Quantitative EEG Applying the Statistical Pattern Recognition Method: A Useful Tool in the Dementia Diagnostic Work-up

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Methods

In this study 422 controls and 734 clinical patients, were recruited. The EEGs were recorded using 19 electrodes within the IS 10-20 placement system. The EEG was recorded for three minutes at rest with eyes closed. The SPR method was used to construct a classifier: Healthy control – [AD,FTD,DLB]. Subsequently each electrophysiological data was classified by the statistical pattern recognition (SPR) method. Furthermore the separation of healthy controls and AD: AUC = 0.92, ACC = 0.85, SS = 0.81, SP = 0.88, LR+ = 6.8, LR- = 0.32. For the separation of healthy controls and FTD: AUC = 0.92, ACC = 0.95, SS = 0.95, SP = 0.85, LR+ = 6.3, LR- = 0.06. For the separation of AD and DLBL: AUC = 0.95, ACC = 0.90, SS = 0.95, SP = 0.89, LR = 0.95. Results have been verified in an independent 3rd party multicenter study demonstrating: Healthy controls vs AD: AUC = 0.93, ACC = 0.93, SS = 0.95, SP = 0.83 and DLBL vs Clinical: AUC = 0.95, ACC = 0.87, SS = 0.87, SP = 0.87, LR = 0.87, LR- = 0.15. (Engø et al. Dement Geriatr Cogn Disord 2015;40:1-12)

Results

To diagnose a dementia disorder clinical criteria are applied based on findings from a comprehensive clinical assessment. However, most of these clinical criteria are not very strongly on the index value.

The positive likelihood ratio, LR+, depends strongly on the index value.

The distribution of indices in the control group.

The distribution of the indices in the combined group [AD, FTD, DLBL].

Groups in the MentisCura EEG database. MCI: mild cognitive impairment; AD: Alzheimer’s disease; FTD: frontotemporal dementia; DLBL: dementia with Lewy bodies (Lewy body dementia and Parkinson’s disease dementia).

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>422</td>
</tr>
<tr>
<td>MCI</td>
<td>77</td>
</tr>
<tr>
<td>AD</td>
<td>294</td>
</tr>
<tr>
<td>FTD</td>
<td>81</td>
</tr>
<tr>
<td>DLBL</td>
<td>50</td>
</tr>
<tr>
<td>Other clinical</td>
<td>232</td>
</tr>
</tbody>
</table>

Introduction

To diagnose a dementia disorder clinical criteria are applied based on findings from a comprehensive clinical assessment. However, most of these clinical criteria are not very helpful when patients seek care services in a very early phase of a dementia disorder. The aim of this study was to examine the discriminatory power of the electrophysiology to separate healthy controls from clinical patients, in particular the separation of healthy controls from AD patients using statistical pattern recognition (SPR) method. Furthermore the same methodology was used to investigate the separation of three types of dementia: Alzheimer’s Disease (AD), Frontotemporal Dementia (FTD), and Dementia with Lewy Bodies (DLB).

Methods

In this study 422 controls and 734 clinical patients, were recruited. The EEGs were recorded using 19 electrodes within the IS 10-20 placement system. The EEG was recorded for three minutes at rest with eyes closed. The SPR method was used to construct a healthy control classifier by contrasting the 422 healthy controls against 425 clinically demented patients from the MentisCura EEG database (AD, N=294; FTD, N=81; DLBL, N=50). Subsequently each electrophysiological data was classified by the healthy control classifier: A receiver operating curve (ROC) analysis was performed on the resulting healthy control indices. These classifiers were constructed using SPR in order to estimate how well electrophysiology as recorded by EEG can separate individuals who suffer from either AD, FTD, or DLBL. The three classifiers are 1) AD vs. (FTD, DLBL); 2) FTD vs. (AD, DLBL); and 3) DLBL vs. (AD, FTD).

Conclusion

Using the healthy control classifier the SPR method separated well the controls from the patient groups and the AD group. The result can be seen as a “proof of concept” of the SPR method, and may be used in order to increase its diagnostic accuracy when diagnosing the causes of dementia. The SPR method is useful in separating these groups of dementia: AD, FTD, and DLBL.