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Network connectivity in migraine with aura
A graph theory study

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Introduction

Routine EEG is not useful in clinical assessment of patients with migraine, because EEG abnormalities are usually absent in these patients. Nevertheless, the use of specific analysis tool based on EEG (frequency analysis, topographic brain mapping, etc) has apparently contributed more to the understanding of migraine pathogenesis. Some studies hypothesized a 'network dysfunction' in migraine. Graph theory represents an interesting method to study connectivity networks.
Aim of the study was to evaluate the network connectivity in patients with migraine with aura.

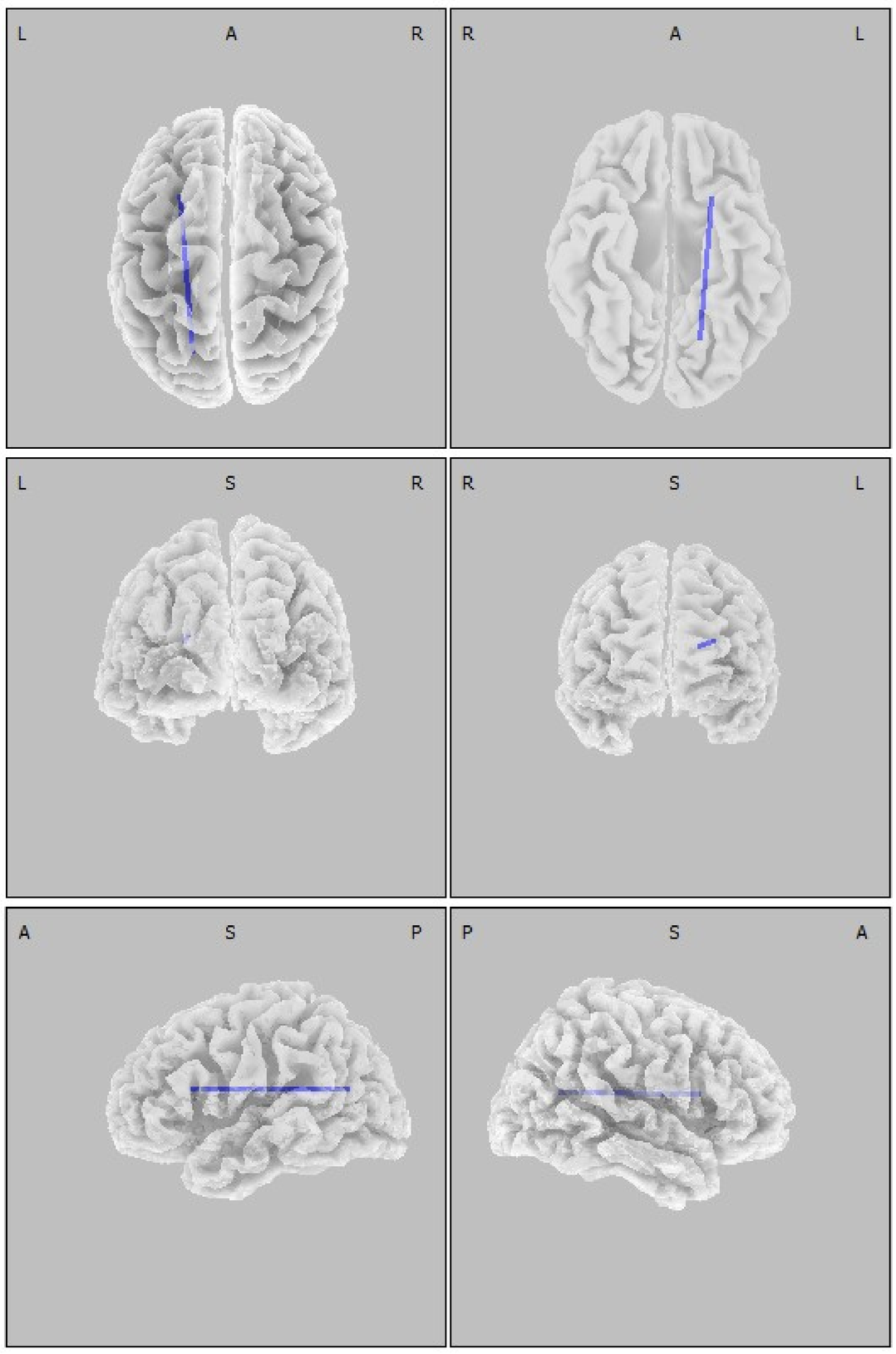
Methods

We selected 12 subjects with a diagnosis of episodic migraine with aura according to the International Classification of Headache Disorders (III beta edition) (Table). A history of epilepsy, cerebrovascular disease, sleep disorders and use of drugs (apart from acute treatment drugs) were exclusion criteria.
We analyzed and compared EEG recordings of patients with migraine with aura and EEG data obtained from 12, age and gender matched controls. We selected five minutes of quiet rest EEG recording. In order to analyze the neural generators of EEG signal, we used standard LOw Resolution Electromagnetic Tomography (sLORETA software). We then computed EEG lagged coherence, an index of functional connectivity, between 6 Regions Of Interest. A weighted graph was built for each band in every subject, and characteristic path length (L) and clustering coefficient (C) have been computed. Statistical comparisons were performed by means of Analysis Of Variance (Group X Band) for mean lagged coherence, L and C.

Results

