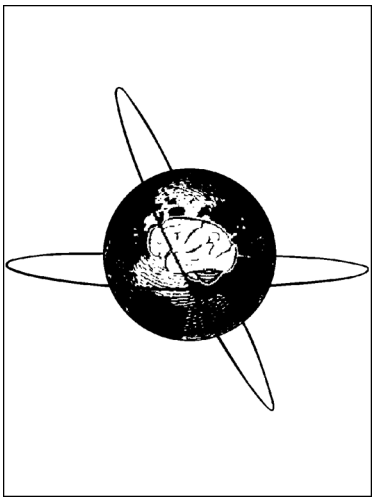

Letter to the Editor

Little effort with big effect – implementing the new IFCN 2017 recommendations on standard EEGs

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Little effort with big effect – implementing the new IFCN 2017 recommendations on standard EEGs

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One year ago, the International Federation of Clinical Neurophysiology (IFCN) recommended the 25-channel montage for the standard use in clinical EEG recording (Seeck et al. , 2017), augmenting the world-widely used 60-year old 10/20-System by 6 additional inferotemporal electrodes to a “triple banana” configuration. Still many EEG centers have not yet implemented this simple but very effective measure. Here we demonstrate the big effect of this simple measure in a demonstrative case.

This 58-year-old patient was admitted to our long-term video EEG monitoring unit for a re-diagnostic workup after decades in an unsatisfactory situation with epileptic seizures. The short-lasting focal sensory seizures with impaired consciousness occurred 2-6 times per month, were never controlled completely, and since 2010 she was forbidden to drive the car.

Her first two generalized seizures occurred at the age of 20 (in 1980) and at that moment treatment with carbamazepine was started. At the age of 36, vigabatrin was introduced due to increased seizure frequency, but without improvement. Although bilaterally spreading seizures had disappeared after carbamazepine was increased to 600 mg bid, focal-sensory seizures with impaired consciousness persisted, which (until the use of lamotrigine in 2010) began by a several-seconds lasting characteristic aura with piloerection on the right buttocks.

The seizures were reported to display altered breathing, staring, and dystonia of the right hand (sometimes both hands) for 10-60 s followed by amnesia and sometimes difficulty finding her words. Under lamotrigine, however, the seizure situation worsened and lamotrigine was finally discontinued also. Likewise, attempts with levetiracetam as an add-on and later also perampanel were unsuccessful, and both drugs were discontinued. The last attempt with brivaracetam also led to no improvement.

The patient was right-handed. Clinical examination revealed pallhypesthesia of the lower extremities but was otherwise normal. The lab showed mild hyponatremia and vitamin D deficiency. A cranial MRI in 2003 showed absent frontal sections of the septum pellucidum with consecutively atypical presentation of the lateral ventricles frontally, but otherwise no other pathological alterations. Multiple EEG recordings were always normal until 2010. Thereafter, non-specific left fronto-temporal slowing was described repeatedly with standard EEG (Figure 1A).

We then performed a long-term video-EEG monitoring, after having stopped brivaracetam under maintenance of carbamazepine. The 25-channel-montage with the additional inferior temporal

electrodes revealed an intermittent epileptogenic focus with sharp waves and phase reversal in the left inferotemporal leads T9-F9 (Figure 1B).

=== Figure 1 about here ===

We recorded one electric seizure during sleep, which started from left inferotemporal regions, and which was not reported by the patient. Consequently, a 3-Tesla cerebral MRI was performed. It showed a left-sided volume reduction and hyperdense signal in the FLAIR sequence, concordant with a left hippocampal sclerosis.

We then run the fully automatic EPILOG ProOp algorithm on this patient's whole EEG track, to automatically detect the spikes and use them for an EEG source localization (van Mierlo et al. , 2017). It localized the source of the spikes into the medial part of left hippocampus, consistent with seizure semiology and the new MRI findings (Figure 1C).

This basic work-up eventually yielded a classic mesiotemporal epilepsy, which, however, could not be diagnosed with certainty since 1980 for lack of a specific pathological EEG and MRI. The patient's seizure semiology with automatism and amnesia pointed towards the mesiotemporal region, the dystonic right arm and the postictal speech disturbances suggested lateralization into the left hemisphere. The characteristic auras with piloerection of the right buttock suggested an involvement of the insula. Concurrent with these semiological considerations, an intermittent left inferotemporal epileptogenic focus was seen in the sleep EEG, and after additional reduction of the medication, even an electroencephalographic seizure was seen, concordant to the hippocampal sclerosis in the new MRI.

