

Supplementary Material

Risk Factors for Postoperative Delirium Severity After Deep Brain Stimulation Surgery in Parkinson's Disease

SUPPLEMENTARY METHODS

POD screening

In case of missing values of NU-DESC or CAM-ICU, written reports of doctors and nurses were searched for comments referring to the existence of POD. The following parameters are considered signs of delirium according to the DSM V criteria of POD: disturbance on attention and awareness, agitation, restlessness, disorientation, day-night-rhythm disturbance, illusions or hallucinations and memory deficit.

Here is an example for the calculation of POD severity: If a patient was rated POD-positive on two days with the highest NU-DESC scores on day one being 4 and on day two being 3, then the sum is 7. Subsequently, this sum of 7 is divided by 2 POD-positive days result in a POD severity of 3.5.

Description of CANTAB Connect™ tests

The Reaction Time Test (RTI) provides assessments of attention, motor and mental response speed, as well as measures of movement time, reaction time, response accuracy and impulsivity. When a yellow dot appears in one single or five different circles presented, the participant must select this circle as soon as possible. Pattern Recognition Memory (PRM) assesses visual learning in a 2-choice forced discrimination paradigm with an immediate and delayed recognition phase after 20 minutes. Spatial Span (SSP) assesses visuospatial (working) memory capacity. The participant must select boxes that change color in a predetermined order. There is a forward and a backward variant of the test. Verbal Recognition Memory (VRM) assesses verbal learning and memory. It measures the ability to encode and subsequently retrieve verbal information with a delayed recall after 20 minutes. The Emotion Recognition Task (ERT) measures the ability to identify six basic emotions in facial expressions along a continuum of expression magnitude. The Multitasking Test (MTT) is a test of executive functions. The participant must manage conflicting information provided by the direction of an arrow and its location on the screen and ignore task-irrelevant information. The Spatial Working Memory (SWM) test assesses visuospatial

information, executive function and working memory abilities. The participant needs to find tokens placed under boxes in a process of elimination. Paired Associates Learning (PAL) assesses visual memory and new learning. The participant is asked to select several boxes which showed displayed patterns in the middle of the screen before.

EEG analysis

41 participants had EEG recordings during electrode implantation. EEG data was pre-processed using MATLAB¹ and EEGLAB² running in MATLAB. The specifications of the raw data in SedLine® devices were set at the beginning of each data file but could change during the recording by changes in the display specifications of the device.³ Since such possible changes were not saved and therefore are not directly traceable, the following two measures were applied during analyses of the recorded data: 1) If the sampling rates of two chronologically consecutive files were different, we removed the former data file since there must have been a modification in the display in this time window, and 2) we used the normalized power spectral density (nPSD),³ i.e., the power spectral density of each epoch divided by the average power in that epoch, before averaging across available epochs.

Measure 1) resulted in removing data from one participant. For the remaining 40 participants with EEG recordings from electrode implantation, data from every channel were downsampled to 60 Hz, concatenated across multiple data files available for that participant, high-pass filtered at 1 Hz, epoched in non-overlapping 2-second windows, and epochs contaminated with artifacts were removed. Next, nPSD was calculated for the pre-processed data for each participant³ as normalized PSD averaged across epochs and channels. Spectral edge frequency at 95% (SEF95) was estimated as the frequency where the cumulative nPSD up to that frequency exceeded 95% of total nPSD.

In order to locate the peak of the average nPSD for each participant, we used the FOOOF toolbox⁴ in Python. The nPSD from each participant was loaded into Python and modeled between 5 and 15 Hz by FOOOF with two peaks. If the resulting model had one peak, it was considered as the power peak. In the event of two peaks, the one with higher frequency was considered as the power peak. FOOOF failed to find a peak in the data from one participant which was also confirmed by visual inspection that revealed a high ratio of burst suppression. Therefore, this participant was removed from further analysis as well.

Burst suppression patterns as an indicator of deep sedation were manually extracted using EEGLAB and the ratio of the extracted periods in relation to overall duration of surgery was calculated.

REFERENCES

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4. Donoghue T, Haller M, Peterson EJ, et al. Parameterizing neural power spectra into periodic and aperiodic components. *Nat Neurosci* 2020; 23: 1655-1665.