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QEEG CHARACTERISTICS OF CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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Summary

Attention Deficit Hyperactivity Disorder (ADHD), characterized with inattention, impulsivity and hyperactivity, is one of the most frequent developmental disorders in childhood If not treated properly, it can persist in the adulthood. Onset is usually in the preschool and early school years. The worldwide prevalence diverse from 2 to 10%. The prevalence in Macedonian schoolchildren is estimated to be about 2%.

The diagnosis is usually made clinically, by using classifications of disorders like ICD-10 or DSM-IV. In the recent decade, a quantitative analysis of the EEG data (QEEG) has proven to be additional valid tool for making a precise ADHD diagnosis. Recently, five QEEG subtypes in ADHD children were introduced.

This study presents 20 Macedonian children with ADHD, mean age 10.5±2.35 years, both genders. For each child QEEG data (in eyes open and eyes closed conditions) were recorded, together with the continuous performance tests (CPT). Analysis showed that 45 % of the children belong to the fifth subtype (slow alpha excess), 30% to the first subtype (increased theta amplitude in the frontocentral cortex) and 25 % to the fourth subtype (over activated beta in frontal, central or parietal cortex). The analysis was used for planning the individual neurofeedback protocols.

Key words: *children, Attention Deficit Hyperactivity Disorder, QEEG*

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most frequent developmental disorders in childhood. If not treated properly, it can persist in the adulthood. Onset is usually in the preschool and early school years.

Clinically disorder is characterized with

1. Inattentiveness: a child cannot concentrate on a task over a longer period of time;
2. Impulsivity: a child cannot sufficiently manoeuvre and control his response behaviour e. g. impulses break through at unfavourable times;
3. Hyperactivity: hyperactive behaviours are more expressed in comparison with other children, when a motor and linguistic activities are is more extensive [1].

The prevalence diverse from 2 to 10% [2, 3]. Discrepancies in estimations probably occur due to different diagnostic criteria and methodological approach. A recent study showed that the worldwide prevalence is 5, 44% [4]. Our study from 1998 showed that the prevalence in Macedonian schoolchildren is around 2% [5].

The etiology of the ADHD is heterogeneous. Heritability seems to be one of the most possible origins e. g. ADHD tends to run in the families. Some studies showed that identical twins with severe ADHD forms share the same trait and genes mutations [6]. However, prenatal toxic agents, especially expositions to lead and other heavy metals, insecure attach-

ment can also provoke ADHD symptoms.
Diagnosis of ADHD is usually made clinically, by using international classifications of disorders like ICD-10 or DSM-IV. In the recent decade, a quantitative analysis of the EEG data (QEEG) has proven to be additional, valid tool for making a precise ADHD diagnosis.
In the last years, several neuroscientists described ADHD subtypes according to the QEEG data. In Europe, the most recent one is the classification of five QEEG subtypes in ADHD children described by Andreas Muller and Yuri Kropotov [7].

Aim of the study

The aim of this study is to investigate the applicability of the QEEG subtypes described by Muller and Kropotov on our ADHD patients.

Subjects and methods

Subjects

This study presents 20 children diagnosed with ADHD. Mean age of the subjects is 10.5±2.35 years (min. 7; max 12 years old) from both genders. Inclusion criteria for the study were:
1. diagnosis established according to ICD-10;
2. schoolaged children from 7 to 12 years old;
3. IQ > 90;
4. children free of any medications;
5. parents agreement for participitaion of their children in the study.

Exlusion criterias were:
1. IQ<90;
2. children under 7 and above 12 years old;
3. children with comorbid conditions like other developmental disorders or some acute or chronic medical illness;
4. children without parent agreement for the participation in the study.

