Noninvasive radioelectric asymmetric brain stimulation in the treatment of stress-related pain and physical problems: psychometric evaluation in a randomized, single-blind placebo-controlled, naturalistic study

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Background: The aim of this study was to investigate the effects of noninvasive radioelectric asymmetric conveyer brain stimulation (REAC-BS) on pain and physical problems, a measurement cluster of the Psychological Stress Measure (PSM) test. When the symptoms of pain and physical problems do not respond to various therapeutic approaches such as medication, physiotherapy, and psychotherapy, they are often called medically unexplained symptoms. As such, these symptoms are reported to be a response to stressful situations or emotional states, often unknown to patients themselves. To explore the effectiveness of noninvasive radioelectric brain stimulation in the amelioration of symptoms of pain and physical problems, we administered a neuropsychophysical optimization protocol using a REAC device.

Methods: The PSM, a self-administered questionnaire, was used to measure psychological stress and pain and physical problems in a group of 888 subjects. Data were collected immediately prior to and following a 4-week REAC treatment cycle.

Results: There was a significant reduction in scores measuring subjective perceptions of stress for subjects treated with one cycle of neuropsychophysical optimization REAC-BS. At the end of the study, the number of treated subjects reporting symptoms of stress-related pain and physical problems on the PSM test was significantly reduced, whereas there was no difference in placebo-treated subjects.

Conclusion: One cycle of neuropsychophysical optimization REAC-BS appears to reduce subjective perceptions of stress as measured by the PSM, particularly on the pain and physical problems cluster.

Keywords: stress disorders, adaptation disorders, medically unexplained symptoms

Introduction

Pain and physical problems of various kinds which display a chronic course and do not meet diagnostic criteria for specific treatments are generally defined as medically unexplained symptoms. These symptoms may be present in people of all ages and social groups, and represent a difficult problem for both general practitioners and specialists. Pain and physical problems and medically unexplained symptoms (PPP-MUS) are often considered to be, and treated as, psychiatric disorders. However, it may be more accurate to consider PPP-MUS as stress-related maladaptive illnesses or psychosomatic disorders, which are classified as “psychological factors...
affecting medical condition” in the DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision). The most common PPP-MUS include migraine, headaches, neck and low back pain, and joint pain. Usually the treatment plan for medically unexplained symptoms involves a combination of behavior modification and pharmaceutical treatment, as well as good communication between patient and doctor. The purpose of the current work is to determine whether the use of noninvasive radioelectric asymmetric conveyor brain stimulation (REAC-BS) is effective in reducing subjective perceptions of stress as measured by the Psychological Stress Measure (PSM) test, a validated questionnaire allowing for the classification of a subject’s stress level and stress-related symptoms of pain and physical problems.

**Materials and methods**

**Participants**

Eight hundred and eighty-eight subjects were included in the study from an initial group of 1453 patients (Supplement 1) who attended the Rinaldi-Fontani Institute in Florence, Italy. These patients presented with different types of stress-related PPP-MUS such as migraine, headaches, neck and low back pain, joint pain, and functional somatic pain syndrome. In all subjects, the pain had been present for several years, and patients had found little or no benefit from previous treatments including drugs, physiotherapy, or any of several psychotherapeutic approaches. The subjects included in the study were taking pain medication as needed for unbearable pain, but were asked not to take specific psychotropic drugs. The study was performed in accordance with the Declaration of Helsinki.

**Sample size and randomization**

This was a naturalistic study, so patients with stress-related pain and physical problems came unsolicited to our private medical center and were observed in normal clinical practice. To obtain a sample of control subjects for comparison with the treated patients, two groups were created. Subjects were randomly assigned to each group using simple computerized randomization by an external operator. Group A subjects received active treatment and Group B subjects received placebo treatment, ie, inactive REAC. Group A included 200 subjects comprising 123 (61.5%) females of average age 48.8 ± 19.4 years, and 77 (38.5%) males of average age 45.8 ± 18.5 years. These patients were treated with active REAC. Group B included 200 subjects comprising 123 (61.5%) females of average age 48.8 ± 19.4 years, and 77 (38.5%) males of average age 45.8 ± 18.5 years. These patients were treated with inactive REAC (see Table 1).

