Positive Effects of EMFs

The fact that electromagnetic fields (EMFs) have biological effects has been investigated not only for the health ***risks*** they invoke, but the potential for healing that has also been suggested. Much of the research originally was undertaken in those countries that had been unwilling or unable to afford the sort of expensive high-tech medical equipment used in many medical interventions in the West, though not everybody is convinced of its therapeutic effects (Hug 2011). The benefits are being more widely explored in recent times.

It is difficult to deny that EMFs have no effects on biological systems in the body when the number of papers and medical practices are highlighting the positive effects of EMFs.

ELF-EMFs have been found to produce a variety of biological effects. These effects of ELF-EMFs depend upon frequency, amplitude and length of exposure. They are also related to intrinsic susceptibility and responsiveness of different cell types. ELF-EMFs can influence cell proliferation, differentiation, cell cycle, apoptosis, DNA replication and protein expression. These effects are important considerations for the application of ELF-EMFs for wound healing, tissue regeneration (Patruno 2010), and Parkinson's and Alzheimer's diseases (Patruno 2012).

The use of a low-intensity ultrahigh frequency (UHF) electromagnetic radiation emitting device on sick children helped reduce the frequency of intake of anaesthetics in the post-operative period, correct metabolic disorders in children with type 1 diabetes mellitus, reduce severity of diabetic nephropathy and polyneuropathy, and prevent formation of fresh foci of lipoid necrobiosis (Azov & Azova 2009).

Superimposing electromagnetic noise blocked reactive oxygen species (ROS) increase and DNA damage of the sort induced by acute exposure to 1.8 GHz RF (Yao 2008).

Devices using EMFs employed in healing

SCENAR (Self-Controlled Energo Neuro Adaptive Regulation) devices

These are widely used in Russian hospitals to revitalise virtually any body system and thus promote healing. When 3,000 practitioners were surveyed, they reported achieving on average:

- 79% improvement in the musculoskeletal system, muscle injuries and diseases such as arthritis, sciatica, lumbago and osteoporosis
- 82% improvement in many circulatory disorders, including strokes, thromboses and heart failure
- 84% improvement in virtually any respiratory problems
- 93% improvement in both eye conditions and diseases of the digestive tract

SCENAR analyses the body's own electromagnetic emissions, detects any abnormalities and automatically adjusts its output to correct the abnormality. By regularly monitoring and adjusting the immune system in this way, problems can be treated even before they are clinically detectable.

Originally developed to keep astronauts healthy during space flights, SCENAR devices are now widely used in Russian hospitals and even carried by ambulance crews because of their ability to

aid recovery from cardiac arrest, accident trauma and coma. They were also used by Russian athletes during the 2000 Australian Olympics to treat minor ailments, combat pain and fatigue, and speed up muscle repair. Reported in Greenhealthwatch 2006 :8:2(30) S9.

TENS machines

Transcutaneous electric nerve stimulation (TENS) is a non-invasive treatment used in physiotherapy practice to promote analgesia in acute and chronic inflammatory conditions. High frequency (HF) and low frequency (LF) TENS were used in a study by Sabino (2008). LF TENS had a longer-lasting effect than HF, partially due to the local release of endogenous opioids. Aarskog (2007) found that the TENS analgesic effect was dependent on whether the electrodes were placed on the same side of the body as the pain site and the stimulation intensity had to be at a subjectively strong level to work.

However, Milham reports a strong association between the use of TENS machines and other equipment such as electrical diathermy in the treatment of sports injuries, and amyotrophic lateral sclerosis (ALS), a type of motor neurone disease, also called Lou Gehrig's disease, after the baseball player in whom it was first diagnosed.

BEMER device

A significant synergistic ant-tumour effect was found when mice were treated with a BEMER device as well as a low amount of doxorubicin. The authors of the study (Ríhová 2011) suggested that such a combination could be useful for heavily treated patients suffering from advanced tumours and requiring additional aggressive chemotherapy which may otherwise be life-threatening.

