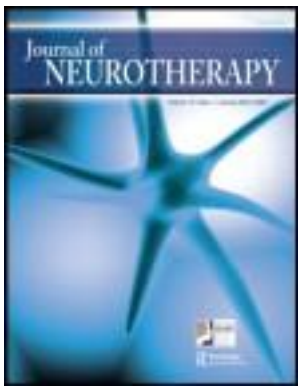

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ABSTRACTS

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ABSTRACTS

EEG-Defined Subtypes of Children with Attention-Deficit/Hyperactivity Disorder

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Introduction

An overview is presented of our research into the electrophysiology of Attention Deficit/Hyperactivity Disorder (ADHD), with particular emphasis on EEG profiles in children. This is complemented by our studies of normal EEG development, and the work of colleagues in our group examining EEG profiles of ADHD in adolescents and adults, together with our ERP studies in normal and ADHD children and adolescents.

Method

In a number of studies, DSM-IV criteria were used to define membership in groups of the combined and inattentive types of ADHD, with diagnostic agreement between a pediatrician and a psychologist required for research inclusion. Age- and gender-matched normal control groups were used. EEG power spectra were obtained from an eyes-closed resting condition, using 21 standard electrode placements.

Results

While our EEG studies have repeatedly reported the common profile of increased slow wave and decreased fast wave activity in ADHD, our recent work with a sample of 298 ADHD children has confirmed the existence of a distinct subgroup of patients primarily within the combined type of ADHD, who have excess beta activity. Such patients were previously noted in two of our papers, and in one report from outside our group. These patients were noted to be moody and more prone to temper tantrums than others. More recently, analysis of EEG data from 184 boys with the combined type of ADHD found three dis-

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tinct clusters of EEG profiles: the excess beta subgroup, and what we have labelled as "maturational lag" and "hypoaroused" subgroups.

Discussion

These studies ranged across a number of laboratories and clinics, and provide a consistent picture of cortical anomalies in ADHD. Such data appear to hold promise for assisting in diagnosis and the tracking of treatment effects, and this is briefly discussed in relation to our separate EEG studies of ADHD patients with comorbid learning and conduct disorders.

Conclusion

The consistent indications of electrophysiological heterogeneity reported here suggest the value of EEG-defined subtypes, and have important implications for the conceptualisation, diagnosis and treatment of ADHD.

Motor System Function as a Product of CNS Arousal Levels: Two Case Studies

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Introduction

Since Sterman's early work with epilepsy patients (Sterman, 2000), it has been apparent that operant conditioning of the electroencephalogram (EEG) has the potential to influence motor system functioning in human beings. In this presentation, two cases were discussed in which EEG operant conditioning, or neurofeedback, was used to effect observable changes to sensorimotor functioning. The first case involved a 63-year-old woman who suffered a right parietal stroke two-and-a-half years prior to commencing neurofeedback training. A CT scan indicated a 3 cm hemorrhage in the right internal capsule, with an MRI investigation confirming a subacute hematoma present in the white matter deep in the Sylvian fissure in the right parietal lobe. The second case concerned a 10-year-old male with a diagnosis of Myotonic Dystrophy characterised by extremely low muscle tone.

Method

In both cases, neurofeedback training protocols were selected based on presenting issues and current knowledge of central nervous system functionality.

An examination of the spectral display at selected training sites was also employed to establish appropriate training bandwidths. Moment-by-moment visual and auditory feedback was provided to reward incremental amplitude changes in selected frequency bands. Version 3.10 of the Neurocybernetics EEG Biofeedback System was utilised, along with the Procomp+ EEG signal amplifier. Nicolet gold cup electrodes were used for signal detection, with an ipsilateral reference/contralateral ground ear montage used for single scalp site protocols and a single ear to ground lead used for sequential (bipolar) scalp placements.

The stroke patient was rewarded for enhancing 12-15 Hz amplitudes and inhibiting 4-7 Hz and 22-30 Hz over the sensorimotor cortex at C4. A spectral display of EEG recorded during the first session indicated elevated delta and theta amplitudes, but the client found that inhibiting 2-7 Hz activity caused dizziness and general uneasiness. Similarly, training proximal to the site of injury was tried briefly, but deemed to be ineffective. Training consisted of 20 discrete 30-minute trials.

In the Myotonic Dystrophy case, rewards were given for enhancing 15-18 Hz amplitudes, while simultaneously inhibiting 2-7 Hz and 22-30 Hz rhythms, largely at C3-A1, but also at C3-Fz and C3-Pz. A 13-16 Hz enhancement at C3-C4 was also utilised. A spectral display of EEG recorded at C3-A1 during the first session showed slightly elevated delta and theta amplitudes, with a marked lack of beta activity. Training consisted of 50 discrete 30-minute trials divided as follows: C3-A1 (7 sessions); 15 minutes C3-A1, 15 minutes C3-C4 (37 sessions), 15 minutes C3-Fz, and 15 minutes C3-Pz (6 sessions).

Discussion

Reported gains for the stroke patient included remediation of anxiety symptoms, improved gait and manual dexterity, decreased muscle tension, reduction in tremors, and a resumption of sensation in the left side of her face, including the left half of the mouth and tongue. By the conclusion of the intervention this client had recommenced driving her motor vehicle and had cancelled her home help, since she was now able to take care of her own household chores.

Results for the child with Myotonic Dystrophy included increased muscle tone, improved clarity of speech, remediation of sleep apnea symptoms, normalization of the sleep/wake cycle, increased physical activity, and improved learning outcomes at school. A sleep study performed approximately one year prior to the commencement of neurofeedback training showed below average oxygen saturation levels at 85% and 88% for REM and non-REM sleep respectively. Although diagnosed with obstructive sleep apnea, the low saturation levels were not associated with any respiratory events. A follow-up sleep

study performed after the completion of neurofeedback training indicated oxygen saturation levels to be in the normal range at 94% and 92%, respectively, for REM and non-REM sleep periods. This result contradicts the expectation that this client's condition will deteriorate over time.

Conclusion

Although these two cases are distinctly different in terms of etiology and symptom presentation, it is proposed that each represented a dysfunction of central nervous system arousal levels–chronic overarousal in the first instance and underarousal in the second. Furthermore, it would appear that neurofeedback training at the sensorimotor cortex influenced the regulation of arousal, along with motor activity. While the stroke patient showed improved motor function by calming the sensorimotor cortex, it is worth noting that anxiety symptoms were also ameliorated. Similarly, the Myotonic Dystrophy case showed improvements in the motor areas of speech output and increased physical activity, as well as in a number of other areas, including sleep and attention. Thus, it is proposed that a variety of symptoms might be addressed by restoring central nervous system homeostasis, regardless of etiology.

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AUTHOR NOTE

Six months after the conclusion of neurofeedback training the boy with Myotonic Dystrophy had reputedly lost all of the gains mentioned above. Therefore, twice weekly training was recommenced and all previous gains returned. It would appear that in this instance ongoing training might be required to postpone the degenerative nature of the condition. Because of this deterioration process, medical specialists had previously predicted that this boy would be in a wheelchair by now. However, he is now 12 years old and has recently commenced a track and field training program for disabled children. He is currently running times in the 400 metres that would have qualified him to run at the 2000 Sydney Paralympic Games and is being groomed to compete in several track events and the high jump at Athens in 2004. Neurofeedback training continues once per week during school terms.