Effects of occupational exposure to electromagnetic fields (EMFs) in healthcare facilities

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In recent years, concerns have been expressed about possible adverse effects of the numerous electromagnetic sources present in the daily life and work environments. Several lines of evidence indicate that exposure to EMFs markedly impact on cell biology, with possible beneficial as well as potential adverse effects (Leone et al., 2015; Iachininoto et al., 2016). In particular, occupational exposure in magnetic resonance imaging (MRI) facilities has been addressed in a recent focus of the International Committee of Non-Ionizing Protection (ICNIRP) [ICNIRP, 2009, 2010, 2014] and European Union (EU) Directive 2013/35/EC, thus confirming relevance of these issues for occupational and public health.

In order to identify possible risks for the health of hospital workers, we explored the biological effects of exposures to gradient magnetic fields (GMFs) emitted by nuclear magnetic resonance (NMR) devices and to 50 Hz Magnetic Fields (MFs) in specific working scenarios.

We measured exposure to GMFs of staff working at 1.5T and 3T MRI units and quantified occupational and environmental exposure to EMFs at 50 Hz for five tasks professionally exposed (technicians of clinical engineering, technicians of research laboratory, technicians of neurophysiopathology, physiotherapists and electricians). We focused on the effects induced by GMFs and 50 Hz MFs in hematopoietic stem cells in both *in vivo* and *in vitro* exposure settings. In particular, we investigated if CD34+ hematopoietic progenitors are susceptible to EMFs in terms of modification of molecular pathways related to cell senescence, stemness and epigenetic machinery. Moreover, we evaluated if EMF exposure could affect the HPC commitment towards specific hematopoietic lineages (myeloid, erythroid and megakaryocytic).

CD34+ cells were obtained by Fluorescence Activated Cell Sorting from non-exposed blood donors and exposed workers. We stimulated non-exposed CD34+ cells through an experimental device reproducing the same sequence of stimuli experienced by workers. The exposure system reproducing measured signals was realized to expose *in vitro* CD34+ cells to GMFs and 50 Hz MFs.

Results showed that *in vitro* exposure to GMF generated by MRI scanners promoted the commitment of CD34+ cells towards erythroid and monocyte lineages. Instead, after *in vitro* 50 Hz MFs-exposure (real or sham), CD34+ cells exhibited the modulation of several genes involved in epigenetic chromatin modifications. Data obtained in CD34+ cells obtained from *in vivo* exposed healthcare workers did not differ significantly in comparison with controls. On the other hand, EMFs effects we observed *in vitro* encourage further investigations to assess whether occupational exposure causes changes at molecular and epigenetic levels that would provide evidence of long-term biological effects of EMFs on exposed workers.