**Psychological and psychiatric assessment**

The PSM was developed specifically to detect stress levels in a nonclinical population. The PSM usually consists of a 49-item self-report pencil and paper questionnaire. In this study, we used an electronic version to collect and process the data, and to analyze the results. Patients were asked to answer questions about their psychological stress using a four-point scale to describe the intensity of their condition (very much = 4, much = 3, little = 2, none = 1). The final score is expressed in total points. To detect the presence of symptoms of pain and physical problems, scores were specifically obtained from questions referring to difficulty with digestion, stomach pain, feelings of a knot in the stomach (question 12), physical aches and pains, including a sore back, headache, stiff neck, stomach ache (question 14), diarrhea or intestinal cramping or constipation (question 28). Both groups of subjects at time 0 were examined by a psychiatrist to detect possible psychiatric disorders that could affect symptoms of pain and physical problems. The average total PSM test score was 122.53 ± 6.75 for Group A and 122.96 ± 7.041 for Group B.

**REAC technology and therapeutic protocol**

REAC is an innovative medical technology for bioenhancement. REAC-specific treatments have proven efficacious in ameliorating stress-related disorders, depression, anxiety, bipolar disorder, and other psychiatric disorders. REAC administration has also been shown to be effective in treating neuromotor dysfunction, post-traumatic pain and injury, and improving functional recovery in arthritic lower limb joints. REAC utilized a typical

**Table 1** Demographic characteristics

<table>
<thead>
<tr>
<th>Gender</th>
<th>Group A</th>
<th>Group B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>401 (58.28%)</td>
<td>123 (62%)</td>
<td>688 (100%)</td>
</tr>
<tr>
<td>Male</td>
<td>287 (41.71%)</td>
<td>77 (39%)</td>
<td>200 (100%)</td>
</tr>
<tr>
<td>Age n</td>
<td>688</td>
<td>200</td>
<td>888</td>
</tr>
<tr>
<td>Mean</td>
<td>41.8</td>
<td>47.7</td>
<td>43.13</td>
</tr>
<tr>
<td>SD</td>
<td>11.35</td>
<td>19.14</td>
<td>13.71</td>
</tr>
</tbody>
</table>

**Abbreviation:** SD, standard deviation.
range of frequencies of 2.4, 5.8, or 10.5 GHz, as selected by
the operator for each specific protocol. In the brain stimula-
tion protocols used in this study, a frequency of 10.5 GHz was
used with a specific absorption rate of 7 mW/kg. A sequence
of seven radiofrequency pulses of 500 milliseconds, termed
the neuropsychophysical optimization protocol, was applied
by touching the metallic tip of the REAC probe onto seven
specific reflex auricular points. This protocol consists of
18 sessions, usually administered on alternate days. The goal
of neuropsychophysical optimization is gradual ameliora-
tion of symptoms of both physical and mental dysfunction. To
achieve this, the amount of treatment given is in relation to
the sufferer to use or abuse narcotic drugs, and physicians
may prescribe painkillers or tranquilizers to reduce the ten-
sion associated with pain.51 Therefore, a targeted therapy that
improves the neuropsychophysical response to environmental
stressors could represent a viable alternative to pharmaceuti-
cal treatments. REAC is a noninvasive, drug-free alternative

Table 2 Number needed to treat analysis

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given (Group A)</td>
<td>196</td>
<td>496</td>
<td>688</td>
</tr>
<tr>
<td>Not given (Group B)</td>
<td>135</td>
<td>65</td>
<td>200</td>
</tr>
<tr>
<td>Total</td>
<td>331</td>
<td>557</td>
<td>888</td>
</tr>
</tbody>
</table>

Statistical analysis
Statistical analysis was performed using number needed to
treat analysis (Table 2). To compare total points before and
after treatment or placebo, the Wilcoxon signed-rank test was
used, while the McNemar test was used to test for the pres-
ence of symptoms of pain and physical problems. \( P < 0.05 \)
was considered to be statistically significant.

