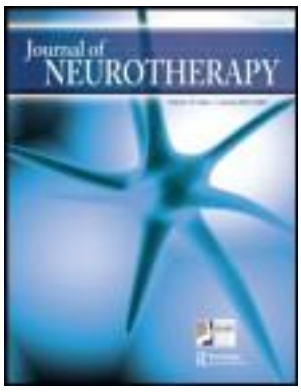

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Abstracts

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ABSTRACTS

QEEG Assessment of Traumatic Brain Injury and Stroke Patients

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Introduction

The advantages of patient-specific narrow band QEEG analysis in the evaluation of neurofeedback treatment outcomes were examined in patients with traumatic brain injury and stroke.

Methods

Pre- and post-neurofeedback treatment QEEG data for three brain-injured patients were analyzed using the SKIL analysis program, normative database, and pre-/post-treatment comparison capability. The patients included a 60-year-old male stroke patient, a 27-year-old male closed head injury patient, and a 12-year-old male with anoxic brain injury subsequent to a drug induced cardiac arrest. In order to avoid rater bias all raw eyes-closed and eyes-open data were cleaned by the SKIL automatic artifact rejection subroutine. Corrected data were analyzed using traditional clinical band designations (e.g., 1-4 Hz delta, 4-8 Hz theta, 8-12 Hz alpha, etc.). In addition to these clinical bands, the data were also analyzed using more accurate narrow bands identified as relevant through single hertz analysis of spectral density distribution.

Results

Analysis via selected narrow frequency bands was more sensitive to neurofeedback treatment effects than analysis via "traditional" clinical bands. Treatment effects that appeared minimal in traditional band analyses were more significant and clearer when a customized, patient-specific resting dominant or pathological frequency band was used.

Conclusions

These findings support the superiority of patient-specific, narrow band frequency analysis as opposed to "standard" clinical bands when assessing neurofeedback outcomes. Subtle individual differences in patients' EEG can

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be obscured by traditional wide clinical band analysis. These preliminary results suggest the importance of increased specificity in the frequency band analysis of QEEG data. They also suggest that the use of QEEG-confirmed, patient-specific frequency bands in neurofeedback protocols would improve training and clinical outcomes as well.

QEEG Assessment of Combined Therapy with Hyperbaric Oxygen and Neurofeedback

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Introduction

Low pressure hyperbaric oxygen therapy (HBOT) is proving useful in the treatment of chronic brain injury. Improvement has been well documented on serial SPECT scans by several hyperbaricists. A possible theoretical basis for the clinical progress seen in many patients during a course of treatment is that breathing oxygen at higher than normal atmospheric pressure may revive idling neurons in the ischemic penumbra. Over twenty years ago, Holbach, Wassmann, and Hohelucter (1976) and Holbach, Wassmann, and Sanchez (1978) published several papers which indicated that EEG change in response to hyperbaric oxygen treatment can be used to differentiate between patients with reversible and irreversible brain damage. They utilized quantitative measures derived from analog data which showed that patients who increased their alpha and beta power, especially over the affected region, were likely to experience functional improvement from a series of hyperbaric treatments and further improvement after surgical intervention. However, the promise of this groundbreaking research has never been fully realized.

Method

We treat brain injured patients using a combination of HBOT and neurofeedback. The patients described in this report were treated in a multiplace hyperbaric chamber at 1.5 ATA for 60 minutes BID, five days per week, and concurrently received one neurofeedback session daily on a Neurocybernetics system. Sixteen-channel QEEG data was collected before, during and after treatment. Data was also obtained in the chamber during oxygen breathing and an hour after treatment. As far as we know, this is the first report in the literature of QEEG data acquisition during hyperbaric oxygen breathing. All QEEG data was analyzed using SKIL.

Results

The first case is a 56-year-old male with a 25-year-old traumatic brain injury from a motor vehicle accident. He had been hospitalized for a month, required ventilator support, underwent facial reconstruction and was permanently amnesic for the first two post-injury weeks. He was left with a left hemianopsia, depression and cognitive difficulties. QEEG revealed left anterior temporal lobe slowing. He received a total of 67 HBO treatments and more than 40 neurofeedback treatments over a five-month period. Both map-guided and symptom-based neurofeedback protocols were used. Serial studies show stepwise improvement and remarkable test retest reliability of the data from the less affected side. This correlates clinically with the patient's self-report of improved mood and cognition.

