EEG cordance findings in patients with attention deficit hyperactivity disorder: Stimulant challenge paradigm

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Introduction

•Cordance is a relatively new quantitative EEG (QEEG) measure that combines complementary information from absolute (the amount of power in a frequency band at a given electrode) and relative (the percentage of power contained in a frequency band relative to the total spectrum) power measures (Leuchter et al., 1994a)

•This measure has been demonstrated to have a moderately strong association with cerebral perfusion (Hunter et al., 2006; Leuchter et al.,1994b)

•In patients with depression, cordance measures have been used successfully in predicting response to antidepressant medications (Bares et al., 2007; Bares et al., 2008; Cook et al., 2002; Cook et al., 2005)

- •Reduction of prefrontal QEEG cordance in theta frequencies has been found to be significant in positive responders to antidepressants as compared to non-responders

•Use of cordance measures to predict medication response has only been minimally investigated in populations other than major depression

•Acute changes in cordance measures may be indicative of positive medication response that correlates with behavioral presentation

Methods

•Sample included 20 self-referred individuals (12 females, 8 males, mean age 24.35 ± 12.32) meeting diagnostic criteria for ADHD based on DSM-IV-TR criteria

- •All subjects were medication-free at time of study

•Subjects were evaluated using the acute medication challenge study paradigm developed by Konopka & Poprawski (2008)

- •In this method, subjects undergo baseline attention, mood, & electrophysiological assessment including:
  - •Integrated Visual & Auditory Continuous Performance Test (IVA+)
  - •Beck Depression Inventory (BDI-II)
  - •Beck Anxiety Inventory (BAI)
  - •Profile of Mood States (POMS)
  - •Quantitative EEG (QEEG)

•Baseline measures were followed by an oral administration of 10-20mg of methylphenidate or dextroamphetamine

- •Selected based on medication history

•Behavioral & QEEG measures were repeated post-medication

•Subjects were separated into groups by medication response

- •Positive medication response was defined by normalization of absolute & relative power QEEG findings to within 2 std. deviations of the mean
- •Positive responders were matched to non-responders based on age, gender, and medication type

•Cordance values were calculated for pre- and post-medication states for each reference electrode using the 3-step algorithm described by Leuchter et al. (1994)

- •Values were statistically compared

Results

QEEG findings

•Positive medication responders:

- •Alpha frequencies:
  - •Significant increases in cordance values at C3 ($p < .028$) and C4 ($p < .015$) electrodes
  - •Significant decreases in cordance values at O1 ($p < .008$), O2 ($p < .037$), and FP2 ($p < .011$)

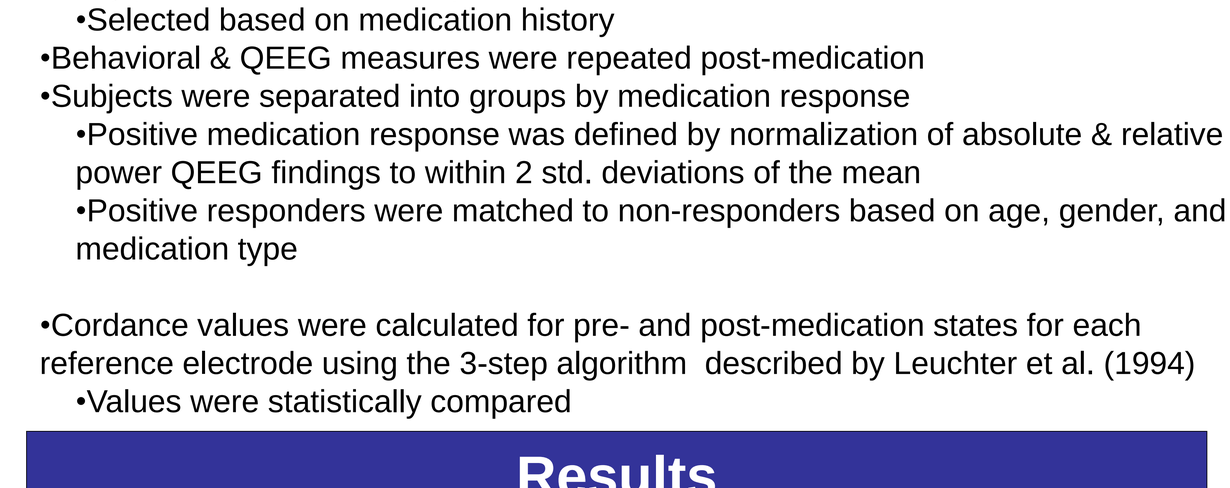

Figure 1. Mean Changes in QEEG Cordance Z-Score Values from Pre- to Post-Medication States in Positive Medication Responders in Alpha Band (8-12Hz)

