INTRODUCTION

• The overarching goal of the research group is to investigate the role of the subcortical nuclei in language processing.
• Language perception, comprehension and production consist of several different steps, including the semantic system (Ellis & Young, 1996).
• Electrophysiological registration (EEG) has been primarily done at the level of the cortex. It is unclear if semantic related event-related potentials can be elicited in the main subcortical nuclei.
• Semantic processing can be modified by lesions or Deep Brain Stimulation (DBS) in the subcortical nuclei. To what extent, for which demands and how these nuclei are related to each other in the temporal processing of semantics is not known yet.
• The current study aims to explore the temporal interaction between the subthalamic nucleus (STN), pedunculopontine nucleus (PPN) and the thalamus during semantic processing through direct registration of electrophysiological signals in these deep brain nuclei.
• Direct registration of language elicited EEG in the deep brain nuclei is only possible in patients recruited for deep brain stimulation as a treatment for their illness and in the short period after the operation during which the electrode leads are still externalized.

METHODOLOGY

• Deep Brain Stimulation (DBS) neurosurgical procedure:
  • Implantation of electrodes in target site based on stereotactic procedures.
  • DBS electrode leads stay externalized for 1 week during which electrophysiological registration is possible.
• Recording through quadripolar electrodes while the externalized leads were connected to the registration device (Neurosoft) using an in-house made interface.
• Signal processing, analysis and source localization were performed in BrainVision Analyzer 2.
• Population:
  • 18 patients with STN stimulation for Parkinson’s disease (age 45-71; 8 male, 10 female).
  • 2 patients with thalamic VIM (ventrointermediate nucleus) stimulation for essential tremor (age 56-73; 1 male, 1 female).
  • 1 patient with PPN stimulation for Parkinson’s disease (age 50; male).
• Paradigm:
  • Silent reading task consisting of 30 body action verbs (e.g. to throw, to point, to wave) and 30 mental action verbs (e.g. to think, to develop, to succeed).
  • Testing both with (ON) and without (OFF) dopaminergic medication in case of Parkinson’s disease.

RESULTS

Difference waves: Body action verbs – Mental action verbs

Monopolar analysis

Bipolar analysis

DISCUSSION

• Subthalamic nucleus:
  • Right hemisphere: early semantic processing (100-500ms).
  • Left hemisphere: late semantic processing (500-700ms).
  • cfr. N600 reflects explicit interpretation of stimulus semantics (Cummings et al., 2006).
• Pedunculopontine nucleus:
  • Right hemisphere: activation (250-450ms).
  • Decision making (Gut et al., 2016).
  • Left hemisphere: no activation was found.
• Thalamus (ventrointermediate nucleus):
  • Bilateral: Semantic processing (200-500ms).
  • cfr. N400 reflects established meaningful, but not necessarily lexico-semantic representations (Cummings et al., 2006).

CONCLUSION

• Subthalamic nucleus: partial participation in semantic processing.
• Thalamus (VIM): full participation in semantic processing.
• Pedunculopontine nucleus: decision making during semantic processing.

Scan to see abstract 46: