

# Brief Transcranial Pulsed Electromagnetic Stimulation In Patients With Anorexia And In Those With Anxiety

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## Abstract

In a pilot study, 5 patients with severe anorexia (BMI < 17.5), 5 patients suffering from severe anxiety (Hamilton Anxiety Scale > 41), and 5 normal controls were exposed to one hour long biweekly sessions of transcranial exposure to a low frequency specific pulsed electromagnetic field (PEMF, < 1000 Hz, +/- 200µT) during one month. There was a statistically significant improvement following one month of biweekly PEMF in the anxiety group: the patients' scores on Hamilton Anxiety Scale, Hamilton Depression Scale, and Yale-Brown Obsessive Compulsive Scale significantly decreased ( $p < .05$ , 1-tailed). These trends were also in the expected direction in the group of anorexia patients, however, without reaching statistical significance, perhaps due to small sample size and to the short duration of PEMF.

## INTRODUCTION

A randomized controlled multi-center trial by O'Reardon, Solvason, Janicak, Sampson, Isenberg, Nahas, McDonald, Avery, Fitzgerald, Loo, Demitrack, George, and Sackeim (2007) of transcranial magnetic stimulation (TMS) has shown that this medical approach is effective in treating major depression and has minimal side effects. TMS has been approved for treatment resistant depression in Canada, Australia, New Zealand, the European Union and Israel (Marangell, Martinez, Jurdi, Zboyan, 2007). There is also some evidence that TMS reduces anxiety in patients with panic disorders with comorbid depression (Mantovani, Lisanby, Pieraccini, Olivelli, Castrogiovanni, and Rossi, 2007). TMS have been successfully applied to numerous other psychiatric disorders. For example, a recent study at Harvard Medical School (Camprodon, Martinez-Raga, Alonso-Alonso, Shih, Pascual-Leone, 2007) suggests that transcranial magnetic stimulation (TMS) may successfully help to reduce craving in cocaine addicts. A double blind randomized study by Prikryl, Kasperek, Skotakova, Ustohal, Kucerova, and Ceskova (2007) has demonstrated its therapeutic impact on negative symptoms in schizophrenia. Lisanby, Kinnunen, and Crupain (2002) have reviewed its use in the treatment of major depression, schizophrenia, and anxiety disorders. Herrold, Kletzel, Harton, Chambers, Jordan, and Pape (2014) indicated that

TMS is useful in treating PTSD combined with alcoholism and mild traumatic brain injury. Many of these clinical trials have found a significant effect, however, in some studies the effect is small or short lived. A major priority in the field of research is to identify medical or psychiatric conditions for which magnetic stimulation would be particularly efficacious. Our study explores the effects of a PEMF (specific pulsed low frequency electromagnetic field), a very low power TMS-like treatment, on patients suffering from anorexia nervosa and on those suffering from anxiety.

**Materials and Methods:** eight patients with anorexia (BMI < 17.5), 5 patients suffering from severe anxiety (Hamilton Anxiety Scale > 41), and 5 normal controls participated. The difference in BMI between our anorexia group (mean = 14.9, SD=2.1) and normal controls (mean BMI = 20.6, SD=2.4) was statistically significant (t-test,  $p = .002$ , 1-tailed). Similarly, our anxiety group scored significantly higher (t-test,  $p = .002$ , 1-tailed) on the Hamilton Anxiety Scale (average score of 69.6, SD = 22.6) than the controls (average score of 17.0, SD = 19.8). The three groups did not significantly differ with respect to their age and body height (ANOVA,  $p > .05$ ). All were females. As all of our anorexia patients were very severely ill, with the prognosis of shortened life expectancy, we opted not to apply placebo methodology and this weakens the experimental design.

All 18 participants were exposed to one hour long biweekly sessions of PEMF during one month, via a portable source of pulsed magnetic field of 100 micro Tesla (see photograph of the apparatus), designed to fit over the cranium. The apparatus has the appearance of head phones with an audiotape player. The magnetic field generated by our device is approximately of the same strength as from the regular hand held hair dryer. The apparatus is described in more detail in Keenliside, Thomas, and Prato (2005) and a similar unit is currently approved and used in clinical research and treatment of chronic pain patients in Canadian and European settings (CNPTerapeutics, Balyis Medical, Toronto, Ontario, Canada).

