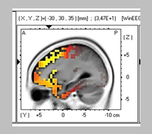

Pharmaco-EEG: A Study of Individualized Medicine in Clinical Practice

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Introduction

Psychiatry does well in many instances, though some refractory cases do not respond to traditional psychotropic intervention. However, Pharmaco-EEG studies are a promising area that could improve psychotropic intervention by using neurological data. The combined use of EEG and qEEG with clinical presentation to identify neurobiomarkers has the potential to link the link neuronal irregularities with presenting symptoms for each age group.

Research Question

Does the combined use of EEG and qEEG with clinical presentation have the potential to identify and link neuronal irregularities with presenting symptoms for each age group?

Emerging Neurobiomarkers

- Encephalopathy (EN) is an organic diffuse disturbance in brain functions that manifests as neurological and psychological abnormalities.
- Focal Slowing (FS) is a predominance of slower electrical activity, often in the left temporal area.
- Beta Spindles (BS) are synchronous activity in the beta range that indicates hyperarousal, often located frontocentrally.
- Transient Discharges (TD) are "EEG cerebral dysrhythemias identified by isolated episodic paroxysmal bursts of slow activity, controversial/anomalous spikey waveforms, and/or true non-confrontational epileptiform discharges."[1]

Diagnoses analyzed in this study

- Attention Deficit Disorder (ADD)
- Autism Spectrum Disorders (ASD)
- Depressive Disorders (DEP)
- Anxiety Disorders (ANX)

Method

Participants

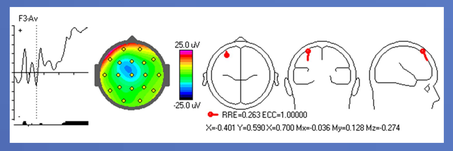
- N = 386: Age in years 5 – 11 (n=119), 12 – 17 (n = 105), and 18 – 69 (n = 162).
- All cases were refractory with at least two failed attempts of psychotropic intervention.
- The Tarnow Center for Self-Management's archival database provided data regarding the demographic information, diagnosis, neurobiomarkers, and the number of medications prescribed for each patient.

Design and Data Collection Equipment

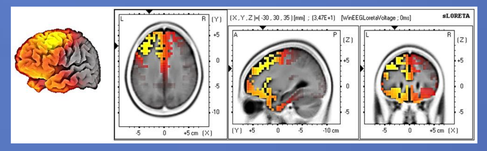
- Deymed TruScan 32 recorded the patients' EEG data.
- Linked ears and averaging montages were referenced, using the international 10/20 system.

Procedure

- Patients wearing EEG electro-caps had Electrogel applied to 19 sites to record their brain activity while resting for 10 minutes with their eyes open, and later 10 minutes with their eyes closed.
- An electroencephalographer identified abnormalities in the raw EEG, while a qEEG researcher analyzed all of the topographical brain maps.



Automatic spike detection maps, based on amplitude-temporal parameters



QEEG 3D low-resolution brain electromagnetic tomography (LORETA) maps

Results

Table 1
Data analyses and *p* -values for each age group

	Depressive Disorders (DEP)		Anxiety Disorders (ANX)	
Age Groups and Neurobiomarkers	Fisher's Exact Test	Logistic Regression	Fisher's Exact Test	Logistic Regression
Children (5 - 11 years)				
EN	.788	.778	.003**	.019*
BS	.588	.483	.619	.826
Adolescents (12 - 17 years)				
EN	.732	.282	.262	.210
BS	.019*	.010**	.420	.374
Adults (18 - 69 years)				
EN	.341	.159	.063	.067
BS	.008**	.006**	.865	.892

Note . * $p < .05$. ** $p < .01$. EN = encephalopathy. BS = beta spindles.

Fisher's exact test and logistic regression indicated three significant findings, one per age group. Children with EN were 11 times more likely to have an anxiety disorder. Adolescents with BS were over five times more likely to be diagnosed with a depressive disorder; adults with BS were three times more likely to be diagnosed with a depressive disorder.

Discussion

- When used separately, an EEG, qEEG, and clinical presentation lack synergy; however, when they are analyzed by an experienced clinician, the shortcomings of each are minimized.
- EEG and qEEG technologies can identify and quantify neuronal irregularities that reflect the brain dysfunction that may cause correlated, psychiatric pathologies.
- The neurobiomarker model across age groups may explain previous medication failure for these patients. If left unidentified, any substantial improvement in psychiatric medication management and efficacious treatment planning would be thwarted.
- The primary limitations are practical concerns: not all refractory patients were medication free prior to the EEG and not all variables were standardized (time of day, mental breaks, eyes open or closed first in the EEG, and time of the last meal).

Conclusions

The findings suggest that EEG/qEEG evaluation provides individualized understanding of medication failures in pharmacotherapy and improving medication selection, guided by the neurobiomarker identification model.

Future Directions

- The neurobiomarker identification model could be validated to assess the long-term impact of medication on children and adolescents.
- Replication with random assignment and pretest/posttest research designs would allow for outcome comparisons between treatment and control groups.

Reference

Neubrander J, Linden M, Gunkelman J, Kerson C. QEEG-guided neurofeedback: new brain-based individualized evaluation and treatment for autism. *J Austimone.* 2011;3:90-100.