ASSESSMENT OF THE BRAIN RATE PARAMETER IN THREE PROTOCOL-DEPENDENT GROUPS OF EPILEPTIC PATIENTS

Biljana Gjoneska[1], Silvana Markovska-Simoska[1], Aleksandar Kandikjan[2]

biljanagjoneska@manu.edu.mk silvana@manu.edu.mk akandikjan@yahoo.com

[1] Neuroinformatics Division, Macedonian Academy of Sciences and Arts, Skopje, R. Macedonia
[2] Department of Neurology and Psychiatry, Polyclinic Bukuresht, Skopje, R. Macedonia

INTRODUCTION

The main characteristic of any EEG spectral distribution is its mean frequency weighted over the whole spectrum. This parameter is called "EEG spectrum gravity" or "Brain rate" [1,2].

Algorithm for brain rate calculation:

$$f_b = \sum_i f_i P_i = \sum_i f_i \frac{V_i}{V} \qquad V = \sum_i V_i$$

Brain rate is related to the level of consciousness i.e. general activation of the mind.

The influence of some antiepileptic drugs (AED) over the background EEG activity, thus affecting the level of mental arousal, is well documented.
Source: Over 20 papers in referenced journals published on PubMed [3,4].

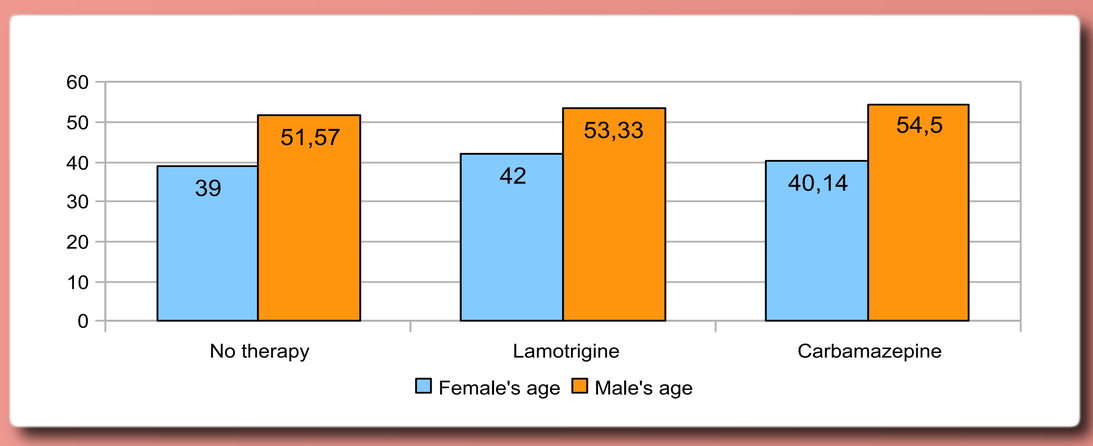
Specifically, it has been shown therapy with either Phenytoin or Carbamazepine has been associated with generalized slowing of EEG background rhythms.
Source: Over 20 papers in referenced journals published on PubMed [5,6].

OBJECTIVE

The aim of this study is to assess the brain rate parameter in three protocol-dependent groups of epileptic patients, in order to estimate whether it can be used as an indicator of the therapeutic efficacy of the anti epileptic treatment.

METHODS

Thirty patients, selected over a period of 3 years (2006-2009) and diagnosed with epilepsy were divided in 3 equal groups. The first group of patients (6M/4F) were free from anti-epileptic medications; the second group (4M/6F) were treated with Lamotrigine only, whereas the third group (3M/7F) received only Carbamazepine:



The EEG data was obtained under equivalent conditions and electrodes were applied according to International 10/20 system using standard bipolar montage

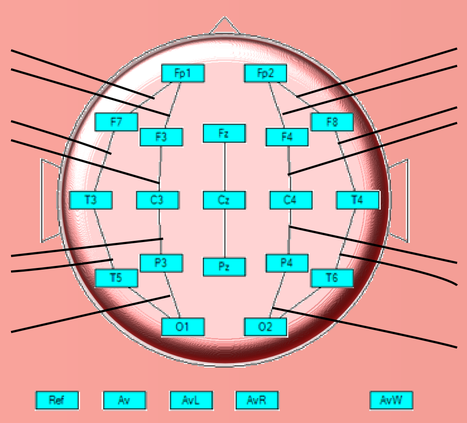
For each patient, 40 artefact-free baseline EEG epochs (4 seconds each during eyes closed) were selected for further analysis. The sampling rate was 256 Hz. Low-cut frequency was 0.53 Hz, whereas high-cut was 30 Hz.

RESULTS

Visual analysis of the raw EEG data was performed before obtaining the statistical results.

