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IN THIS ISSUE

ADHD

Stimulants in the Treatment of ADHD

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Dr. Fisher has disclosed that she has no relevant relationships or financial interests in any commercial company pertaining to this educational activity.

The gold standards of treatment for ADHD are the stimulants amphetamine and methylphenidate. They are old friends, having been used for decades, and there is a wealth of patient experience with them. Although we use them all the time, an occasional review of the tools in our toolbox is always helpful.

Stimulants appear to work by enhancing dopamine and norepinephrine in the prefrontal cortex. (See for example, Stahl SM, *J Clin Psychiatry* 2010;71(1):12–13.) This seems to enhance frontal lobe functions including planning, delaying gratification, controlling behavior, and focusing. Children with ADHD who also display oppositional or explosive behavior may improve behaviorally when treated with stimulants.

Common Side Effects of Stimulants

Unfortunately, the dopaminergic effects of the stimulants also lead to unwanted side effects. Dopamine regulates satiety, and children on stimulants often lose their appetites. Tics are also mediated by dopamine, but there is variable response to stimulants. Stimulants alone are not thought to induce new onset tics (Roessner V et al, *Dev Med Child Neur* 2006;48(7):616–621).

There are several other common side effects of stimulants. Insomnia is a regular complaint of patients, although it is also a common complaint of kids with ADHD who are not on stimulants. This is partly because the duration of action of the stimulants is not as long as the half-life, so blood levels may still be significant despite the beneficial action having worn off. This is also true of caffeine, and may be the source of many cases of apparent insomnia.

The subjective sensation of anxiety, or worsening anxiety, is another common reason for discontinuing stimulants. ADHD is often comorbid with generalized anxiety disorder or OCD, and in these cases each must be treated separately. The disorder that seems to be most impairing should be treated first. Otherwise, reducing the dose or adding guanfacine (Tenex, Intuniv) or clonidine (Catapres) may help the feeling.

Irritability can be an issue, either concurrent with the stimulant or when the stimulant is wearing off. When irritability happens all day long, switching from one stimulant to the other sometimes helps, as does adding guanfacine or clonidine. Rebound irritability can often be successfully eliminated with an afternoon dose of a short-acting stimulant or clonidine.

Dry mouth is an often experienced but rarely acknowledged side effect, occurring in many children. In addition to contributing to a loss of appetite, chronic

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Learning objectives for this issue: **1.** Understand how to select the appropriate medications for patients with ADHD. **2.** Describe the evidence regarding neurofeedback for ADHD. **3.** Explain how ADHD relates to executive function. **4.** Understand some of the current findings in the literature regarding psychiatric treatment. This CME/CE activity is intended for psychiatrists, psychiatric nurses, psychologists and other health care professionals with an interest in the diagnosis and treatment of psychiatric disorders.

Stimulants in the Treatment on ADHD

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dry mouth may cause cavities.

Cardiac Effects of Stimulants

The cardiac effects of stimulants are well known, and there is a small risk of sudden cardiac death when taking stimulants. However, in a retrospective study of children in the UK taking methylphenidate, there were seven deaths in more than 18,000 person-years. The cause of six of the deaths was known and none were sudden cardiac death. The majority of kids who have died while taking stimulants had underlying cardiomyopathy, and the American Heart Association (Vetter VL, *Circulation,* 2008, 117(18):2407–2423), the American Academy of Pediatrics, and the combined position statement of the Canadian Paediatric Society, the Canadian Cardiovascular Society, and the Canadian Academy of Child and Adolescent Psychiatry all agree that a thorough cardiac history should be obtained, including asking about exercise intolerance, being quick to fatigue or become short of breath, and the experience of palpitations, syncope, or chest pain (Warren AE, *Can J Cardiol* 2009;25(11):625–630). Practitioners should also listen to the child's heart for abnormalities. Family history of sudden death, especially under age 35, and including motor vehicle accident and drowning is also a risk factor.