- •Beta frequencies:
  - •Significant increases in cordance values at P4 ($p < .034$), Pz ($p < .034$), and O2 ($p < .022$) electrodes
  - •Significant decreases at F3 ($p < .040$)

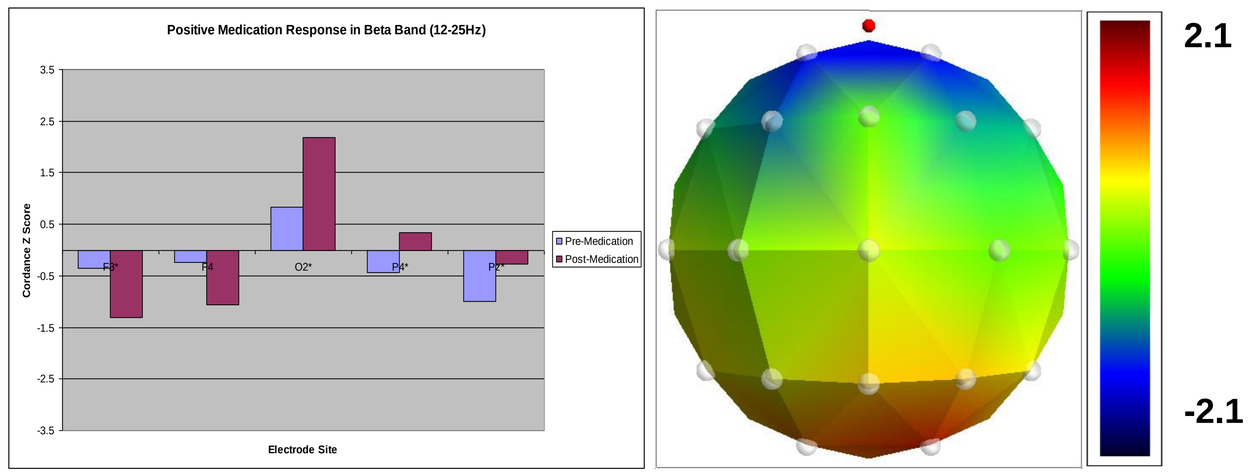

Figure 2. Mean Changes in QEEG Cordance Z-Score Values from Pre- to Post-Medication States in Positive Medication Responders in Beta Band (12-25Hz)

•Negative Medication Responders:

- •Alpha Frequencies:
  - •Significant decreases in cordance intensity at Pz ($t = 2.774$, df = 9, $p < .022$) and O2 ($t = 2.641$, df = 9, $p < .027$)

Behavioral Findings

Positive Medication Responders

Behavioral Measure	Pre-Medication Mean	Post-Medication Mean	Significance
BDI	17.89	10.44	.006*
BAI	9.89	5.89	.018*
POMS			
Tension	14.11	7.67	.015*
Depression	23.33	9.00	.002*
Anger	14.11	3.67	.015*
Confusion	12.89	7.78	.001*
IVA Attention Quotient	83.29	104.86	.070
IVA Response Quotient	82.14	93.71	.152

*p < .05

Negative Medication Responders

Behavioral Measure	Pre-Medication Mean	Post-Medication Mean	Significance
Blood Pressure (Systolic)	116.75	125.13	.006*
POMS			
Depression	24.33	19.67	.005*
Anger	13.50	9.50	.021*
IVA Attention Quotient	84.44	104.44	.025*

*p < .05

Conclusion

•Pre-medication cordance differences between medication responders and non-responders may predict individual responses to stimulants

• Between groups, behavioral measures did not differ appreciably in the pre-medication state

- •Post-medication, both groups showed improvement with significant score increases in a greater number of measures for positive responders

•Future research is needed to investigate differences between stimulant medication groups

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