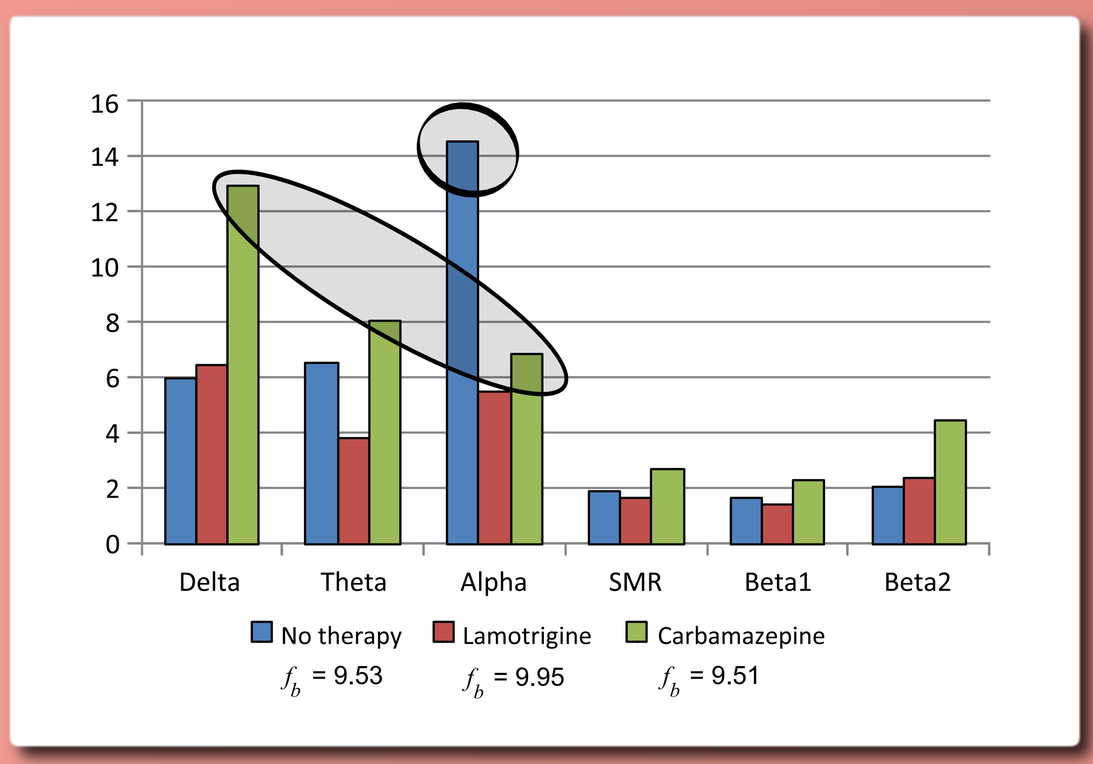
The final assessment resulted in power spectra values, calculated within 6 frequency bands: Delta (1 - 4 Hz), Theta (4 - 8 Hz), Alpha (8 - 12 Hz), SMR (12 - 16 Hz), Beta1 (16 - 20 Hz) and Beta2 (20 - 24 Hz).

LEFT BIPOLAR MONTAGE: LOCATIONS SELECTED FOR CALCULATION OF POWER-SPECTRA VALUES BASED ON WHICH BRAIN RATE WAS ASSESSED



RIGHT BIPOLAR MONTAGE: SEVEN CONTRALATERAL EQUIVALENT LOCATIONS ALSO SELECTED FOR CALCULATION OF POWER-SPECTRA.

One-way ANOVA test estimated statistically significant difference among the groups in Fp2-F8 location for the absolute power of delta frequency band:
- Mean values were 5.98 μV, 6.44 μV and 12.92 μV for each group respectively;
- F value was 3.46 which is greater then F critical (3.35), for p=0.05.



The results from statistical analysis of the absolute power value corresponds well with various clinical findings confirming that Carbamazepine is potent AED in slowing background EEG activity.

CONCLUSIONS

The results have shown that the conscious relaxation is much greater in the patients free from medication, while the level of consciousness is slightly decreased in the patients treated with Carbamazepine and increased in the group under Lamotrigine treatment.

Due to the small sample size further investigations are needed in order to validate the notion that brain rate can be used as an indicator of the therapeutic efficacy in the antiepileptic drug treatment.

REFERENCES

1. Pop-Jordanova N, Pop-Jordanov J., Spectrum-weighted EEG frequency ("brain-rate") as a quantitative indicator of mental arousal., Prilozi. 2005 Dec;26(2):35-42.
2. Pop-Jordanov J, Pop-Jordanova N., Neurophysical substrates of arousal and attention., Cogn Process. 2009 Feb;10 Suppl 1:S71-9. Epub 2008 Oct 31.
3. Salinsky MC, Oken BS, Morehead L., Intraindividual analysis of antiepileptic drug effects on EEG background rhythms., Electroencephalogr Clin Neurophysiol. 1994 Mar;90(3):186-93.
4. Salinsky MC, Oken BS, Storzbach D, Dodrill CB., Assessment of CNS effects of antiepileptic drugs by using quantitative EEG measures., Epilepsia. 2003 Aug;44(8):1042-50.
5. Marciani MG et al, EEG changes induced by carbamazepine therapy at rest and during mental processes., Ital J Neurol Sci. 1992 Dec;13(9):729-33.
6. Clemens B et al, Quantitative EEG effects of carbamazepine, oxcarbazepine, valproate, lamotrigine, and possible clinical relevance of the findings., Epilepsy Res. 2006 Aug;70(2-3):190-9. Epub 2006 Jun 9.