Transcranial Magnetic Stimulation (TMS) and repetitive TMS (rTMS)

Wassermann & Zimmermann (2012) say about TMS "*Although we understand many of its effects at the system level, detailed knowledge of its actions, particularly as a modulator of neural activity, has lagged, due mainly to the lack of suitable non-human models*". They continue "*Moderate success has been achieved in treating disorders such as depression, where the US Food and Drug Administration has cleared a TMS system for therapeutic use. In addition, there are small, but promising, bodies of data on the treatment of schizophrenic auditory hallucinations, tinnitus, anxiety disorders, neurodegenerative diseases, hemiparesis, and pain syndromes.*

Transcranial magnetic stimulation (TMS) is rapidly developing as a powerful, non-invasive tool for studying the human brain. It can also alter the functioning of the brain beyond the time of stimulation, offering potential for therapy (Hallett 2000). The effect on a reporter of exposure to TMS was an interruption of the normal exchange of information between the brain and the hand that facilitates writing, touching the nose with the hand, raising a glass of water to the mouth to drink. The disruption stopped when the electromagnetic field was off.

The effect of 20 daily deep-TMS sessions over the prefrontal cortex of 15 patients with schizophrenia indicated improvement in cognition and negative symptoms that was maintained at 2-week post-treatment follow-up (Levkovitz 2011).

Single or paired pulse TMS. The pulse(s) causes neurons in the neocortex under the site of stimulation to depolarise and discharge an action potential. Effect from single or paired pulses do not outlast the period of stimulation

Repetitive TMS (rTMS). This produces effects which last longer than the period of stimulation. RTMS can increase or decrease the excitability of corticospinal or corticocortical pathways depending on the intensity of stimulation, coil orientation and frequency of stimulation. The mechanism of these effects is not clear although it is widely believed to reflect changes in synaptic efficacy akin to long-term potentiation and long-term depression.

It is unclear what might be the long-term effects of using a large magnetic impulse on the brain. The treatment effect could be on the whole of the brain and it could inhibit or switch off a part.

Comparison of treatments

Pulsed radiofrequency therapy was better at relieving low back pain than electro-acupuncture (EA) therapy, but the functional improvement of the lumbar spine was improved under EA therapy (Lin 2010).

The research

Addictions

Transcranial magnetic therapy improved health, mood, sleep and reduced alcohol craving in 75% of patients in the second stage of alcoholism (Staroverov 2008). Repeated sessions of high frequency rTMS may be most effective in reducing the level of smoking and alcohol consumption (Barr 2011).

Arthritis

People with pain from osteoarthritis and rheumatoid arthritis have had significant relief from pain using therapies involving magnets both static and 'pulsed' (Pipitone 2001, Hinman 2002, Wolsko 2004, Ganesan 2009). A pulsed electric field (PEF) was found to be effective as a potential treatment for joint pain due to cartilage degradation (Fitzsimmons 2008, Luo 2009, Ongaro 2012).

Kumar (2005) found a reduction in oedema and other inflammatory effects after exposure to low frequency pulsed electromagnetic fields.

It is important that high-strength magnets are not used all the time as this may well reduce their effectiveness and could even have a negative effect.

Autism Spectrum Disorder (ASD)

Deep rTMS may help aspects of cortical dysfunction in those with ASD. A new study (Enticott 2011) provides a potential new avenue for the development of a biomedical treatment of impaired social relating.

Bacterial & microbial effects

Exposing H pylori to extremely low frequency EMFs reduced its capability to protect itself (Di Campli 2010).

Electric fields generated using insulated electrodes can inhibit the growth of planktonic Staphylococcus aureus and Pseudomonas aeruginosa and the effect is amplitude and frequency dependent, with a maximum at 10 MHz. The combined effect of the electric field and chloramphenicol was found to be additive (Giladi 2008).

Extremely high frequency EMF irradiation in combination with antibiotics enhanced the antibacterial effects on E.Coli (Torgomyan 2011).

Akan (2010) also found that ELF EMFs affected bacterial growth and the response of the immune system to bacterial changes, suggesting that EMFs could be exploited for beneficial uses.

Blood circulation

Yambe (2005) used a therapeutic alternating EMF device on the hands of 11 volunteers for 20 minutes. Microcirculation changes were inferred using skin temperature measurements. The authors concluded that a significant rise in skin temperature was suggestive of a rise in peripheral circulation. This could be useful in a variety of conditions, where peripheral circulation is poor. Xu (2000) also found a similar result.