An EKG is not necessary but may be reasonable in some circumstances. According to the Canadian consensus statement, children without risk factors and not under the care of a cardiologist can be prescribed without further evaluation, while children with risk factors or findings not previously worked up should be sent to a cardiologist for evaluation. Children with current cardiology involvement need not have a separate appointment to evaluate for stimulants—a phone call will do.

Methylphenidates

Regular methylphenidate has a peak effect one to two hours after dosing, and a duration of action of three to six hours. It comes in a tablet and a liquid, and there are several extended release versions.

Concerta is methylphenidate in an osmotic capsule with an outer coating of methylphenidate. It has an onset to peak action of one to two hours (for the immediate release of the outer coating), and a fairly smooth release of methylphenidate thereafter, for a duration of action of nine to 12 hours.

Metadate CD and Ritalin LA also have immediate release methylphenidate coating a slow-release capsule, resulting in two peak blood levels: in effect, two doses of the regular release medication without the visit to the nurse's office. Duration of action is about eight hours.

Methylin ER and Metadate ER have slower onsets of action, and peak between four and seven hours, with a duration of eight to 10 hours in one big curve. Daytrana, the transdermal patch, has a two hour onset of action that can be accelerated by applying heat. It lasts for about three hours after removed from the skin, or 12 hours total. Methylin ER and Metadate ER are markedly less expensive than the other long acting agents and so may be covered by insurance at a lower tier than the other preparations. However, the morning rush to get out the door may be helped by a concurrent dose of short acting preparation.

Methylphenidate is chiral molecule, meaning there are two possible molecules that are mirror images of one another. Both are active, but one is quite a bit more active than the other. Focalin and Focalin XR are purified enantiomers of methylphenidate—they contain only the right-hand molecule. Whether this makes a difference is open to debate. Typically the active entantiomer of any given chiral molecule is three or more orders of magnitude more active (ie, a thousand times), and so removing the not very active entantiomer and replacing it with inert ingredients like the packing material in a pharmaceutical tablet seems gratuitous. However, it is patentable. Industry material suggests there are subtle differences in side effects, and onset of action is listed at 30 minutes. Because half the molecules have been removed, equivalent dosing is half the dose of regular methylphenidate. Focalin XR has a reported duration of effect of 12 hours.

Amphetamines

Like methylphenidate, regular acting amphetamine (Adderall) has an onset of action of 30 to 60 minutes and a duration of action of four to six hours. The extended release preparation, Adderall XR, has an onset of action of 30 to 60 minutes and a duration of action of around 12 hours. The half-life of amphetamine is around nine hours in younger children and 13 to 14 hours in adolescents. There is some evidence to suggest that amphetamine has a longer duration of action than methylphenidate. A single dose of regular Adderall may be sufficient for some children for the entire school day (Pelham et al, *Pediatrics* 1999;104(6):1300–1311).

Like methylphenidate, amphetamine is a chiral molecule. However, the racemic mixture is 75% of the dextro-amphetamine and only 25% of the levo-amphetamine. It is available as a purified active entantiomer, dex-amphetamine, Dexedrine. Dexedrine comes in time release form, Dexedrine Spansules. Onset of action is one to 1.5 hours, and duration of action is comparable to regular amphetamine.

A new innovation is lisdexamfetamine (Vyvanse), which is the dextro-amphetamine molecule attached to the peptide lysine. When the molecule encounters a peptidase, the lysine is cleaved off, leaving amphetamine. Peptidases are not difficult to find; saliva is full of them, and so are the rest of the digestive tract and the blood stream.

Pharmacokinetic studies suggest that the majority of conversion takes place in the blood stream, primarily in the portal blood system. The half life of lisdexamfetamine is 30 minutes, and serum concentrations of lisdexamfetamine have dropped to negligible by two to three hours after ingestion. Peak serum concentration of dextro-amphetamine occurs at 3.5 hours, and the half life is eight to nine hours.

Lisdexamfetamine itself is not active. The theoretical advantage of this system to the patient is less variability from dose to dose: time release capsules are affect-

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Neurofeedback as a Treatment for ADHD

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Dr. Carlat has disclosed that he has no relevant relationships or financial interests in any commercial company pertaining to this educational activity.

