QEEG as a possible biomarker for ASD diagnosis

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Autism spectrum disorder (ASD)

ASD is a neurodevelopmental disorder characterized by a deficit in social communication, interaction and the presence of repeated stereotypical patterns of behavior, interests and activity.

Research in recent years has focused on the development of ASD biomarkers, characterized by objectivity of measurement and used in the evaluation of physiological and biological processes, pathological processes and the body's response to therapeutic actions.

Among the biomarkers that are important in the diagnosis of neurological and psychiatric diseases, neuroimaging, genetic, electrophysiological and neurobehavioral biomarkers are distinguished. The most accessible electrophysiological biomarker is the EEG examination.

Electroencephalography (EEG)

Non-invasive method of monitoring is easily repeatable, does not require motor or verbal responses from the participant, and most often does not require special preparation
EEG is divided into quantitative and qualitative assessment

Quantitative EEG (QEEG) (power spectra and coherence) provides objective measures in the search for global or focal abnormalities . This method evaluates the spatial distribution of the typical alpha, beta, theta, gamma frequency bands

Aim of study

Analyze QEEG as a **potential biomarker for all frequencies in all areas of the brain,** and compare it with a group of healthy subjects. An important factor is the quantitative evaluation of alpha, beta, theta, and delta waves amplitudes in the QEEG study in children with ASD, depending on the age of the patient.
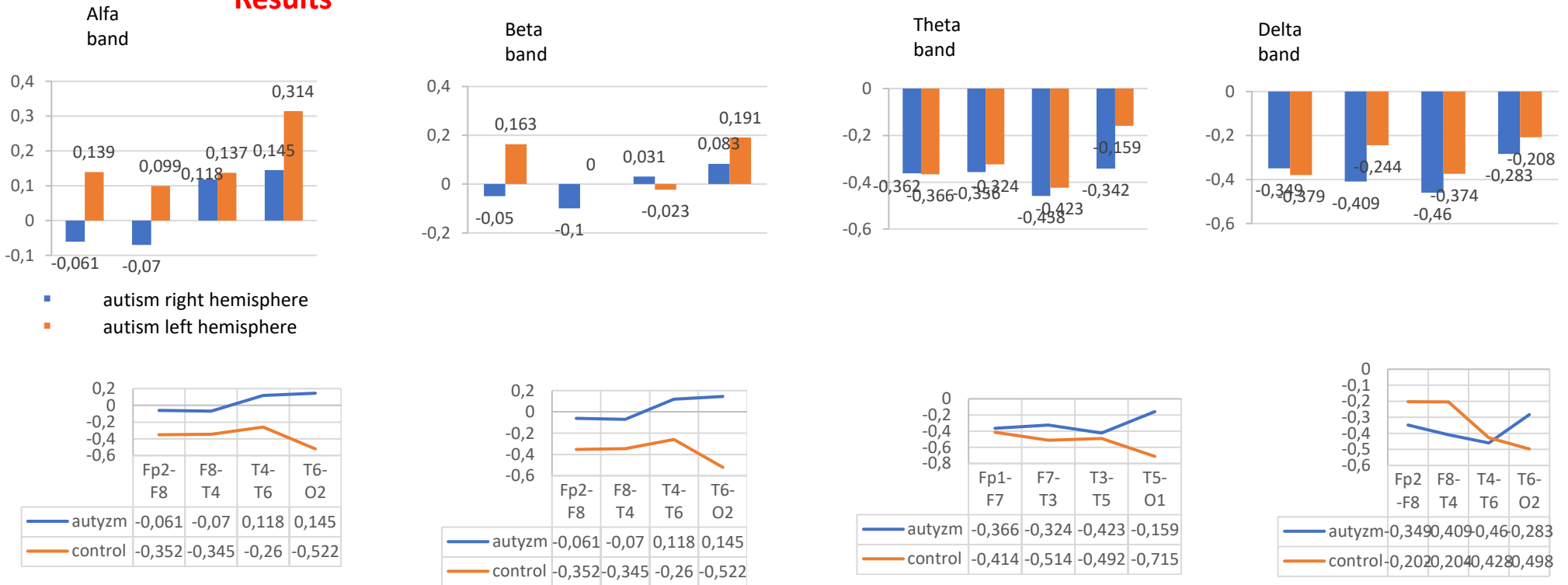
Materials

All patients enrolled in the study were assigned to either autism (36 subjects) or control groups with headache (68 subjects). All headache patients had a history of frequent episodic tension-type headaches (type 2.2 according to ICHD-3 beta classification

Methods

- The examination was carried out with the use of the Elmico device according to the international 10–20 protocol
- The signal was recorded with 19 leads
- For the statistical evaluation of EEG phenomena: the absolute power spectrum was calculated over 5 frequency bands: delta (1-3.99 Hz), theta (4-7.99), alpha (8-12.99 Hz) and beta (13-30 , 99 Hz).

- The amplitudes were measured at every point for each hemisphere: O1, P3, T5, C3, T3, F3, F7, and Fp1 for the left side, and O2, P4, T6, C4, T4, F4, F8, and Fp2 for the right side.

- Amplitude analysis by age was conducted in both groups

Group	Gender	N	Mean	Std.Deviation	Median	Minimum
ASD	Boys	29	9.52	3.313	9.00	4
	Girls	7	7.86	4.298	7.00	3
	Total	36	9.19	3.520	9.00	3
Control	Boys	20	11.90	2.989	12.00	7
	Girls	48	13.50	3.345	14.00	6
	Total	68	13.03	3.305	13.00	6

Results

Alfa band

Values: -0,061; 0,139; -0,07; 0,099; 0,118; 0,137; 0,145; 0,314

- autism right hemisphere
- autism left hemisphere

	Fp2-F8	F8-T4	T4-T6	T6-O2
autyzm	-0,061	-0,07	0,118	0,145
control	-0,352	-0,345	-0,26	-0,522

Beta band

Values: -0,05; 0,163; -0,1; 0; 0,031; -0,023; 0,083; 0,191

	Fp2-F8	F8-T4	T4-T6	T6-O2
autyzm	-0,061	-0,07	0,118	0,145
control	-0,352	-0,345	-0,26	-0,522

Theta band

Values: -0,362; -0,366; -0,356; -0,324; -0,423; -0,438; -0,342; -0,159

	Fp1-F7	F7-T3	T3-T5	T5-O1
autyzm	-0,366	-0,324	-0,423	-0,159
control	-0,414	-0,514	-0,492	-0,715

Delta band

Values: -0,349; -0,379; -0,244; -0,409; -0,374; -0,46; -0,208; -0,283

	Fp2-F8	F8-T4	T4-T6	T6-O2
autyzm	-0,349	-0,409	-0,46	-0,283
control	-0,202	-0,204	-0,428	-0,498

Conclusion

- ➢ Our analysis confirmed that there are differences in the spread of brain waves in people with ASD compared to healthy individuals.
- ➢ Alpha waves, which indicate the level of basic activity organization, in children with ASD show much worse spatial differentiation, mainly in the parieto-occipital areas.
- ➢ These differences were also recorded in the range of beta waves, mainly in the occipital and frontal regions. Differences were recorded in the range of other waves.
- ➢ Theta and delta waves do not need to be pathognomonic for patients with ASD.
- ➢ Alpha and beta waves may be the leading factors to be assessed in EEG testing in children with suspected ASD.
- ➢ The results of the EEG study may represent individual characteristics that distinguish a group of patients with ASD from a healthy group and may be a biomarker of ASD