

Attention Deficit/Hyperactivity Disorder and Attention Disorders due to Brain Injuries

ADHD (Attention Deficit/Hyperactivity Disorder) is not a simple diagnosis to make. There are many disorders which have shared symptoms with ADHD and can make a child look like they have this disorder when they do not. Also, current research indicates that 80% of individuals with ADHD have at least one other coexisting disorder. Therefore, the clinical picture is rarely as simple as ADHD alone. It is important, therefore, to systematically rule out these other disorders as part of an ADHD evaluation.

Unfortunately, the media puts out a lot of misinformation about ADHD and the medications used to treat it, which leads some parents to avoid diagnosing and treating their child. The purpose of this paper is to provide accurate and up to date information about ADHD.

Diagnostic Terminology

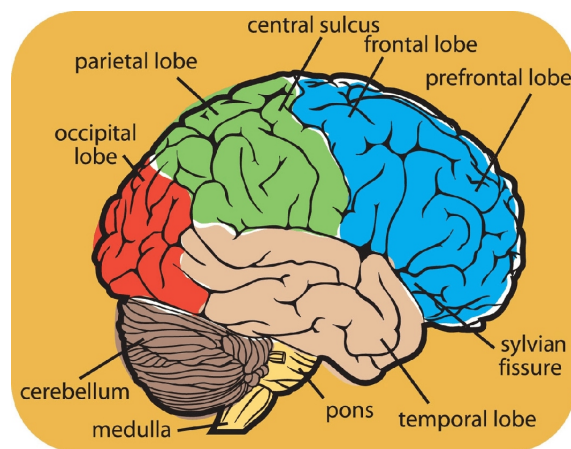
First let's start with a little history. ADHD as a diagnosis did not exist until 1979. Prior to that we recognized that children were hyperactive and inattentive, but we did not have a specific diagnostic label for these symptoms. The official diagnosis in 1979 was Attention Deficit Disorder (ADD) and the clinician added a modifier to the diagnosis, either "with hyperactivity" or "without hyperactivity." The assumption was that all individuals with this disorder were inattentive. In 1989 the diagnosis was changed to Attention Deficit/Hyperactivity Disorder (ADHD) because it was discovered that there was a third type, someone who was hyperactive but could pay attention. There was no modifier that could be added to ADD to make that diagnostic label work. Therefore ADD is now an outdated term for the diagnosis. The three modifiers for ADHD are "inattentive type", "combined type" and "hyperactive/impulsive type", which is the more recent addition. This is actually a somewhat rare subtype.

Prevalence of ADHD

In 1979 it was estimated that this disorder affected approximately 2 to 3% of the population. In the subsequent 30 years this estimate has gone from 2-3%, 3-5%, 5-7%, 7-10%, with 10% being the currently accepted number. While we regard ADHD as a developmental (hereditary) disorder, children who were drug impacted in utero or suffered a brain injury after birth often receive this diagnosis. Regardless of cause, this means one in 10 children suffer from this disorder, and most teachers would readily agree that, in a classroom of 30 children, three will have ADHD. This also very likely means that one in every 10 adults has this disorder, because we now know that people do not outgrow ADHD like we once thought. The only reason we ever thought people outgrew ADHD was based on a behavioral observation that when we took older teenagers and young adults off of their medication, they were not hyperactive anymore. This led us to believe that some people outgrew all of the symptoms of ADHD.

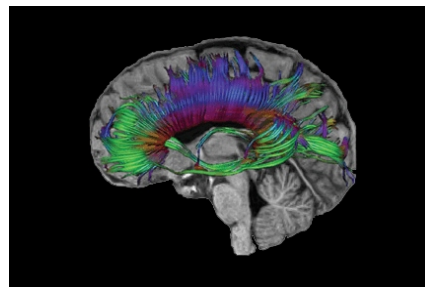
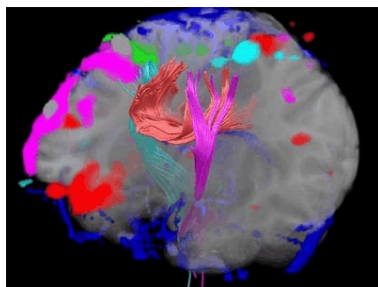
In reality, you do outgrow hyperactivity, but not the attention problems. We now know why this occurs because we know much more about how the brain develops. The very last part