Neurofeedback, also known as "EEG biofeedback," has been around for a long time, but its history is checkered. Clinicians have hawked devices for treating ADHD and other psychiatric conditions in the absence of reliable efficacy data. Since the treatment is rarely covered by insurance companies, families may pay several thousand dollars for a typical treatment course.

Recently, however, a new meta-analysis was published and concluded that some recent well-designed studies endorse the technique for ADHD. Let's go through some of this literature and decide whether neurofeedback is ready for prime time.

First, a little background. Neurofeedback is based on the notion that patients with ADHD have characteristic patterns on the electroencephalogram (EEG). Specifically, some studies have shown that, when presented with a task requiring attention, ADHD patients don't generate enough fast beta waves (typically associated with focus), and instead generate too many slow theta waves (usually associated with daydreaming) (Fox DJ et al, *Appl Psychophysiol Biofeedback* 2005;30(4):365–373).

In neurofeedback for ADHD, kids are trained to produce more beta waves and fewer theta waves. A typical session lasts about an hour. The patient is wired up to an EEG monitor, and sits in front of a screen. Computer software translates the EEG waves into video games. In one system, for example, beta waves make a rocket ship fly faster, while theta waves cause a competing rocket to overtake it. The child is rewarded with points for activating beta waves. The sessions are usually weekly, and a treatment course is from 20 to 40 weeks, with each treatment costing about $100. You can watch a short informational video at http://bit.ly/fohi7k.

The Evidence for Neurofeedback

Until recently, most of the scientific evidence for neurofeedback consisted of either case reports or uncontrolled clinical trials. While many of these trials reported positive results, it was impossible to rule out the placebo effect as the operative mechanism.

The first, and thus far the only large randomized controlled study was published in 2009. In this study, 102 German children with ADHD (ages eight through 12) were randomly assigned to either neurofeedback training (NF) or to computerized attention skills training (AST). The computerized AST consisted of video games to practice attention, vigilance, reactivity, and visual and auditory perception. Researchers considered this a kind of placebo condition because it controls for the nonspecific effects of concentrating on a task. Neurofeedback is thought to be a more specific treatment than simply training kids in attention and vigilance—rather, it presumably teaches them to identify specific brain waves associated with being alert and focused. In order to control for positive expectancy, parents were told that both the neurofeedback and the AST were "experimental but promising treatments for ADHD."

The participants were not on medication for attention and most had never been on medication, but had presented for outpatient treatment of ADHD. Comorbid tics, dyslexia, emotional disorders,

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ed by gastric pH. The difference in breakfast from day to day can affect the serum level of the medication. However, there is no direct correlation between serum level and therapeutic effect, so whether the prodrug form is a clinical benefit or merely a stockholder benefit is in the eye (or belly) of the beholder.

Correction
Many thanks to Jonathan C. Gamze, MD, who points out that Strattera is not serotonergic as it was described in the May 2010 issue of *CCPR*.

Guide to Common Stimulants

MEDICATION	PEAK	DURATION OF ACTION	DELIVERY SYSTEM
Methylphenidates			
Ritalin and Methylin	1 to 2 hours	3 to 6 hours	Tablet and liquid
Concerta	1 to 2 hours	9 to 12 hours	Osmotic capsule
Metadate CD and Ritalin LA	Biphasic peaks at 1 hour and 4 to 7 hours	8 hours	Slow release capsule
Methylin ER and Metadate ER	4 to 7 hours	8 to 10 hours	Slow release tablet
Daytrana	2 hours	12 hours	Transdermal patch
Amphetamines			
Adderall	30 minutes to 1 hour	4 to 6 hours	Tablet
Adderall XR	30 minutes to 1 hour	12 hours	Slow release tablet
Dexedrine Spansules	1 to 1.5 hours	4 to 6 hours	Capsule
Focalin XR	30 minutes	12 hours	Capsule
Vyvanse	3.5 hours	8 to 9 hours	Capsule

Q&A With the Expert

Expert Interview

ADHD as an Executive Function Disorder

Russ Barkley, PhD

Clinical professor of psychiatry
Medical University of South Carolina

Dr. Barkley has disclosed that he receives payment from Shire, Eli Lilly, and Janssen-Ortho Canada pharmaceutical companies. He also receives book royalties from Guilford Publishing.