All patients were administered the Eating Disorder Inventory (EDI), Version 2 (Garner, 1991). This is a 64-item, 6-point forced-choice inventory assessing several behavioral and psychological traits common in bulimia and anorexia nervosa. The EDI scoring system includes the following scales: drive for thinness, bulimia, body dissatisfaction (dissatisfaction with the shape and size of certain body regions, especially the stomach, hips, thighs, buttocks), ineffectiveness (low self-esteem, feelings of inadequacy), perfectionism (excessively high standards for personal performance), interpersonal distrust (social alienation, reluctance to form close relationships or to verbalize feelings), interoceptive awareness (confounded visceral sensations with respect to hunger or satiety), maturity fears (return to a prepubertal appearance, coping, and hormonal status), as well as scales measuring ascetism, impulse regulation, and social insecurity.

As patients with anxiety or anorexia may frequently suffer from the Obsessive Compulsive Disorder, we have also administered the Yale-Brown Obsessive Compulsive Scale (Goodman et al, 1989), the Hamilton Anxiety Scale and Hamilton Depression Scale (Hamilton, 1959, 1960). All scales have been administered both in the first and in the last treatment sessions.

## RESULTS

### Pre-treatment differences:

At the onset of the study, our patients with anorexia scored higher than normal controls on the majority of scales of the EDI: they were more dissatisfied with their bodies, felt more ineffective, and suffered from the excessive drive for thinness, social insecurity, and interpersonal mistrust (ANOVA,  $p < .05$ , 1-tailed). The only scale on which no

significant difference was noted was the EDI scale of perfectionism ( $p > .05$ , 1-tailed).

Both the anorectic and the anxious patients had significantly (ANOVA,  $p < .05$ , 1-tailed) higher scores than the control group on the Hamilton Anxiety Scale, Hamilton Depression Scale, and Yale-Brown Obsessive Compulsive Scale.

### Comparisons of pre-treatment to post-treatment scores:

Anorexia group: There were no statistically significant changes from pre-treatment to post-treatment scores on any of the measures during this brief PEMF study. Although the trends in the anorexia group on our measures of depression, anxiety, and obsessive-compulsive symptoms were in the expected direction, suggestive of an improvement, none of these trends was sufficiently strong to reach the criterion of statistical significance ( $p < .05$ , 1-tailed). The changes on EDI scales were nonsignificant, small and inconsistent.

Anxiety group: following one month of PEMF, there was a significant decrease (t-test,  $p = .004$ , 1-tailed) on the Hamilton Anxiety Scale from an average pre-treatment score of 69.6 (22.6) to a post-treatment score of 23.4 (19.3). Similarly, these patients also experienced a significant decrease (t-test,  $p = .018$ , 1-tailed) on Hamilton Depression Scale, from an average pre-treatment score of 39.2 (11.0) to a post-treatment score of 19.2 (13.8).

Their average score on Yale-Brown Obsessive Compulsive Scale has also significantly (t-test,  $p = .043$ ) decreased, from a pre-treatment average of 21.1 (9.6) to a post-treatment average of 11.8 (4.6).

## DISCUSSION AND CONCLUSIONS

The key finding of this study indicates that PEMF may significantly reduce anxiety, depression, and obsessive-compulsive symptoms in patients who seek treatment for anxiety. Our findings are consistent with the results of randomized controlled TMS trials on patients with depression (O'Reardon et al, 2007) and also with the findings of both anxiolytic and antidepressant effects of TMS on depressed patients with Parkinson's Disease (Epstein, Evatt, Funk, Girard-Siqueira, Lupei, Slaughter, Athar, Green, McDonald, and Delong, 2007) and on those with panic disorder (Mantovani et al, 2007).

Consistently with findings by Mosimann, Rihs, Engeler, Fisch, and Schlaepfer (2000), the PEMF has not induced any significant mood changes in our healthy volunteers.

Our anorexia patients showed only nonsignificant changes (trends towards improvement) on various psychiatric measures. TMS may need to be applied over much longer time with anorexia patients than in our brief pilot study. Our study has the severe limitations of brief uncontrolled pilot studies: longer studies on larger samples and in the format of the random controlled trials are needed.

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