

Nutritional supplementation and Neurotherapy in the treatment of ADHD

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Abstract

In the last decade, an increasing number of studies have highlighted the importance of Omega 3 Essential Fatty Acids and associated micronutrients in the prevention and treatment of modern diseases, and in particular Attention Deficit Hyperactivity Disorder (ADHD) and neurodevelopmental disorders. Excessive slow brainwave electrical activity is the most common finding of abnormalities in children with (ADHD) and Learning difficulties [1]. At the same time, Neurophysiology research and clinical practice has highlighted the effectiveness of Neurotherapy (EEG biofeedback) in permanently redressing ADHD symptoms in over 80% of children with ADHD. The technique was developed in the early 1970s by Prof. Barry Sterman at UCLA and later by Prof. Joel Lubar at Tennessee University. This paper provides an overview of these approaches in the treatment of ADHD.

Background of the problem

Over the last decades, the worldwide increase in the incidence of ADHD, substance abuse, anxiety, depression, mental illness and consequently severe behavioural abnormalities in children has caused great concern to health authorities and the public. The notion that stimulants, anti-depressants and anti-psychotic drugs should be used to control behaviours is even more concerning to some. The trend towards behaviour control by prescription drugs has become so alarming that some aspect of ADHD is discussed on national television or in the newspapers almost every week. Opponents of medication argue that young developing brains are being subjected to powerful mind-altering medications for years on end without any long-term studies of their possible effects on brain development and brain function. In many cases, children with ADHD function better on medication and in the short term it may be necessary; however, it begs the question: "Are there effective and more palatable alternatives?"

The answer to this question takes us on a journey into our evolutionary past. Modern humans developed from Hominid, a species whom fossil records indicate lived in delta regions of Africa, where aquatic life was abundant. Hominid's diet was primarily fish, and throughout the 200,000 years of the Paleolithic period hominid lived close to waterways and the sea. It developed its brain structures and immunity by evolutionary interactions with a hunter gatherer diet: fish, meat, fruit, vegetables, roots and nuts. Scientists from various disciplines agree that the large volume of brain cells of Homo Sapiens, containing 40% Omega 3 fatty acids, could not have developed without an evolutionary history of high levels of fish consumption.[2]

Some 10.000 years ago the hunter-gatherer cave-men formed communities, leading to the development of agriculture and farming. This brought about a change into the evolutionary diet of man, as we introduced wheat, cereals and milk. Many scientists believe that evolution has not been able to keep pace with the rapid changes in diet and

life style and the rise in chronic stress levels, since Civilisation started[2]. More recently in the last 100 years we have introduced processed foods made from high intensity agriculture using chemical fertilisers. This “modern diet” consisting of food grown in soils that have been depleted of micro nutrients is often lacking the natural nutrients that the soil can no longer provide[2].

Evolution teaches us that whenever we change the natural diet of any species, a subset of that species will genetically be less able to adapt and will develop disease from nutritional interactions with that diet. Mad cow’s disease is a classic recent example, feeding herbivorous cows a carnivore’s diet overwhelmed their immune system, allowing the disease to run rampant.

Genetic interactions with deficiencies in our “modern” diet may be at the root of the epidemic of modern diseases and effective treatment may require that we treat the root causes by promoting better diet with increased Omega 3 fatty acids (from fish) and micronutrients. The safest and best diet for our physical and mental health, as well as our immune system is one that most resembles that of our evolutionary ancestors. [2-6]

Several large epidemiological studies have identified that most modern diseases stem from dietary insufficiencies, mostly fish consumption and micronutrients associated with essential fatty acid metabolism. Certain genetic weaknesses, it seems, run in families, but their expression into diseases are triggered when the diet is deficient in some specific nutrients. [2]

Meanwhile how does this help us treat ADHD and neurodevelopmental disorders in our schools and at home? The children that we see in the clinic already demonstrate the dysfunctions brought about by the interactions between their genes and nutritional deficiencies. Each child is genetically and biologically unique, and his genetic weaknesses may have caused a different interaction with nutrient deficiencies than the next child, resulting in a specific underlying biological dysfunction. We see our task as finding out what that dysfunction is and attempting to redress it.

The possible solutions

Faced with the task of improving the behaviours of children with neurodevelopmental disorders we have chosen to adopt a five-step holistic approach.

- **Medical conditions:**

Based on presenting symptoms, we first attempt to rectify intestinal dysbiosis, leaky gut, nutrient malabsorption and food allergies. If indicated, we investigate a number of medical conditions such as thyroid dysfunction, hypoglycaemia and heavy metal toxicity.

The medical aspects are handled at the clinic by Dr. Joe Nastasi, a Medical Practitioner. We jointly manage nutritional aspects, as we both have postgraduate training in nutritional medicine and are members of the Australasian College of Nutritional and Environmental Medicine (ACNEM). In children with Tics and

obsessive/compulsive behaviours, including oppositional defiant behaviours we investigate the possibility of Paediatric Autoimmune Neurodevelopmental Disorder Associated with Streptococcus infections (PANDAS). This is a medical condition in which autoimmune antibodies to group A beta haemolytic streptococcus can in some children affect brain function, causing obsessive compulsive disorder or symptoms of cognitive inflexibility, TICs and ADHD.

- **Diet and nutrient supplementation:**

If indicated, we test for autoimmune antibodies to foods and Essential Fatty Acid Profile in the red cell, through a blood test. We remove the allergic foods from the diet. We stress the importance of a balanced diet with a paleolithic-like profile. Third, we supplement the diet as required with *specific* amino acids, Omega 3 Essential Fatty Acids from fish oils and associated micronutrients.

- **Neurotherapy:**

Based on QEEG brain-mapping findings, we use Neurotherapy to redress any abnormalities in slow/fast brainwave ratios in brainwave activity.

- **Cognitive Behavioural Therapy:**

If necessary, when biological functioning has improved sufficiently or normalised, we use Behaviour modification and Cognitive Behavioural Therapy, supplemented with Metacognitive strategies to replace dysfunctional thinking patterns with more adaptive and useful ones.

- **Educational remediation:**

Finally, when the child's body and mind is functioning more optimally, we recommend tutoring and/or remedial teaching, so as to maximise the learning process.

Brain electrical activity underpins behaviours

By repeatedly challenging dysfunctional thinking patterns and changing them through cognitive restructuring and Cognitive Behaviour Therapy, Psychologists are effectively reprogramming the firing patterns of neurons in the brain. However when a disorder is underpinned by a neurophysiological dysfunction, directly retraining brainwave patterns by operant conditioning of the EEG has been shown to be a more effective method of reprogramming neuronal firing patterns. This has been demonstrated in ADHD [7-16], depression [17-19] and post-concussion syndrome [20-22].

Research in psychophysiology over the last 30 years supports the view that electrical oscillations in networks of neurons are responsible for the timing and transfer of information between various structures in the brain. This view further purports that disruptions in brainwave activity are associated with a range of brain dysfunctions and consequently mental disorders [23-27]. There is a wealth of evidence that psychiatric disorders are related to specific dysfunctional brainwave patterns identified in the QEEG [1, 28]

Teasing out brain dysfunction with QEEG brainmaps

In 1988, Dr. E. Roy John, and his research team at the Brain Research Laboratories at New York University Medical Center, published in *Science* the seminal work in computer-assisted differential diagnosis of brain dysfunctions using Quantitative EEG (neurometric analysis). QEEG is the statistical analysis of brain electrical activity recorded from the surface of the scalp.

Building on that work, John and Prichep and other research teams since have created an objective evaluation system that is highly sensitive and specific for assessment and interpretation of brain dysfunction [28]. Several researchers have suggested that Neurotherapy could be used to redress the dysfunctional brainwave patterns identified by QEEG neurometric analysis [22, 29-31]. There is a wealth of evidence indicating that over 80% of subjects in studies to-date are able to change their brainwave patterns towards normal and consequently normalise the associated behaviours, improve IQ scores and academic output.

QEEG measures the minute electrical activity of a person's brain and then, using proprietary software, compares that unique pattern to known databases of "normal" and "abnormal" patterns. This type of computer-driven statistical analysis is particularly useful in evaluating difficult and borderline cases.

The Patient's Data Collection Experience



The data collection procedure begins with a simple, non-invasive procedure in which a clinician or qualified technician captures a sample of the raw electrical activity of the patient's brain, using an "electrode cap" (fig. 1).

Electrodes in the cap are electrically connected to the scalp by means of a gel that can be simply washed off with water after the data recording. The cap is connected to specialized medical equipment that amplifies the microscopic electrical signals that the patient's brain produces and sends those signals to a computer.

Fig 1. Electrocap used in data collection procedure

Using a 19 channel QEEG recording, Chabot and colleagues were able to discriminate replicably ADHD versus normal children, with a sensitivity of 90% and a specificity of 94% [32, 33] and ADD versus specific learning disorders with a sensitivity of 97% and a specificity of 84.2% [29, 34-36]. Their most common findings were of generalized or

focal theta/alpha excess mostly at frontal and central sites. Monastra and colleagues found that the power ratio of theta/beta measured at the vertex (CZ) was able to distinguish their large sample of ADHD children from normals with a Sensitivity of 86% and a specificity of 98% [32, 33]. Researchers have suggested that Neurotherapy may be the treatment of choice to target the theta and alpha excesses, for example [29, 32, 37].

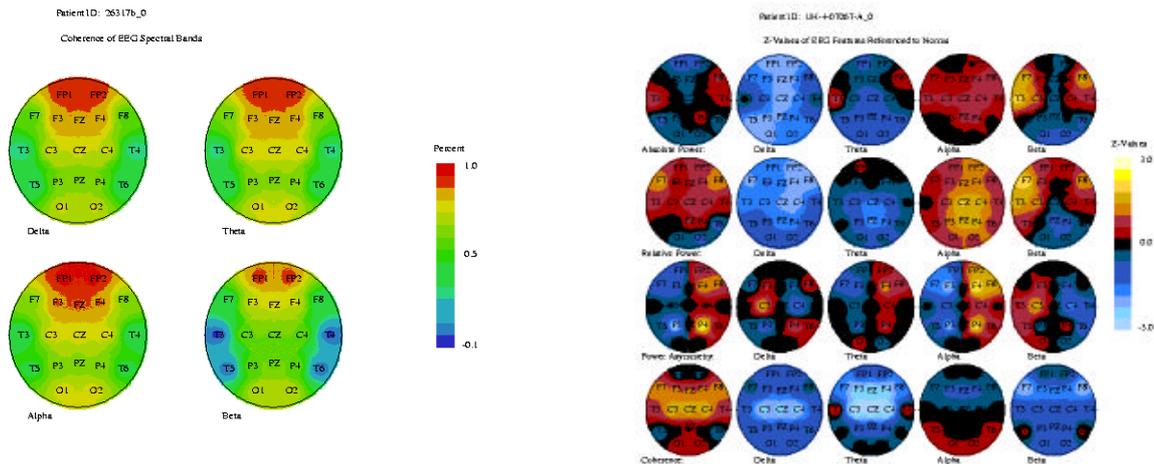


Fig 2. Topometric maps expressed in Z scores (standard deviations from the norm). In the map on the right Black is normal, cool colours signify deficits and hot colours signify excesses. This is a map of a child diagnosed as ADHD but actually suffering from depression and anxiety, with attention deficits being secondary to the depression.