of the brain to develop is the prefrontal region of the cerebral cortex. This part of the brain begins developing at approximately 11 years of age and finishes developing at approximately 22 years of age. The prefrontal region of the brain is primarily responsible for high-level reasoning, problem solving and abstract thinking skills. However, this part of the brain is also involved in behavioral regulation or “impulse control”. As it develops, the child who is hyperactive progressively acquires the neurological ability to consciously inhibit themselves and sit still, an ability they did not have at a younger developmental age. This is why you really do not see hyperactive adults. However, the attention problems are likely to be lifelong and it is therefore necessary to remain on medication if you want to function at your best. It is also important to recognize that the prefrontal cortex is very vulnerable to be damaged with closed head injuries which results in many cognitive and behavioral changes often associated with ADHD.



Neurophysiology of Attentional Disorders

In recent years we have learned a great deal about how the brain functions physiologically and, more importantly, what is going wrong physiologically in the brain of individuals with various disorders. This detailed physiological information has allowed us to learn exactly what is going wrong in the brain of somebody with an attentional disorder. The following description of the neuroanatomy and neurophysiology greatly simplified, but it will give you the basic information that will allow you to understand ADHD and its treatment.



(Diffusion Tensor Imaging)

The source of the problem is a pathway system deep in the brain called the reticular activating system. The reticular activating system originates in the brain stem, which is a very primitive part of the brain that regulates basic functions. The reticular activating system is primarily responsible for regulating sleeping and waking cycles. It essentially physiologically shuts down the brain when you go to sleep and, as the name implies, is supposed to activate the brain physiologically when you wake up so that it is prepared to efficiently process incoming information. However, in individuals with ADHD this pathway system does not function correctly. It does not activate the brain to its proper level. This under activation is seen in the frontal lobe. The reticular activating system primarily projects out to the front half of the brain and not the back half. This is why the physiological under activation associated with ADHD is recorded in this area.

The functional consequence of this under activation is that when the individual attempts to focus their attention on a low stimulation activity, that is something boring like schoolwork, the individual has to dedicate considerable mental energy in order to stay focused and process this information while simultaneously tuning out all visual and auditory distractions and not go off into "La La land." It is more than they are capable of maintaining for very long. Consequently, they get distracted. Conversely, put that same individual on a highly stimulating activity, which is anything personally fascinating to them, and they have no difficulty staying focused. This is because the highly stimulating activity holds their attention and engages them. They do not have to engage the activity. This seeming inconsistency typically creates a great deal of confusion for parents, because it is presumed that if an individual has an attentional disorder, they cannot pay attention to anything at any time. Parents then attribute the child's off task behavior to poor motivation, rather than an inability to remain focused. In reality, the child's ability to pay attention is solely dependent on how stimulating the task is.

Not all children with ADHD have symptoms of hyperactivity, or they do to varying degrees. However, many people assume that hyperactivity represents physical energy because the child is moving around so much. If this were true, all you would have to do is run the hyperactive child around the track a few times and burn it off. Unfortunately, this will not work. This is because hyperactivity is actually due to being overstimulated. If you bring a hyperactive child into a quiet doctor's office, a low stimulation environment, he or she will likely be fairly well contained. However, take that same child into a highly stimulating environment such as Chuck E. Cheeses, and they will go off like a rocket. This is because all of the visual and auditory sensory stimulation of that environment is coming in faster than their physiologically underactivated brain can process it. Consequently, the child is on overload, and they get "wound up" and hyperactive. Essentially, hyperactivity is agitation. Also, while hyperactive children can get overstimulated by the external environment, they can also become overstimulated internally by their own emotions. It is not uncommon for children with ADHD to exhibit poor frustration tolerance and flash anger. Once an emotion is generated, they become overstimulated by it and have difficulty regulating it.

Neurochemistry of Attention Disorders

The brain is made up of billions of nerve cells called neurons. Not everybody knows that all of these billions of neurons do not actually make physical contact with each other in order to send their signals. There is a gap between the neurons called a synapse. Simply put, an electrical discharge travels down the neuron and when it reaches the end it stimulates the release of a neurochemical transmitter that travels across the synapse and binds to receptors sites on the next neuron, which then stimulates another electrical discharge and so forth. Different parts of the brain use different neurochemical transmitters to function. The reticular activating system specifically uses the neurochemical transmitter dopamine. To a minor extent it also utilizes the neurochemical transmitter norepinephrine. However, it is primarily a dopamine pathway system.