CCPR: Dr. Barkley, you have a long career studying ADHD. Let's start with a little biographical background.
Dr. Barkley: In addition to a career as a professor of psychiatry, I have studied ADHD since 1973. I have published about 260 articles and book chapters, along with 19 books with about 29 editions.
CCPR: Based on all this experience, can you give us a brief overview of what ADHD is?
Dr. Barkley: ADHD is defined clinically by two developmentally or age inappropriate behaviors that have been present for at least six months, and that developed sometime during childhood or adolescence. The first symptom is related to difficulty paying attention, and the second is a problem with inhibition, whereby the person is very impulsive in actions, words, and thinking. More recently we've recognized a problem with emotional impulsiveness, characterized by the quickness with which a person shows raw, unmoderated emotion.
CCPR: Can you tell us a little bit more about emotional impulsiveness?
Dr. Barkley: People with ADHD tend to have trouble regulating their initial emotional reactions to things, whether they are positive or negative. In particular, they have difficulties regulating anger, hostility, and frustration, which come out as being very irritable and quick to emote. The emotions themselves are not irrational, as they would be in bipolar disorder or a mood disorder like depression. It's just that the person with ADHD shows them immediately, whereas the rest of us have the power to inhibit that initial emotional reaction, and then to moderate it.
CCPR: You've done some research on sluggish cognitive tempo (SCT). Tell us how this is different from ADHD.
Dr. Barkley: Research has shown that about one-third to one-half of people considered to have inattentive type ADHD may actually have sluggish cognitive tempo. They have symptoms that are very different from ADHD, like daydreaming, spaciness, staring, becoming easily confused, mentally foggy, slow moving, lethargic, and hypoactive. These are problems with the "focusing" aspect of attention, not the "persistence" aspect like ADHD. These people are shy, apprehensive, reticent wallflowers, but they do have and keep friends, unlike many ADHD kids (Penny AM et al, *Psychol Assess* 2009;21(3):380–389). People with SCT have low comorbidity of oppositional defiant and conduct disorders, but high comorbidity for anxiety disorders (Milich R et al, *Clin Psychol: Sci Prac* 2001;8(4):463–488).
CCPR: What do you think of neuropsychological testing for ADHD and SCT?
Dr. Barkley: Neuropsychological testing is not useful for diagnosis, at least not for distinguishing between these disorders. There are a number of papers that have come out in the last few years that have argued that if you use executive function test batteries (eg the Wisconsin Card Sort or Continuous Performance Task), you're going to miss between 50% and 75% of all ADHD. And so I have been a strong opponent of psychological testing for diagnosis. I tell people you are better off using a rating scale of executive functioning such as the BRIEF, than you are using a test. The rating scales are more valid, they're more ecologically sensitive, they pick up real deficits in the real world as perceived by themselves and others, and they correlate with major areas of impairment. The rating scales are very sensitive to executive deficits.
CCPR: Executive function is how the brain organizes cognitive processes. How do people with ADHD have problems with it?
Dr. Barkley: There are six dimensions of executive function, and they are: self awareness; nonverbal working memory; verbal working memory; inhibition; emotional regulation; and self motivation. People with ADHD show widespread failure of the executive system, often in all six dimensions.
CCPR: Let's talk about the problems with each dimension, starting with self awareness.
Dr. Barkley: Most people in neurology or neuropsychology think the "chief" executive function is self awareness or self consciousness. This is the ability to see yourself and to monitor your actions. This is a major issue for people with ADHD. They don't monitor their actions as well as the rest of us and they're less aware of their failures, so they're less likely change course as quickly from a bad strategy than everyone else. We also see what's called a "positive illusory bias"—people with ADHD don't see their deficiencies to be as great as they actually are. They might think: "I'm as good a driver as most people," but when you actually examine it, they're horrible! And then they just can't understand why they're having their licenses revoked or getting speeding tickets.
CCPR: What about nonverbal and verbal working memory?
Dr. Barkley: Nonverbal memory is basically hindsight. You can activate images of your past that are relevant to a situation, and use those as a guide. And that leads to foresight—using our memories and our sense of time to predict where we're going and what we're doing. But people with ADHD have problems with hindsight *and* foresight. They are terrible at time management and making predictions based on experience, like how long it's going to take to get out the door to school, for example. Verbal working memory is just self speech, or using internal language to reason with and guide yourself. People with ADHD do this, but it's very weak in terms of its impact on ongoing behavior.
CCPR: Interesting. Those of us who treat kids with ADHD are quite familiar with disinhibition as an aspect of ADHD.

