A novel peripheral biomarker for Mild Cognitive Impairment and Alzheimer's disease

Mario A Parra[1,2], Marcela Schumacher[3], and Gerardo Fernandez[3,4]

(1) University of Strathclyde, Glasgow, United Kingdom, (2) Universidad Autónoma de Caribe, Barranquilla, Colombia, (3) Instituto de Investigaciones en Ingeniería Eléctrica "Alfredo Desages" (IIIE_CONICET), Bahía Blanca, Argentina, (4) Axis Neurociencias, Bahia Blanca, Argentina

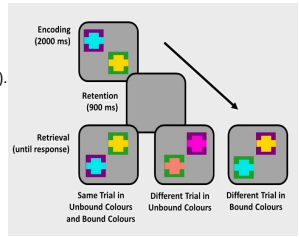
Background

Recent evidence suggests that oculomotor behaviours linked to cognitive performance can be a biomarker of Alzheimer's disease (AD) (Fernandez et al., 2018). Short-Term Memory Binding (STMB) declines in patients with AD dementia and in those at risk of dementia. STMB relies on brain regions relevant to visual processing which are known to support oculomotor behaviours. A combined analysis of oculomotor responses during STMB can enhance the sensitivity of the assessment of patients at risk of AD such as those with Mild Cognitive Impairment (MCI). We investigated this hypothesis.

Methods

The sample comprised 42 controls (Age M=72±SD=6.7; education = 12 years) and 63 patients with MCI (Age 73±6.1; education = 12). The sample was recruited at the AXIS Neuroscience Centre, Bahía Blanca, Argentina. The mean score of MCI patients in the MMSE was 26.6 (SD = 2.2) vs. 29.7 (SD = 0.4) in controls. The mean score of MCI patients in the ACE-R was 78.3±10.8 vs. 93.2± 0.8 in controls. The mean score of MCI patients in the INECO's Frontal Screen was 18.4±5.2 vs. 27.0±1.1 in controls. Yesavage's Geriatric Depression Scale (GDS) in MCI was 8.5±2.8, cut-off point 9. Pfeffer functional activity in MCI was 6.1±1.5, cut-off 6. Hamilton's Anxiety Scale in MCI was 16.3±3.5, cut-off 18. Patients and controls were assessed with the STMB test (Figure 1). Patients' clinical status was reassessed one year after their enrolment in the study.

Figure 1. Using eye-tracking technologies, we measured fixation and saccadic amplitude in patients with MCI and in healthy controls while they performed the STMBT. The STMBT assesses the ability to temporarily hold bicoloured objects whose colours have to be remembered either as individual features (Unbound Colours - UC) or integrated within unified representations (Bound Colours - BC).



Results

Relative to controls, MCI patients displayed significantly shorter fixation durations at baseline (Figure 2). This was more pronounced during the encoding (t=-21.81) than during retrieval (t=-4.34), and during the BC condition (t=-16.98) than the UC condition (t=-13.82). MCI patients also displayed larger saccades. Again, these were more pronounced during the encoding (t=23.51) than during retrieval (t=-9.06), and during the BC condition (t=21.46) than the UC condition (t=-11.68).

Figure 2. Eye-tracking data during STMB performance at baseline.

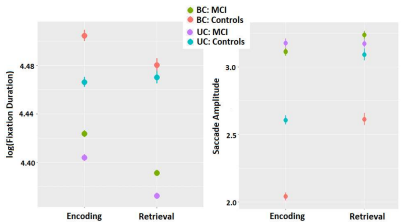
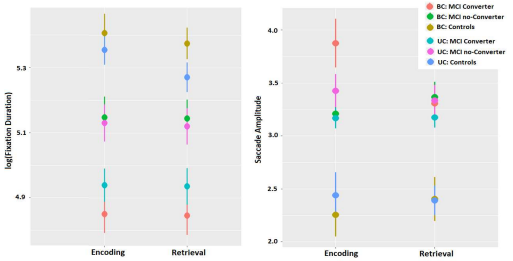


Figure 3. Retrospective analysis of eye-tracking data after follow-up.



At follow up, 28 patients with MCI had progressed to dementia. Retrospective analysis (Figure 3) revealed the pattern above described was more pronounced in MCI patients who latter developed dementia than in those who remained stable.

Discussion

Taken together, the results above suggest that eye-tracking measures combined with cognitive markers for AD (STMB) can (1) enrich the clinical phenotype of this type of dementia, (2) unveil novel features of AD dementia unknown to date, and (2) provide more sensitive tools which can detect and trace aspects of such phenotype in people at risk, thus helping to ascertain the presence of the prodromal stages of the disease.

- Fernandez, G., Orozco, D., Agamennoni, O., Schumacher, M., Sanudo, S., Biondi, J., & Parra, M. A. (2018). Visual Processing during Short-Term Memory Binding in Mild Alzheimer's Disease. J Alzheimers Dis, 63(1), 185-194. doi:10.3233/jad-170728