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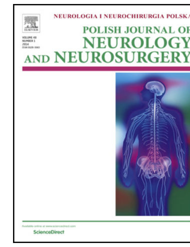

Original research article

Intracranial video-EEG monitoring in presurgical evaluation of patients with refractory epilepsy

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ABSTRACT

Objective: Reviewing our experience in intracranial video-EEG monitoring in the presurgical evaluation of patients with refractory epilepsy.

Methods: We report on 62 out of 202 (31%) patients with refractory epilepsy, who underwent a long term video-EEG monitoring (LTM). The epileptogenic zone (EZ) was localised either based on the results of LTM or after intracranial EEG recordings from depth, subdural or foramen ovale electrodes. The decision on the location of the electrodes was based upon semiology of the seizures, EEG findings and the lesions visualised in MRI brain scan. Intraoperative corticography was carried out before and right after the resection of the seizure onset zone.

Results: The video-EEG monitoring could localise EZ in 43 (69%) cases based. The remaining patients underwent invasive diagnostics: 10 (53%) had intracerebral depth electrodes, 6 (31%) depth and subdural and 3 (16%) foramen ovale electrodes. Intracranial video EEG recordings showed seizure focus in all the patients. Ten of them had EZ in mesial temporal structures, 4 in accessory motor area, 3 at the base of the frontal lobe and 2 in parietal lobe. There was one case of an asymptomatic intracerebral haematoma at the electrode. All patients were subsequently operated on. In 15 (79%) cases the seizures subsided (follow-up from 2 to 5 years), in 4 (21%) they decreased.

Conclusions: The intracranial EEG is required in all patients with normal MRI (so-called nonlesional cases) in whom EZ is suspected to be located in the hippocampus, insula or in the basal parts of the frontal lobe.

1. Introduction

Patients with refractory epilepsy are potential candidates for epilepsy surgery. Precise preoperative identification of the epileptogenic zone (EZ) is crucial for achieving satisfactory surgical results and hence for the prognosis [1].

Patients with refractory epilepsy require long term video-EEG (LTM) lasting for at least 24 h [2]. In order to localise EZ one begins with preoperative non-invasive tests such as LTM, high

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resolution MRI, functional imaging (fMRI, PET, ictal SPECT, MRS or MEG, Wada test) and neuropsychological testing [3]. When those noninvasively obtained data are insufficiently concordant, discordant or inconclusive and/or suggested an early involvement of eloquent areas, then the invasive recordings are necessary [4]. This requires an intracranial EEG recording from depth or/and subdural or foramen ovale electrodes. Indications for the invasive tests may differ among various epilepsy centres, probably depending on individual experience in planning, implantation of the electrodes as well as interpretation of the obtained results [5–7]. However, there are some general recommendations for intracranial recording, namely: non-lesional extratemporal epilepsy, discordant data, seizures originating at the contralateral side to the MRI abnormality, dual pathology, seizures with undetermined side of the onset, mesial versus neocortical onset, mesial onset versus onset in the neighbouring structures, ''temporal plus epilepsies'', occipitotemporal epilepsy and neocortical epilepsy (lesional or non-lesional) with suspected EZ in the close vicinity to the eloquent cortex (motor or language) [8–12].

In his paper we wanted to present our experience in the field of invasive tests in presurgical evaluation of patients with refractory epilepsy.

2. Materials and methods

In the last 5 years in our Epilepsy Monitoring Unit, long term video-EEG monitoring (LTM) was performed in 202 patients with refractory epilepsy in an attempt to establish or confirm the diagnosis, modify the treatment and/or identify candidates for epilepsy surgery. Each LTM lasted for minimum 72 h. For EEG recording we used Beehive Horizon LTM system (Grass Technologies, USA), with amplifiers Aura 32 or Aura 64 LTM (32- and 64-channel digital video-EEG system). Surgery was advised in 62 (31%) patients. There were 27 males and 35 females with age ranging from 21 to 52 years (average 33 years, median 32).