The second case is a 30-year-old male with life-long learning, attention, memory and mood problems, possibly related to fetal alcohol exposure. His baseline QEEG revealed diffuse slowing as well as elevated beta activity, especially in the right frontal cortex. He received 100 HBO treatments and more than 50 neurofeedback treatments over a three-month period. Improved interval map findings correlate with the patient's subjective improvement, normalization of TOVA scores, improved MicroCog scores (9th to 42nd percentile on processing accuracy) and reduced medication requirements (discontinued SSRI and psychostimulant).

Conclusions

Hyperbaric oxygen therapy and neurofeedback in combination appear to be clinically efficacious in the rehabilitation of patients with a wide range of brain injury and dysfunction. QEEG is a useful, objective assessment tool for evaluating the progress of these patients. Preliminary analyses of QEEG data collected during hyperbaric oxygen breathing suggest this method may have potential as a predictor of treatment efficacy as well as a method for optimizing treatment protocol.

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Mapping the Use of QEEG in the Medical Area: A Search for Data

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Introduction

In the medical area, there has been a considerable scepticism regarding the application of neurofeedback on the basis of Quantitative Electroencephalography (QEEG) data. At the basis of this negative attitude appears to be the assumption that QEEG as a method is an experimental tool, only to be used as an extension of the visual analysis of the clinical EEG done by an expert, the neurologist. The current paper sought to investigate the actual position of the QEEG as a method within the medical area.

Method

A computer-based literature search was done by PubMed, using the key words: EEG, QEEG and quantitative EEG.

Results

The results are an overwhelming 17,366 EEG publications and 1,831 QEEG publications. The search by medical specialty revealed a surprisingly high hit of more than 600 publications about QEEG in the field of pharmacology. Specificity, sensitivity and predictive value of QEEG as a diagnostic and measurement tool for therapeutic treatment effects are discussed by means of review articles, partly written in defense of the QEEG positioning report of the American Academy of Neurology and the American Clinical Neurophysiology Society by Nuwer (1997). The positioning article of the ANA states, "... on the basis of current clinical literature, opinions of most experts and proposed rationales for their use, QEEG remains investigational for clinical use in post-concussion syndrome, mild or moderate head injury, learning disability, attention disorders, schizophrenia, depression, alcoholism and drug abuse." In the rebuttal papers written by two other groups of experts (Hoffman et al., 1999; Thatcher et al., 1999), the investigational status of QEEG with regard to the above mentioned syndromes is questioned on the basis of peer reviewed publications. They ask for a revision of the recommendation of the ANA on the basis of this evidence. The evidence shown by Hughes and John (1999) in their review paper is discussed. In their article a very clear theoretical expose is given about the basics of EEG and QEEG. The essential role of very specific EEG patterns that are typical for normal functional humans at rest, the dominant alpha frequency, is discussed. The fact that this QEEG variable is free of racial, cultural and regional influences has been well researched. The use of

normative databases to distinguish abnormal from normal patterns has revealed distinctive patterns for several syndromes.

In depression, increased alpha and theta power have been found. Additionally, an inter-hemispheric asymmetry in the frontal areas was found. In agreement with other imaging methods, Sterman and Kaiser (2001) report a pattern of pre-frontal and frontal cortical hyper-comodulation in the patients' true dominant frequency band that is highly correlated with the diagnosis of depression. For the use of QEEG in depression Hughes and John (1999) give on the basis of multiple class I studies a type B, or positive, recommendation. In anxiety disorders there is not a clear picture yet. A beta and an alpha subtype have been seen. More research has to be done in this area. In alcohol related disorders there is broad consensus that the effects on the EEG are seen as marked abnormalities. Increase in slow activity, with lower alpha or beta accompany the intake of alcohol. With cannabis and cocaine, increases in alpha activity are reported. However, John and Hughes offer a negative, type D, recommendation for the use of QEEG in this area, on the basis of conflicting class II evidence.

The use of QEEG in the diagnosis of Mild Traumatic Brain Injury (MTBI) is also reviewed by Hughes and John (1999). On the basis of several class II studies and multiple concordant class III studies, they propose a type C, or positive recommendation. The evidence given by more recent studies are corroborating this recommendation. Thatcher (2000) states that QEEG is the only imaging tool today that can reliably detect abnormal brain function in mild traumatic brain injury. Thatcher's research indicates that the distinctive and persistent QEEG patterns, increased coherence and decreased phase in frontal and fronto-temporal regions, reduced alpha band amplitudes in the parieto-occipital regions, and decreased power differences between anterior and posterior regions, may indicate a difference in the neurophysiological organization of the cerebral cortex in mild TBI patients. He also recommends the use of QEEG as a guidance tool for planning and evaluating neurofeedback therapy in patients with mild traumatic brain injury.

