



Review Article

Pulsed Magnetic Field Treatment of Anxiety, Panic and Post-Traumatic Stress Disorders

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Abstract

Anxiety is a normal adaptive response to stress that allows coping with adverse situations. However when anxiety becomes excessive or disproportional in relation to the situation that evokes it or when there is no special reason for it, such as irrational dread of routine stimuli, it becomes a disabling disorder and is considered to be pathological. Anxiety disorders comprise the most frequent psychiatric disorders and can range from relatively benign feelings of nervousness to extreme expressions of terror and fear.

Anxiety disorders are the most common type of psychiatric disorders. In the United States the lifetime presence of anxiety disorders is about 29%.

Anxiety Disorders Include:

- Separation anxiety
- Selective mutism
- Specific phobia
- Social anxiety (social phobia)
- Panic disorder
- Agoraphobia
- Generalized Anxiety Disorder (GAD)
- Substance/medication-induced anxiety
- Anxiety due to another medical condition

Anxiety can be very disabling and although the available methods of treatment are safe and effective (that is, medications, psychotherapy and cognitive behavioral therapy), about 25% of people do not respond [1]. Many medications carry the risk of addiction or lifetime dependence with problematic withdrawal reactions. With advances in

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the understanding of the neurobiology involved in anxiety disorders, new treatments are being considered, including Pulsed Electromagnetic Fields (PEMFs).

Many people with anxiety disorders experience physical symptoms related to anxiety and subsequently visit their primary care providers. Despite the high prevalence rates of these anxiety disorders, they often are under-recognized and under-treated clinical problems.

What Happens in the Brain that Relates to Anxiety?

Some believe that there is an imbalance between the hemispheres of the brain and/or a deficit of limbic and brain cortex control. This could mean that anxiety, considered a “withdrawing from a situation” related emotion, is located in the right hemisphere, whereas emotions related to being able to “approach”, such as joy or happiness, are based in the left hemisphere. There appears to be increased right hemisphere activity in anxiety disorders.

Panic Disorder (PD) is considered to be a more severe form of anxiety. PD is seen with recurrent and unexpected attacks of sudden onset and short duration (10 - 15 minutes). A panic attack may be followed for up to one month by persistent worry regarding another panic attack. It may consist of symptoms such as feelings of shortness of breath, hyperventilation, palpitations, chest pain, sweating, chills, nausea, trembling, fear of dying or losing control, numbness and a feeling of detachment or unreality. Brain neuroimaging studies have verified specific abnormalities involved in panic disorder.

In Generalized Anxiety Disorder (GAD) brain scanning shows that limbic or frontal brain regions were activated in people with a high degree of hesitation in reacting to stressful stimuli. The same areas were found to be not activated in less anxious individuals when exposed to anxiety provoking situations. Repetitive Transcranial Magnetic Stimulation (rTMS) given to GAD patients over the right upper forehead for 15 minutes (900 pulses/day) significantly reduces anxiety.

Quantitative EEG (QEEG) gives a glimpse into the underlying electrical patterns of the brain. The electrical activity of the brain causes various neurochemical changes or can be the result of neurochemical processes in the brain. The diagnostic and therapeutic clinical discipline of neurofeedback relies on QEEG measurements. Neurofeedback uses the latest developments in neuroscience. Through neurofeedback, changes in EEG patterns result in improvement of cognitive, psychological and emotional symptoms and conditions. There is a large body of neuroscience research to support this approach to managing behavioral health conditions [2].

Conventional Treatments for Anxiety

Psychological interventions are still the keystone to non-medication management of anxiety disorders. There are a few studies comparing the value of psychological interventions versus medical therapies. The long-term effectiveness of Cognitive Behavioral Therapy (CBT) compared to medications in panic disorder was evaluated.

A review of the research done using CBT showed a modest protective effect of CBT in panic disorder patients. CBT plus medication had a 70% benefit but CBT alone only had benefit from 14 to 28% [3]. Effectiveness of different types of psychological interventions are: Individual CBT - not very effective, group CBT 8%, exposure and social skills 14%, self-help with support 14%, self-help without support 25% and psychodynamic psychotherapy 38%. Individual CBT compared with psychological placebo had a 44% benefit. SSRIs and SNRIs compared with pill placebo were 56% effective [4]. One of the biggest challenges with psychological interventions, is that many people are resistant to doing them, preferring the anonymity and the assumed effectiveness (without considering the risk) of medications.

Use of complementary and alternative medicine in general has increased over the past decade. A variety of studies have suggested that this use is greater in persons with symptoms or diagnoses of anxiety and depression. Data support the effectiveness of some popular herbal remedies and dietary supplements; in some of these products, particularly kava, the potential for benefit may be greater than that for harm with short-term use in patients with mild to moderate anxiety [5].

The most common medical approach to managing anxiety is with the use of medications. Medication treatments for GAD currently licensed in the United Kingdom were ranked: duloxetine was ranked first for response (third across all treatments, 3% effectiveness); escitalopram was ranked first for remission (second across all treatments, 27%) and pregabalin was ranked first for tolerability (second across all treatments, 8%). A 3% response rate is clearly not that effective [6]. Therefore, medication treatment of anxiety is not a panacea and is associated with significant long-term risks, not the least of which is drug dependency and dementia [7].

Few economic evaluations of pharmacological treatments for GAD have been published to date. However, the evidence indicates that for one drug in particular it would cost over \$20,000 USD per extra Quality Adjusted Life Year (QALY) gained. A QALY of zero indicates that there is an equal benefit to cost. A negative QALY would indicate that there's more benefit than cost. There are few QALY studies for any health care intervention, never mind the medical management of anxiety. Nevertheless, this study indicates that for at least one drug, which appears to be one of the most effective medications for anxiety, it is extraordinarily expensive for its value in improving quality of life [8]. This evidence clearly indicates the need for alternative approaches to the management of anxiety. With advances in the understanding of the neurobiology involved in anxiety disorders, new treatments are being considered, including PEMFs.

Neuroscience and Anxiety

QEEG research has found fairly typical patterns in the complex disorder of anxiety. Anxiety has been found to have at least six or seven patterns. QEEG patterns seen in anxiety include: imbalance in the frontal lobes in alpha frequencies, excessive beta frequencies in many parts of the brain, and possibly high alpha frequencies >11.5 Hz. Based on these findings, neurofeedback practitioners recommend treating either both frontal lobes with lower alpha or alpha at the sides of the head. Some call this alpha training [2].

While neurofeedback is typically applied in a practitioner's office, it is a very different approach to PEMF stimulation. There is evidence

that PEMF stimulation causes changes to the underlying brain EEG patterns. This is called entrainment. Many other forms of entrainment have been tested and used, particularly cranial electrical stimulation (CES) and Audiovisual Stimulation (AVS). The value of PEMFs over these other forms of entrainment is that PEMFs could do the same kind of entrainment stimulation but penetrate deeper into the brain and have the opportunity to be able to heal the underlying causes of a problem in the brain.

Can PEMFs Can Entrain to the Alpha Level Frequencies?

Oscillatory brain wave activity within the EEG alpha band has many brain function aspects, including memory processing and attention. Brain cells responsible for perception, cognition, and action have distinct vibration patterns. Increase in resting state alpha activity in the back of the brain denotes a state of relaxed wakefulness [9].

Magnetic field strength is measured in Tesla (T) or Gauss (G). One T equals 10,000 G. One milliT (mT) is about 10 G. The Earth's magnetic field intensity averages about 0.5 G (50 microT). Even very weak 0.01 G (1 microT) PEMF at <1 Hz (Hz is frequency at cycles/second) applied across both sides of the head cause the EEG frequency change present in the brain to change to the applied PEMF frequency - called entrainment. Even very weak PEMFs in the micro T range can cause entrainment or "synchronization" of the EEG frequencies [10]. One of the more obvious results of applying extremely low frequency (ELF) PEMF stimulation to the brain is more EEG alpha (8-13Hz) activity [11].