Dr. Barkley: Right, disinhibition and impulsiveness are cornerstones of the disorder. This goes back to the emotional impulsiveness. People with ADHD can't inhibit their initial emotional reactions to things like the rest of us can. So they come across as very emotional people.

CCPR: And then this ties into the emotional regulation part, as well?

Dr. Barkley: Yes, so not only can these kids not inhibit their initial reaction, of anger for instance, they then don't have the tools to regulate the emotion, by counting to ten or using positive imagery for example—all of the ways we self calm, self sooth, and moderate the initial strong emotion. And what we now find is that people with ADHD have problems with both of those steps. They don't inhibit the initial urge, that's part of the inhibition problem, and then they can't self regulate it subsequently and moderate it. So they come across as very emotional people, quick to anger, easily upset, or quick to get happy or silly, clownish, or overly affectionate. In certain social situations that's very costly, particularly with anger. People forgive "class clown" kind of behavior and silliness, but they don't forgive hostility. This is partly why 50% to 70% of ADHD kids have no friends by the third grade (Pelham WE & Bender ME eds, *Advances in Learning and Behavioral Disabilities.* Greenwich, CT: JAI Press; Vol 1:365–436; Normand S et al, *J Can Acad Child Adolesc Psychiatry* 2007;16(2):67–73).

CCPR: And finally, self motivation. This is a problem we know all too well, too.

Dr. Barkley: Self motivation is the ability to activate yourself toward your goals when there are no consequences occurring right now for doing so. It's the whole basis of delayed gratification. And people with ADHD don't do this very well. They are very dependent on the immediate environment and its arrangement of consequences to sustain their actions, and if there are no consequences in a situation, they fall apart. This easily explains to parents why ADHD kids can pay attention to video games for hours, but can't sit still to do their homework. Parents and others view that as a choice, when in fact it's evidence of a massive executive failure, because the video game provides continuous external consequences for interacting with it, whereas homework does nothing.

CCPR: And that's why successful school interventions have very immediate contingencies.

Dr. Barkley: Yes, with ADHD we use behavioral modification for motivation, not for skills training. These kids don't really need skills training, what they need are artificial consequences to help keep them motivated. It's used to compensate for a disability, like a ramp into a building for a person in a wheelchair. And this is why we have to maintain therapy with these kids too, because even if I've made it into the building 30 days in a row riding my wheelchair up the ramp, I still need the ramp. And that's very hard to understand but that's something we've found to be a very profound insight, especially for parents and teachers. This is a whole different beast and whole different premise. The behavior modification has to stay there.

CCPR: So they are not going to learn to focus or learn to be motivated or learn to delay gratification, we're just going to help them do it.

Dr. Barkley: That's right. I don't want to be overly dramatic here: they do learn a little bit. We all learn. But the fact is that the underlying deficit is not a failure of learning and it's not a failure of knowledge. To put it bluntly, they're not stupid. These people know what you know; they just can't do what you do. It's the doing that kills them.

CCPR: Thank you, Dr. Barkley.