Methods

We have recorded QEEG data for children diagnosed as ADHD, in eyes open and eyes closed conditions. Appropriate electrode cap with leads was placed according to the international 10/20 system, in order to achieve a standardized 21 Mitsar EEG recording. A referential montage is obtained with linked earlobes. Electrode impedance of less then 5 Kohms is required at all sites prior to the initiation of recording. EEG signals are lead directly to a quantitative topographic analysis system where they are digitized at a rate at or above 512 samples per second. The data is band-pass filtered between 1 and 50 Hz and stored on a hard disk for subsequent analysis. QEEG is a collection of quantitative methods designed to process EEG signals and includes spectral and wavelet analysis of the EEG data.
Andreas Muller and Yuri Kropotov described the following five QEEG subtypes in ADHD children:
Type 1: Increased theta amplitude in the fronto-central cortex (app. 30%);
Type 2: Increased theta/beta ratio in fronto-central cortex (app. 4%);
Type 3: Increased frontal-midline theta (app. 4%);
Type 4: Over-activated fronto-central or parietal cortex (app. 30%);
Type 5: Slow alpha excess (app. 30%)
- Monkey Face (Mu-rhythm);
- Over whole cortex;
- In posterior temporal and/or temporal area.

Results

Analysis of the EEG data showed that most of the children in our study (45%) belongs to the fifth subtype-slow alpha excess (Figure 1, 2, 3). Impairment in this group of ADHD children is in the limbic system. Generator is the middle frontal cortex and anterior gyrus cingulum. This influences executive functions which are the highest cognitive process. The idling of these areas fits very well their behavioural problems. Behaviourally, they have emotion problems like aggression, emotional instability, irritation etc. They also show lack of control of their impulses and have a lot of acting-out reactions.

