European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 9, Issue 7, Summer 2022

EEG changes in autism children

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Abstract

Purpose: The purpose of our study was to compare EEG changes of AUSTISM patients with normally developing children, by comparing alpha wave frequency in different EEG electrodes.

Methods: The present study was conducted at SPMCHI, J. K. Lone Hospital attached to S. M. S. Medical College, Jaipur after obtaining the desired clearance from Institutional Research Review Board (IRRB) and Ethics Committee of the Institution. An informed written consent and assent was taken from every subject's parent before commencing any procedure. The study population consisted of 25 Autistic Spectrum Disorder cases of below 18 years of age. An equal number of healthy control subjects were recruited as controls.

Results: The mean value of alpha wave frequency in F3 electrode was 10.77±2.94 in cases while in the control group it was 9.62±1.23. Although the p value was not significant here (0.078). Mean value of alpha wave for P3 electrode. Here for cases, mean value it was 12.42±5.73while for controls it was 11.49±1.57. Again, P value was not significant here (0.439. Comparison of alpha wave profile among cases showed that cases with severe ASD have significant difference from cases with mild &moderate autism. The mean value of alpha wave relative power in F8 electrode in mild cases was 11.28±3.29, in moderate cases was 8.01±2.21 & in severe cases was 7.52±1.92 and here the comparison among them shows that differences are significant (P=0.014). Similarly, we found statistically significant difference in F7 electrode. Although there was no difference in rest of frontal region electrodes and in any of parietal &temporal region electrode.

Conclusion: We conclude that currently EEG cannot be used as a digital biomarker for early diagnosis of ASD till further larger studies.

Keywords: EEG, ASD, Alpha

Introduction

Autism spectrum disorder was first described by Kanner in 1943 and he identified the triad of core characteristics[1]. These features are thought to be the result of atypical neural connections within the brain[2-7]. Autism may be described as a dynamical disorder and analyzed from the perspective of complex dynamical system. Electroencephalography (EEG) can measure neural activity & thus provide an opportunity for early intervention[3-4].

The brain develops rapidly during the first years of life and atypical neurodevelopment is likely due to a combination of genetics, biological, and environmental condition. Some models of ASD are based on atypical development of neural connectivity. This has fueled a search for early neural correlates or biological indicators that could identify ASD in the prodromal phase.[8]

Reliable and relatively low cost, simple EEG measurements may provide important digital neuromarker for early risk assessment and for monitoring the condition's progression.

Methods

STUDY DESIGN- hospital based comparative case control study.

STUDY PLACE-Department of pediatric Medicine, SPMCHI, SMS medical college, Jaipur.

STUDY DURATION-July 2018 to June 2019(1 year)

SAMPLE SIZE- 25 cases & 25 controls were taken in study.

The present study was conducted at SPMCHI, J. K. Lone Hospital attached to S. M. S. Medical College, Jaipur after obtaining the desired clearance from Institutional Research Review Board (IRRB) and Ethics Committee of the Institution. An informed written consent and assent was taken from every subject's parent before commencing any procedure. The study population consisted of 25 Autistic Spectrum Disorder cases of below 18 years of age. An equal number of healthy control subjects were recruited as controls.

Cases were divided into 3 categories-mild, moderate and severe on the basis of severity of core symptoms of autism assessed by ISAA score(Indian scale for assessment of autism).

The patients with score 70-106 were classified as mild cases, patients with score 107-153 were classified as moderate autism and score >153 was taken for severe autism.

In our study, we had 17 patients in mild category, 6 patients were in moderate autism category and 2 patients were in severe autism category. Then we compared these patients for alpha wave relative power in different electrodes.

Inclusion Criteria for Cases

- Children aged below 18 years with Autistic Spectrum Disorder (ASD) presenting to the Child Developmental Centre (CDC)
- Subject who gave written consent

Exclusion Criteria for Cases

- ASD patient with seizures
- Patient who was not cooperative

Data analysis

The quantitative data was expressed as mean ± standard deviation. Significance of difference in means was inferred by t test. For significance 'p' value <0.05 was considered significant.