Pulsed low-intensity electromagnetic field (PLIMF) increased the blood flow to areas of pain or inflammation, bringing more oxygen and removing toxic substances. In a study by Durović (2009), this avoided heterotopic ossification, a complication of head and spinal cord injuries.

Ischemia-reperfusion injuries, such as those suffered from various types of cardiovascular disease, are major causes of death and disability. Studies have looked at several mechanisms of protection from the injuries caused by resumed blood flow, heat shock proteins, opioids, collateral blood flow and nitric oxide induction, and have indicated that magnetic fields may be used as a means of providing protection via each of these mechanisms (Robertson 2007).

Bone healing and fracture repair

There seems to be an increasing body of research agreeing that pulsed electromagnetic stimulation increases bone healing. There have been a number of theories suggesting why this should be so.

It has been suggested by Tepper (2004) that magnetic fields heal fractures due to their effect on vascularity rather than osteogenesis. Pulsed electromagnetic fields were found to increase the number of bone cells or cause cell differentiation or both (Chang 2004, Tsai 2009, Sun 2010, Feng 2011). Sun suggested it possibly resulted from the shortening of the lag phase. A further study by Sun (2009) confirmed the proliferation effect on cells by pulsed EMFs, which also significantly altered the temporal expression of osteogenesis-related genes. Hopper (2009) found that osteoblast cells stimulated with ELF-PEMF increased endothelial proliferation 54-fold; they believed the effect was an indirect one, altering paracrine mediators. Sollazzo (2010) reported that PEMFs appeared to induce cell proliferation and differentiation by changing the action of specific genes. Noriega-Luna (2011) found changes in the cytoskeletal proteins of osteoblasts following treatment with pulsed magnetic fields.

Sinusoidal EMFs (SEMFs) inhibited osteoblast proliferation, but promoted differentiation and mineralization potentials which may help promote fracture healing (Zhou 2011).

The stimulation of the formation of new blood vessels by PEMF was felt to accelerate bone fracture healing by Goto (2010).

Grana (2008), Marquéz-Gamiño (2008) found that short daily stimulation with pulsed electromagnetic fields accelerated bone growth and healing (Gupta 2009) and peri-implant bone formation, and Shen & Zhao (2010), found that bone mass loss was decreased. Itoh's (2008) study found that wrist fixators could be removed earlier when the fracture was stimulated with an alternating electric current.

It has been suggested that pulsed EMFs might be a new treatment for people with osteoporosis (Bai 2009), due to its effects on osteoclastic like cell formation and apoptosis. Not all studies found postive effects, and van der Jagt (2012) suggests that this may be because of subtle differences in experimental set-up.

Non-pulsed EMFs have also been associated with effects on bone marrow stem cells resulting in increased differentiation into osteoblasts (Y Yang 2010). JC Yang (2010) also looked at the mechanism of osteoblastic maturation following differentiation.

A review by Zhong (2012) concluded that EMFs ameliorated disbility due to fracture non-union.

Cancer treatment

Pulsed EMFs reduced the blood flow (vascularisation) of breast tumours (Williams 2001), thus reducing growth and metastasis (Cameron 2005). Some frequencies were more effective than others, suggesting 'windows' which warrant further investigation. Zimmerman (2011) found that the growth of hepatocellular carcinoma (HCC) and breast cancer cells was significantly decreased by HCC-specific and breast cancer-specific modulation frequencies. The same frequencies did not affect proliferation of nonmalignant hepatocytes or breast epithelial cells. The authors concluded *"These findings uncover a novel mechanism controlling the growth of cancer cells at specific modulation frequencies without affecting normal tissues, which may have broad implications in oncology."* The modulation frequencies are different for different cell types and the amplitude modulation frequency range they found effective was between 100 Hz and 21 kHz – i.e. the audio spectrum. So it could have implications for healing using sound (and harming using sound) as well. It is, anyway, indicative of the reality that cells (or components of cells) can detect (or demodulate) RF, despite the wireless industry and most main-line authorities repeatedly denying it. Here we have the specific amplitude modulation frequency determining the interaction. The 27 MHz RF is just the carrier.

