EMFs as treatment

Section 1

Bone healing, cancer, depression, fibromyalgia, neurological diseases, pain relief

Intercellular cross-talk is a fundamental process for spreading cellular signals between neighbouring and distant cells to properly regulate their metabolism, to coordinate homeostasis, adaptation and survival as a functional tissue and organ. In this review, we take a close molecular view of the underpinning molecular mechanisms of such complex intercellular communications. There are several studied forms of cell-to-cell communications considered crucial for the maintenance of multicellular organisms. The most explored is paracrine signalling which is realised through the release of diffusible signalling factors (e.g., hormones or growth factors) from a donor cell and taken up by a recipient cell. More challenging is communication which also does not require the direct contact of cells but is organised through the release of named signalling factors embedded in membranous structures. This mode of cell-to-cell communication is executed through the transfer of extracellular vesicles. Two other types of cellular cross-communication require direct contact of communicating cells. In one type, cells are connected by gap junctions which regulate permeation of chemical signals addressed to a neighbouring cell. Another type of cell communication is organised to provide a cytosolic continuum of adjacent cells joined by different tiny cell membrane extensions coined tunnelling nanotubes. In this review, we consider the various cell communication modes in the heart, and examples of processes in non-cardiac cells which may have mechanistic parallels with cardiovascular cells (Plotnikov 2017).

Pulsed electromagnetic fields (PEMF) are known to affect biological properties such as differentiation, regulation of transcription factor and cell proliferation.

Bone healing

In an experiment by Zhong (2012) exposed bone marrow cells were inserted into the femurs of mice; the bone healing in the right femur (exposed cells) was significantly more sophisticated when compared to the left femur (unexposed cells), especially after 8 weeks. The authors conclude that magnetic field-exposure of bone marrow mesenchymal stem cells of mice could increase cell proliferation and cell differentiation.

Cancer

Ehrlich Carcinoma

In 2013, El-Bialy & Rageh found that ELF-MF enhanced the cytotoxic activity of cisplatin and potentiated the benefit of using a combination of low-dose cisplatin and ELF-MF in the treatment of Ehrlich carcinoma.

Glioblastoma

The data in a study by Akbarnejad (2017) suggest that the proliferation and apoptosis of human glioblastoma cells are influenced by exposure to extremely low frequency pulsed electromagnetic fields (ELF-PEMFs) in different time-dependent frequencies and amplitudes. The fact that some of the ELF-PEMFs frequencies and amplitudes favour U87 cells proliferation indicates precaution for the use of medical devices related to the magnetic fields on cancer patients. On the other hand, some other ELF-PEMFs frequencies and intensities arresting U87 cells growth could open the way to develop novel therapeutic approaches. Pasi (2016) also found that synergistic electromagnetic stimulation can elicit an epigenetic pro-apoptotic effect in the chemo- and radioresistant T98G glioblastoma cell line.

Glioma

Previous studies showed that magnetic hyperthermia could efficiently destroy tumours both preclinically and clinically, especially glioma. Magnetosome (new type of nanoparticle) superior antitumour activity could be explained both by a larger production of heat and by endotoxins release under alternating magnetic field application. Most interestingly, this behaviour was observed when magnetosomes occupied only 10% of the whole tumour volume, which suggests that an indirect mechanism, such as an immune reaction, takes part in tumour regression (Alphandéry 2017).

Lung cancer

A study by Y Xu (2017) proved that LF-MFs can inhibit lung cancers through miR-486 induced autophagic cell death, which suggest a clinical application of LF-MFs in cancer treatment.

Ovarian cancer

Results from a study by Baharara (2016) showed that changes generated by ELF-EMF can make otherwise resistant ovarian cancer cells sensitive to cisplatin.

Depression

Transcranial magnetic stimulation or repetitive transcranial magnetic stimulation (TMS/rTMS) are currently used in treatments of diseases of the central nervous system, such as recurring depression. However, Møllerløkken (2017) shows that the exposure of staff in this type of treatment may exceed the given guidelines for occupational exposure.

Electric fields

Incubation in a weak extremely low-frequency field (ELF) during the period of declining viability (due to egg storage) significantly improved viability and condition of the embryos rather than the expected converse. Thus for a few days, the field could keep viable some embryos that would otherwise not have survived. The rescued embryos and their untreated controls seem the most promising place to seek any carcinogenic effects of ELF fields (Cooper 2016).

Fibromyalgia

ELF-MF treatment significantly reduced pain, which increased on cessation of therapy but remained significantly lower than baseline levels (Paolucci 2016).

Neurological diseases

Urnukhsaikhan (2016) concluded that exposure of human bone marrow-derived mesenchymal stem cells to a pulsed 60 Hz magnetic field might enhance cell survival and induce neuronal differentiation. This result might be beneficial for future work on cell transplantation therapy for neurological diseases.

Bai (2013) and Kim (2013) found that exposure to 50 Hz-magnetic fields could promote the differentiation of particular rat bone cells into functional neurons. Therefore, according to the authors, extremely low frequency magnetic fields could represent a potential therapeutic option for treating neurodegenerative diseases. Tasset (2013) suggests that recent studies show that the beneficial effects of transcranial magnetic stimulation (TMS) may be at least partly due to a neuroprotective effect on oxidative and cell damage.

Pain relief

In a study on land snails, Nittby (2012) found that comparing the reaction pattern of each snail before and after exposure, the GSM exposed snails were less sensitive to thermal pain as compared to the sham controls, indicating that RF exposure induces a significant analgesia.

In a study by Kortekaas (2013), pain control may be achieved with PEMF and for this analgesic effect, coil design does not appear to play a dominant role. In addition, the flexible configuration with small coils on a head cap improves clinical applicability.

Pulsed radiofrequency-induced pain relief of sciatic pain may be due to temporary blockage of nerve signals through the nerve pathway responsible for reversible neuronal depression. However, continuous radiofrequency-induced pain relief may be due to permanent blockage of nerve signals through other nerve pathways (Choi 2014).

In a study of patients with persistent chronic lower back pain associated with degenerative disc disease, Arneja (2016) found improvements in overall physical health, social functioning and reduction in bodily pain. The pain relief rating scale showed a high level of pain relief at the target area.

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