Results

Table 1. General characteristics

Variable	Case	Control	p-value
Male: female	19:6	15:10	0.891
F3 alpha frequency	10.77±2.94	9.62±1.23	0.078
F4 alpha frequency	10.93±3.37	11.85±2.37	0.269
F7 alpha frequency	10.54±3.31	11.78±369	0.815
F8 alpha frequency	10.21±3.12	10.26±3.07	0.959
Fz alpha frequency	11.55±3.59	11.98±2.36	0.612
T3 alpha frequency	10.68±3.52	10.9±1.89	0.777
T4 alpha frequency	11.52±2.85	10.63±2.32	0.215
P3 alpha frequency	12.42±5.73	11.49±1.57	0.439
P4 alpha frequency	10.86±5.1	10.25±1.97	0.582
PZ alpha frequency	12.02±4.72	11.67±1.72	0.733

Of the 25 patients with autism (19males and 6 females), The mean value of alpha wave's relative power in ASD group in F3electrode was 10.77±2.94 while for well children it was 9.62±1.23. This was not statistically significant between them as P value was 0.078. The mean value of alpha wave relative power in F4 electrode was 10.93±3.37 while for well children it was 11.85±2.37. This was not statistically

significant as P value was 0.269. The mean value of alpha wave relative power in F7 electrode was 10.54±3.31 while for well children it was 11.78±369. This was not statistically significant as P value was 0.815. The mean value of alpha wave relative power in F8 electrode was 10.21±3.12 while for well children it was 10.26±3.07. This was not statistically significant between them as P value was 0.959. The mean value of alpha wave relative power in Fz electrode was 11.55±3.59 while for well children it was 11.98±2.36. This was not statistically significant between them as P value was 0.61. The mean value of alpha wave relative power in T3 electrode was 10.68±3.52 while for well children it was 10.9±1.89. This was not statistically significant between them as P value was 0.777. The mean value of alpha wave relative power in T4 electrode was 11.52±2.85 while for well children it was 10.63±2.32. This was not statistically significant between them as P value was 0.215. The mean value of alpha wave relative power in P3 electrode was 12.42±5.73 while for well children it was 11.49±1.57. This was not statistically significant between them as P value was 0.439. The mean value of alpha wave relative power in P4 electrode was 10.86±5.1while for well children it was 10.25±1.97. This was not statistically significant between them as P value was 0.582. The mean value of alpha wave relative power in Pz electrode was 12.02±4.72 while for well children it was 11.67±1.72. This was not statistically significant between them as P value was 0.733.

Table 2. Comparison of alpha wave frequency among mild, moderate & severe cases

Variable	Mild case	Moderate case	Severe case	p-value
F3 alpha frequency	11.89± 2.4	8.73 ± 2.81	8.58 ±2.01	0.131
F4 alpha frequency	11.91 ± 3.36	9.25 ± 3.09	8.67 ±1.95	0.085
F7 alpha frequency	11.65± 3.44	9.08 ± 2.16.	8.13 ± 1.68	0.34
F8 alpha frequency	11.28 ±3.29	8.01± 2.21	7.52 ± 1.92	0.014
Fz alpha frequency	**12.55± 3.58**	**9.45± 3.32**	**9.73± 3.03**	0.09

T3 alpha frequency	12.06 ± 4.14	9.27 ±1.91	9.08± 1.89	0.13
T4 alpha frequency	11.30 ± 3.41	9.19 ± 1.87	8.84 ± 1.70	0.16

When we compared alpha wave profile among cases, we found cases with severe ASD have significant difference from cases with mild &moderate autism. The mean value of alpha wave relative power in F8 electrode in mild cases was 11.28±3.29, in moderate cases was 8.01±2.21 & in severe cases was 7.52±1.92 and here the comparison among them shows that differences are significant (P=0.014). Similarly, we found statistically significant difference in F7 electrode. Although there was no difference in rest of frontal region electrodes and in any of parietal &temporal region electrode.

