Effects of Pulsed Electromagnetic Fields (PEMFs) on Stress

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The very presence of life means that stress is also present. The recognition of and the reaction to stressors is fundamental to physical and emotional existence. Our reactions to stressors are either healthy, that is, adaptive, or unhealthy, that is, maladaptive. Maladaptive reactions to stress create physical and psychological damage, if either too large to withstand or too frequent to recover from. An example of an adaptive physiologic response is perspiring when the body temperature increases. This response becomes maladaptive, or harmful, when the body is not able to perspire or if the stress continues too long and bodily fluids are not replenished. Stressors may also be psychological or mental. Again, the reaction may be helpful or harmful. For most of us, the use of the term "stress" refers most often to the negative psychological or physiological responses to life's stimuli.

The original human need for a stress response was adaptive, called the "fight or flight" response. Typically, this response allowed us to engage a threat, such as an attacking animal. In modern Western society, the most common daily stressors are minor psychological events, such as an angry client on the telephone or the tension of driving in heavy traffic. Even these seemingly minor occurrences produce a low-level "fight or flight" reaction in the body. The cumulative or chronic occurrence of these mild stressors may not allow adequate or full recovery and results in many of modern society's health problems.

The stress response causes the brain to release chemicals that stimulate the nervous system. Adrenalin is pumped into the bloodstream along with extra sugar and fat, from body stores, for energy to fuel muscles. Mental activity is focused; some organs slow their activity, while others are accelerated. The muscles tense up, the breathing rate increases, there may be tightness in the chest and queasiness in the stomach. In a high stress state, most of these reactions will be present. In a lower stress state only one or several may be present and in varying degrees.

Many believe that a healthy human body could be able to live as long as 120 years before organs gradually slow down and stop. Stress accelerates the decline by actually damaging some organs and accelerating the wear and tear on others. Stress may accelerate aging and cause heart disease, atherosclerosis, diabetes, arthritis, fatigue, immune problems, adjustment disorders and anxiety and depression, and many other problems, including cancer. Close to 70-80% of the problems seen by doctors are most likely caused by stress.

Some of the physiologic reactions to stress are: muscle tension, rapid heartbeat, sweaty palms, diarrhea or constipation, increased gastric acid, high blood pressure, increased adrenal hormones, exaggerated mental alertness, increased blood sugar, increased blood lipids, dry mouth, increased insulin, increased thyroid hormone and immune changes.

The physical problems that can result from stress are: insomnia, nervous irritability, headaches, atherosclerosis, hypertension, irritable bowel, gastritis, arrhythmias, panic attacks, anxiety, depression, fatigue, substance abuse, immune deficiencies, asthma, skin problems, allergies, muscle spasms, neuralgias, vision changes, hyperventilation, dehydration, sudden cardiac death, vasospasm, increased cholesterol, increased platelets, decreased oxygen, appetite problems, accelerated auto immune problems increased actually, miscarriages decreased libido, impotence, menstrual changes, disturbed memory, among others.

Clearly not all of these problems happen to everybody under stress. They happen to varying degrees depending on genetics, life and environmental experiences and the level and duration of the stress. Most of us throughout our lifetimes will develop at least some of the above problems.

Once a stress reaction is initiated it is difficult to turn off immediately. The reaction is immediate but the recovery takes hours to days. Since the effects of stress are cumulative, a daily routine of reducing the physiologic response becomes necessary to ward off long-term damage. Many approaches are used to reduce the effects of stress, including relaxation, meditation, yoga and stress avoidance. A new, simple, easily useable approach to reducing the physical response to the effects of daily stress is whole body, pulsed electromagnetic field (PEMF) therapy.

The body is very sensitive to magnetic fields (MFs). The Earth is a large magnet. We are also bombarded by electromagnetic activity from outside the planet. Physiologic changes are seen during solar storms in healthy humans, in patients with cardiovascular diseases and in cosmonauts in SOYUZ spacecraft and the MIR space station. They had nonspecific adaptive stress reactions, with increased cortisol secretion, activation of the sympathoadrenal system (SAS) and suppressed melatonin.

