Stereoelectroencephalography case series

A retrospective review of children under 2 years of age who had undergone SEEG while at Children's Hospital of Philadelphia between November 2017 and July 2021 was performed. Data on clinical characteristics, surgical procedures, imaging results, electrode accuracy measurements, and postoperative outcomes were examined.

Results: Five patients younger than 2 years of age underwent SEEG during the study period (median age 20 months, range 17-23 months). The mean age at seizure onset was 9 months. Developmental delay was present in all patients, and epilepsy-associated genetic diagnoses included tuberous sclerosis (n = 1), KAT6B (n = 1), and NPRL3 (n = 1). Cortical lesions included tubers from tuberous sclerosis (n = 1), mesial temporal sclerosis (n = 1), and cortical dysplasia (n = 3). The mean number of placed electrodes was 11 (range 6-20 electrodes). Bilateral electrodes were placed in 1 patient. Seizure onset zones were identified in all cases. There were no SEEG-related complications, including skull fracture, electrode misplacement, hemorrhage, infection, cerebrospinal fluid leakage, electrode pullout, neurological deficit, or death. The mean target point error for all electrodes was 1.0 mm. All patients proceeded to resective surgery, with a mean follow-up of 21 months (range 8-53 months). All patients attained a favorable epilepsy outcome, including Engel class IA (n = 2), IC (n = 1), ID (n = 1), and IIA (n = 1).

Conclusions: SEEG can be safely, accurately, and effectively utilized in children under age 2 with good postoperative outcomes using standard SEEG equipment. With minimal modification, this procedure is feasible in those with immature skulls and guides the epilepsy team's decision-making for early and optimal treatment of refractory epilepsy through effective localization of seizure onset zones [1)].

Between April 2016 and March 2018, 23 patients underwent implantation of 213 depth electrodes with the use of this technique. Mean (SD) operative time was 123 (32) minutes (range, 66-181 minutes). A mean (SD) of 9.3 (1.4) electrodes was placed for each patient (range, 8-13 electrodes). Two of the 213 electrodes (0.9%) were associated with postimplantation asymptomatic hemorrhage. One of the 213 electrodes (0.5%) was placed extradural or incorrectly. None of the 213 electrodes were associated with symptomatic complications. No patients experienced infectious complications at any point in the preoperative, perioperative, or postoperative stages.

This minimally invasive, cost-effective technique for SEEG depth electrode implantation is a safe, efficient method that uses basic neurosurgical equipment that is readily available. The utilization of this technique may be useful in neurosurgery centers with more limited resources. This study suggests that leaving patient hair largely intact throughout the procedure does not present an additional infection risk [2)].

Five patients (three male, age 5-33 years) with drug-resistant focal epilepsy presented a single NH at brain MRI. Following video-EEG monitoring, patients underwent SEEG recording to better identify the epileptogenic zone. All patients received RF-THC of the NH, using contiguous contacts of the electrodes employed for recording. The contacts for RF-THC lesions were chosen according to anatomical (intranodular position) and electrical (intranodular ictal low-voltage fast activity) criteria.

At SEEG recordings, ictal discharge originated from the NH alone in three cases and from the NH and

ipsilateral hippocampus in one case. In the remaining case, different sites of ictal onset, including the NH, were identified within the left frontal lobe. No adverse effects related to the RF-THC procedures were observed, apart from a habitual seizure that occurred during coagulation in one patient. Postprocedural sustained seizure freedom was detected in four cases (mean follow-up 33.5 months). In the case with left frontal multifocal ictal activity, RF-THC of the NH provided no benefit on seizures, and the patient is seizure-free after left frontal lobe resection.

SEEG-guided RF-THC proved to be a safe and effective option in our small case-series of NH-related focal epilepsy. The indications to this treatment were strictly dependent on findings of intracerebral recording by SEEG, which can define the role of the NH in the generation of the ictal discharge [3].

2012

Fifteen patients (9 girls and 6 boys, mean age 34.1 ± 7.3 months, range 21-45 months), potentially candidates to receive surgical treatment for their focal drug-resistant epilepsy, were evaluated using stereo-EEG recording for a detailed definition of the epileptogenic zone. Stereoelectroencephalography was indicated because neuroradiological (brain MRI) and video-EEG data failed to adequately localize the epileptogenic zone. Stereotactic placement of multicontact intracerebral electrodes was preceded by the acquisition of all pertinent anatomical information from structural and functional MRI and from brain angiography, enabling the accurate targeting of desired structures through avascular trajectories. Stereoelectroencephalography monitoring attempted to record habitual seizures; electrical stimulations were performed to induce seizures and for the functional mapping of eloquent areas. Stereoelectroencephalography-guided microsurgery, when indicated, pointed to removal of the epileptogenic zone and seizure control.