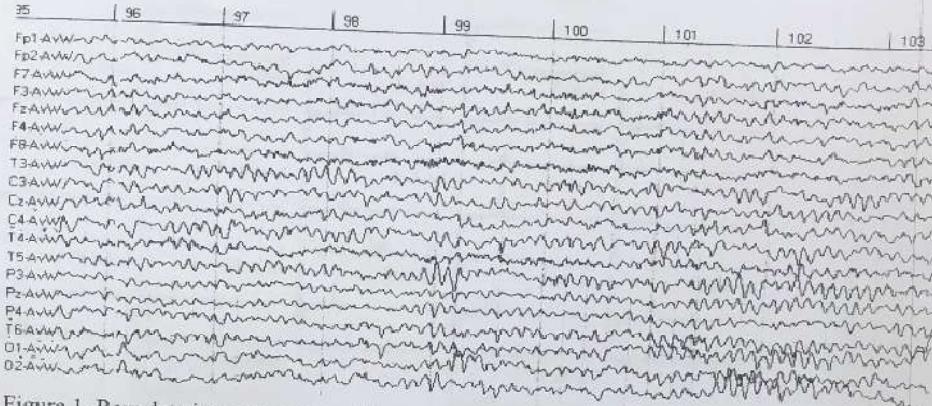

Figure 1. Raw data in eyes open condition

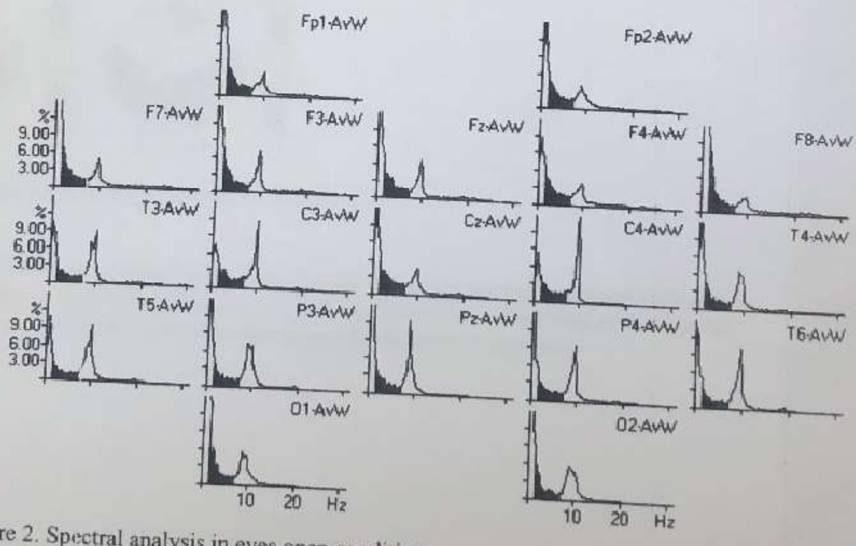

Figure 2. Spectral analysis in eyes open condition

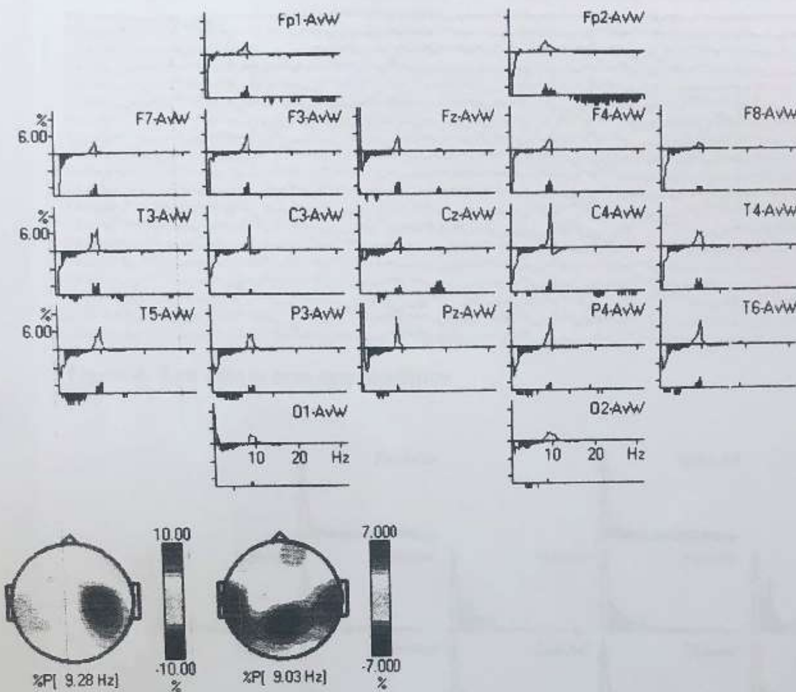

Figure3. Comparation with the normative database

Thirty percentages of the children in the study belong to the first subtype-increased theta amplitude in the fronto-central cortex (Figure 4, 5, 6). Their behaviour is described as the "typical"-ADHD type. Impairment is in the cortex-basal ganglia-thalamus-cortex loop.