There is much experimental evidence that almost all biological systems are highly sensitive to weak PEMFs, with a wide range of biologic effects. Research, on humans and animals, has shown that PEMFs alter stress responses by action directly on the nervous system, glands, cells, tissues and organs.

The SAS is activated by stress. PEMFs inhibit activation of the SAS and prevent decreases in nonspecific stress resistance. Through PEMFs, the plasma catecholamines, adrenalin and noradrenalin, chemical messengers associated with increased sympathetic nervous system arousal, decrease. PEMFs do this by acting on the hypothalamus and increasing urine excretion of adrenalin. Generally, the excitability of the nervous system also decreases and emotional reactions accompanying stress are corrected. Long-term use of weak PEMFs may be able to help the body remodel tissues that tend to be hyper-reactive to chronic or acute stress so that over time they will become less and less reactive.

Environmental stressors, such as heat or sunlight, affect cellular homeostasis. Thermal stressors and electromagnetic fields (EMFs) interact to induce intracellular heat stress

proteins (HSP), protective proteins in the cell. PEMFs can be used preventively prior to anticipated heat, toxicity or surgical injury to prevent cellular harm and thus increase cellular stress resistance and reduce damaging cellular stress responses. This phenomenon could be exploited as a protective presurgical cardiovascular treatment. Other potential uses include protection against viral infections, autoimmune diseases, inflammatory diseases and to enhance the normal stress response in the elderly, by counteracting the normal loss of a healthy stress response during aging.

PEMFs not only activate metabolic processes in the immediate tissues exposed but also act indirectly through the endocrine system and control centers of the nervous system. For example, exposing the thyroid area produces a similar response with a lower field dose vs. the higher dose required by local area exposure, e.g., to the heart in ischemia. In experimental hepatitis, microwave PEMFs to the thyroid were more effective in restoring liver function than exposing the liver itself. Exposure of the adrenals in patients with rheumatoid arthritis activated the body's own natural cortisone and made lymphocytes function normally. Again, controlled exposure to short-term, weak PEMFs increases the resistivity of the organism to other more severe stressors, including low temperatures, physical load, ischemic heart damage, ionizing radiation, etc.

Stress causes a very quick and significant decrease in white blood cell counts, creating a sudden state of immune vulnerability, such as may be caused by lack of sleep or travel. It also increases serum cortisol two to three-fold, a useful indicator of the level of stress. PEMFs increase host resistance by enhancing some immune functions. After exposure, neutrophils increase gradually and neutrophil metabolism and superoxide production are increased significantly. The cortisol level decreases.

Ascorbic acid (AA) is key to the antioxidant, neuroendocrine and immune mechanisms of stress adaptation (34). PEMFs cause ascorbic acid and serotonin to increase nearly two-fold by the 30th day of exposure. By the 90th day, ascorbic acid concentration returns to the initial (pre-exposure) value, while serotonin still remains significantly increased. This indicates that PEMFs may be useful in acute stress situations as well, by enhancing ascorbic acid function.

In athletes, PEMF therapy of the adrenal glands, thyroid gland or collarbone areas augments immune status and production of hormones, specifically, T-lymphocytes, testosterone and growth hormone and decreases circulating B-lymphocytes, cortisol and initially elevated levels of thyroid hormones. The athletes therefore have higher resistance to disease and higher work capacity.

In rabbits, emotional stress increases risk of sudden death. PEMFs increase resistance of the rabbits to stress. Death risk is lowered almost two-fold.

Pain is a major stressor. Pain inhibition has been consistently found by exposure to PEMFs in various species of animals, including: land snails, laboratory mice, deer mice, pigeons, as well as humans.

Heart rate variability (HRV) results from a complex interplay of neural and hormonal control mechanisms. Changes in HRV have been associated with increased risk of severe arrhythmia and sudden cardiac death in patients with recent myocardial infarction. Heart-rates (HR) are slowed. Some individuals may be more sensitive to or more consistent in having these PEMF-induced changes in HR and HRV. This effect appears to be due to changes to the cardiac pacemaker, the sino-atrial node, giving rise to a more normal beat-to-beat variability. Intermittent exposure daily is more effective than continuous exposure, e.g., overnight.