This case illustrates the limitation of repeated outpatient standard EEGs with 19 electrodes of the 10/20 system and highlights the usefulness of performing long-term and sleep EEGs to unveil potential epileptic discharges. Additionally, it clearly demonstrates that inferotemporal spikes are hardly visible in the middle temporal electrodes and can easily be overlooked, whereas the 2x3 additional inferotemporal electrodes of the 25-channel montage according to the 2017 IFCN guidelines (Seeck et al. , 2017) clearly demonstrate epileptic activity in the inferotemporal regions. With this little effort it was possible to give an exact diagnosis to the patient's epileptic condition, after 38 years.

While the impressive technological development of digital cameras is recognized by everyone, the same progress applies to MRI scanners: a 0.2-Tesla MRI of 15 years ago is not comparable with a modern 3-Tesla machine with specific epilepsy protocols (Wellmer et al. , 2013), and in our patient hippocampal sclerosis could be visualized without any doubt.

In the case of our patient, we should not forget that many patients significantly underrate their seizure count because the patients' awareness of especially left-sided temporal lobe seizures is often low, if not absent (Cook et al. , 2013).

A presurgical evaluation in this patient is indicated, as the chance of seizure freedom without medication after epilepsy surgery of mesiotemporal sclerosis is about 70%, which is significantly higher than with medication alone (Tellez-Zenteno et al. , 2010). The chance of successful epilepsy surgery in this patient, however, is somewhat compromised because the shorter the duration of epilepsy, the better the surgical outcome (Simasathien et al. , 2013). Unsatisfactorily, in most countries, the average duration of epilepsy until admission to a pre-surgical evaluation is still around 20 years, and sometimes much more, as in our patient. The new 25-channel EEG montage may be a helpful tool to overcome this disastrous situation.

Disclosures

MG has no disclosures related to this project. PvM is shareholder of EPILOG. SR is a registered customer of EPILOG.

References

Cook MJ, O'Brien TJ, Berkovic SF, Murphy M, Morokoff A, Fabinyi G, et al. Prediction of seizure likelihood with a long-term, implanted seizure advisory system in patients with drug-resistant epilepsy: a first-in-man study. Lancet Neurol. 2013;12:563-71.

Seeck M, Koessler L, Bast T, Leijten F, Michel C, Baumgartner C, et al. The standardized EEG electrode array of the IFCN. Clin Neurophysiol. 2017;128:2070-7.

Simasathien T, Vadera S, Najm I, Gupta A, Bingaman W, Jehi L. Improved outcomes with earlier surgery for intractable frontal lobe epilepsy. Ann Neurol. 2013;73:646-54.

Tellez-Zenteno JF, Hernandez Ronquillo L, Moien-Afshari F, Wiebe S. Surgical outcomes in lesional and non-lesional epilepsy: a systematic review and meta-analysis. Epilepsy Res. 2010;89:310-8.

van Mierlo P, Strobbe G, Keereman V, Birot G, Gadeyne S, Gschwind M, et al. Automated long-term EEG analysis to localize the epileptogenic zone. Epilepsia Open. 2017;2:322-33.

Wellmer J, Quesada CM, Rothe L, Elger CE, Bien CG, Urbach H. Proposal for a magnetic resonance imaging protocol for the detection of epileptogenic lesions at early outpatient stages. Epilepsia. 2013;54:1977-87.

Figure caption

Figure 1:

A. The traditional standard 10/20-montage would have been interpreted as showing a left temporal focal slowing.

B. The exact identical episode as displayed with the 25-channel-montage with the additional inferior temporal electrodes (left F9, T9, P9 and right F10, T10, P10) shows an intermittent epileptogenic focus with sharp waves and phase reversal in the left inferotemporal leads T9-F9 (arrow).

C. The automated EEG source localization using EPILOG PreOp (Epilog NV, Ghent, Belgium) revealed a source of the spikes in the left medial hippocampus.