The research in learning and attentional disorders by Chabot, de Michele, Prichep, and John (2001); Monastra, Lubar, and Linden (2001); and Sterman (2000) has been reviewed. This literature shows several distinctive QEEG profiles involving increased frontal or generalized theta and alpha activity in children with ADD/ADHD, and suggesting several different pathophysiological subtypes. These patterns are not seen in children with specific learning disorders who, instead, show deceased alpha and/or beta activity and high coherence frontally. The data show further that children with ADHD can be discriminated from normals by means of the QEEG with a 88% specificity and a 94% sensitivity. The number of children that are involved in the reviewed studies is very high: a few thousand; this gives the statistical data more power.

Hughes and John (1999) gave a positive recommendation for the clinical use of QEEG in ADHD on the basis of multiple class II studies and abundant class II evidence a type B.

Conclusions

These data clearly justify QEEG as a measurement tool for brain function. QEEG offers a unique contribution to the armamentarium of imaging technologies. The sensitivity and specificity of QEEG is at the same level as clinical measurement tools like MRI and clinical blood tests. On the basis of the high specificity of normative and syndrome related databases, QEEG is well suited to be used as a guidance instrument for neurofeedback treatment planning and evaluation.

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Analysis of QEEG Data from Eastern European Orphans with Reactive Attachment Disorder

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Introduction

Reactive attachment disorder (RAD) presents a more complicated array of symptoms and problems than the attachment issues addressed in the DSM-IV. A number of children adopted from orphanages in Eastern Europe have been identified as having this diagnosis. This presentation examined the QEEG findings from a group of these children.

Method

Participants were eight children ranging in age from 6 to 12 years old. The children were all adopted from Eastern European orphanages and were between one and seven years of age at adoption. The children were all independently identified as having RAD and were in treatment programs at the time of the study. EEG was recorded on these subjects using the Lexicor NeuroSearch-24 and analyzed using the SKIL QEEG analysis program. This program provides for the plot of both multiple individual or group data in a statistical comparison of specific frequency components of the EEG against a normative database, and in both resting and engaged states.

Results

Analysis of the group data revealed significant magnitude elevations in 1-4 Hz activity at all sites except for FP1 and FP2 and elevated 4-7 Hz activity at the temporo-central strip of T3, C3, CZ, C4, and T4 in the eyes-closed condition. In the eyes-open condition, magnitude elevations were seen in the 1-4 Hz range in all sites except FP1, FP2, F7, F4, and F8, while elevated 4-7 Hz activity was seen in all sites except FP1 and FP2. Widespread hypo-comodulation problems in the dominant frequency were discovered in both the eyes-closed and eyes-open conditions, particularly between bilateral frontal and temporal sites.

Conclusions

Generalized 1-4 Hz activity could result from medications, artifact, or both, and should be viewed with caution. However, the statistically documented elevation in 4-7 Hz appears meaningful. The hypo-comodulation observed offers an explanation for the common learning and affect regulation problems seen in

this population. Implications for neurofeedback training focus on 4-7 Hz suppression and facilitation of dominant frequency comodulation. The need for a child database addition to the SKIL program was emphasized, although relative measures were still helpful in this mixed-age group.

Assessment and Treatment of TBI and Seizures: An Olympic Athlete Returned to Competition

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Introduction

This case presentation details the QEEG findings and neurofeedback outcomes in a middle-aged female athlete who specialized in the Winter Olympics sport of Luge. After many years of competition in this sport the client had sustained multiple and significant head injuries. The most recent, in 1999, was followed by an outbreak of major-motor seizures and a diagnosis of epilepsy. Medications failed to control these seizures. Due both to these medications and the persistence of seizures she was disqualified for competition in the 2002 Salt Lake City Olympic games.

Method

The baseline QEEG disclosed significant frontal disturbance indicated both by elevated dominant activity and a peculiar slow pattern. Additionally, SMR activity was low in left central cortex. An intense training program, spanning only one month, was undertaken to facilitate left central SMR while suppressing frontal 1-4 Hz activity.

Results

The client subsequently experienced a cessation of seizures and was able to withdraw from medications. The post-training QEEG showed a significant reduction of frontal slow activity and an attenuation of the excessive dominant activity as well.

Conclusion

The subject reapplied for qualifying trials for the 2002 Winter games. She was qualified, and competed successfully, her time being in the top 50%. This was particularly satisfying as she was the oldest female athlete competing in these games. She is currently continuing neurofeedback treatment when possible.

A Diagnostic Dilemma: ADHD or Not?

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Introduction

The purpose of this study was to assess the utility of tests, including QEEGs typically used to diagnose ADD/ADHD. A male client, 11 years old, was the focus of the study. The mother had referred the child because his school was insisting the child was ADHD and requesting he be maintained on medication. The mother also sought services because her child was not sleeping or eating very well. The child was taking 10 mg of Prozac each day and 36 mg of Concerta during the week. When he was tested only the 10 mg of Prozac had been administered.

Methods

The tests and tools compared were the child's history, TOVA, TOVA Interpret (from EEG Spectrum), symptom checklist based on ADD/ADHD DSM IV criteria, Thatcher Normative Database analysis through Datalex, the Datalex ADHD indictor, and the SKIL QEEG analysis program. The strengths and weaknesses of these various tests were examined.

Findings

The first difficulty with arriving at a diagnosis was the subjectivity of the DSM IV criteria and the fact that the onset had to have been established by age seven. This child had not demonstrated any of the symptoms prior to this year. The TOVA and TOVA Interpret pointed to ADHD. Left hemisphere beta training was suggested via the TOVA Interpret. However, the DATALEX ADHD indictor based on the work of the Lubar group ruled out ADHD and all subtypes. The Thatcher Normative Database analysis through Datalex suggested an anxiety/depression subtype, due to frontal and left-right hemisphere asymmetry. The SKIL analysis confirmed a left-right frontal dissociation via comodulation analysis and also demonstrated medial-frontal slowing but with significant elevation of 15-18 Hz activity in the right frontal region. ADHD was not indicated. Since the child had experienced the 9/11 terrorist attack and one month later the attempted suicide of his father, we proposed a working diagnosis of Post-Traumatic Stress Disorder.

Conclusions

The findings point to the difficulty of using only one or a small number of tests to separate out and accurately diagnose any disorder. The subjectivity of

the clinical criteria for ADD/ADHD, the high percentage of false positives for the TOVA, which influences the TOVA Interpret, and the lack of the midline in the Thatcher database all indicate that these tests need to have corroborating data to support their conclusions. The DATALEX ADHD analysis and the SKIL Topometric analysis provided the most conclusive information for formulating a diagnosis and training plan.

Attentional Synchrony: A Novel Method to Index Attention with QEEG

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Introduction

Behavioral synchrony between individuals is well established (e.g., mother-infant, conversational). Attentional synchrony between individuals is presumed in such examples and other situations but no one has investigated it. Attentional synchrony may be investigated by examining the natural fluctuations in attention observed during lengthy stimulus presentations ("arousal jags," Berlyne, 1971). When many individuals process the same stimulus at the same time, attentional fluctuations are expected to co-occur to the degree that a stimulus is engaging, to the extent that it regulates each person's attentional state.

Method

Synchronization of attention between individuals was evaluated in 20 subjects with quantitative EEG during short films and baseline conditions. Attentional synchrony was defined as between-subject variance of successive alpha magnitude (8-12 Hz, 1 s epochs). Boring films were expected to produce diverse processing responses as some subjects followed the storyline closely while others pondered unrelated thoughts or followed the narrative not as closely. Interesting films were expected to induce comparable alpha amplitudes across subjects across time as a narrative's temporal pattern engages and holds subjects' attention similarly. Parietal sites were selected for analysis as these sites had previously been found sensitive to overall interest levels.

Results

As expected, eyes-open baseline conditions most resembled boring films in attentional synchrony. Boring films resulted in high amounts of between-subjects variance in alpha magnitudes (i.e., low attentional synchrony), especially

during the last 30 s of each film, whereas interesting films produced little variance between subjsects. Interest ratings significantly correlated with mid-parietal alpha magnitude between-subject variance (rho = -0.80, $p < .01$).

Conclusions

Attentional synchrony appears to exist in film watching and can be readily measured in a group. Attentional synchrony between individuals may prove to be initially more relevant to clinical application than the time-consuming and subject-intensive technique of measuring between-subject variance of dominant frequency activity. Attentional synchrony is likely a necessary component of joint attention, and probably plays a role in the rewarding nature of this common occurrence. Impairments of joint attention are symptomatic of autism, schizophrenia, and other devastating disorders (e.g., Claussen, Mundy, Mallik, & Willoughby, 2002; Mundy & Crowson, 1997). This technique has the potential to become an objective measure of a child's or adult's ability to demonstrate age-appropriate attentional patterns. Early intervention effects in autism are currently hampered by a lack of precision in outcome measurement (Mundy & Crowson, 1997). Other clinical applications were discussed.