Wherever there is electrical activity there are magnetic fields. The brain produces its own very weak magnetic fields. Alpha waves have been measured in humans by Magnetoencephalography (MEG). The natural magnetic fields of the brain will interact with externally applied magnetic fields like PEMFs. The electromagnetic force that is generated in the brain during rhythmic TMS can cause local entrainment of natural brain oscillations. TMS tuned to the alpha (α) frequency (called α -TMS), entrains alpha-oscillations in the brain area stimulated, increasing progressively with the duration of exposure. The greater the underlying amount of alpha in the brain before starting stimulation, the faster and the greater the entrainment. These frequencies can look very similar to the types of brain rhythms seen naturally during mental tasks. The end result is that TMS action on brain activity can result in behavioral changes that are frequency-specific [12].

In addition, research in Germany found that 10 Hz(alpha) entrainment stabilized circadian rhythms [13]. Use of this frequency can restore jet lag and other sleep disturbances. Circadian rhythm control the hormone orchestra of the body and when they are out of alignment or not in proper phase, many problems begin to show up in the body related to poor hormone function. Stress and anxiety are clear examples of how they can cause circadian rhythms and brainwave frequency patterns to become disrupted. So, 10 Hz stimulation can be very useful for reducing many of the physical effects of stress by balancing circadian disruption.

Intense magnetic field brain stimulation has also been reported to affect monoamine neurotransmitter function. Daily exposure to 10Hz fields at 1.8-3.8milliT (18-38 G) increased synthesis of dopamine and 5-Hydroxytryptamine (5-HTP) in the frontal cortex of rats. So, in

addition to entrainment, alpha frequencies also increase significant amounts of neurotransmitter production [14].

What is the Evidence those PEMFs can Improve Anxiety?

The evidence comes from animal studies and human studies using both high intensity (TMS) and lower intensity PEMF stimulation.

Animal Studies

A specific pulsed low- frequency magnetic field of 100 micro T peak intensity was studied in a mouse experiment of anxiety. The mice had a reduction of “anxiety-like” behaviors, seen in the first 10-15 minutes of exposure. When compared to a relatively low dose of a classical anxiety medication, benzodiazepine, behavior was similarly improved by the magnetic field [15,16]. Rats have also been found to have similar results in reducing anxiety levels [17]. PEMF at a modulation frequency of 4 and 6 Hz in rats significantly decreased the emotionally negative reactions of anxiety and fear by 370% and 450%, respectively. By contrast, environmental EMF with a modulation frequency of 20 Hz significantly increased emotionally negative reactions of anxiety and fear by 200% [18].

rTMS on rats selectively bred for High (HAB) and Low (LAB) anxiety-related behavior found that rTMS of frontal brain regions induces profound reductions in acute stress reactions and hormonal system reactions to stress. This only happened in HAB rats and not in LAB rats. The HAB results were similar to antidepressant drug treatment [19].

While data evaluating for possible origins of GAD and panic disorder have been obtained using imaging studies, tissue studies have found results too. Low intensity PEMFs positively affects brain 5-Hydroxytryptamine (5HT) receptors at 0.1-2 mT (1-20 G), with about 50% of the effect at 0.5 mT [20]. This means that PEMFs lead to physiological changes in the central nervous system, helpful for mood disorders, where the 5HT system plays a major role. This may explain the benefits seen with higher intensity PEMF stimulation in treating depression.

Human Studies - Low Intensity

Most alpha brain stimulation research is conducted by stimulating the brain directly. However, stimulating other parts of the body may have an indirect action on the brain as well. Alpha EEG brain activity in healthy individuals with PEMF applied separately to the right or left hand was increased in 77%. The smallest EEG changes were seen in those who were self-reliant and showed little indication of strain and anxiety. The greatest changes happened in those showing anxiety, constraining activity, and less addictiveness. Other PEMF research also reveals that healthy cells, tissues or individuals show little response to PEMFs [21].

