Abstract:

Implantation of electrodes in the left hippocampus and chronic deep brain stimulation has been performed in one patient who suffered from refractory epilepsy. Continuous recordings of intra-cortical electrical activity (sEEG with the DBS contacts) and scalp-recorded activity (EEG) with and without DBS were made during a period of about 72 hours. On the basis of these recordings, the authors discuss the nature of the different generators implied in the generation of the different EEG patterns classically recorded in EEG during normal sleep. We discuss the inhibitory action of DBS in epilepsy and the repercussion on the scalp sleep EEG Pattern. The number of observed discharges from the DBS localization electrodes suggests a strong link between sleep and hippocampal discharges without correlate on Scalp EEG recording.

Introduction:

The increasing use of deep brain stimulation (DBS) in the treatment of various movement disorders, pain and now in the treatment of epilepsy has facilitated the study of subcortical electrophysiology (sEEG) recorded through the DBS microelectrodes. Modern digital technology allows for substantial on-line and off-line signal processing and easy storage of large amounts of data. One interesting opportunity is the ability to study combined scalp-DBS contacts activity in sleep and epilepsy. Recent articles have interpreted the findings of such studies to support specific hypotheses of transsynaptic cortical–subcortical transmission across neuroanatomical pathways previously thought to be involved in the generation of sleep potentials (Velasco 2002) and epileptiform activity (Chiron 2002). The objectives of this paper is to examine and compare the intracranial discharges of the EEG during sleep and scalp discharges recorded intracranially from deep brain (DBS) electrodes (use for stimulation) in one patient treated with DBS for epilepsy (psychomotor epilepsy and hippocampal site for stimulation).

Material and method:

Subject

- TB Female
- Onset: 13.10.1975
- On last convulsive seizures: 5 months to 2 years old (psychomotor seizures)
- Status at admission: 24 years old of psychomotor seizures
- Increase the number of seizure by suction and emotional situation
- Crede: typical sleep discharges
- Embryology: localisation electrodes reveals an increase in the hippocampus rate of ictal discharges; EEG electroencephalography and localization on the left hemisphere and more on the temporal region with a maximal on the sphenoidal electrodes.
- Vertigo: nystagmus in position of the right ear.
- 20-02-02: WADA test and with 67% decrease of the verbal memory.
- 30-07-02: stereotactic implantation of DBS electrode (Medtronic 3487A, four leads 46cm and 6mm diameter.
- 26-03-02: Wada test: 46% decrease of the verbal memory
- 10-02-02: stereotactic implantation of the stereotactic coordinates (Electronics: Medtronic 4601).
- 10-02-02: stereotactic implantation of the stereotactic coordinates: left hemisphere, and more on the temporal region
- Postoperative: control of the surgery.
- Postoperative: control of the surgery.
- Postoperative: control of the surgery.
- Postoperative: control of the surgery.

Recordinig

- 72 hours (T1-02) continuous EEG recording after implantation (stereotactic EEG).
- 72 hours (T1-02) continuous EEG recording after implantation (stereotactic EEG).
- 4 monopolar derivations were recorded from the DBS contacts (P1-P2-P3-P4) with FP1 from the frontal pole and visualized in bipolar.
- 4 monopolar surface EEG derivations were recorded (FF-F1) and C4-C3 scalp electrodes recorded in bipolar.
- 27-08-02: stereoencephalographic analysis (level 1-2-3-4- and REM sleep) on the scalp EEG and recording of the DBS activity.
- 27-08-02: stereoencephalographic analysis (level 1-2-3-4- and REM sleep) on the scalp EEG and recording of the DBS activity.
- The new EEG data was analyzed by visual scoring to detect epileptic abnormalities and sleep stage scoring.

Literature and site of stimulation in refractory epilepsy:

- 1970: mamillary (Cooper)
- 1985: centromedial thalamic nuclei (Velasco)
- 1986: vagus nerve
- 1989: caudate nucleus (Bowers 1990)
- 1994: posterior hypothalamus
- 2000: hippocampus (Velasco)
- 2000: subthalamic nucleus (Velasco)

DBS on site activity

- Direct stimulation of the epileptic focus and adjacent structure.
- Stimulation of the network implicated in the generation and propagation of the ictal discharges.
- Stimulation of specific synchronizations, de-synchronizations.

Results:

On the continuous recording of surface and DBS EEG, we were able to demonstrate specific patients on deep EEG that did not correlate with surface EEG before the DBS therapy. The continuous recording of surface EEG (sEEG) showed all abnormalities and sleep discharges disturbances (bipolar, positiver, ...). In the hippocampus and at the site of implantation occurred predominantly discharges during sleep (3 wit). In the same way, the percentage of hippocampal-synchronous discharges predominated during surgery day 1 and 2.

Discussion:

DBS therapy is intractable epilepsy is still controversial. Furthermore, few publications confirm the feasibility of electrophysiological recording using DBS electrodes contacts in epilepsy, movement disorders and Parkinson. On the other hand, the use of deep recordings electrodes (sEEG) for the pre-surgical evaluation of epilepsy is well documented. This study was performed in a 26-year-old female patient presenting psychomotor seizures with verbal memory deficit in a uniconal seizure. The clinical examination of the patients focal disease presented focal cognitive deficit with a left hemispheric predominance. Continuous recordings of 72 hours EEG on surface and on DBS electrodes. Continuous recordings of 72 hours EEG on surface and on DBS electrodes. Continuous recordings of 72 hours EEG on surface and on DBS electrodes. Continuous recordings of 72 hours EEG on surface and on DBS electrodes. Continuous recordings of 72 hours EEG on surface and on DBS electrodes. Results were in the hippocampus and at the site of implantation occurred predominantly discharges during sleep (3 wit). In the same way, the percentage of hippocampal-synchronous discharges predominated during surgery day 1 and 2.

Conclusion:

- We confirm that it is possible to record paroxysmal electrophysiological activity using contacts of DBS electrode used in the treatment of epilepsy.
- Long term continuous recording of EEG activity using DBS electrode confirmed the nocurnal characters of hippocampal discharges in our patient.
- Results of EEG recordings helped to quantify the number and the localisation of infra and clinical crisis not observed on surface EEG. These recordings should help to follow the longitudinal evolution of the patient under DBS therapy.