In the presurgical evaluation, EZ was localised based on the results of LTM or after intracranial EEG recordings from depth, subdural strip or foramen ovale (FO) electrodes. The type and the location of the electrodes was planned according to the semiology of the seizures, LTM findings and abnormalities seen on MRI scan. For planning and implantation the depth electrodes (with 5, 10 or 18 leads) BrainLab Neuronavigation System (Germany) was used. Subdural strip electrodes (with 4 or 6 contacts) were implanted through burr holes, using linear skin incision. FO electrodes with 5 or 10 leads were implanted transcutaneously under fluoroscopy. All procedures were performed under general or local (FO) anaesthetic. All types of intracranial electrodes (DIXI, France) were MRI compatible. As a rule, on the day following the implantation, MRI was carried out to check up the position of the electrodes and to rule out possible complications. Intracranial EEG recordings lasted for 168–216 h (7–9 days) and minimum 3 seizures in every patients had to be recorded. The epilepsy surgery was performed at least 6 weeks after removal of the intracranial electrodes. Before and right after the EZ resection, corticography was performed using strip or grid electrodes. Postoperative follow-up was from 2 to 5 years and Engel's classification [13] was used to evaluate the postoperative outcome.

3. Results

In 43 (69%) patients noninvasive evaluation was sufficiently conclusive to localise the EZ, whereas 19 (31%) patients required the invasive tests and the intracranial recordings. In the latter group, 10 (53%) patients had depth electrodes implanted, 6 (31%) – both depth and a single subdural (strip) electrode and 3 (16%) – FO electrodes. We implanted 3–5 depth electrodes per case, so a single patient had from 30 to 66 leads. The strip electrode had from 4 to 6 leads. Only 3 patients had the electrodes implanted bilaterally. The number of the intracranial electrodes and their target were determined based on the results of the previous noninvasive studies. In 16 patients there was no abnormality on MRI scan and EEG did not localise EZ. As to the other 3 cases, one patient had an arachnoid cyst, one DNT and one a focal cortical malformation, nevertheless in all these cases the seizures symptomatology was not consistent with the lesions. The intracranial LTM successfully localised EZ in all the cases. The locations were as follows: mesial temporal lobe (MTLE) – 10 cases, supplementary motor area (SMA) – 4, base of frontal lobe – 3 and parietal lobe – 2. There was one case of clinically uneventful minor intracerebral bleeding around a tip of the depth electrode. No other complications were observed. The location of EZ was confirmed by means of intraoperative corticography in all the patients. The surgical results (the follow-up from 2 to 5 years) were as following: 15 patients (79%) are seizure free (Engel class I) and 4 (21%) have a worthwhile improvement (Engel class III). In the latter group, 3 cases presented with frontal lobe epilepsy and 1 with parietal lobe epilepsy.

3.1. *Illustrative case*

A male patient who at age of 10, in 1992 sustained a minor head injury and had a CT scan which showed an arachnoid cyst in the left Sylvian fissure (Fig. 1). He was operated on – a cysto-cardiac shunt was inserted and later in 1996 replaced for

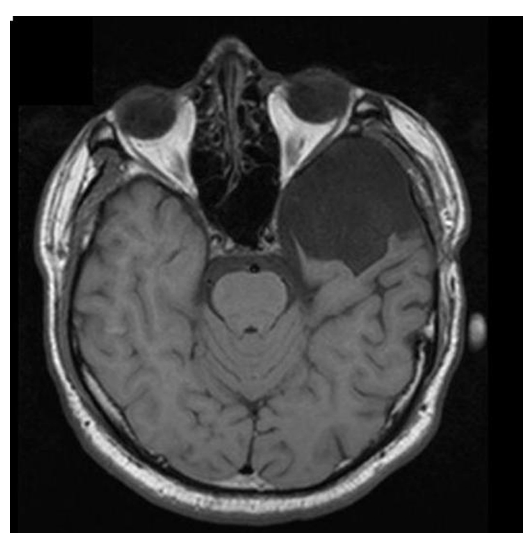

Fig. 1 – MRI scan, T1 weighted image. A arachnoid cyst (Galassi 2) is seen in the left Sylvian fissure.