On the other hand, very low intensity PEMF in healthy women applied simultaneously to 2 brain areas at the top of the sides of the head for only 9 minutes at 10 Hz (mid-alpha), 14 Hz (high alpha) and 18 Hz (low beta) caused EEG changes. The 10 Hz stimulation also significantly simultaneously decreases beta (15-25Hz), sensor motor rhythm (13-15Hz) and theta (4-8Hz) by 12-27% after exposure. This study shows that PEMF to the top of the head at 10Hz alpha also decreases higher anxiety-associated frequencies, adding to the anxiety treatment benefit [22].

People with other medical conditions can experience significant anxiety. A 62 yr old male with Parkinson’s disease at age 51 had typical symptoms of Parkinson’s. He also experienced sleep disturbances and continuous anxiety. He was treated with a very low intensity PEMF for 6 minutes (2 minutes over each temple area and 2 minutes over the top of his head). Immediately following PEMF, he reported decreased anxiety, complete disappearance of muscle aches, marked elevations in mood and level of energy, increased appetite, and generalized feeling of well-being. He also had marked improvements in ability to move his muscles. The effects of this single treatment lasted about 3 days. Because of this treatment success he began similar magnetic field treatments at home nightly using a portable device [23].

While PEMFs may be helpful in the management of anxiety disorders, whether applied locally or to the whole body, some of these effects may be due to coincidental stimulation of the acupuncture points under the magnetic applicator. As early as 1990, PEMFs have been used in the local treatment of so-called biologically active points (BAP; acupuncture points or “acupoints”). They called this “Magnetic Puncture” (MP). In addition to coincidental stimulation of acupuncture points, small and focused magnetic applicators can be applied directly to very small acupuncture points. This approach was used in men with duodenal ulcers, well-known to be caused by significant levels of anxiety and stress. BAPs for general adaptation were exposed for 1 minute. Pain and dyspepsia were controlled in 3 days and ulcer healing in 18 days, 9 days faster than a medication only group. Combining MP and medication therapy actually took longer to control pain and dyspepsia (9 days and six days, respectively) and healing time was the same. MP therapy, like needle or electro-acupuncture, effectively controlled anxiety. The authors stated that correction of anxiety-related autonomic nervous system dysfunction was the physiological mechanism of the therapeutic effect of MP [24].

Low Energy Emission Therapy (LEET) is a way of giving therapeutic low levels of electromagnetic energy. Electrical devices like the LEET deliver both an electrical and a magnetic field. It is impossible to segregate which component is producing the results. Therefore, it is commonly believed that electro stimulation systems produce very similar results biologically to PEMF systems, through a couple of different mutually helpful mechanisms. So what happens with the LEET is also likely to happen with PEMFs.

The LEET is a battery-powered device emitting a carrier frequency of 27.12 MHz, modulated at specific frequencies between 0.5 and 300 Hz. LEET is applied in the mouth by an electrically conducting mouthpiece. The back of the palate is very close to the spinal cord. This where the Reticular Activating System (RAS) is located. The RAS controls sleep depth.

Healthy volunteers received 15-minutes of either active or inactive LEET. EEGs during the 15-min period following LEET treatment showed a decreased time to fall asleep and deeper sleep than placebo and improved feelings of relaxation. LEET was also tested on individuals with chronic anxiety. They received a 15-minute treatment in the morning and a 30-minute treatment in the evening every day for six weeks. Anxiety measured with the Hamilton Anxiety Scale (HAM-A) improved by more than 50% in 61% of the individuals at the end of the first week and in 90% by the end of the third week [25]. Unfortunately, while LEET is effective for sleep and anxiety, it is not commercially available.

Like LEET, Cranial Electro Stimulation (CES) may be considered a form of PEMF stimulation. CES has been used as an alternative therapy for the treatment of insomnia, anxiety, and depression and a variety of other conditions and symptoms worldwide. One group conducted a review of randomized, controlled studies to evaluate the efficacy of CES for selected psychological and physiological conditions. Eight studies were for CES to treat anxiety, 2 to treat brain dysfunction, 2 to treat headaches, and 2 to treat insomnia. Analysis for treating anxiety showed CES to be significantly more effective than sham treatment [26].