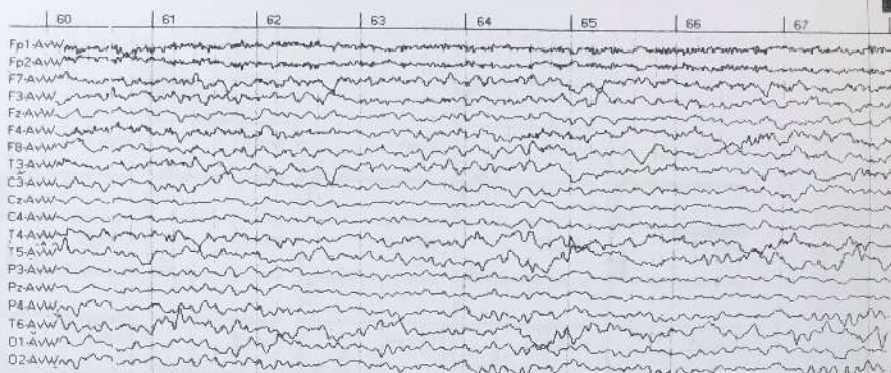

Figure 4. Raw data in eyes open condition

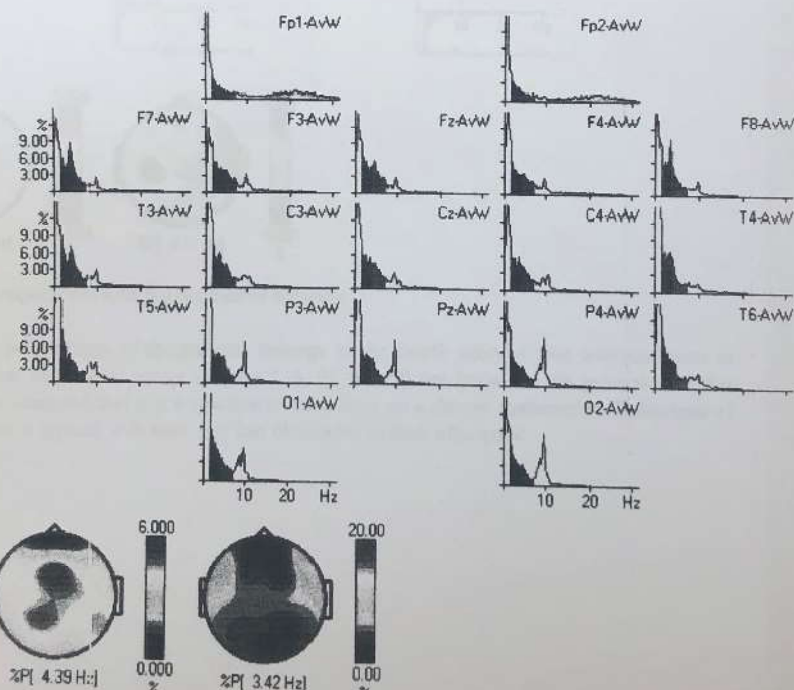

Figure 5. Spectral analysis in eyes open condition

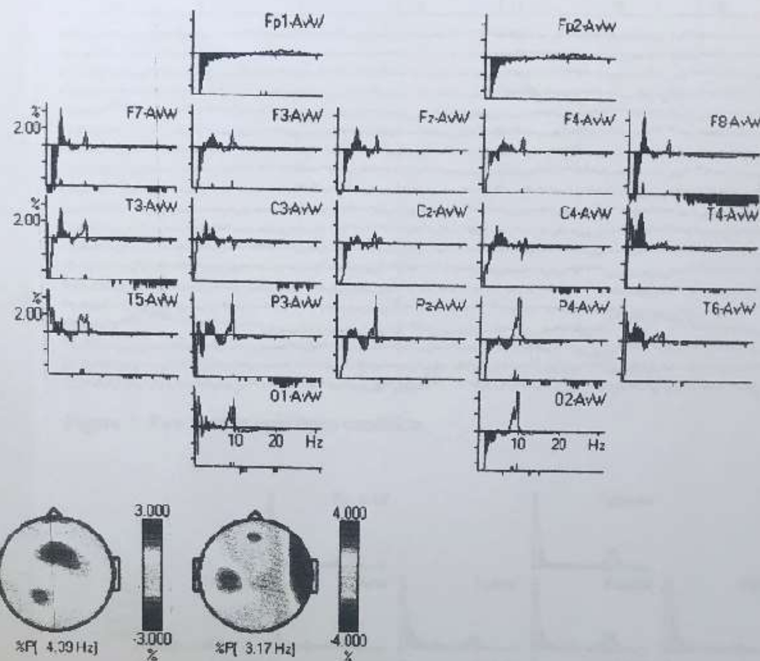

Figure 6. Comparation with the normative database

Twenty-five percentages of the patients belongs to the fourth subtype-over activated beta in frontal, central or parietal cortex (Figure 7, 8, 9). Its still not know the the generator of this subtype. It is assumed that it is a reaction of the cortex on a deeper dysfunction. Behaviour of these children is typical with easy and fast blockades in their efficiency.