No significant result was found for neural generators. Functional connectivity between anterior frontal and occipital areas in Theta band is lower (p=0.02) in patients when compared with control subjects. Furthermore, graph theory analysis showed significant differences between groups for clustering coefficient and path length both in Theta (C: p= 0,008; L: p=0,001) (Figure) and in Delta bands (C: p= 0,012; L: p=0,003).

ID	Gender	Age	Aura	Photophobia	Phonophobia	Activities Worse	Nausea	Vomiting	Frequency	Drugs
#1	F	40	Scintillating scotoma	1	1	1	1	1	1/3 months	Rizatriptan
#2	F	45	Fortification spectra	1	1	1	1	0	1/4 months	Ketoprofen - Nimesulide
#3	F	44	Scintillating scotoma	1	1	1	1	0	2/3 months	Almotriptan
#4	F	32	Parestesia left hemisoma	1	1	1	1	0	2/3 months	Frovatriptan
#5	F	47	Scintillating scotoma	1	1	1	1	1	>weekly	Eletriptan - Nimesulide
#6	F	40	Fortification spectra	0	1	1	0	1	1-2/month	Acetaminophen - Rizatriptan
#7	M	50	Parestesia right hemisoma + slurred speech	1	1	0	0	0	1/3-6 months	Almotriptan - Eletriptan
#8	M	32	Scintillating scotoma	1	1	1	0	0	2-3/month	Acetaminophen - Sumatriptan
#9	F	29	Scintillating scotoma	1	1	0	0	0	1-2/month	Ketoprofen
#10	F	31	Parestesia rigth hemisoma	1	1	1	1	1	2/month	Sumatriptan
#11	M	43	Fortification spectra	1	1	1	0	0	1-2/month	Ketoprofen - Almotriptan
#12	M	44	Scintillating scotoma + facial parestesia	1	1	1	0	0	2/month	Acetaminophen+Codeine - Zolmitriptan



Conclusions

Migraine with aura is associated with an atypical pattern of brain connectivity. The disrupted functional connectivity for theta band between frontal and occipital areas confirm the elective involvement of these brain areas in the pathogenesis of migraine attacks.
The significant differences in path length and clustering coefficient permit to hypothesize different brain connectivity patterns in migraine with aura.
Finally, both findings are consistent with a peculiar modality of brain integration and processing the incoming stimuli in patients with migraine with aura when compared to non migraine subjects.

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