Voltage-Gated Calcium Channels, EMF and Chronic Disease

By Michael Gerber, MD, HMD

Practitioner of Homeopathic Medicine

A Powerful Mechanism of Cellular Disruption

Research has found that calcium channel blocking drugs could mitigate the non-thermal damaging effects of EMFs. Numerous articles indicate that voltage-gated calcium channels (VGCCs) in our cell membranes were powerfully affected by EMF radiation and allowed a massive increase of calcium to flood into our cells, about one million ions per second per channel. Dr. Martin Pall, biochemist at Washington State University, feels the current safety standards are off by a factor of about seven million[4]. This increased calcium greatly boosts nitric oxide (NO) which in physiological levels has beneficial health effects but excessive NO forms peroxynitrite and superoxide, potent oxidant stressors. It is broken down by superoxide dismutase (SOD) to form hydrogen peroxide and hydroxyl free radicals. He explains that the end result is extreme harm, as increased oxidative stress and nitrosative stress are involved in nearly all chronic disease.

Neuropsychiatric Effects of EMF Exposure

The highest density of VGCCs are in the central nervous system (CNS) and studies dating back to 1950s and 1960s show that the CNS is the organ that is most sensitive to EMFs. Some of the studies show major changes in the structure of neurons, including cell death and synaptic dysfunction. As the VGCCs are stimulated in the brain they release neurotransmitters and neuroendocrine hormones. The consequences of EMF exposure to the brain include anxiety, depression, autism and Alzheimer's. Pall shows that the increase in intracellular calcium can result in numerous problems [5]. Epidemiological studies also trace fatigue, insomnia, memory and concentration difficulties. VGCCs are present in nearly every biological system in the human body; for example, in the immune, endocrine, nervous, and circulatory systems. EMFs can thus result in increases of allergies and inflammation, affect hormone regulation, brain function and heart rhythms.

Dr. Pall, [2] [4] in his review, shows that the increase in intracellular calcium can result in numerous problems:

- Oxidative stress results in DNA breaks - contributes to cancer cell formation.
- Activation of matrix metalloproteases degrades the tight cell/cell junctures

and breakdown in the blood-brain barrier.

- DNA breaks of gamete precursor cells can result in a decrease in fertility and sperm count

as well as adverse effects on sperm morphology and function.

- Activation of kinases lead to apoptosis (cell death).
- Depressed melatonin levels leading to sleep disruption. Dr. Pall, and other scientists have shown that low level microwave EMF exposure can result in VGCC activation and elevated intracellular calcium. [2,4,5] In a recent review [2,5] and in two dozen studies, calcium channel blockers, which block voltage-gated calcium channels, also block the increased influx of calcium caused by EMFs. This suggests that activation of these channels is primarily responsible for the results noted in studies on the effects of EMFs. VGCCs normally open calcium channels for short periods, in the millisecond range; EMF activation can result in much longer open periods, resulting in significantly higher intracellular calcium influx.

A large number of studies have documented the effects of EMF exposure.

Symptom(s)	Numbers of studies reporting
Sleep disturbance/insomnia	17
Headache	14
Fatigue/tiredness	11
Depression/depressive symptoms	10
Dysesthesia (vision/hearing/olfactory dysfunction)	10
Concentration/attention/cognitive dysfunction	10
Dizziness/vertigo	9
Memory changes	8
Restlessness/tension/anxiety/stress/agitation/feeling of discomfort	8
Irritability	7
Loss of appetite/body weight	6
Skin tingling/burning/inflammation/dermographism	5

Cardiac Effects

The heart is very sensitive to EMFs, particularly the pacemaker cells which have the highest density of VGCCs. Cardiac arrhythmias such as atrial fibrillation/atrial flutter, premature atrial contractions (PACs), premature ventricular contractions (PVCs), tachycardia and bradycardia may be related to EMF exposure.

EMFs and Cancer

Pal suggests that studies about EMFs and cancer have been blocked by industry. Carcinogenesis is a powerful consequence of mitochondrial damage from VGCCs, a la' Warburg and Seyfried. Dr. Thomas Levy, MD, JD in his book Death By Calcium presents formidable data relating excess calcium to cancer, heart disease and arteriosclerosis. Anecdotally, I have had two entrepreneurs with brain cancer, one on the right side of his brain and he always used his cell phone on the right ear and the other with brain cancer on the left side and always held his phone on the left.

Limiting ones exposure to EMFs including cell phone towers, cordless phones, Wi-Fi routers, Bluetooth headsets, wireless mice, keyboards, smart thermostats, baby monitors, smart meters and microwaves in the kitchen among others is important to work toward.

The recommendations by Dr. Pall [2] and others include the implementation of new, biologically based, safety standards [6] and the lowering of exposures to EMFs by factors of 100 to 1000-fold. Biological standards suggested by Dr. Pall include measurement of nitrous oxide levels in cell culture sensitive to EMFs; biological tests such as cardiac, hormone, and neurological changes in animals in response to EMF; and whole animal studies looking at nitrous oxide levels in blood.

Protecting Against EMFs

Pall revealed magnesium deficiency will aggravate the effects of VGCCs and that most of us should supplement it. I am particularly fond of magnesium glycinate. Nrf2, (nuclear factor erythroid-2-related factor) upregulates SOD, catalase and other beneficial intracellular antioxidants and lowers inflammation, improves mitochondrial function, stimulates mitochondrial biogenesis, and helps detoxify the body from xenobiotics, carbon-containing toxins and toxic metals. It improves and activates the transcription of over 500 genes in the human genome most of which have cytoprotective functions and includes three

genes that encode enzymes required for the synthesis of reduced glutathione, one of our body's most important antioxidants.

Nrf2 can be activated many ways including consuming sulforaphane from cruciferous vegetables, foods high in phenolic antioxidants, omega -3 fats, DHA and EPA, carotenoids (especially lycopene), sulfur compounds from allium vegetables, isothiocyanates from cabbage and terpenoid-rich foods.

Understanding VGCCs as the principle causative agent in EMF damage to our cells and that it is even more important than ionizing radiation will help us to avoid this energy and do more to shield ourselves and neutralize its damaging effects.

References

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