Dr. Barkley's Suggested Changes to ADHD in DSM-5

- **Add our understanding that ADHD is an executive function and self regulation disorder into the text.** It's not a good idea to change the name (for legal reasons), but DSM needs to explain that this is so much more than simply an attention problem.
- **Get rid of subtyping.** The subtypes are really just variations of severity and often change as a result of normal aging. You can go through all the subtypes in the course of regular life (a hyperactive four-year-old becomes a mixed type eight-year-old becomes an inattentive 20-year).
- **Add sluggish cognitive tempo.** This can either be a subtype of ADHD or, more likely, a separate attention disorder from ADHD.
- **Change or eliminate the age of onset.** Ideally they would just drop the exact age and write: "onset in childhood and adolescence," since nature simply is not this precise.
- **Add new items or clarifications for adults and change the threshold from six to four.** The current symptoms and thresholds were based only on children and do not work well in detecting the disorder in adults.
- **Explain what "impairment" means.** Every disorder must "produce impairment in major life activities," but we don't really know what that means. Impairment needs to be defined as functioning significantly below the norm. Not below your IQ, not below some high octane peer group you're involved with, but below the norm.

Neurofeedback as a Treatment for ADHD

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and conduct disorders were allowed, but other comorbidities were not. The children underwent 36 sessions of NF or AST at a frequency of two to three sessions per week. The main outcome measures was the total parent rating on the German ADHD rating scale; secondary outcomes included teacher ratings and response rates, defined as at least a 25% improvement in the rating scale.

Ninety-four children were included in the final analysis. Neurofeedback produced significantly more improvement in parent ADHD ratings than the control condition, with an effect size of 0.6. (This is generally considered a "moderate" effect size. For comparison, note that the effect size of atomoxetine (Strattera) is around 0.71 (Michaelson et al, *Am J Psychiatry* 2002;159:1896–1901). Effect size is a statistical method that can be used to compare different studies with different methodologies. Here, these are expressed as a Cohen's d, which is the difference between two means divided by a standard deviation for the data.)

Children in the NF group had a response rate of 51.7% vs. 28.6% for the control group, which was also statistically significant. The study itself was sponsored by the German Research Foundation (Gevensleben H et al, *J Child Psychol Psychiatry* 2009;50(7):780–789).

Neurofeedback has also been evaluated in several smaller studies with generally positive findings, but none as large and as well controlled as this one. If you're interested in poring over these other studies, you can find a review of them in Arns M et al, *Clin EEG Neurosci* 2009;40(3):180–189. This was a meta-analysis of all the research neurofeedback for ADHD done to date. It concluded with the rather bullish statement that "we con-

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Research Updates IN PSYCHIATRY

SUICIDE

Acne Increases Suicide Risk, With or Without Accutane

Despite having been around for 30 years, there is still controversy surrounding the acne drug isotretinoin (Accutane) and its association with psychiatric problems. The drug insert carries a warning that it may "rarely" cause suicidal ideation, suicide attempts, and suicide (Accutane [package insert]. Nutley, NJ: Roche Laboratories, Inc; 2010). Research has been mixed, with some finding a connection between depression and Accutane (Friedman T et al, *Eur Neuropsychopharmacol* 2006;16(6):413–416) and some, not so much (CH Ng and Schweitzer I, *Aust N Z J Psychiatry* 2003;37(1):78–84).

Recently, Swedish researchers looked at this issue, this time in a retrospective study of 5,756 people, ages 15 to 49, who had taken Accutane any time between 1980 and 2001. Examination of medical and death records took place from up to three years before the start of medication until up to 15 years after completion.

The mean age of patients at first prescription was 22.3 for males and 27.1 for females. Both groups took Accutane for an average of six months. In all, 128 people in this group were admitted to the hospital for suicide attempts. There were a total of 210 discharges (1.6 per person), which is explained through some patients making multiple suicide attempts.