CES was also tested for its ability to relieve anxiety in more severely affected psychiatric inpatients. They received either active CES or placebo stimulation. Stimulation was at 100 Hz for 30 minutes for five sessions on consecutive days. They were retested six to nine days following the last treatment. The active CES group showed significantly greater anxiety reduction than the control group [27].

A more complicated group of individuals with anxiety are those who are chemically dependent. The more severe need treatment in a hospital setting. Chemically dependent hospital inpatients was evaluated for the effectiveness of CES in a double-blind study. About 60% were alcohol abusers and 40% were single or poly-drug abusers. CES was at 100 Hz applied through electrodes placed just behind the earlobe. Fifteen 30-minute treatment/sham treatment sessions were given to each person, once a day for 3 weeks excluding weekends. Sham-treated people had minimal improvement. Those treated with CES had significantly reduced anxiety levels compared to their initial level on every anxiety measure. So, even this challenging treatment group, commonly resistant to most forms of therapy, benefited from this form of electromagnetic therapy [28].

Human Studies - High Intensity

Some studies show benefit using rTMS in the treatment of GAD. rTMS applied to the right forehead area at low frequency was found to be effective in relieving depression and panic symptoms, and additionally it reduced the cortical excitability associated with anxiety. On the other hand, treatment with low frequency rTMS (<10 Hz) of the right upper forehead in panic disorder patients under SSRI medication has been not significant [29].

Anxiety can occur in people with other psychiatric disorders. Reducing their anxiety can often have an impact on the underlying condition as well. A study in which 1-Hz, 1-T rTMS was given to schizophrenic and major depression patients for 10 days reported that the depressed patients appeared to show improvements in mood and the schizophrenic patients showed some decrease in their degree of anxiety and restlessness [30].

In individuals with major depression, taken off their usual medications, single session rTMS made them feel more relaxed or calmer after treatment, but this effect disappeared by next morning [31].

High-frequency 20 Hz (HF rTMS), as an add-on anti-depressive treatment, was used in individuals with medication-resistant depression and anxiety. They continued their regular medication. Patients were divided into 2 groups to receive HF rTMS or placebo treatment for two weeks with two weeks of follow-up in a randomized double-blind design. Next, rTMS was offered for two weeks to patients who failed to improve or who were in the placebo group. Each received 10 sessions of HF rTMS treatment on consecutive days.

They were all assessed by the Hamilton Anxiety Rating Scale (HARS) at baseline and after weeks 1, 2, and 4. Real HF rTMS decreased HARS scores significantly more in HARS scores in both groups after the first week. This amounted to a 34 fold, 18 fold, and 10 fold improvement between the scores, by week, respectively [32].

A pregnant woman with clinical depression was successfully treated with rTMS during week 19 of her pregnancy. She reported experiencing an acute panic attack with being in open spaces (agoraphobia) while recovering from bronchitis. Her symptoms rapidly worsened over the course of several days to include depressed and anxious mood, severe restlessness and insomnia, constant anxiety about the health of her baby, obsessive feelings about her lack of appetite, and fear about being hospitalized for her bronchitis. At the time of evaluation, she was unable to sit still, was constantly pacing and clenching her fists, had difficulty maintaining focus, and could maintain a conversation only with difficulty. An extensive medical and obstetrical workup ruled out any medical cause for her symptoms. She refused antidepressant medications because of their unknown effect on her fetus and decided to try 1 session per week of active counseling. She had only minimal improvement after 2 weeks, and decided to enroll in an rTMS study.