Brain MRI revealed an anatomical lesion in 13 patients (lobar in 2 cases, multilobar or hemispheric in 11 cases) and was unremarkable in 2 patients. One patient underwent 2 stereo-EEG studies. The arrangement of the intracerebral electrodes was unilateral in all but 1 case. One patient died the day following electrode placement due to massive brain edema and profound hyponatremia of undetermined cause. In 8 cases intracerebral electrical stimulations allowed mapping of functionally critical areas; in 3 other cases that received purposeful placement of electrodes in presumably eloquent areas, no functional response was obtained. Of the 14 patients who completed stereo-EEG monitoring, 1 was excluded from surgery for multifocality of seizures and 13 underwent operations. Postoperatively, 2 patients exhibited an anticipated, permanent motor deficit, 3 experienced a transient motor deficit, and 2 experienced transient worsening of a preexisting motor deficit. Three patients developed a permanent homonymous hemianopia after posterior resections. Histological analysis revealed cortical malformations in 10 cases. Of the 10 patients with a postoperative follow-up of at least 12 months, 6 (60%) were seizure-free (Engel Class Ia), 2 (20%) experienced a significant reduction of seizures (Engel Class II), and 2 (20%) were unchanged (Engel Class IV).

The present study indicates that stereo-EEG plays a prominent role in the presurgical evaluation of focal epilepsies also in the first years of life and that it may offer a surgical option in particularly complex cases that would have scarcely benefitted from further medical treatment. Results of stereo-EEG-guided resective surgery were excellent, with 80% of patients exhibiting a substantial improvement in seizures. In consideration of the potentially life-threatening risks of major intracranial surgery in this specific age group, the authors recommend reserving stereo-EEG evaluations for infants with realistic chances of benefiting from surgery [4].

2005

Two-hundred fifteen stereotactic implantations of multilead intracerebral electrodes were performed in 211 patients (4 patients were explored twice), who showed variable patterns of localizing incoherence among electrical (interictal/ictal scalp electroencephalography), clinical (ictal semeiology), and anatomic (magnetic resonance imaging [MRI]) investigations. MRI scanning showed a lesion in 134 patients (63%; associated with mesial temporal sclerosis in 7) and no lesion in 77 patients (37%; with mesial temporal sclerosis in 14 patients). A total of 2666 electrodes (mean, 12.4 per patient) were implanted (unilaterally in 175 procedures and bilaterally in 40). For electrode targeting, stereotactic stereoscopic cerebral angiograms were used in all patients, coupled with a coregistered three-dimensional MRI scan in 108 patients.

One hundred eighty-three patients (87%) were scheduled for resective surgery after SEEG recording, and 174 have undergone surgery thus far. Resections sites were temporal in 47 patients (27%), frontal in 55 patients (31.6%), parietal in 14 patients (8%), occipital in one patient (0.6%), rolandic in one patient (0.6%), and multilobar in 56 patients (32.2%). Outcome on seizures (Engel's classification) in 165 patients with a follow-up period of more than 12 months was: Class I, 56.4%; Class II, 15.1%; Class III, 10.9%; and Class IV, 17.6%. Outcome was significantly associated with the results of MRI scanning (P = 0.0001) and with completeness of lesion removal (P = 0.038). Morbidity related to electrode implantation occurred in 12 procedures (5.6%), with severe permanent deficits from intracerebral hemorrhage in 2 (1%) patients.

SEEG is a useful and relatively safe tool in the evaluation of surgical candidates when noninvasive investigations fail to localize the epileptogenic zone. SEEG-based resective surgery may provide excellent results in particularly complex drug-resistant epilepsies [5)].

2004

By using these permanently implanted depth electrodes, Guénot et al are able to perform radiofrequency (RF)-thermolesions of the epileptic foci. We report the technical data required to perform such multiple cortical thermolesions, as well as preliminary results in terms of seizure outcome in a group of 20 patients.

Lesions were performed by using 100- to 110-mA bipolar current (50 V), applied for 10 to 50 s. Each thermocoagulation produced a 5- to 7-mm diameter cortical lesion. In total, two to 16 lesions were performed in each of the 20 patients. Lesions were placed without anesthesia. No general or neurologic complication occurred during the procedures. Two transient postprocedure side effects, consisting of paresthetic sensations in the mouth and mild apraxia of the hand, were observed.

At a follow-up time of 8 to 31 months (mean, 19 months), 15% of the patients became seizure free, 40% experienced a > or =80% reduction of their seizure frequency, and 45% were not significantly improved.

SEEG-guided RF thermolesions is a safe technique. The preliminary results indicate that such lesions can lead to a significant reduction of seizure frequency and could be proposed as a palliative procedure if no resective surgery is possible. A randomized controlled trial is needed to determine which patients are likely to respond to SEEG-guided RF thermolesions. [6)].

[1)]

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