P300 Evoked Response Potentials Patterns in Different Complex Concussion Phenotypes

Basil Ike DO[1], Landan Watts BS[2], Dave Oakley PhD[3], Monica Pita ATC[3], Mo Mortazavi MD[3]

[1]Loma Linda University, [2]Midwestern University College of Osteopathic Medicine, [3]Sports Medicine Rehabilitation Concussion Care-(SPARCC) Tucson AZ

Objective:
Determine the utility of P300 Evoked Response Potentials (ERP) voltage patterns in predicting phenotypical sequelae of patients with complex concussions or Persistent Post Concussive Symptoms (PPCS).

Background:
ERPs have been used to aid in the diagnosis of multiple neurological disorders. They have also been recently used in the evaluation of concussions.

Design/Methods:
A retrospective study of 54 patients, 10 to 71yrs (mean age 29.6yrs), with PPCS were tested between 6-12 weeks post-injury using the standard oddball audio P300 ERP protocol with measures extracted including best central parietal P300 ERP. PPCS Phenotyping was completed in each patient using a standardized post-concussive questionnaire and Rivermead method for 5 primary phenotypes and mixed type.

Results:
P300 average Voltage for the entire group was 11.6mV. Overall, these were significantly lower than age-matched non concussed controls whose average voltage was 16.3mV ($p < 0.0001$).

Average P300 voltages for each phenotype:
- Cognition- 14.1mV
- Vestibular- 8.6mV
- Headache- 11.1mV
- Mood- 13.6mV
- Neck Pain- 9.6mV
- Visual- 9.8mV
- Mixed- 6.9mV

Mixed and Vestibular phenotypes demonstrated the lowest average voltage potentials (6.9mV and 8.6mV respectively) which coincided with higher average symptom scores (70.5 and 54.5 respectively). Cognition and Mood demonstrated the highest average voltage potentials (14.1mV and 13.6nV respectively), which coincided with lower average symptom scores (40.3 and 48.7, respectively). Mood (13.6mV) was the lowest average symptom score in the group at 40.3 and Mixed (6.9mV) was highest at 70.5.

Comparing phenotypes against one other, mixed vs mood ($p=0.03$), cognition vs vestibular ($p=0.02$), and cognition vs mixed ($p=0.009$) showed statistical significance.

Conclusions:
P300 ERPs may help identify persistent abnormal complex concussion neurophysiology. ERPs can also potentially exhibit phenotype specific patterns and be a useful tool in helping differentiate more somatic/physiologic vs mood-based phenotypes. This can ultimately lead in the aid in diagnosis, prognosis, subtyping, and targeted phenotype management.