At week 22 of pregnancy, she received active low frequency rTMS once a day for 5 days over a 9-day period at 5-Hz, for 20 minutes each time. rTMS produced no changes in her blood pressure, oxygen saturation, or heart rate. After the 2nd week treatment session, she was tapered off rTMS over the course of 5 sessions (total of 14 days of treatment over 3 weeks). She tolerated the treatment well and repeatedly experienced a calming effect around 12 minutes into the first treatment session and reported being "relaxed and tired". On day 6 of stimulation, this relaxed effect occurred around 3 minutes into the session. Anxiety returned to normal. She also showed improvement in her agoraphobia. For example, on her first weekend of treatment she went shopping with a friend and attended an engagement party. After 9 days of treatment, she attended a job meeting out of town and has not experienced any recurrence of her anxieties. Her mood became bright, conversation more elaborate, and she was minimally preoccupied with her body. Periodic follow-up evaluations indicated that she remained in remission. She delivered a healthy (3.4-kg) baby boy at term. rTMS may be considered in circumstances such as this because it involves no fetal exposure to anesthesia, used with ECT, or to medications [33].

Post-Traumatic Stress Disorder (PTSD)

PTSD is often considered a type of anxiety disorder. In the strictest sense it is considered to be the psychological and emotional effects following experiencing or observing trauma. In the broadest sense PTSD results from symptoms arising from any negative psychological event or events. It is characterized by symptoms that appear suddenly, cause psychological withdrawal and hyper arousal that may result in significant social or occupational dysfunction. It is estimated that 8% of the United States population experience PTSD in their lifetime and it is estimated that it causes impaired ability to work that costs in excess of \$3 billion per year in lost productivity. There is no definitive medical treatment for core PTSD symptoms. Although medications and psychotherapy have been shown to help reduce symptoms and treat co morbid anxiety and depressive symptoms, in one third of individuals there is no improvement in symptoms.

In PTSD, EEG studies have shown alpha decreases in the right hemisphere compared to control groups while they are exposed to trauma-related pictures. These findings have been corroborated by SPECT studies that have shown brain blood flow to the right hemisphere is increased in PTSD when they hear trauma-related sounds. Trauma-related stimuli during visual memory tests in combat veterans without PTSD and combat veterans with PTSD are different. There is greater activation in the right frontal brain compared to the control group in PTSD. PTSD patients may require more effort to ignore emotionally distracting stimuli [34]. These findings mean that people with PTSD could benefit from PEMF treatment.

Relatively few studies have investigated the effects of TMS on anxiety disorders, and even fewer in PTSD. In PTSD patients, one session of single-pulse TMS applied over the top of the head for 15 minutes produced a significant improvement that lasted 24 hrs. However, the symptoms returned to baseline by 7 days after treatment. PTSD and depression show different brain changes on imaging studies [35].

One study described Individuals with accidents, combat reactions and assault, experiencing their trauma about six years earlier on average. A majority were being treated with medications. In addition, they received a single TMS treatment with 30 stimuli, maximum output of 25,000 gauss (2.5 T) over the top of the head. Results were assessed at 2 hours before treatment (baseline), 24 hours, 1 week, and 28 days after treatment. All individuals showed significant improvements in symptoms during the first 24 hours after TMS which gradually returned to baseline levels. Psychological withdrawal symptoms, which are core PTSD symptoms, were significantly decreased for up to 7 days after TMS. Anxiety and physical preoccupation were significantly decreased after 24 hours and the decrease in the physical preoccupation persisted for 28 days. So, even with a single TMS treatment, PTSD symptoms improved markedly. Multiple courses of treatment would be expected to produce more enduring results [36]. Similar higher intensity PEMF devices are now available for home use for both initial treatment and maintenance.

