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Each person is an individual and has a unique psychological profile, biochemistry, developmental and social history. As such, advice will not be given over the internet and recommendations and interventions within this website cannot be taken as a substitute for a thorough medical or allied health professional assessment or diagnosis.

QEEG and Neurofeedback - diagnostic and training modalities for the enhancement of CNS functioning in ADHD and other disorders

INTRODUCTION

Attention Deficit/Hyperactivity Disorder (ADHD), learning disabilities, autism and mental illness including depression, anxiety and suicide have all increased at an alarming rate over the past decades. This is cause for great concern amongst health professionals/authorities worldwide and the public.[1-4] While the effect of these disorders are far reaching for the individual and their quality of life, they have major impacts on society as a whole. They have a stratifying socio-economic impact with associated losses in productivity, increased costs of medical care and education, escalating substance abuse, criminality and the social costs of treating all these ailments.[5] ADHD has recently made news headlines on account of concerns of misdiagnosis, possible over-prescription of Ritalin and its untested long-term effects on developing brains.

Research has shown that ADHD is often accompanied by other brain-related problems. The findings of genetic studies indicate a strong correlation and a genetic link between ADHD and a number of other disorders. These disorders include: conduct disorder, adult antisocial personality disorder, criminality, mood disorders (anxiety and depression), substance abuse and obsessive-compulsive disorder In particular, the combination of ADHD and Conduct Disorder is a strong predictor of adult Antisocial Personality Disorder, Criminality and substance abuse.[6-9] Children may, and often do, have multiple disorders coexisting with their ADHD at the time of initial clinical presentation. Such comorbid disorders may interact with and exacerbate each other, resulting in different developmental courses and adolescent and adult outcome, have a somewhat different pattern of causes, and even a different response to treatment, than just ADD alone.[10-13]

It is not uncommon to find a family where one child has ADHD, another dyslexia or learning difficulties, a third dyspraxia and it is quite common for an individual to suffer from more than one of these conditions. In fact:

- "As many as 65% of children with ADHD also struggle with at least one other learning disorder, and sometimes bipolar disorder and/or Tourette's Syndrome (TS).[14]
- 50% of dyspraxic children also have ADHD.[14]
- Some 30 to 50 percent of children with dyslexia have ADHD and vice versa. (The Dyslexia Research Institute puts this figure at 60%)".[14]
- It is estimated that 60% of people with Tourette's Syndrome (TS) have ADHD and 50% have Obsessive Compulsive Disorder (OCD) and that there is a high association of these disorders in their family histories.[15]

Self-esteem problems are both primary and secondary in children with ADD. These children do not develop an appropriate self-concept and have difficulty relating to their family and peers. Feelings of inadequacy, anxiety and depression are therefore more common. Only 11% of ADHD children are free as adults from any psychiatric diagnosis, function well and have no significant symptoms of their disorder.[16-19]

Psychostimulant medication which is the mainstream treatment for ADHD alters the biochemical interactions in the brain in an attempt to mask symptoms and is not a cure but rather akin to taking aspirin for pain management. These pharmacological agents frequently fail to produce the desired long-term effects and lead to unwanted and unacceptable side effects in as many as 30-40% of ADHD patients. In 20-50% of patients, unacceptable side effects result in discontinuation of treatment and the underlying neurological and physiological symptoms remain unaddressed.[20] As early as 1978, Barkley and Cunningham found that :

1. "stimulant drugs appear to have little, if any impact on the academic performance of hyperkinetic children;
2. the major effect of the stimulant drugs is on the short-term manageability of hyperkinetic behaviour;
3. any positive behavioural response to the stimulants is not likely to be accompanied by improvements in academic performance".[21]

Swanson et al. in a comprehensive examination of 341 reviews of the use of medication concluded that hyperactivity and attending might improve amongst 60 to 75% of children. For some that may be a huge improvement, however, their concentration, learning ability and cognitive skills may not improve.[22] This relatively poor outlook is contrary to what is required for adaptive learning and may partially be explained by the findings that stimulant medication may actually decrease responsiveness to positive rewards, while increasing responsiveness to punishment.[23] The limitations of psychostimulant medications have led to the widespread adoption in clinical practice of alternative and adjunctive modalities. While short-term use can be very useful, it can be argued that medication may in essence reduce the ability of the brain to self regulate and promote normal functioning. Since all learning and behaviour starts in the actual physical functioning of the brain, assessing brain function whenever learning or behavioural disorders are suspected, is therefore of paramount importance.