Therefore, to treat ADHD, you must raise dopamine levels in the brain. If you do it correctly and redo the physiological brain scans mentioned earlier, they will come back perfectly normal. In other words, the brain is now functioning physiologically as it is supposed to. Unfortunately, this is not what the media betrays. The media makes it sound as if doctors are giving children powerful narcotics for the purpose of behavior control. This is ridiculous. Treating ADHD is no different than treating diabetes or thyroid disorder. Rather than regulating the pancreas or the thyroid gland, we are regulating a pathway system deep in the brain to get it to work properly. Granted, when you treat ADHD in a hyperactive child, their behavior is much better, but their behavior is not the reason that the medication is given.

Medication and Attention Disorders

The interesting thing is that there is really only one type of medication that will effectively raise dopamine levels in the brain of individuals with ADHD; stimulants/amphetamines. Of course, when most people think of amphetamines, they think of powerful narcotics such as methamphetamine and cocaine. In fact, the media portrays ADHD medications as being powerful narcotics. If this were true, then ADHD medications would have abuse potential. If they had abuse potential, they would be sold on the street. Have you ever heard a news story of somebody being arrested for dealing Ritalin on the street. Of course not. This is because you would have to take handful of an ADHD medication all at one time to get the type of amphetamine high that someone who is abusing amphetamines is looking for. It is not that there hasn't been occasions of a student who has ADHD, selling his medication to someone else and they grind it up and try to snort it to get an amphetamine high. However, people will do many things to try to get a high that are not very effective.

There is a common misconception that amphetamines are physically addictive. This is not true. When people hear about the addictive potential of amphetamines, what is being referred to is "psychological" addiction. The psychological addiction is to the euphoric high and elevated energy that is experienced by somebody who is abusing powerful amphetamines. Some people love that euphoric high and want to experience it every day. That is the psychological addiction potential to powerful amphetamines. However, ADHD medications do not have this potential because you cannot feel anything when they are in

your system. They do not alter your mood or how your body feels physically. If you cannot feel it, you cannot become psychologically addicted to it.

Physical addictions only occurred of those substances that your body will build a tolerance to. This means that your body gets used to it. There are only three classes of medications which have this potential. Sedative hypnotics (commonly known as barbiturates), which include drugs like seconal, phenobarbital, alcohol, and many prescription sleep medications. Benzodiazepines, which are the antianxiety medications such as Xanax, Ativan, Librium and Valium. Last are the opiates (the pain killers). Certainly opium and heroin fall in that drug class, but this includes medications like morphine, codeine, OxyContin and Vicodin. Take any of these medications on a daily basis, for several months, and your body will gradually build a tolerance, which will require you to gradually increase the dosage in order to get the same response. Once the dosage is high enough, if you abruptly stop taking it, you will experience withdrawals, which can be very serious. Therefore, you need to have a great deal of respect for these three classes of medications as you can get into serious trouble quite quickly. However, physical addiction is not a problem with amphetamines. Taken as prescribed, you can take ADHD medications your entire life without any secondary health risks. They are not hard on your liver, your kidneys, or aggravate other health conditions.

Parents sometimes express concern about the possibility that taking medication for ADHD might raise the risk of subsequent substance abuse in adolescence. Actually, the research shows just the opposite. It has been consistently shown that, if treatment for ADHD started in the primary grades (first through third), there is no greater chance of substance abuse in adolescence than any other child. However, if ADHD is left untreated, there is a high probability of substance abuse in adolescence. This is because children with untreated ADHD struggle academically throughout elementary school and junior high which subsequently destroys the child's self-esteem. If the child is hyperactive, they likely have a history of getting in trouble at home and at school for their impulsive behavior. Consequently, these children have a long history of conflict with authority figures. By the time children with untreated ADHD reach adolescence, their self-esteem is destroyed, they hate school, and they have no regard for authority figures. They consequently hang out with children have the same attitude and these children are the ones who are doing drugs and getting into trouble. Therefore, treating ADHD greatly reduces the risk of substance abuse.

ADHD Medication and Neurodevelopment

Recent research has consistently shown a difference in the size of certain brain structures between normal individuals and those with ADHD. More striking, however, are the recent studies that show that individuals with ADHD that take stimulant medication show greater development of these brain structures than children who do not take medication, often to normal levels. In other words, the medication is not only correcting the immediate physiological problems associated with ADHD, but is also facilitating brain development. This is probably the most compelling reason to diagnose and treat children with ADHD as soon as possible.

