experiment preparation required intense research activity in order to: i)standardize procedures for collecting biopsies, model preparation, tissue culturing and monitoring, postflight analysis of samples; ii) define the requirements for hardware development. To ensure tissue viability throughout the experiment (4 weeks), we studied and developed a new tissue culture technique based on enriched culture media and a device able to model the physiological mechanical tension in the tissues and monitor its changes during WH, thus studying suture mechanical properties. The culture technique and WH models developed for the SUTURE in SPACE experiment can be applied to study: i) mechanical properties of tissues, tissue constructs, wounds and sutures in different loading conditions; ii) the role of gravity in tissue repair; iii) the relationship between biochemical and mechanical factors in repair mechanisms; iv) the influence of mechanical factors on scar quality; v) the effectiveness of treatments promoting WH, when applyed in different loading conditions.

The results of the experiment are expected to help in defining: i) strategies to manage wounds and promote healing in Space and on Earth; ii) suture techniques and materials to be used in Space environment.