PEMFs and static magnetic fields (SMFs) act on carotid baroreceptors to reduce blood pressure by causing vasodilation and lowering heart rate. The stimulated baroreceptors reset sympathetic tone. The effects are thought to be due to changes in cell membrane calcium ion (Ca++) transport since they were abolished by verapamil, a potent Ca++ channel blocker. The effects may be of minimal clinical significance in healthy individuals but could be very significant in individuals with cardiovascular disease with abnormal HRV. In other words, strong SMFs had a parasympathetic or vagotonic action. Parasympathetic or vagotonic stimulation is stress reducing.

One group compared the effects of PEMFs and constant (static) magnetic fields on stress. Both weak PEMFs and SMFs (up to 100 gauss) were antitumorigenic, protective against toxic agents and X-ray radiation and produced rejuvenation effects in states of stress.

Millimeter wave (MMW) PEMF exposure of an acupuncture point affects heart rate and heart rate variability and labiality of the nervous system (NS) processes. Physical exercise increases labiality of the nervous system (NS). Humans may naturally have predominance in their autonomic NS of either sympathetic or parasympathetic responses. With parasympathetic predominant people, exercise increases both heart rate and its variability. With sympathetic predominance, individual reactions to exercise vary greatly. MMW stimulation of selected acupuncture points helps recovery of heart rhythm changes after exercise in parasympathetic toned individuals, but not consistently in sympathetic predominance.

Use of PEMFs on acupuncture points may produce similar results to electroacupuncture (EA). The stress responses induced by painful tooth pulp stimulation in rats are reduced by electroacupuncture (EA). EA decreases nor/adrenalin, dopamine, ACTH, and cortisol. Stress-induced elevation of blood pressure is blunted by EA. In addition, stress can also induce brain neuron atrophy and death, especially in the hippocampus. Neurotrophic chemicals are implicated in stress-induced hippocampal degeneration. EA stimulation significantly restores these neurotrophic chemicals.

Healthy 20 to 24 yr. old humans treated with MMWs applied to the outer hand had improved heart rate variability (HRV). Stress-induced EEG changes include suppression of alpha rhythm, increased theta and other decreases in bioelectric activity. EEG rhythms caused by stress are reversed with MMW treatment. Stressed animals have precipitous decreases of non-specific resistance and activation of lipid peroxidation. Lipid peroxidation is very damaging to tissues. Normal control animals exposed to MMWs

have a 10-15% increase in neutrophil metabolism and increased thalamic and hypothalamic anti-oxidant exchange. The abnormal changes in stressed animals are reversed by MMW PEMFs.

Soft tissue may also respond negatively to stress and high lipid levels. Stress and high lipid levels can lead to breakdown of elastin and collagen fibers of heart muscle and other tissues. PEMFs directed from the front to the back of the head reduce this tissue breakdown by inhibiting the enzyme that causes it and by anti-oxidant action.

PEMFs result in the several apparently related long-lasting effects, that reduce stress: an increase in blood volume, increase in tissue oxygen, increased pH (reduced acidity), increased depth of respiration, decreased heart rate and improved blood pressure. The magnitude of these effects in humans shows significant inter-individual variability. The benefits appear to be caused by lowered blood acidity, as indicated by measurements of lactic acid and pyruvic acid concentration, blood carbon dioxide levels and hydrogen ion (H^+) concentration. PEMF effects are increased during periods of high muscle activity, after drinking alcohol, while sleeping or after inhaling carbon dioxide. Conditions that raise pH such as hyperventilation and eating large meals could be expected to reduce the magnitude of the benefits.

Extremely low-frequency (ELF) PEMFs to the head and chest induce dilation of the larger blood vessels in these areas and increased tissue oxygen. Various kinds of PEMFs applied to the neck of human volunteers altered the respiration cycle, heart rate, blood pressure, and vessel perfusion. These effects showed wide variability and poor reproducibility.

To summarize, mild chronic daily stress causes untold damage to humans. Research has shown that PEMFs produce a number of anti-stress changes in the body, both to ward off stress, that is, create stress resistance, and to decrease the hormonal, immune, neurologic, soft tissue, cardiac, vascular, low pH and low-oxygen damage caused by stress. From this perspective, very low-level PEMFs used regularly should be able to prevent or reverse many of the effects of stress that all of us experience daily.

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