Neurotherapy in the treatment of ADHD

Neurotherapy is an operant conditioning paradigm developed in the Seventies by Professor Barry Sterman of UCLA. Sterman successfully trained cats to increase specific brainwave activity by operant conditioning of the EEG. The cats were rewarded for producing 12-15Hz brainwaves over the sensorimotor cortex in a study of brainwave activity [38]. Subsequently when NASA commissioned Sterman to investigate the seizure causing effects of Hydrazine fuel, it was discovered serendipitously that the same cats were highly resistant to seizures. A series of published studies followed which indicated that EEG operant conditioning or EEG-Biofeedback, now called Neurotherapy was highly effective in reducing seizure incidence in humans [39-48].

Since the 1970s, research in neuroscience, psychophysiology and clinical practice in universities and clinical settings have shown that through Neurotherapy (EEG biofeedback) patients can be taught to restore self-regulation in the brain by retraining their brainwave patterns. A more recent improvement in Neurotherapy protocols is in the use of QEEG Neurometrics to identify the specific brainwave patterns that need to be redressed [14, 30, 31, 49].

During Neurotherapy, real-time QEEG is displayed on a computer in the form of a game, and the patient is given contingent audio-visual rewards for producing less Theta and more Beta waves. There is now significant evidence in the literature, which suggest that most ADHD children can learn to produce a brainwave pattern with more normal theta/beta ratios [7, 24, 50-52].

Typical Neurotherapy training screen.



The forward movement of the spaceship on the left is dependant on theta activity (4-7Hz) , That in the middle on Beta (15-18Hz) and the one on the right on high beta and muscle artifact (>25Hz).

Thresholds are set so that the child is rewarded (audio-visual rewards, points and tokens) when the middle ship is winning the space race. In other words reward is contingent on increasing beta (15-18Hz) and suppressing theta and muscle activity.

Improvements in theta/beta ratios of ADHD subjects following Neurotherapy have been found to 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 Tasks (TOVA)[53-58]. In addition, there were reductions in hyperactivity and impulsivity on behaviour scales, increases in attention and cognitive skills in Individual Achievement Tests scores, and increases in IQ scores [9, 16, 58-62]. Overall, results of several studies indicate that Neurotherapy treatment is effective in over 80% of cases in significantly reducing the undesirable ADHD symptoms, and the effects appear to be permanent [60, 63-66]. In many of the studies cited, the ADHD subjects were on psychostimulant medication at the start of the study. In all of the studies where medication was involved, the subjects were able to reduce their stimulant medication or completely come off the medication by the end of Neurotherapy treatment [53, 56, 60, 64, 67].

Critics have rightly pointed out that other “non-specific” causes may be responsible for the observed effects, since no double blind placebo controlled studies of Neurotherapy have been carried out to prove that the observed outcome are indeed due to Neurotherapy treatment effects. While the preferred double blind method is well suited to the investigation of the effectiveness of medications, it is not applicable to client intensive psychotherapies for ethical and practical reasons. However many outcome studies, including controlled studies, lending support to the effectiveness of Neurotherapy have been published in peer reviewed journals and suggest that Neurotherapy should be

viewed as a scientifically viable treatment for ADHD with results capable of permanent remediation of symptoms [37, 66].

The January 2000 edition of the medical journal *Clinical Electroencephalography*, was entirely devoted to Neurotherapy. The editorial opinion by Neurology Editor, Frank Duffy M.D. stated:

“The literature, which lacks any negative study of substance, suggest that Neurotherapy 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.” [68]

Conclusion

The most effective treatment methodology may be one that uses a multidisciplinary team approach, where medical, nutritional, psychophysiological and psychological approaches are tailored to the individual patient presentation for the benefit of the patient. The challenge in this new century is for healthcare professionals to seek to understand each other’s perspectives and to freely cooperate with each other to promote the best treatment outcome for their patients.

This paper can be freely copied and passed
on to parents and teachers

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