Hu (2010) found a low level magnetic field (0.001 – 0.005 microtesla) was more effective than higher levels (2-5 microtesla) at limiting tumour growth. Novikov (2009) found that 0.1, 0.3 and 0.15-0.3 microtesla inhibited tumour growth, prolonging the life of the animals involved.

Berg (2010) found both pulsed electromagnetic fields (PEMF) and sinusoidal electromagnetic fields (SEMF) killed cancer cells in laboratory mice.

Short duration electric fields were used to permanently damage cancerous tissue in aggressive cutaneous tumours in mice (Al-Sakere 2007). It effected cell membrane damage without heating and induced complete regression in 12 out of 13 treated tumours.

The application of 1500 V/cm in three sets of ten pulses of 300 microseconds each produced the complete removal of hepatocarcinoma cells (Miller 2005). The researchers also found that multiple pulses appeared to be more effective than using one single pulse. Treatment with EMFs administered into the mouth area increased progression-free survival in patients with advanced liver cancer (Costa 2011).

Rabbits treated with alternating electric tumour treating fields (TTFs) survived longer than untreated animals (Kirson 2009). This extension in survival was found to be due to an inhibition of metastatic spread, seeding or growth in the lungs of TTFields treated rabbits compared to controls. In addition to their proven inhibitory effect on the growth of solid tumors (Kirson 2004, Salzberg 2008), TTFields may also have clinical benefit in the prevention of metastatic spread from primary tumors. TTFields were found to slow down tumor growth in people with gliomas

(Kirson 2007). Evangelou (2011) found that RF-EMFs increased the number and cytotoxicity of killer cells, which they felt contributed to an improvement in end-stage cancer patients.

Plotnikov (2004) found that the combination of electric fields and chemotherapy effected a significant reduction in tumour size and a prolongation of survival time. A complete cure was obtained in 33 - 83% of the mice, depending on the chemotherapy used. Carefully focussed microwaves were also found to increase the effectiveness of chemotherapy in treating breast cancer, shrinking tumours by nearly 50% more than chemotherapy alone (Dooley 2010). Other synergistic effects were found with chemotherapy drugs and electromagnetic fields (Tofani 2003), without affecting metastasis (Zhang 2011).

ELF EMFs increased the cell apoptosis effects of low doses of X-ray irradiation on liver cancer cells (Jian 2009).

Radiofrequency fields (RF) in combination with single-walled carbon nanotubes (SWNTs) could produce lethal thermal injury to cancer cells. In a study by Gannon (2007) the SWNTs target cancer cells and leave normal cells unaffected by the RF.

Some studies (Hall 2007, Ren & Beebe 2011) have found that nanosecond pulsed electric fields (nsPEFs) could have therapeutic potential to induce apoptosis (cell death) of colon cancer cells, in specified circumstances. Beebe (2009) found that nsPEFs induced cell death by multiple apoptosis mechanisms that involve mitochondrial responses, potentially inducing cell death that bypasses cancer mechanisms that evade apoptosis.

The presence of more than one dental alloy in the mouth often causes pathological galvanic currents and voltage resulting in superficial erosions of the oral mucosa and eventually in the emergence of oral cancer. Direct current electrical fields induce cancer cell death (Wartenberg 2008).

Mi (2004) also found that therapeutic radiation by steep pulsed electric field (SPEF) destroyed the integrity of induced tumour cells in mice. Their survival time was 52 days, as opposed to the 33 days of the control group.

ELF alternating magnetic fields under conditions of exposure tuned to Zn(2+) according to the IPR model of Blanchard and Blackman inhibited the growth of cancer and normal cells (Sarimov 2005).

A review of literature, mainly from Russian sources, found that low-intensity electromagnetic radiation in the millimetre band was helpful in experimental and clinical oncology. It was used in 1) preparation prior to radical treatment, 2) prevention and treatment of side-effects and complications from chemotherapy and radiotherapy, 3) prevention of metastases, relapses and dissemination of the tumour, 4) treatment of the paraneoplastic syndrome and 5) palliative therapy of incurable patients (Teppone & Avakyan 2010).

Cancer-related frequencies appear to be tumour-specific and treatment with tumour-specific frequencies is feasible, well tolerated and may have biological efficacy in patients with advanced cancer (Barbault 2009).