 Novel Methodology for the Non-invasive Measure of Cholinergic Functioning

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Introduction

Alzheimer’s Dementia (AD) is a neurodegenerative disorder which is often accompanied by distinct irregularities in the flash visual evoked potentials (FVEP) when compared with healthy controls (Moore, Tucker, Jann, Hostetler, & Coburn, 1995; Coburn, Arruda, Estes, & Amoss, 1993). Many researchers focus on the P2 portion of the FVEP (FVEP-P2) because it appears to be selectively delayed in those with AD (Moore, Tucker, Khairy, & Coburn, 1996; Coburn, Parke, & Pritchard, 1995).

The current methodology used by many researchers to obtain FVEP-P2 measures utilizes a single strobe flash intensity and latency scores are averaged across multiple trials (Coburn et al., 1993; Moore & Moore, 1995; Moore et al., 1996; Swanwick et al., 1996). Although this method has proven useful for differentiating control groups from groups with AD, there is too much overlap in the group distributions to differentiate on an individual level (Coburn, Ashford, & Moreno, 1991; Moore et al. 1995).

Method

FVEP-P2 data was taken from two different electrode sites on the scalp of two participants. The P2 was measured at the recording site O2 and OZ, where previous research has demonstrated that the FVEP-P2 is most reliably measured (Coburn et al., 2005). A pre/post design was used to test for the reliability of the proposed methodology, resulting in four pre-test (two subjects, two electrode placements) measures and four post-test measures.

The pattern of P2 amplitudes were obtained by measuring the average P2 amplitude (in millivolts) at each of five strobe light intensity levels (measured in lumens). We then performed a simple linear regression on the amplitudes. An example of the simple linear regression is shown in Table 1. With the simple linear regression, we are able to measure the slope of the amplitude vs. intensity curve. In order to determine if the pattern is reliable over time, we performed a Pearson’s correlation on the slopes of the pre/post data.

Results

The slopes of the pre-test and post-test are summarized in Table 1. Participant 1 displayed amplitude vs. intensity slopes of approximately zero, meaning that P2 amplitude was independent of strobe intensity. Participant 2 showed slightly positive slopes, meaning that as stimulus intensity increased, the P2 amplitude increased in the same direction. Our results indicate, at the alpha level of .001, that there was a significant positive correlation of r=.996 between the pre-test slopes and the post-test slopes. Our results also indicate a between-groups correlation of r=.770 and p=.230.

Table 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Pre-test Slope</th>
<th>Post-test Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 at O2</td>
<td>.005</td>
<td>.012</td>
</tr>
<tr>
<td>1 at OZ</td>
<td>.018</td>
<td>.002</td>
</tr>
<tr>
<td>2 at O2</td>
<td>1.74</td>
<td>1.93</td>
</tr>
<tr>
<td>2 at OZ</td>
<td>.087</td>
<td>.122</td>
</tr>
</tbody>
</table>

Conclusions

We conclude, based upon the Pearson’s correlation, that the slope method is an extremely reliable method of EEG analysis over time. With a larger sample size, we may develop a larger between-groups correlation. Because of the relatively high degree of between groups reliability, we feel that, with a larger sample size, this method may be sensitive to groups with Alzheimer’s dementia. To test a group of Alzheimer’s dementia patients against a group of healthy controls may yield significantly different amplitude slopes. The methodology proposed here may be a reliable way to reduce measurement error associated with the FVEP-P2 and therefore become diagnostically useful.

References