Results
Prior to REAC treatment, 403 (58.58%) patients in Group A
were positive for stress-related pain and physical problems.
In Group B, pain and physical problems were detected in 159
(79%) patients. Following REAC treatment, only 196 of 403
patients (48.63%) in Group A still presented symptoms of
stress-related pain and physical problems (McNemar Chi-
square test = 170.426, asymptotic significance = 0.000). In
Group B, pain and physical problems were observed in 135 of
159 subjects (84.90%). Total point scores decreased signifi-
cantly in Group A subjects following treatment, from 122.3
to 96.01 (Wilcoxon signed-rank test \( Z = -22.735 \), asymptotic
significance \( [\text{two-tailed}] = 0.000 \), Table 3). The decrease
in total point scores from 122.96 to 122.11 in Group B
was not statistically significant (Wilcoxon signed-rank test
\( Z = -0.914 \), asymptotic significance \( [\text{two-tailed}] = 0.361 \),
Table 3). There was no significant effect of age or gender
upon therapy-induced changes in total points.

Discussion
The REAC reshapes electrical changes due to ion flows,35
which likely balances the distributions of two main neu-
rotransmitters, ie, excitatory glutamate36 and inhibitory
gamma aminobutyric acid.37 The neuropsychophysical
optimization protocol induces a new positive regulation of
bioelectric activity in the central nervous system, leading
to normalization of brain function that can be tailored to
the individual,22–34,38 according to symptoms of pain and
physical problems. The current study was designed based
upon the results of a previous study that demonstrated the
beneficial effects of REAC in stress-related disorders,24
and was targeted to assess specific stress-related clusters on the
PSM test.25 The perception of acute and chronic pain may be
influenced by stress and the psychological state of sufferers,
often without awareness.39–50 This unrelieved pain may cause
the sufferer to use or abuse narcotic drugs, and physicians
may prescribe painkillers or tranquilizers to reduce the ten-
sion associated with pain.51 Therefore, a targeted therapy that
improves the neuropsychophysical response to environmental
stressors could represent a viable alternative to pharmaceuti-
cal treatments. REAC is a noninvasive, drug-free alternative

Table 3 Psychological Stress Measure test results

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Total points PSM test</th>
<th>PPP subjects (%)</th>
<th>Wilcoxon test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (n = 688), ( T_0 )</td>
<td>122.53 ± 6.747</td>
<td>403 (85%)</td>
<td>Asymp sig (two-tailed) = 0.000</td>
</tr>
<tr>
<td>Group A, ( T_1 )</td>
<td>96.01 ± 8.520</td>
<td>196 (48%)</td>
<td>( Z = -22.735, P &lt; 0.005 )</td>
</tr>
<tr>
<td>Group B (n = 200), ( T_0 )</td>
<td>122.96 ± 7.041</td>
<td>159 (79%)</td>
<td>Asymp sig (two-tailed) = 0.361</td>
</tr>
<tr>
<td>Group B, ( T_1 )</td>
<td>122.11 ± 7.450</td>
<td>135 (85%)</td>
<td>( Z = -0.914, P &gt; 0.005 )</td>
</tr>
</tbody>
</table>

Notes: PSM test results: Total points and Wilcoxon test results obtained in Group A and in Group B, before \( (T_0) \) and after \( (T_1) \) NPPO REAC treatment/placebo. Values of
total points are expressed by mean ± standard deviation. \( *P < 0.05 \).

Abbreviations: NPPO, neuropsychophysical optimization; REAC, radioelectric asymmetric conveyer; PSM, Psychological Stress Measure; PPP, pain and physical problems; asymp sig, asymptotic significance.
for the treatment of pain, particularly in situations where emotional state and stress levels of the individual clearly affect overall symptomatology.

**Conclusion**

This research highlights the efficacy of REAC neuropsychophysical optimization on the pain and physical symptoms cluster measurable using the PSM test. The pain and physical symptom cluster represents a set of disorders that can severely impact quality of life in a large proportion of the population. For this reason, it is necessary to find new therapeutic strategies able to treat the various components that underlie these symptoms. Of course, because symptoms of pain and physical problems are often chronic, it is desirable that efficacious treatments also be safe and cost-effective. Further studies are needed to verify the stability of symptoms over time when using more than one cycle of REAC neuropsychophysical optimization, although there may be difficulties in obtaining and following a selected group of patients, especially after treatment. A longer period of observation and administration of additional REAC therapy cycles is necessary to assess the stability of their therapeutic effects over time.

**Acknowledgments**

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**Disclosure**

SR and VF are the inventors of the radioelectric asymmetric conveyer.

**References**

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Supplement 1
This trial was registered with the Australian New Zealand Clinical Trials Registry (ANZCTR) with the number ACTRN12607000456459. Registration is available at the following link: http://www.anzctr.org.au/trial_view.aspx?ID=82252.