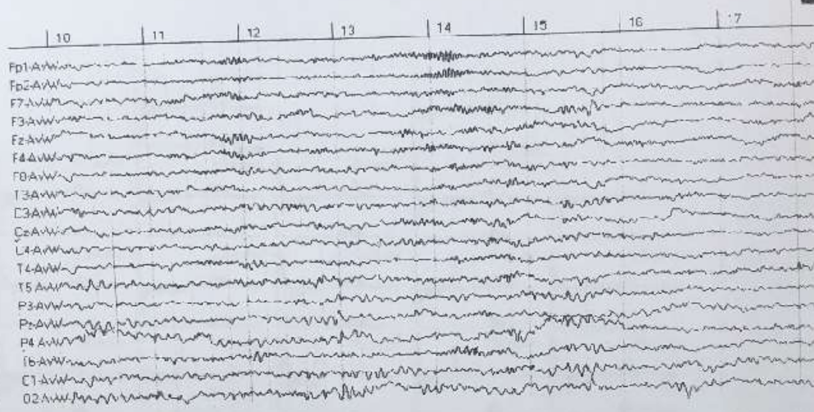

Figure 7. Raw data in eyes open condition

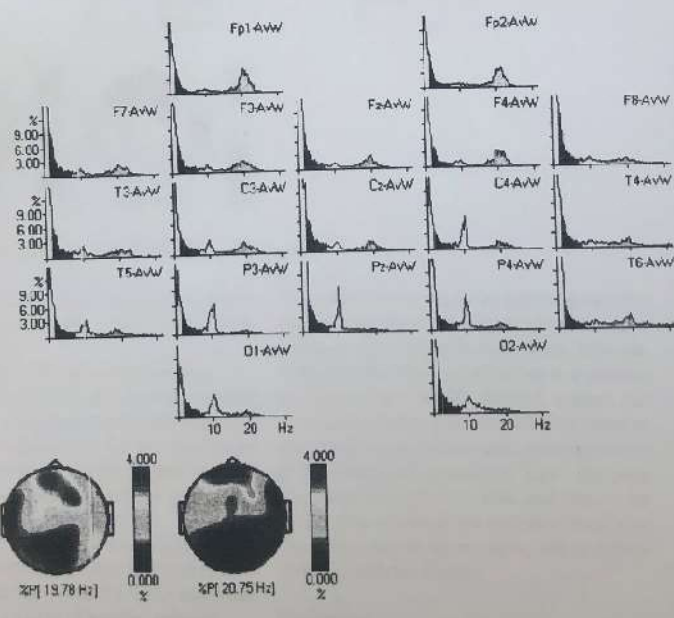

Figure 8.Spectral analysis in eyes open condition

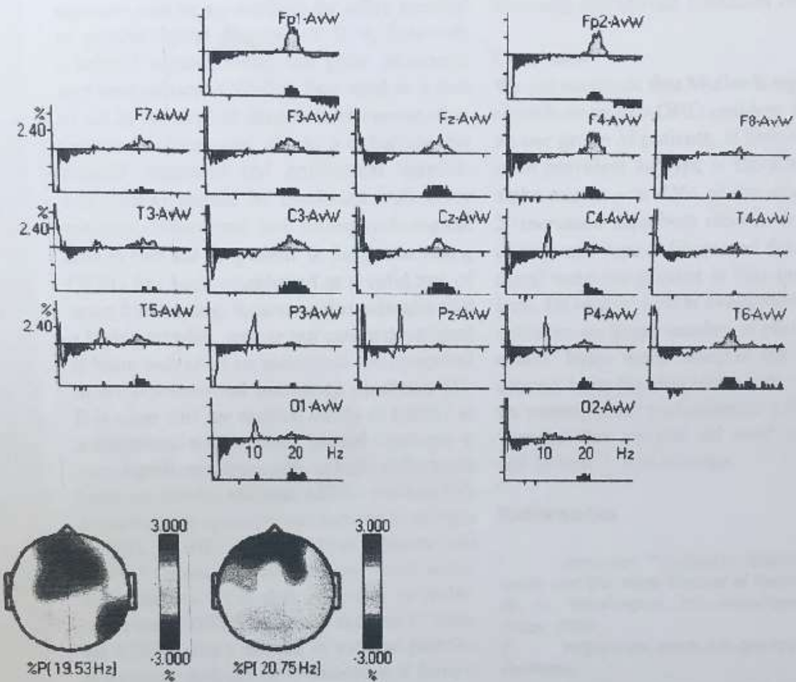

Figure 9. Comparation with the normative database

Type 2 (increased theta/beta ratio in fronto-central cortex) and type 3 (increased frontal-midline theta)
were not found in this group of children.
Results from the QEEG analysis were used for planning the individual therapeutic approach which is combination of the psychotherapy, collaboration with the school professional and the parents, as well as application of the individual neurofeedback protocols.
QEEG shows that in some brain dysfunctions the EEG amplitude in certain frequency bands significantly differs from the EEG amplitude computed for a group of healthy subjects.
Neurofeedback is a tool for correcting such deviation from the normality. Neurofeedback is based on three scientific facts. First, EEG parameters reflect brain dysfunction in a particular disease like ADHD. Second, subject can voluntarily change the state of his/her brain so that changes can be associated with increasing or decreasing the parameters. Third, the brain can memorize this new state and keep it for longer time of period not only in clinical conditions but also in his everyday life in school, at home, with his friends.