The risk of suicide attempt was greatest within the first six months of treatment (1.93 standardized incidence ratio for first attempts; 1.78 for all attempts). The risk was also higher than the general population before treatment began, with a standardized incidence ratio of 1.36 in the year before treatment. After treatment, risk of suicide began to match the general population, until the 11-year point, when it rose for repeat attempts among female patients (Sundström A et al, *BMJ* 2010;341:c5812).

CCPR's Take: This research shows a correlation between suicide attempts and severe acne, but not necessarily a strong association between suicide attempts and Accutane. Among these patients, the risk of suicide attempt was slightly higher than the norm up to six months after taking Accutane, but the risk was already higher before these people ever started taking the drug—making it likely that the social and emotional pain of the acne may be more closely related to the suicide attempts than the medication used to treat it. Nonetheless, this is a lesson that patients with severe acne should be watched closely for signs of suicidality.

Neurofeedback as a Treatment for ADHD

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clude that neurofeedback treatment for ADHD can be considered 'Efficacious and Specific' (Level 5) with a large Effect Size for inattention and impulsivity and a medium Effect Size for hyperactivity." *Caveat emptor,* however: the authors are all affiliated with a large Dutch clinic specializing in neurofeedback, so their opinions might be just a teeny bit biased.

Nonetheless, overall the research thus far suggests that neurofeedback may indeed be an effective non-drug option for children with ADHD, and that the beneficial effects may be sustained for at least six months after treatment is discontinued. It's likely that many practitioners would use NF in conjunction with medication, perhaps as a way of weaning kids off stimulants or reducing the dose.

Quantitative EEG Neurofeedback

Quantitative EEG scanning, or qEEG, is another system that has been tested for neurofeedback in ADHD. The simplified hypothesis behind qEEG is this: a database of EEGs is collected and normed—those closer to the average are considered normal, and those on the extremes are compared with other evidence of diagnosis or impairment, all in an attempt to find reliable markers for disease states.

In neurofeedback, the qEEG scan is used to provide the basis of feedback: the participant's job is to "normalize" his or her brainwaves to look more like the average. This is different from standard EEG neurofeedback, in which patients are trying to enhance specific brain waves.

The published research on qEEG neurofeedback is minimal and of poor methodologic quality. The largest study, published in 2002, was an open label trial in which 100 children with ADHD, ages six to 19, were assigned to either qEEG based neurofeedback training plus methylphenidate, or to methylphenidate alone. Both groups also received 10 sessions of parent coaching. The treatment assignments were not done randomly; instead, parents were asked to choose which group they preferred.

The neurofeedback group had weekly EEG sessions which continued until the participant was able to maintain a state in which his or her cortical activity was within one standard deviation of normed peers for a period of 40 minutes on three consecutive trials (an average of 43 sessions were required).

The participants were tested at completion of the study and one year later, by parent and by teacher questionnaires as well as by the test of variables of attention (TOVA). Neurofeedback was found to have a significant effect on improvement in primary symptoms, both on initial and follow up testing, while having taken medication was found to have no effect on the TOVA at one year follow up, no particular surprise. It must be noted as well that the study's main author was involved in the creation of the initial qEEG database (Monastra VJ et al, *Appl Psychophysiol Biofeedback* 2002;27(4):231–249).

While qEEG remains a controversy, this recent German study makes neurofeedback sound at least interesting for some patients. The practicalities are daunting, however. First, it is not generally covered by insurance, and the number of trainings is high—between 40 and 60 needed to obtain the results in the German study. If each session costs between $100 and $200 dollars, the total cost will be $4,000 to $12,000 per patient!

Second, finding a reliable provider can be another hurdle. There is a certification process available, but not a uniform standard for certification or practice. (For more information on this, see the Biofeedback Certification Institute of America (BCIA) at www.bcia.org.)

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CME Post-Test

As a subscriber to *CCPR*, you already have a username and password to log on www.TheCarlatChildReport.com. To obtain your username and password, please email CME@thecarlatreport.com or call 978-499-0583.

