Brain Network Activation (BNA) - A Novel EEG-based Tool for diagnosis, prognosis and monitoring high-definition tDCS treatment

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Background

Brain-Network-Activation (BNA) is a novel non-invasive image technology for the visualization and quantification of brain functionalities cleared by the FDA & CE. In this study we employed the BNA to assess the reorganization of brain dynamics following focal tDCS stimulation in fibromyalgia patients. BNA is an integral treatment progression monitoring system based on the high-temporal resolution of ERPs, and by using a formal graph representation depicts the evolving network dynamics. We examined whether the BNA score, a measure reflecting the network-level synchronization, could serve as a predictor of responsiveness.

BNA technology

1. Measuring All Brain Action Potentials (“Neuronal Firing”)
2. Automatic signal-noise separation & quality check
3. Dynamic, multi-parameter signal processing, clustering & network analysis
4. Big Data Repository of Brain Maps
5. Clinical reporting
6. BNA Creation of Specific Brain Processes & Report Generation

BNA Mapping of Induced Pain Pathways

<table>
<thead>
<tr>
<th>Pain threshold</th>
<th>• BNA score ROC Analysis</th>
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<tbody>
<tr>
<td>35°C</td>
<td>Sensitivity = 86.0%</td>
</tr>
<tr>
<td>42°C</td>
<td>Specificity = 87.3%</td>
</tr>
<tr>
<td>48°C</td>
<td>AUC = 0.907</td>
</tr>
<tr>
<td>52°C</td>
<td>Delta (0.54 Hz)</td>
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<td>Theta (3 Hz)</td>
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High Diagnostic Utility of BNA™ Biomarkers

<table>
<thead>
<tr>
<th>BNA score ROC Analysis</th>
<th>Baseline</th>
<th>Week1</th>
<th>Week2</th>
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<tbody>
<tr>
<td>AUC</td>
<td>0.81</td>
<td>0.68</td>
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Correlation Between BNA and VAS

- A significant correlation was obtained between differential BNA scores and VAS scores. The AUC demonstrated a clear separation ability between responders and non-responders.
- A similarity to the pain network of healthy controls may indicate potential responsiveness to treatment.

Conclusions

- BNA may be useful as an objective and quantitative tool for the assessment of pain perception.
- BNA may predict the effect of stimulation treatment.

Current study:

A single-center, open-label trial using HD-tDCS over the motor cortex (M1) in 20 fibromyalgia patients. Sensory-evoked potentials (SEP) were recorded as a measurement of pain-related central-sensitization. The subjects completed 10 stimulation sessions in a period of two weeks, after which they completed a first response assessment. Study participants kept receiving stimulation sessions if they were deemed as non-responders. Response was defined as a reduction of 50% compared to VAS baseline.