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Time-of-Day Effects: A Chronic Confound of Psychophysiology Evaluations

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Introduction

Chronobiological rhythms have been studied for more than 250 years (e.g., Jean Jacques de Mairan in 1729). Circadian and ultradian (less than 24-hour)

rhythms are present in most if not all physiological variables. Diurnal variations have been commonly reported in a variety of arousal indices, from task performance to subjective ratings to EEG frequencies (e.g., Chapotot, Jouny, Muzet, Buguet, & Brandenberger, 2000). Although ultradian rhythms were identified in human EEG more than 30 years ago (Scheich, 1969) and were suggested as a possible confounding influence on EEG biofeedback training 20 years ago (Gertz & Lavie, 1983), their role in quantitative EEG assessment has been largely ignored. The current research attempts to identify and quantify the effect of ultradian rhythms in the standard frequency bands.

Method

Nineteen-channel quantitative EEG was recorded from 126 normal participants (102 males, 22 females, 19 to 43 years of age with a mean of 32 years, all right-handed) during eyes-closed and eyes-open resting conditions across the day (8 a.m. to 6 p.m.). Participants contributed two or more recordings per condition one to two hours apart. Spectral magnitudes in standard frequency bands (delta, theta, alpha, SMR, low beta, high beta) were analyzed for one-hour segments across the day.

Results

The time-of-day effect (i.e., the difference between one-hour means from the entire sample's mean) ranged from 4 to 16 % across the morning and afternoon. Reduced interindividual variability was also observed when data were binned into one-hour segments compared to the global (all-day) average, $p < .05$. Dominant spectral magnitudes peaked around 1 p.m. and varied most noticeably between 10 a.m. and 11 a.m. for all sites and at parietal sites between noon and 1 p.m. and between 1 p.m. and 2:30 p.m., $p < .01$. An ultradian rhythm with a 2.5-hour period was evident in dominant frequency activity.

Conclusions

Despite the cross-sectional nature of the data, strong evidence of ultradian and circadian rhythms was found, suggesting that time of day may play a confounding influence in multiple comparisons if not controlled. Diurnal variations were greatest around mid-day, which is consistent with the chronobiological literature (e.g., Cacot, Tesolin & Sebban, 1995; Cummings, Dane, Rhodes, Lynch, & Hughes, 2000). All frequency bands exhibited ultradian rhythms (to varying degrees), confirming the conclusions of Chapotot et al. (2000).

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Using Bipolar Placements to Address Comodulation Issues: Hobbling Along While Awaiting the NeuroNavigator

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Introduction

One of the major contributions of SKIL software to quantitative EEG analysis is comodulation (Sterman & Kaiser, 2001). Frequently topometric analyses fall well within normal limits, but comodulation reveals underlying deviant patterns needing attention. The ideal neurofeedback protocols for addressing these discordant relationships require real-time feedback for successive approximations towards normalized comodulation between affected sites. To date, no existing neurofeedback equipment and software package offers this capability though the NeuroNavigator (under development) promises to provide it for up to four pairs of sites simultaneously.

A young couple sought neurofeedback treatment for their eight-year-old daughter and described her as follows: (a) 80% ADD, 20% ADHD, (b) emotionally labile cycling from mildly difficult to intransigent over a course of six to eight weeks, (c) periodically impulsive, (d) difficulty in shifting gears, and (e) intermittently obsessional. The mother described herself as from an alcoholic family with her father very prone to rages.

Method

A 16-channel MindSet and an Electro-Cap were used to collect three- to five-minute samples of EEG activity with eyes-closed, eyes-open, while read-

ing, and solving math problems. These samples were analyzed with SKIL QEEG software. Bipolar placements were used in sixteen sessions of training using NeuroCybernetics equipment and version 3.12k software. Although bipolar placements do not allow precise determination of changes in EEG at specific sites during training, the protocol requires some change in relationship to occur between sites during training to obtain reward. Training frequencies used were pegged just slightly above the child's dominant frequency. The mother made regular verbal reports about symptoms from session to session and somewhat erratically recorded notes on a calendar both prior to and during treatment. Data for a mid-treatment QEEG was collected and analyzed as noted above.