Accurate Diagnosis and Treatment

All this is not to say that there has not been legitimate controversy in the area of ADHD. The legitimate controversy has been in two areas. The first area has been accurate diagnosis of ADHD. Until recently, there were no accurate, objective tests of concentration and impulse control. Those tests which have been traditionally utilized by psychologists were only tests which could be affected by concentration, not tests measuring it directly. Examples would be tests assessing memory, visual processing, and auditory processing. Clearly, an individual could obtain abnormal scores on these tests because they actually have a problem in the area that the test is supposed to measure. Therefore, one could only make inferences from these tests. For this reason, psychologists have not played a central role in the diagnosis of ADHD.

To this day, the diagnosis of ADHD is primarily done by physicians. The way a physician diagnoses ADHD is based on presenting symptoms. They will typically have the parents fill out an ADHD symptom checklist and often have the teacher fill one out as well. They review the checklists and, if the child exhibits enough symptoms, they conclude that the child has ADHD. Unfortunately, the most accurate ADHD symptom checklist is only 70% accurate in diagnosing ADHD. This is because so many disorders have shared symptoms with ADHD and can make a child look like they have this disorder when they do not. A symptom checklist is a very good place to start. They are very useful for developing “hypotheses” about what may be going on, but a risky place to diagnose from.

Fortunately, there are now at least two tests which are very accurate in diagnosing ADHD. We have extensive experience using the Test of Variables of Attention (TOVA) and the IVA Continuous Performance Test. These two tests are very accurate and objective measures of concentration and impulse control (ADHD), and are not affected by processing disorders (a weakness of the Connor’s CPT), psychiatric disorders or other conditions. With tests such as these, the diagnosis of ADHD can be made based on objective performance, not subjective symptom ratings. Also, it would be important for the psychologist performing the evaluation to be looking for any other coexisting disorders which might exist given the high rate of other disorders co-existing with ADHD.

The second area of legitimate controversy has been around medication management of ADHD. Many people have heard horror stories about children being “zombied out” on ADHD medications. The media betrays this as a problem with the medication. However, this only occurs when individuals are overmedicated. It has nothing to do with the medication itself. The question then becomes, “how do individuals become overmedicated?” After an individual has been diagnosed by a physician with ADHD, the way they adjust the medication is based on the parent’s and teacher’s opinions of how the medication is working. The physician has no objective way in their examination room to assess medication response. Therefore, the physician starts at the lowest level of medication and has the parents come back in about three weeks in order to report how the medication is working, as well as getting feedback from the teacher. Typically, the parents will report noticing a very minor functional improvement, which will lead to the conclusion that the child is undermedicated. The physician will then increase the medication and have

the parents come back in another three weeks to provide feedback regarding the patient's response to the medication increase. Typically, the parents will report noticing a significant improvement at home and at school. However, they may still report noticing symptoms of ADHD, which will lead the physician to conclude that the medication is still not at the proper level and result in another medication increase. As mentioned earlier, 80% of individuals with ADHD have at least one other coexisting disorder, which, in all probability, has shared symptoms with ADHD. If the physician is unaware of this other disorder, he is going to assume that the parent's continued complaints of these symptoms means that he has not raised the medication high enough. He will then continue to raise the medication until dopamine levels are driven to high in the brain, which results in a "zombied out kid."

Fortunately, the TOVA and IVA are designed to be used for medication challenge testing. There are no "practice effects" on these tests. In other words, you cannot learn how to take these tests by taking them over and over. Therefore, the child can start at the lowest level of medication and retake the test on slightly higher doses until all of the scores fall within normal limits. At this point, we know that the brain is now working normally physiologically. If one were to continue raising the medication and drive dopamine levels too high, it would interfere with performance on the tests and the scores would go down. Therefore, a child cannot accidentally overmedicated. It would be very obvious by the child's test performance that this has occurred.

With the tests that are available today, used within the context of a careful and comprehensive evaluation, the diagnosis and treatment of attention disorders can now be done very objectively and with a minimal chance of an error. The distributors of the TOVA and IVA can be contacted directly to find out if there is a psychologist in your area that has one or both of these tests.

Test of Variables of Attention

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