Many psychiatrists, paediatricians and psychologists involved in the diagnosis of learning disorders and ADHD are unaware of a significant body of research which supports the use of topometric quantitative electroencephalographic (QEEG) analysis as a diagnostic tool for differentiating between organic and functional brain disorders including learning difficulties, ADHD, schizophrenia, epilepsy, cerebral atrophy associated with alcohol abuse, depression and anxiety.[24] Psychophysiologists have established normative QEEG databases. The differences in brain wave patterns revealed in these comparisons point to subtypes of ADHD that are not documented in the DSM-IV.[25-28] Studies of QEEG patterns of ADHD children and adults are consistent with findings revealed by PET, fMRI, SPECT and other neuroimaging studies.[28-32] More recently, research from SPECT brain studies by Daniel Amen and his colleagues have identified six subtypes of ADHD which correlate to QEEG patterns found in individuals with ADD.[33-34] Thus, topometric QEEG analysis is a powerful adjunct to psychometric assessment in this area.

The topometric QEEG is an objective and effective tool that uses digital technology to measure electrical patterns at the surface of the scalp which primarily reflect cortical activity or "brainwaves". A multi-electrode recording of brainwave activity is made under different conditions (eyes closed, eyes open, and during cognitive challenges such as reading and arithmetic) and converted into numbers by a computer. These numbers are then statistically analysed and compared to a database. Such comparisons allow the clinician to determine whether or not brain functioning is abnormal, to what degree, in what locations and in which frequency band. The procedure has the advantage of being non-invasive and requires no more than a few hours administration.

Neurologist John Hughes from the Department of Neurology, University of Illinois School of Medicine and psychiatrist E. Roy John from the Department of Psychiatry, New York University Medical Centre state in their 1999 paper titled "Conventional and Quantitative Electroencephalography in Psychiatry": **"New three-dimensional QEEG imaging methods offer an economical alternative to other functional brain imaging modalities...** During the last decade more than 500 EEG and QEEG papers have reported well designed studies, concurring that EEG and QEEG abnormalities are found in a high proportion of psychiatric patients. Conditions such as anxiety disorder, depression, dementia, obsessive-compulsive disorder, schizophrenia, learning disabilities and attention deficit disorder with and without hyperactivity are now understood to involve interactions between brain dysfunctions or altered neuroanatomical structure and environmental influences. **An overview of the findings reveals numerous consistent and concordant conventional EEG and QEEG findings among studies within the same DSM (III & IV) diagnoses"**.[24]

Concerning Specific Learning Difficulties (SLD) and ADHD/ADD, Hughes and John state: "a large percentage of children with attention deficit problems (more than 90%) show QEEG signs of cortical dysfunction, the majority displaying frontal theta or alpha excess, hypercoherence and a high incidence of abnormal interhemispheric asymmetry. **Using QEEG measures, it has been possible to discriminate replicably ADD/ADHD versus normal children with a specificity of 88% and a sensitivity of 94% and ADD versus SLD children with a sensitivity of 97% and a specificity of 84.2%**.[24] Their conclusion is

that **"QEEG studies are particularly well suited to identifying subtle changes in the topographic distribution of background activity and can aid in difficult differential diagnoses such as assessing cognitive, attentional or developmental disorders"**.[24]

There is increasing consensus amongst brain researchers that many mental disorders are the result of disturbances in the rhythm of oscillations between the thalamus and the cortex in the brain. The dysregulation may, for the most part, be genetic in origin.[6-9] This view purports that thalamocortical oscillations are responsible for the timing and transfer of information between various structures in the brain, and that disruptions in their regulation are responsible for a wide range of psychiatric disorders.[36-40] The topometric QEEG is a valuable diagnostic tool because brain activity (driven by thalamocortical oscillations) is reflected in patterns of electrical activity at various parts of the cortex, and these patterns can be statistically analysed. It is a technique that has sufficient test-retest reliability for use in assessing clinical changes in cognitive status.[45]

What is also not commonly known is that in many cases significant improvements or normalisation of ADHD symptoms can be achieved without the use of medication through EEG biofeedback (neurofeedback).[46] Neurofeedback is based on the research of Professor M. Barry Sterman of the UCLA School of Medicine, Departments of Neurobiology and Behavioural Psychiatry. He recognised that rhythmic EEG properties and brain function could be altered and normalised by operant conditioning of the EEG.[26, 36-37] EEG biofeedback is an Applied Psychophysiology paradigm developed in the mid 70s, to train the brain to generate a brainwave pattern similar to or approach those of non-ADHD persons. Typically the brainwave training involves reinforcement of specific EEG frequencies while inhibiting others. During training sessions real-time QEEG is displayed on a computer in the form of a game, and the client is given contingent audio-visual rewards for producing the desired brainwave patterns. There is now significant evidence in the literature, which suggests that most ADHD children can learn to produce a brainwave pattern that is more normal.[41-44] This process empowers children to regulate their own brainwaves and behaviour, thus enhancing their self-esteem.

The training is believed to normalise the asymmetrical dopaminergic and noradrenegic neural control networks in the brain, and to help regulate sensorimotor integration. A complete discussion of the neurological underpinnings of ADHD and neurofeedback is beyond the scope of this article. However interested readers are invited to attend the SNR Conference being held in Sydney in August 2001 and / or refer to the references listed, in particular, "A Symphony in the Brain", by Jim Robbins.[46]

Neurofeedback allows the therapist to address the physiological basis of behavioural problems without medication or in conjunction with medication. Thus, neurofeedback augments a pharmacological intervention in learning and behavioural disorders. Improvements in ADHD subjects following EEG biofeedback training correlate significantly with a number of empirical and subjective measures. Studies have shown improvement in impulsivity, attention, response time and variability of response time scores on Continuous Performance tests, such as the Test of Variables of Attention (TOVA). Additionally, reductions in hyperactivity and impulsivity on behaviour scales,

increase in attention and cognitive skills in Individual Achievement Tests scores, and increases in IQ scores have also been shown.[47-51] Overall, results of several studies indicate that neurofeedback training is effective in over 80% of cases in significantly reducing the undesirable ADHD symptoms, and the effects appear to be lasting.[52-56] In many of the studies cited, the ADHD subjects were on psychostimulants at the start of the study. In those studies, where children were on medication, most of the subjects were able to reduce their stimulant medication or completely come off the medication by the end of training. These results are being replicated by neurofeedback practitioners in Australia.

A recent book by William Sears, a Paediatrician and former Assistant Professor at the University of Southern California School of Medicine and co-author Lynda Thompson, Director of the ADD Center in Toronto, outlines the current state of the clinical use of neurofeedback. They maintain that although neurofeedback studies to-date lack the power of double blind studies, there is sufficient valid research, to justify the mainstream clinical use of the treatment which teaches the brain to self-regulate.[53]

The entire January 2000 edition of Clinical Electroencephalography, an authoritative peer-reviewed medical journal in the field of EEG, was devoted to neurofeedback. The Neurology Editor, Frank Duffy MD who directs the Clinical Neurophysiology Laboratory and Developmental Neurophysiology, a research Laboratory at the Children's Hospital, Boston, which is affiliated with the Harvard Medical School stated in his editorial: **"The literature which lacks any negative study of substance, suggests that EEG biofeedback should play a major therapeutic role in many difficult areas. In my opinion, if any medication had demonstrated such a wide spectrum of efficacy, it would be universally accepted and widely used"**.[57]

There have been growing concerns amongst medical practitioners and the general public over the use of psychostimulant medications in the treatment of ADHD. In this regard, neurologist John Hughes and psychiatrist Roy John have stated, **"Medications that profoundly alter the availability of neurotransmitters and affect hypothesised pathophysiology are routinely prescribed by psychiatric practitioners. Nonetheless, little or no attempt is made in most cases, even in the treatment-resistant patient, to use biological assessment methods to select a treatment, to evaluate its physiological effect and to demonstrate its efficacy objectively"**.[24]

In January this year, a forty-week clinical trial to determine the effects of Ritalin on 312 severely afflicted ADHD children between the ages of three and eight years began at six different sites in America because, as Steven Hyman, director of the National Institute of Mental Health (NIHM) Rockville, USA stated: **"it has been shown that more and more children in this age group are receiving this medication and we don't have any idea about safe dose range or how it works over time"**.[58] Although this trial raises obvious ethical and practical questions, Hyman maintains that it is necessary because without it **"in essence every kid is an uncontrolled experiment—but we never learn anything"**.[58]

The topometric QEEG enables the practitioner to predict which medication and neurofeedback protocols are most appropriate and evaluate their effectiveness with a good degree of accuracy. The responsiveness of particular ADHD subtypes to psychostimulant medication can be predetermined in the majority of cases[59], "eliminating much of the hit and miss experimental approach prevalent in clinical practice".[60] However, using effective diagnostic tools and pre-training measures as comparison data with post treatment measures, provides ethical, evidence-based practice.

In the last decade, neurofeedback has become progressively more popular in the amelioration of ADHD symptoms, partly due to advancements in technology which enable real-time EEG analysis and feedback. In 1995, The Yonkers School District, one of New York's most socially disadvantaged areas, began using neurofeedback with its most difficult students. Some of the continued benefits include less teacher absenteeism, less student truancy, a decrease in aggressive and violent student behaviour together with more positive and academic outcomes for students with learning, attentional and behavioural difficulties [61]. In Australia, however, neurofeedback remains largely unrecognised or dismissed by mainstream professionals. The medical community continues to call for double-blind studies in EEG biofeedback. While this is an appropriate paradigm for drug testing, is inappropriate for use in this operant conditioning paradigm, for ethical and practical reasons.

As Daniel Amen, psychiatrist, so cogently writes in his book "Change your Brain, Change your Life", the brain is the "hardware of your soul" and as such "is the very essence of a human being".[15] The early and accurate differential assessment of brain function and other physiological factors[20], together with EEG biofeedback, offer learning disabled and attention deficit children the opportunity for amelioration of their difficulties with all the life-enhancing and life-affirming progress this implies.

For more information or to make an appointment please contact us on (02) 9637 9998 during business hours.

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