Results

The child's dominant frequency with eyes closed was 10-11 Hz. Comodulation patterns were examined emphasizing the dominant frequency using a 2.4 standard deviation criterion for significance to compensate for the current lack of a child database in SKIL. A number of disconnection patterns were noted across states primarily involving sites F3, F4, C3, and C4. The most striking site, F4, appeared disconnected from the entire left front quadrant (i.e., Fp1, F7, F4, T3, and T4) for the eyes-open, reading, and math conditions.

Training emphasized C3-C4, C3-F4, and F3-F4 to address the most salient comodulation issues. The training frequencies used were 12-15 or 11-14 Hz. Comodulation patterns showed conspicuous pre-post alterations. At least two of the previous five sites disconnected from F4 no longer showed significant disconnection for the eyes-open, reading, and math tasks. C3 and C4 also showed relatively greater comodulation with each other or nearby sites for those tasks.

The mother reported that her daughter showed substantial changes between assessments over the course of the 16 sessions. She reported a several-week period during which her daughter was very pleasant to be with and showed markedly reduced intransigent behavior. She also exhibited a three-week dip in behavior much milder than previous down cycles after which she reverted to a relatively symptom-free period. Several weeks into the training the child's teacher spontaneously reported that the child had suddenly improved in her phonetic word attack skills while reading.

Conclusions

Comodulation seems to offer another avenue for accessing dysregulatory features of the brain's activity. Inter-site training with precise definition of desired co-regulation parameters seems to offer a good strategy for ameliorating some deviant patterns. In the absence of such precision, the bipolar training described appeared to jostle disconnected sites both forcing them to harmonize better and to allow a happier relationship between parents and child.

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Topometric and Comodulation Findings in Depression, Work-Related Stress and Chronic Fatigue Syndrome

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Introduction

This was an inductive study using the SKIL QEEG comodulation analysis algorithm to assist in identifying regional brain differences in subjects with depression, work-related stress (on work leave), and chronic fatigue syndrome (CFS). The comodulation analysis examines spatial-temporal cross-correlation of spectral estimates in the resting dominant frequency band. Investigation of comodulation as shown by (Sterman & Kaiser, 2001) indicates CNS structural alterations and functional disturbances in a number of different disorders. It is well established in the literature that the hypothalamic pituitary adrenal (HPA) axis is altered in affective disorders and that the prequel to depression is often the chronicity of the stress response, with concomitant alterations in prefrontal norepinephrine and dopamine pathways. Chronic fatigue syndrome is also sometimes considered to be part of a dysfunctional HPA axis. This research attempted to explore the EEG findings in depression, work-related stress (on work leave) and CFS, with and without SSRI anti-depressant medications, using the comodulation metric and topometric database comparisons.

Results

All analyses examined the eyes-closed condition only. Subjects were assigned to groups based on the initial diagnosis (depressed, CFS or stress) and QEEG evaluation. For the depressed subjects three group trends emerged which included: (a) an un-medicated group that showed frontal hyper-comodulation in the resting dominant frequency of 9-11 Hz and high alpha levels compared to the database in topometric analysis (N = 6), (b) a second depressed group that was medicated (SSRI) and in whom the QEEG did not reveal atypical comodulation but the topometric database comparison showed

low alpha activity (N = 6), (c) a third depressed group similar to the first was unmedicated and showed a frontal hyper-comodulation but differed in the topometric by showing low alpha levels (N = 6).

The CFS group showed two trends. First, the unmedicated CFS group showed an anterior-posterior dissociation (APD) pattern in the comodulation metric in the resting dominant frequency (9-11 Hz) and high alpha magnitudes compared to the database mean (N = 5). Second, the medicated CFS group (SSRI) did not show any clear APD pattern and similarly to the medicated depressed group showed low alpha levels compared to the topometric database mean (N = 5). None of the work-related stress leave subjects were medicated (N = 5). The QEEG evaluation of this group showed no atypical findings in the comodulation metric; however, the alpha band was lower than the database mean in the topometric comparison.

Conclusion

The QEEG appears to be a sensitive and necessary measure in determining response to and efficacy of medication. Further, it shows that medications alter the temporal modulation of the EEG. This may be helpful in the accurate evaluation of patients presenting with the above disorders and subsequently medicated with an SSRI. This small study indicates that medication may impose a general suppression of the dominant frequency resulting in a profile similar to those evaluated as stressed, and calls into question the efficacy of such medications. Additionally, these early results indicate that depressed patients with the finding of low baseline alpha may not be good candidates for SSRI administration.