Discussion

QEEG is not intended to be a "stand alone" diagnostic tool or a substitute for other medical or psychological diagnostics. It is, however, a helpful adjunct which can guide prognosis and intervention. QEEG is best used as a tool to aid in the clinical diagnosis of various dysfunctional states and not as a substitute for clinical judgment and profesional opinion. The QEEG should be combined with other medical, behavioral and neuropsychological data to best aid the patient. In the recent years, QEEG has been established as a valid test of brain functioning. Research also indicates that a highly reliable, precise test can be developed if brain waves of an individual are compared to well-constructed normative databases [8]. It is clear that the clinical utility of QEEG as a diagnostic tool in many mental illnessess is very significant, especially in EEG differences between ADHD and non-ADHD children [9]. It shows to be sensitive and specific to subtype ADHD, ADHD versus normal subjects, and ADHD versus specific developmental learning disorders. It is also important to understand that a QEEG is not the same as a "clinical EEG," which is used in medical practice to evaluate epilepsy or to determine if there is serious brain pathology, such as a tumor. By contrast, the QEEG does not assess the structure of the brain, but rather, evaluates the manner in which a particular person's brain functions.

If QEEG is so good, why aren't there more clinicians using it? It is estimated that perhaps 3500 clinicians are actively using QEEG in the U.S. Most psychologists and physicians simply have not been educated in the clinical applications of QEEG and have not read the existing research and clinical literature, in spite of the fact that applications to ADHD date back to the 1970's. Furthermore, the instrumentation is rather expensive and requires serious study and training to use it competently. However, a growing number of psychologists and psychiatrists are now beginning to use this tool to assist them in client evaluation and thus in choosing appropriate treatment modalities.

Conclusion

We can conclude that Muller/Kropotov QEEG classification of ADHD children is applicable on our group of patients. It happened that the most prevalent subtype is the fifth one (slow alpha excess – in 45% of the subjects). Type 2 (increased theta/beta ratio in fronto-central cortex) and type 3 (increased frontal-midline theta) were not present in this group of subjects. Of course, further evaluation of the classification on larger number of children is necessary. Brain wave analysis through QEEG appears to be the diagnostic tool of the future for mental health professionals. QEEG has advantages that are still not used in maximum and its time is still to come.

References

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Press; 2000.
2. http://www.nimh.nih.gov/publicat/adhd.cfm#intro.
3. http://www.aacap.org/cs/adhd_a_guide_for_families/what_is_adhd.
4. Polanczyk G, de Lima M, Horta B, Biederman J, Rohde L. The worldwide prevalence of ADHD: a systematic review and met regression analysis". Am J Psychiatry, 2007, 164 (6): 942–8.
5. Pop-Jordanova N, Markovska-Simoska S, Zorcec T. Neurofeedback treatment of children with attention deficit Hyperactivity disorder, MASA, Contributions, Sec.Biol.Med.Sci, 2005; XXVI, 1: 71-80
6. Spencer T, Biederman J, Mick E. Attention-deficit/hyperactivity disorder: diagnosis, lifespan, comorbidities, and neurobiology. J Pediatr Psychol, 2007 Jul; 32 (6): 631-42.
7. Muller A. Neurobiological diagnostics and therapy in ADHD, International Pediatric Days, March 2006, Skopje, Macedonia
8. Chabot, R. Sensitivity and specificity of QEEG in children with attention deficit or specific developmental learning disorders. Clinical Electro-

encephalography. 1996, Jan Vol 27 (1) 26-34.
9. Zorcec T., Pop-Jordanova N., Mueller A. QEEG subtyping of Macedonian children with Attention Deficit Hyperactivity Disorder; Electrical brain oscillations along the life-span conference, October 12-13, 2007, Guttingen, Germany