Towards Objective Targeting of Intracranial Electroencephalography Using Data-Driven Semiology-Brain Visualisation

Fernando Pérez-García[1,2], Ali Alim-Marvasti[1,3,4], Gloria Romagnoli[3,4], Matthew J. Clarkson[1], Rachel Sparks[2], John S. Duncan[1,3,4] and Sébastien Ourselin[2]

1. Wellcome / EPSRC Centre for Interventional and Surgical Sciences (WEISS), University College London, United Kingdom
2. School of Biomedical Engineering & Imaging Sciences (BMEIS), King's College London, United Kingdom
3. Department of Clinical and Experimental Epilepsy, UCL Queen Square Institute of Neurology, London, United Kingdom
4. National Hospital for Neurology and Neurosurgery, London, United Kingdom

Rationale

- Intracranial electroencephalography (icEEG) is used to define the seizure onset zone (SOZ)
- The choice of targets for icEEG is performed subjectively, analysing non-invasive data such as scalp EEG, MRI and seizure semiology
- There is a need for objective tools to highlight 1) potential regions involved in the SOZ and 2) less common or unexpected relationships between seizure semiology and brain regions
- These tools can supplement clinical knowledge during planning of icEEG implantation and resective surgery
- We present a visualisation tool to display the link between clinical semiology and cerebral regions involved in seizures

Methods

- We performed a systematic literature review to generate the *Semio2Brain* database, that maps seizure semiology to brain structures (see poster #893 by Gloria Romagnoli)
- We developed a multi-platform, open-source Python module on top of 3D Slicer that acts as interface between the user and the database
- Code and documentation are available on GitHub: https://github.com/thenineteen/Semiology-Visualisation-Tool

Results

- First, the user chooses the filters for the ground-truth criteria, and the observed semiologies from a list of 56 terms (Fig. 1), although custom terms can be entered (see poster #1014 by Ali Alim-Marvasti)
- A table is created to show the number of observations reported in the literature for each semiology and brain region (Fig. 2, left)
- Next, corresponding brain regions are displayed on 2D and 3D quantitative visualisations (Fig. 2, right)
- Users can select different normalisation strategies to combine results from multiple semiologies

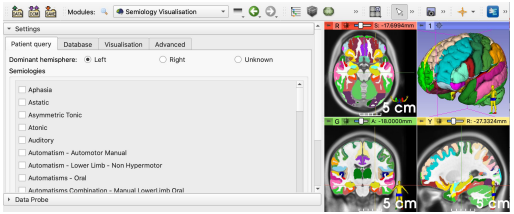

Fig. 1: Semiology visualisation tool before a user-defined search. Left: list of suggested semiology terms to be selected by the user; right: Neuromorphometrics parcellation obtained using geodesic information flows on the Montreal Neurological Institute (MNI) template.

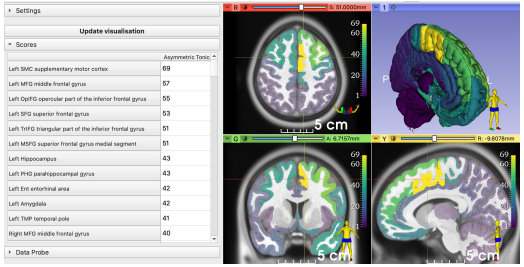

Fig. 2: Result of querying the database with the semiology term 'Asymmetric tonic - right'. Left: list of brain regions sorted by number of data points in the database; right: heatmap where brighter intensities (yellow) represent a higher number of data points. The left supplementary motor cortex is the region identified as being most commonly involved.

Conclusions

- We present a data-driven, open-source tool to visualise brain regions associated with a set of seizure semiologies as determined from manuscripts in the literature
- This tool can be used as a clinical decision support system to determine the appropriate strategy for icEEG implantation and resective surgery

American Epilepsy Society 2020 - Contact: fernando.perezgarcia.17@ucl.ac.uk

This work is supported by the UCL EPSRC Centre for Doctoral Training in Medical Imaging (EP/L016478/1) and the Wellcome/EPSRC Centre for Interventional and Surgical Sciences (WEISS) (203145Z/16/Z). This publication represents in part independent research commissioned by the Wellcome Trust Health Innovation Challenge Fund (WT106882). The views expressed in this publication are those of the authors and not necessarily those of the Wellcome Trust.