Association of ictal slow shift with the fingerprint of epileptogenic zone

Masako Kobayashi[1], Olesya Grinenko[2], Jian Li[3], Balu Krishnan[1], Dileep R. Nair[1], Patrick Chauvel[1]

[1] Epilepsy Center, Cleveland Clinic Neurological Institute, Cleveland, OH, USA

[2] Mercy Health, Grand Rapids, MI, USA

[3] Signal and Image Processing Institute, University of South California, Los Angeles, CA, USA

Introduction

Successful surgical treatment of intractable focal epilepsy largely depends on the precise identification and removal of the epileptogenic zone (EZ). Stereo-electro-encephalography (SEEG) is the presurgical method that aims to delineate EZ. Fast activity is considered as one of the major biomarkers of EZ in SEEG recording but it is also often seen in the regions of propagation. Recently, several studies aimed to find more specific biomarkers of EZ[1]. Our previous studies showed that a time-frequency pattern is specific of EZ[2,3]. It is defined by the combination of (i) sharp transients or spikes, preceding; (ii) multi-narrow band fast activity concurrent with; (iii) suppression of lower frequencies. On the other hand, some studies with Electrocorticogram or SEEG suggested that ictal slow shift (infra slow or direct current shift) arises during preictal and ictal period in EZ[4,5]. What is the relation between ictal slow shift and EZ fingerprint pattern?

Methods

We analyzed six patients who underwent SEEG evaluation at the CCF Epilepsy Center and had "fingerprint" pattern. To evaluate the possible combination of "fingerprint" pattern and slow shifts in the EZ, we selected only the seizures (maximum three seizures) and the contacts in which the complete "fingerprint" pattern was seen. For the "fingerprint" assessment, we performed time-frequency analysis and inspected visually in the same way as our previous studies[2,3]. We measured the duration of fast activities. For the slow shift assessment, we first reviewed an SEEG data with no filter. We measured the time to peak, the amplitude at peak, and the duration of the slow shifts, with bandpass filter of 0.016 - 0.2 Hz in bipolar montage.

Results

Two periods with slow shift could be distinguished. An early, mono- or multi-phasic, slow shift corresponding to fast activities in "fingerprint" pattern was observed in all the six patients in 97.5% of the contacts. 82.1% of them showed a monophasic slow shift. A late slow shift was observed in 47.5% of all contacts and more frequently in temporal lobe (especially in hippocampus) than in frontal lobe epilepsies. The time to peak and the amplitude at peak of slow shift were 4.3±3.0 (mean±SD) sec, and 480±277 (mean±SD) μV in bipolar montage. The early slow shift and fast activities occurred simultaneously with similar duration (slow shift=11.6±4.1 sec, fast activities=11.7±4.2 sec).

Conclusion

In SEEG, there are at least two ictal slow shift components; early and late. Duration of the early slow shift varies with the fingerprint duration. The late slow shift varies with propagation duration. The early slow shift can be considered as an element of the fingerprint pattern. Suppression is a band suppression.

References

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