The use of Event Related Potentials in detecting history of Traumatic Brain Injury (TBI)

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Background

Event related potentials (ERPs) are a type of quantitative electroencephalogram (EEG) that may be a potential biomarker of Traumatic Brain Injury (TBI). Currently, there is very little research on the ERP signatures of TBI. Research of biomarkers in TBI is also lacking. Identifying a biomarker may allow clinicians to improve the diagnostic accuracy of TBI. It is also possible that putative TBI biomarkers may have implications for the detection of neurodegenerative diseases including CTE.

Objectives

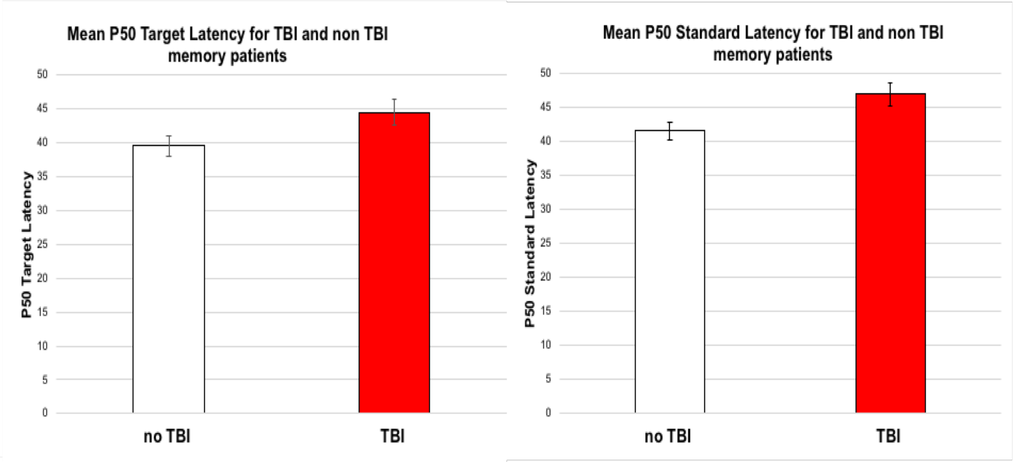
Our study aimed to investigate how ERPs may be a potential biomarker for history of TBI. Using a three-tone auditory oddball task using an eight electrode COGNISION™ rig we aimed to identify ERP measures that significantly differ in memory disorder patients who had a history of TBI compared to those who have not.

Methods

137 subjects who presented with memory complaints and either a history of TBI or no TBI, underwent an EEG with a three-tone auditory oddball task using a 8- active electrode COGNISION™ rig. A way one ANOVA on SPSS (ver.20) was used to find the ERPs measures that showed significant difference between TBI and non TBI memory patients. Predictive ERP measures of TBI status were obtained by using bivariate logistic regression controlling for age with SPSS (ver. 20). Significant ERP predictors were analyzed using receiver operating characteristic (ROC)-curves and logistic regression (SPSS ver.20).

Table 1. Descriptive statistics between groups.

Characteristics	Memory patient with TBI (n=52)	Memory patients without TBI (n=85)
Age*	67.0 (6.6)	73.7 (8.6)
Years of Education	14.0 (2.5)	13.9 (2.8)
MOCA	21.9 (4.8)	19.5 (5.0)
MMSE	25.7 (3.5)	24.6 (3.6)
Button press accuracy (%)	86.5 (19.2)	90.3 (13.7)
False alarms (%)	1.6 (2.8)	1.8 (3.8)
Median reaction time (ms)	492.8 (104.6)	521.2 (131.4)



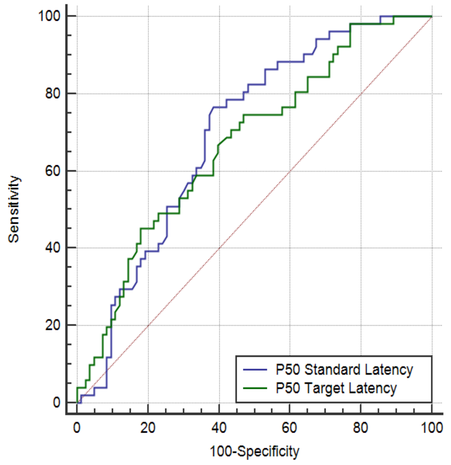


Table 2. ROC Analysis.

	AUC	*z*	*p*
P50 Standard Latency	.697	4.357	<.0001
P50 Target Latency	.671	3.598	<.0005

Results

- There was a significant difference in P50 Standard Latency ERP measure between the two conditions, TBI vs non-TBI ($F_{(1,134)}$ = 6.083; p < 0.005, $\eta 2$= 0.043). A significant difference was also found for P50 Target Latency between the two conditions ($F_{(1,134)}$ = 4.332; p < 0.05, $\eta 2$ = 0.032).
- Age was significantly different between the two groups ($F_{(1,134)}$ = 7.153; p < 0.01) while education was not significantly different ($F_{(1,134)}$= 0.072; p = 0.789).
- Two ANCOVAs were performed to show that the difference between the TBI and non-TBI groups for P50 Target ($F_{(1,134)}$ = 4.719, p < 0.05) and P50 Standard ($F_{(1,134)}$ = 7.014; p < 0.01) Latencies are both still significant when controlling for age.
- In order to test the hypothesis that P50 target and P50 Standard Latencies predict absence/presence of TBI, we performed two logistic regressions, controlling for age. Results showed that both P50 Target Latency (p < 0.05) and Standard Latency (p < 0.01) were significant predictors.
- Regression scores were then submitted to ROC analysis (Table 2). No differences between AUCs of P50 Target and P50 Standard Latencies were found (z = .605; p = .545).

Conclusions

- P50 Target and Standard Latencies may be possible predictors of the presence/absence of a TBI history in older patients with memory disorders.
- P50 has been previously used to examine the ability of the brain to inhibit irrelevant sensory inputs. This process is referred to sensory gating (Ally, 2007). P50 sensory gating seems to be reflecting a preattentional inhibitory mechanism that could be protecting higher order cognitive functions (Lijffijt, 2009). Our results showing greater latency are consistent with the idea that individuals with TBI have impaired preattentional inhibitory control.
- Future research should investigate the link present between TBI and the cognitive function related to the P50 ERP measure, possibly using sensory gating paradigms that are designed to evaluate P50.

References

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