Discussion

Autism is a common neurodevelopmental disorder and has significant impact on patient's life. In current era it is usually diagnosed at 3 years of age.

Current methods of screening and diagnosis rely on clinical presentation & parents' interview. Use of genetic markers, neuroimaging findings and other markers is at initial stage and their utility is yet to be established.

EEG was introduced for diagnosis of epileptiform discharge but recent studies suggested that, in the absence of seizure, it still shows differences in waves particularly for alpha waves in certain brain regions. Since then, it has been used in various studies.

Our study was conducted at department of pediatric medicine, sir padampat mother & child health institute (SPMCHI) attached SMS medical college, Jaipur from July 2018 to June 2019.

A total of 25 cases of autism aged below 18 years were enrolled. EEG was recorded for 5 minutes.

In our study we compared mean value of alpha wave amplitude in various electrodes in both the groups, cases and controls. Here we present our results of alpha wave profile analysis.

1. The mean value in F3 electrode was 10.77±2.94 in cases while in the control group it was 9.62±1.23. Although the p value was not significant here (0.078).

2. We compared mean value of alpha wave for P3 electrode. Here for cases, mean value it was 12.42+_5.73while for controls it was 11.49±1.57. Again, P value was not significant here (0.439)

3. When we compared alpha wave profile among cases, we found cases with severe ASD have significant difference from cases with mild &moderate autism. The mean value of alpha wave relative power in F8 electrode in mild cases was 11.28±3.29, in moderate cases was 8.01±2.21 & in severe cases was 7.52±1.92 and here the comparison among them shows that differences are significant (P=0.014). Similarly, we found statistically significant difference in F7 electrode. Although there was no difference in rest of frontal region electrodes and in any of parietal &temporal region electrode.

Electroencephalography (EEG) has been used to explore the neural correlates of brain functions.

Previous studies have suggested that EEG patterns could relate to social communication disabilities in autism. The alpha rhythm (8–12 Hz) has been focused in various studies. The alpha wave of the primary somatosensory cortex has been traditionally called Rolandic or mu rhythm; now tend to use alpha-mu as a general term. During a task execution or task -observation, alpha-mu is suppressed in normal individual. In ASD, the lack of similar effect during action observation leads to the hypothesis that autism was linked to a dysfunction of the MNS – the so-called “broken mirror hypothesis” (and that this dysfunction could be a biomarker of ASD)

So Numerous studies pointed towards alpha waves abnormalities as a marker of social dysfunction in ASD. However, there is no consensus in the literature concerning the abnormal alpha wave profiles in patients with autism spectrum disorder (ASD). This may be due to phenotypic heterogeneity among patients as well as the limited sample sizes.

Our results contrasted with early studies (studies supporting either increased or decreased power in alpha waves activity). Those discrepancies may rely on a higher variability of brain patterns in ASD patients compared to normal participants.

These results encourage development of new approaches and to move away from the traditional case vs. control approach and tackling heterogeneity among ASD cases.

This also encourages a better account of EEG complexity such as the spatial and electro physiologic properties of information transfer between brain regions

Conclusion

The cases with clear cut symptoms, 'classical case', are easy to observe. However, cases with mild/early stage are bit difficult for clinician. Hence these children need an objective test.

The purpose of our study was to find out whether EEG is helpful to differentiate such ASD patient (without seizure) from normally developing children.

We took comparison of alpha waves in EEG in frontal and temporal and parietal region in ASD & control group.

Findings were not statistically significant. Comparison between severe and mild autism showed significant EEG abnormalities in certain frontal electrodes, but yet not sufficient to consider EEG as a new diagnostic tool.

Hence, we conclude that currently EEG cannot be used as a digital biomarker for early diagnosis of ASD till further larger studies.

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