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QEEG Characteristics in Asperger's Disorder

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Introduction

This study compares the QEEGs of seven children ranging in age from five to fifteen years, six males and one female. Three had been diagnosed with Asperger's Disorder by a psychiatrist and four had not yet been medically

evaluated for Asperger's Disorder, although their symptomatology would support such a diagnosis. Subjects were seen in a private psychology practice specializing in neurotherapy.

Methods

QEEGs were recorded from seven participants using a standard 19 channel recording cap and linked ear reference (Lexicor NRS-24). The data were then analyzed using the SKIL topometric analysis program. Reports were generated showing the data analysis for all participants, and the results of the analysis tabulated to examine the QEEG and neurological characteristics common to some or all participants.

Results

All seven participants were able to suppress dominant frequency in engaged states. All subjects failed to suppress beta 2 activity (18-23 Hz) frontally and showed slowing at CZ while reading. Six showed slowing in the occipital region, possibly due to lambda activity, also while reading. Slowing was defined as activity having the highest amplitude in that state at a frequency equal to or below the subject's dominant frequency. Six of the participants showed significant comodulation disturbances between anterior and posterior regions of the cortex. Six subjects showed significant hemispheric asymmetry in the frontal and prefrontal regions in the beta 2 band while reading. Asymmetries while performing math were greater on the right in five subjects. Other asymmetries varied from right to left between states and with no apparent pattern.

Conclusions

The QEEG characteristics of the seven subjects studied here showed a number of common functional features, including difficulty in suppressing higher frequencies with engagement, slowing at the vertex, and regulatory dissociations between anterior and posterior regions of cortex. These findings may be related to the mechanisms underlying Asperger's Disorder.

Successful EEG Normalization and Symptom Alleviation with Comodulation Neurotherapy: Headache and OCD

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Introduction

Integrated training using two separate sites with adjustable frequency, threshold, and direction logics was used to treat two cases with complicated

neuropsychological symptoms. The first was a middle-aged female with a history of incapacitating exertion-induced headaches and cognitive deficits, subsequent to a MVA-related head injury and CSF pressure shift. The second was a young adult female with disruptive anxiety and diagnosed OCD.

Method

Treatment in both cases was based on QEEG findings, using the SKIL Topometric analysis program. In the first case this involved a clear anterior-posterior dissociation (APD) pattern, detected with comodulation analysis of the dominant resting EEG frequency band, as described by Sterman and Kaiser (2001). In the second, both magnitude and comodulation analysis disclosed a zone of cortical irritability and functional disturbance in the right fronto-central region. An attempt was made to construct treatment-reward contingencies that addressed each of these patterns.

Findings

Pre- and post-QEEG, training records, and clinical changes confirmed significant improvement in both cases. In the first case training data showed the progressive development of parity in magnitude values between frontal and central recording sites in virtually all frequency bands but particularly in the resting dominant range. QEEG statistical analysis confirmed the elimination of the APD pattern identified in the pre-training study. Headache logs and behavioral assessment documented significant symptom reduction, as did a return to gainful employment. In the second case, high frequency, irregular EEG activity at right frontal sites during training was replaced by stable normal traces, and the post-training QEEG showed a statistically significant normalization of all previously deviant quantitative elements. Behaviorally the patient displayed a reduction in her anxiety level and some mastery over OCD manifestations.

Discussion

According to QEEG findings and the primary rationale for neurotherapy, which is EEG normalization (Kuhlman & Kaplan, 1979), these cases could not have been appropriately treated with any presently used standard protocol. The QEEG provided direction in terms of the relevant frequencies, topography, and functional implications in each case. However, positive reward for the medial central 12-15 Hz SMR was periodically combined with the specific elements of QEEG-directed protocols through integrated training, a practice that appeared to facilitate desired results.

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The Neuropsychology of Child Neglect: Developmental Consequences, Case Examples and Legal and Societal Implications

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Introduction

Current understanding of brain development demonstrates the need for proper nutrition, adequate environmental support, and stimulation in order to ensure healthy children. Neuronal plasticity (Kolb, 1995) allows for some recovery of function, but the lack of a healthy developmental environment in utero and during the first three years of life has permanent and irreversible consequences leading to problems in physical, cognitive, emotional and social domains (Siegel, 1999).

Method

Present knowledge of brain development as it relates to child neglect is addressed (Weinstein & Weinstein, 2000). Two case studies are presented.