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Below are the questions for this issue's CME post-test. This page is intended as a study guide. Please complete the test online at www.TheCarlatChildReport.com. Note: Learning objectives are listed on page 1.

1. Regular methylphenidate, such as Ritalin or Methylin, has what duration of action (Learning Objective #1)?
   - [ ] a. one to two hours
   - [ ] b. three to six hours
   - [ ] c. eight to 10 hours
   - [ ] d. 12 hours

2. Lisdexamfetamine (Vyvanse) reaches its peak serum concentration at what point (LO #1)?
   - [ ] a. 30 minutes
   - [ ] b. one to two hours
   - [ ] c. 3.5 hours
   - [ ] d. 6.5 hours

3. Some studies have shown that people with ADHD produce too many beta waves and not enough theta waves (L.O. #2).
   - [ ] a. True
   - [ ] b. False

4. Which of the following is NOT one of Dr. Barkley's suggested changes to DSM-5 (LO #3)?
   - [ ] a. Get rid of subtyping
   - [ ] b. Change or eliminate the age of onset
   - [ ] c. Explain what impairment means
   - [ ] d. Change the name of ADHD

5. Of the 5,756 people who had taken Accutane followed in the Sundstrom et al study, how many were admitted to the hospital for suicide attempts (LO #4)?
   - [ ] a. 128
   - [ ] b. 210
   - [ ] c. 1,930
   - [ ] d. 1,980

To earn CME or CE credit, you must read the articles and log on to www.TheCarlatChildReport.com to take the post-test. You must answer at least four questions correctly to earn credit. You will be given two attempts to pass the test. Tests must be taken by January 15, 2012.

PLEASE NOTE: WE CAN AWARD CME CREDIT ONLY TO PAID SUBSCRIBERS

Your evaluation of this CME/CE activity (ie, this issue) will help guide future planning. Please respond to the following questions:

1. Did the content of this activity meet the stated learning objectives? L.O.#1: [ ] Yes [ ] No L.O.#2: [ ] Yes [ ] No L.O.#3: [ ] Yes [ ] No L.O.#4: [ ] Yes [ ] No
2. On a scale of 1 to 5, with 5 being the highest, how do you rank the overall quality of this educational activity? [ ] 5 [ ] 4 [ ] 3 [ ] 2 [ ] 1
3. As a result of meeting the learning objectives of this educational activity, will you be changing your practice performance in a manner that improves your patient care? Please explain. [ ] Yes [ ] No

4. Did you perceive any evidence of bias for or against any commercial products? Please explain. [ ] Yes [ ] No

5. How long did it take you to complete this CME/CE activity? ___ hour(s) ___ minutes
6. **Important for our planning:** Please state one or two topics that you would like to see addressed in future issues.

Neurofeedback as a Treatment for ADHD

Continued from Page 6

Enter the toy industry. For about the same cost as a single session, interested patients can obtain a Star Wars Force Trainer (Uncle Milton), a toy that links a headset to a blower: the more you "concentrate" the harder the blower blows the ball in the air. The makers of the headset, NeuroSky, do not state what exactly is being measured by the headset. The website describes a "proprietary algorithm" that is able to detect "attention" and "meditation" states, and is able to measure alpha, beta, gamma, delta, and theta bandwidths. The toy makes no claims at all, unless you count the one about padawan training.

This same headset is used in the MindFlex game by Mattel, a similar toy that incorporates an obstacle course into the ball blower combo. It costs closer to a session and a half and makes no padawan training claims.

From there, a variety of neurofeedback equipment is available, generally tending toward the more expensive. Whether it works is open to speculation, especially as the specific markers used for feedback are not well described.

CCPR'S VERDICT:

If you can afford the toy, buy the toy and give it a try. There may well be some decent science behind it. Better, give it 40 to 60 tries, and if homework goes more easily afterwards, it was time and money well spent. If it doesn't, you haven't blown the college fund. May the force be with you.

Next Time in *The Carlat Child Psychiatry Report*: Sleep Disorders

This Issue's Focus:
ADHD

The Carlat Child Psychiatry Report

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