

Altered brain rhythms and functional network disruptions involved in patients with generalized Fixation-off epilepsy

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Authors: A.B. Solana¹, J.A. Hernández-Tamames¹, E. Molina¹, K. Martínez², J.Á. Pineda¹, R. Bruña¹, R. Toledano², V. San Antonio², I. García-Morales², A. Gil-Nagel², E. Alfayate², J. Álvarez-Linera², F. del Pozo¹; ¹Pozuelo De Alarcón/ES, ²Madrid/ES

Purpose / Introduction

Fixation-off sensitivity (FOS) denotes the forms of epilepsy elicited by elimination of fixation. FOS-IGE patients are rare cases [1]. In a previous work [2] we showed that two FOS-IGE patients had different altered EEG rhythms when closing eyes; only beta band was altered in patient 1 while theta, alpha and beta were altered in patient 2. In the present work, we explain the relationship between the altered brain rhythms in these patients and the disruption in functional brain networks.

Subjects and Methods

Patients. Two female patients with FOS-IGE were selected [Fig. 1].

	PATIENT 1 (Female 32 y)	PATIENT 2 (Female 18 y)
INTRACTABLE EPILEPSY	✓	✓
COGNITIVE IMPAIRMENT	✓	✓
INTERICTAL ACTIVITY	ONLY WITH CLOSED EYES OR LOSS OF FIXATION	ONLY WITH CLOSED EYES OR LOSS OF FIXATION
PAROXISTIC ACTIVITY	Generalized Beta rhythms (aprox. 18 Hz) occasionally mixed with generalized delta rhythms and brief discharges of rhythmic generalized 3-4 Hz polyspike-waves or spike-waves.	Generalized Alpha or Beta rhythms occasionally mixed or followed by brief discharges of rhythmic generalized 3-4 Hz polyspikes-waves or spike-waves.
SEIZURES	EYELID MYOCLONIA & MILD-LOSS CONCIOUSNESS	EYELID MYOCLONIA & ABSENCES

Figure 1 : FOS-IGE patients characteristics

Data acquisition and preprocessing. **EEG data** were recorded using a Brain Products MR-compatible EEG system. Brain Vision Analyzer 2.0 was used to remove MR scanner artefacts in the EEG. **fMRI data** were collected using a General Electric Signa 3.0T MR scanner using a GE-EPI fMRI sequence. Two resting-state fMRI (rsfMRI) with opened and closed eyes were acquired. Standard preprocessing was performed on MR images using FSL v4.1.8.

Data analyses. i) RS functional Networks (RSN) were identified after applying an ICA approach. Each RSN characteristic time-course for the opened and closed rsfMRI series was analyzed to achieve the correlation degree among RSNs. ii) Three GLM designs per fMRI series were computed using the EEG power time series (one EEG power value per fMRI volume convolved with the canonical HRF) regressors for three bands of interest -alpha, theta and beta bands – [2]

Results

In Fig. 2, it is shown a RSN [Fig. 2A] that only appears with closed eyes for patient 1 and it coincides with the brain areas correlated with the beta regressor in this patient [Fig. 2B].

In contrast, for patient 2 we found that there was not a RSN only for closed eyes. However, there was a huge correlation among the time-courses of some relevant RSNs when closing eyes [Fig. 3]. Also, for patient 2 almost all the brain areas related to high-cognitive processes were correlated with the alpha, beta or theta regressors [Fig. 4].

Discussion/Conclusion

These findings suggest a different disruption in the functional brain networks of these patients that depends on their altered brain rhythms..In fact, the alteration in all the studied EEG bands and the high correlation among RSNs in patient 2 may explain the presence of absences in this patient and not in patient 1 who has only beta band alterations.

References

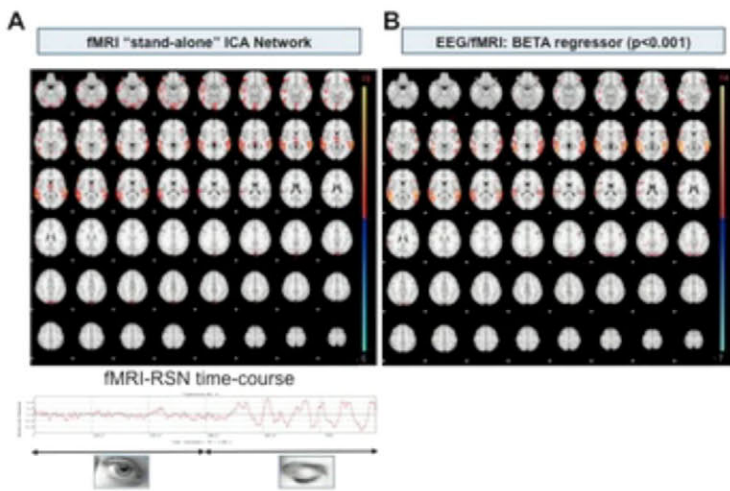


Figure 2 : Patient1 A) close-only fMRI-RSN and B) fMRI spatial map for Beta regressor.

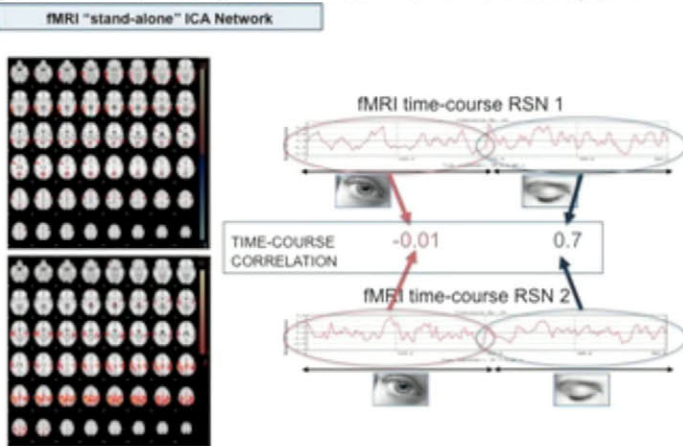


Figure 3 : Patient 2 RSNs for open and close eyes. RSNs are highly correlated with closed eyes

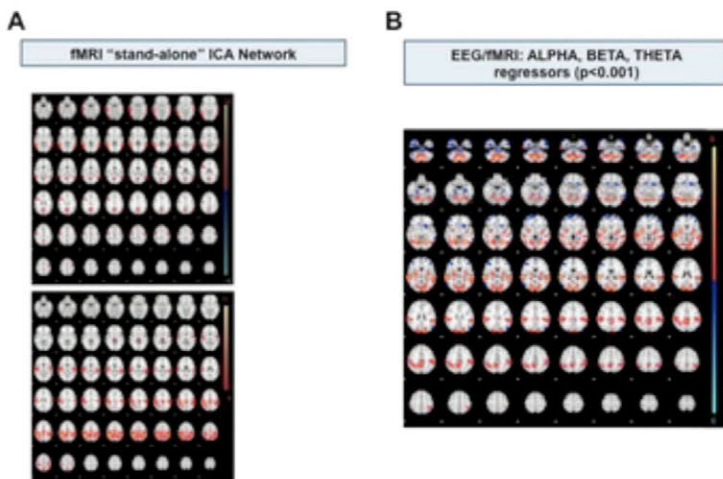


Figure 4 : Patient 2 A) highly-correlated RSN with closed eyes and B) spatial map for Alpha, Beta and Theta regressors.