Results

The first case is of a 16-year-old adolescent who was born and raised in Russian orphanages for the first eight years of her life and then adopted and brought to the United States. Extensive neuropsychological data, psycho-educational information, quantitative EEG, and MRI information demonstrate the damage done by early neglect. Salient information reveals that this child had almost no language, and was severely undernourished and underdeveloped. With proper nutrition and stimulation she was able to recuperate some functions. Neuropsychological and neurophysiological deficits persist to the point of severe learning disabilities and poor social skills.

The second case study is of an individual from an extremely neglectful early development environment that lead to a life of violent criminality and culminated in a death sentence. In contrast to the relatively positive outcome in the case of intensive intervention with the Russian orphan, the examination of death-row inmates reveals that early brain developmental deficits can lead to negative consequences for the individual and society (see Weinstein and Sterman abstract, pg. 133). Neuropsychological and neurophysiological data obtained from a group of individuals accused of and/or sentenced for capital murder will demonstrate the consistent early neglect associated with brain dysfunction leading to a failure of behavioral control.

Discussion

This growing understanding of the importance of brain stimulation in early childhood to healthy development in all domains must be incorporated into the legal principles and processes that determine rights and responsibilities in a civilized society. Failure to provide services that compensate for deficits in brain development due to environmental factors results in harm to individuals and society that might otherwise be prevented (Shonkoff & Phillips, 2000). Welfare costs, the intergenerational cycle of child abuse and neglect and its concurrent costs, the costs of the criminal justice system including costs of long-term incarceration as well as execution, are among the very concrete expenses to society for failing to acknowledge this new information (Polansky, Chalmers, Buttenweiser, & Williams, 1981). Early intervention is the only solution for avoiding these costs (Rutter, 1998).

With early aggressive and comprehensive intervention, society could be spared from many violent acts that are committed by individuals with brain damage resulting from early childhood neglect. Without proper intervention, the only alternative to prevent violent crimes is to provide a highly structured environment that could substitute for the biological brain deficits (i.e., prisons). Likewise, early intervention has the potential to increase the likelihood of educational success for the impacted individuals (Currie, 2000) leading to the possibility of a productive life outside of the mental health and welfare institutions that are now essential to their well-being. The education, juvenile justice and child protection systems are in a particularly suitable position to provide identification and intervention based on current neuroscientific knowledge, and QEEG provides a potentially important tool to help achieve this goal. Presently, in many parts of the United States, these systems lack the means, knowledge and mandate to intervene appropriately (Weinstein & Weinstein, 2000). Early intervention guided by composite neuropsychological and QEEG findings should be incorporated into the educational mandates for special education. Special education laws and the laws governing juvenile courts could

encompass the kinds of interventions proposed. Yet, a lack of information and resources within these systems has led to superficial interventions that often fail to reach the underlying brain deficit problems. Instead of rehabilitating children, the current interventions predictably lead them down a path that, in the most extreme cases, culminates on death row.

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Comparison of SKIL QEEG and Neuropsychological Evaluation of Death Row Inmates

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Introduction

Neuropsychological testing of individuals convicted of capital crimes typically indicates significant neurological disturbances. Appeal of the death sentence based on these findings is often weakened by the subjective nature of neuropsychological methods. In an effort to address this weakness and to explore an additional objective physiological tool for assessment of these inmates, we were engaged to obtain and evaluate QEEG studies in this population.

Methods

A total of 18 adult males, ages 20-45 years of age, were administered a comprehensive neuropsychological battery and recorded with a standard 19 channel QEEG protocol, using a Lexicor NRS-24 system. All of these men were incarcerated prisoners on "death row," awaiting either appeal of their sentence or execution. The QEEG data collected were analyzed using the SKIL Topometric program, with particular emphasis on comodulation characteristics.

Results

Sixteen of the 18 death row inmates showed clear evidence of frontal lobe dysfunction in neuropsychological testing. All 18 showed significant disturbance in cortical integration as indicated by comodulation abnormalities. The anterior-posterior dissociation pattern, the left-right dissociation pattern, or both, were statistically verified in this population (Sterman, 1999; Sterman & Kaiser, 2001).

Conclusions

This convergent and reinforcing evidence for frontal lobe injury and/or dysfunction in a population of violent offenders raises both physiological and social issues of significance. The questions of developmental vs. acquired traits, and their interactions with environment, seem particularly relevant. As discussed by Weinstein and Weinstein (previous abstract, pg. 131), these findings provide a basis for the serious consideration of QEEG and neuropsychological screening of juvenile offenders, and the possible implementation of QEEG-guided neurotherapy in an effort to avoid the human and public cost of converging organic and developmental dysfunctions.

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