Another paper described 2 people with PTSD in whom rTMS appeared to normalize the hyper metabolic areas around their limbic system. One was a 29-yr woman with a 12-year history stemming from traumatic events when she was between 8 and 12. Her symptoms included depressed mood, cognitive dysfunction with poor attention skills, irritability, chronic fatigue, decreased appetite, abnormal sleep patterns, frequent sense of not feeling herself, unpleasant memories that would intrude on other thoughts, and occasional suicidal thoughts. The other was a 42-year old woman with PTSD for 2.5 years, associated with a shooting incident. Her symptoms included flashbacks, sleep disturbances, exaggerated startle responses, panic attacks, depression and irritability. Both women had been treated with a variety of medications with only minimal improvement. 1-Hz rTMS was for 20 minutes/day, seventeen treatments 3 times per week for the first 2 weeks, then increased to 5 times weekly. Improvement in symptoms was more pronounced during the second half of the 4-week treatment period. Frequency of PTSD symptoms was significantly decreased and personal sense of cognitive clarity improved. The benefits of rTMS slowly reduced and PTSD symptoms gradually returned to baseline 1 month after the last rTMS session. The 42-year-old woman was treated with 30 sessions of right frontal 1-Hz rTMS given 20 minutes daily, 3-4 times/week for 3 weeks then increased to

4-5 times/week for another 3 weeks. During treatment she had significant symptomatic improvement. She felt greatest improvement in symptoms when treatments were more given more frequently. Her symptoms returned to baseline 1 month after rTMS ended. In both women, regional brain metabolic rates were measured before and within 24 hr after the final rTMS treatment by PET scans. rTMS caused overall decreases in hyper-excited brain metabolism toward normal. The most prominent decreases were seen over the right hemisphere [37].

Low-frequency TMS (1 Hz) is inhibitory, and high frequency TMS (frequency above 10 Hz) is relatively excitatory to underlying brain tissue. A review paper of five randomized clinical trials studying 118 individuals found that active TMS was significantly superior to sham TMS for treatment of core PTSD symptoms [34].

Caution: EMFs Can Make Anxiety Worse

So far, emphasis has been on the therapeutic actions of PEMFs on anxiety. It appears that individuals living near power lines, who are suffering from significant anxiety disorders, need to be evaluated for the possibility of EMF exposure in their residences, as a potential contributing factor for their anxiety. Over the range of 50-Hz magnetic flux densities encountered in homes (>1-100 mG), longer magnetic-field exposure may be associated with poorer health and more “chronic anxiety” symptoms, consistent with a direct effect of chronic 50-Hz magnetic field exposure on the nervous system [38].

From clinical experience, some individuals, regardless of how much they try to reduce their anxiety with any particular therapeutic approach, just do not respond. Many times this can actually be due to the background EMFs in their environment [39]. As noted above, EMFs in the home environment, that would enter the bedroom in particular, can be potent irritants to the nervous system, especially in electro sensitive individuals [40]. Unless these EMFs are dealt with and reduced or eliminated, it becomes very challenging for any treatment to work.

Conclusion

The treatment of anxiety, panic disorders and PTSD leave much to be desired. Alternative therapies are needed and available. Brain stimulation using Electromagnetic Fields (PEMFs) have numerous physiologic actions which contribute to a benefit to helping with these conditions. They also appear to satisfy an important condition of safety and low risk, along with effectiveness. PEMFs, including higher and lower intensity PEMFs, have been found to be very helpful in the treatment of anxiety disorders, including PTSD. The value of PEMFs is that there is a great potential for ongoing PEMF therapies in the home setting to provide enduring and long-lasting benefits with continued treatment. This can be done with short-term home treatments or potentially with longer times of use with portable PEMF systems applying primarily alpha brainwave stimulation. These home-based, longer-term PEMF approaches would appear to produce the most benefit. Nevertheless, since anxiety disorders are complex, combination approaches, including cognitive behavioral therapy and medications, may well be necessary to produce the best results and long-term use may be necessary. Another benefit of commercially available, portable, battery-operated PEMF devices of around 200-700 Gauss is the ability to do treatment at home throughout the night to the head or under the pillow to enhance sleep and anxiety disorders. While these

are not as powerful as the high intensity TMS devices, they are more affordable and personally commercially accessible.

Conflict of Interest Statement

Dr. William Pawluk owns a website www.drpawluk.com which has commercially available PEMF devices with characteristics similar to some of the magnetic fields mentioned in this review.

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