ANNUAL REPORT on EMF ACTVITIES in ITALY (2014)

General research activities related to EMF health

A review of scientific activities concerning the biological effects of electromagnetic fields (EMF) performed in 2014 in Italy is here reported, based on papers published in peer-reviewed scientific journals, authored or co-authored by researchers affiliated to Italian Universities, research Agencies and research organizations.

Direct electrical stimulation, static fields, radiofrequency (RF) and extremely low frequencies (ELF) fields, as well as pulsed fields (PEMF) effects were studied in investigations concerning *in vitro* and *in vivo studies,* and therapeutic applications in human patients.

In vivo investigations involved different animal models. The effects of electric stimulation by a direct connection with an external fixator on bone healing in experimental osteotomy were assessed in sheep [1]. A pilot study [2] on prostate volume and vascularity in a canine model was performed for the treatment of benign prostatic hyperplasia with PEMF, also applied, at two different frequencies, on a Guinea Pig osteoarthritis model [3]. Effects of GSM-modulated 900 MHz fields on the hematopoietic potential of mouse bone marrow cells (BMC) were examined in two different murine models, transplanting X-irradiated syngenic mice with BMC from exposed, sham-exposed or cage control animals, in order to evaluate the ability of BM precursors to long-term reconstitute peripheral T and B cell compartments [4]. Adult hippocampal neurogenesis was examined in mice following exposure to ELF fields [5], both in vivo by spatial learning and memory tests, and in vitro by gene expression in neural stem cells isolated from newborn's hippocampi.

Several in vitro papers were published spanning on a wide range of experimental endpoints. A human immortalized neuronal cell model, SH-SY5Y cells, was utilized in 3 different experiments. Cell viability, apoptosis-related cleaved caspase-3 protein expression, ROS (Reactive Oxygen Species) production and number of mitochondria were measured after exposure to low-to-high static magnetic fields associated to MRI apparatus [6]. Oxidative stress, enzymatic activity, cytokine gene expression related to neurodegeneration, after 1mT, 50 Hz exposure [7], along with autophagy markers [8] were examined as well. The possible geno- and cytotoxicity of ELF in human neuroblastoma BE(2)C cells were studied by gamma-H2AX foci formation, MTT assay and cell cycle analysis [9]. Diverse cell types were included in other investigations. Adaptive response in human blood lymphocytes exposed to RF fields was assessed in terms of resistance to ionizing radiation-induced damage [10], while effects of intermittent 1.8 GHz RF fields on HSP70 expression and MAPK signalling pathways were investigated in PC12 cells [11]. Telomerase-independent and telomerase-dependent pathways in human adipose-derived stem cells [12] were evaluated following exposure to REAC (Radio Electric Asymmetric Conveyer) microwave emissions, as well as proteomics of human primary osteoarthritic chondrocytes exposed to ELF fields and therapeutic application of musically modulated EMF (TAMMEF) [13], and ionic homeostasis of porcine granulosa cells exposed to a 2 mT static magnetic field [14]. There was also a study that investigated the possible effect of static magnetic field exposure on quorum sensing of Harveyi clade Vibrio strain PS1, a bioluminescent bacterium living in symbiosis with marine organisms [15].

Studies on mechanisms of EMF interactions, even based on molecular dynamic have been also addressed [16-18].

The studies related to biomedical applications were differentiated. The clinical efficacy of a wearable pulsed electromagnetic field (PEMF) therapy was widely studied both on clinical outcome in patients who underwent bone marrow-derived cells transplantation for osteochondral lesions of the talus [19] and in patients undergoing total knee arthroplasty [20]. Moreover, the beneficial effects of PEMF over the long term, was either retrospectively assessed in a population of older adults at risk of falls consecutively treated in an outpatient clinic [21] and was assessed in terms of pain and quality of healing after tooth extraction in patients undergoing unilateral mandibular third molar extraction [22]. Repetitive Transcranial Magnetic Stimulation (rTMS) was used to investigate neuroplastic changes on the intact motor cortex to promote motor recovery in a chronic patient with subcortical stroke [23]. Some other author has focused attention on the impact of GSM like signal on the ongoing spiking activity in human epileptic patients [24] and on patient tolerability of brain imaging that employs an ultrahigh field (7 T) MR system [25]. Epidemiological studies were also considered. [26] analyzed the use of electrochemotherapy (ECT) in the treatment of primary and metastatic tumors. Some studies investigated the potential effects of childhood and adolescent exposure to ELF-EMF on brain tumor risk [27-29]. Another paper aimed to evaluate the association between ALS and occupational exposure to ELF-EMF and chemicals agents [30].

The distribution of the electric field in the brain tissues due to transcranial Direct Current Stimulation has been addressed [31-32]. Hyperthermia and microwave ablation have been also investigated [33-35]. Microwave imaging for breast cancer was addressed by [36]. UWB have been used to investigate astronaut breathing activity [37]. As to the assessment of the exposure to electromagnetic fields, the influence of 50 Hz-harmonics on the exposure of foetuses has been investigated [38], together with the exposure of foetuses at 50 Hz [39]. [40] investigated the temperature increase of fetus tissues when exposed to UHF RFID. UHF RFIDs have been also investigated by [41]. The possible health impact of the residential exposure to extremely low frequency magnetic fields was also investigated [42].

New policies and legislations regarding EMF exposure
Nothing relevant with respect previous year.

Areas of public concern and national responses
Nothing relevant with respect previous year.

Public information activities
Nothing relevant with respect previous year.

ANNEX: Quoted references

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