Published on ADDitudeMag.com

What Is ADHD? Attention Deficit Diagnosis and Treatment Information

An expert on attention deficit and learning disabilities talks about the biology behind ADHD and why it's sometimes so difficult to diagnose and treat symptoms in children.

by Larry Silver, M.D.

In my 40 years as a child and adolescent psychiatrist, I have treated thousands of youngsters. With some children, I am able to make a quick evaluation about attention deficit hyperactivity disorder and outline a course of ADHD treatment.

With others — more often than I care to admit — I have to tell parents that it's not clear what is wrong. It's not that I lack the expertise or diagnostic skills. It's just that psychiatry isn't quite as far along as other medical specialties.

A pediatrician can do a throat culture and tell at once whether a child needs an antibiotic; appropriate treatment follows the diagnosis. In contrast, psychiatrists are often required to initiate a specific treatment and worry about clarifying the diagnosis later on. As I often tell parents, we must "put out the fire and blow the smoke away" before we can figure out what started the fire.

If a child is having problems in school, he may have attention deficit disorder (ADD ADHD), but it's also possible that he has a learning disability. Or depression. Or anxiety. Sometimes what looks like ADHD is the result of family tensions.

If ADHD seems to be even a part of such a mixed clinical picture, I typically prescribe ADHD medication. If this solves the problem, terrific. But in many cases, another intervention is needed to address persistent academic, emotional, or family problems. Only weeks or months after treatment has been initiated will the full clinical picture become clear.

I understand parents' concern about medicating their children. My clinical knowledge notwithstanding, I agonized over whether my granddaughter, who has ADHD, should be on meds. (Ultimately, we decided she should.) I have found, however, that parents often feel better about ADHD meds when they understand a bit about neurotransmitters, the remarkable compounds that govern brain function.

How neurotransmitters work

Before I tell you about these special brain chemicals, let me explain a bit about brain anatomy.

There are millions of cells, or neurons, densely packed into various regions of the brain. Each region is responsible for a particular function. Some regions interact with our outside world, interpreting vision, hearing, and other sensory inputs to help us figure out what to do and say. Other regions interact with our internal world — our body — in order to regulate the function of our organs.

For the various regions to do their jobs, they must be linked to one another with extensive "wiring." Of course, there aren't really wires in the brain. Rather, there are myriad "pathways," or neural circuits, that carry information from one brain region to another.

Information is transmitted along these pathways via the action of neurotransmitters (scientists have identified 50 different ones, and there may be as many as 200). Each neuron produces tiny quantities of a specific neurotransmitter, which is released into the microscopic space that exists between neurons (called a synapse), stimulating the next cell in the pathway — and no others.

How does a specific neurotransmitter know precisely which neuron to

attach to, when there are so many other neurons nearby? Each neurotransmitter has a unique molecular structure — a "key," if you will — that is able to attach only to a neuron with the corresponding receptor site, or “lock.” When the key finds the neuron bearing the right lock, the neurotransmitter binds to and stimulates that neuron.

This article comes from the December 2006/January 2007 issue of *ADDitude*.

Neuroscience 101, Part 2

Neurotransmitter deficiencies

Brain scientists have found that deficiencies in specific neurotransmitters underlie many common disorders, including anxiety, depression, anger-control problems, and obsessive-compulsive disorder.

ADHD was the first disorder found to be the result of a deficiency of a specific neurotransmitter — in this case, norepinephrine — and the first disorder found to respond to medications to correct this underlying deficiency. Like all neurotransmitters, norepinephrine is synthesized within the brain. The basic building block of each norepinephrine molecule is dopa; this tiny molecule is converted into dopamine, which, in turn, is converted into norepinephrine.

A four-way partnership

ADHD seems to involve impaired neurotransmitter activity in four functional regions of the brain:

- **Frontal cortex.** This region orchestrates high-level functioning: maintaining attention, organization, and executive function. A deficiency of norepinephrine within this brain region might cause inattention, problems with organization, and/or impaired executive functioning.
- **Limbic system.** This region, located deeper in the brain, regulates our emotions. A deficiency in this region might result in restlessness, inattention, or emotional volatility.
- **Basal ganglia.** These neural circuits regulate communication within the brain. Information from all regions of the brain enters the basal ganglia, and is then relayed to the correct sites in the brain. A deficiency in the basal ganglia can cause information to “short-circuit,” resulting in inattention or impulsivity.
- **Reticular activating system.** This is the major relay system among the many pathways that enter and leave the brain. A deficiency in the RAS can cause inattention, impulsivity, or hyperactivity.

These four regions interact with one another, so a deficiency in one region may cause a problem in one or more of the other regions. ADHD may be the result of problems in one or more of these regions.

Trial and error

We don't know which brain region is the source of ADHD symptoms. Nor can we tell whether the problem lies with a deficiency of norepinephrine itself or of its chemical constituents, dopa and dopamine. Thus, doctors must rely on clinical experience to determine which medication to try for each child, and at what dosage.

Someday, when our knowledge of the brain is greater, the diagnosis and treatment of ADHD will be more nuanced. Instead of diagnosing simply "ADHD," and prescribing a stimulant, we might be able to say, "Billy's ADHD is caused by a deficiency of dopa in the frontal cortex, so he needs medication A," or "Mary has a type of ADHD caused by a deficiency of dopamine in the limbic system, so she needs medication B," or "José has ADHD caused by a deficiency of norepinephrine in the reticular activating system, and he needs medication C."

What do ADHD medications do? In simple terms, they raise the level of norepinephrine within the brain. (Stimulants work by causing the brain to synthesize more norepinephrine; nonstimulants by slowing the rate at which norepinephrine is broken down.) Once the level is where it should be, the brain functions normally, and the individual becomes less hyperactive, inattentive, and/or impulsive. Once the drug wears off, the level falls — and symptoms return.

And so we come to the conclusion of Neuroscience 101. I hope you have a greater knowledge of, and appreciation for, the human brain. I also hope you have a better understanding of neurotransmitters and how they are linked to ADHD.

In years to come, I'm sure we will gain a more comprehensive understanding of ADHD — and new medications that will be more effective than those we have now. I can't wait.

This article comes from the December 2006/January 2007 issue of *ADDitude*.

To read this issue of *ADDitude* in full, purchase the back issue and SUBSCRIBE NOW to ensure you don't miss a single issue.

Adult ADHD | Parenting ADHD Children | ADHD Treatment | School & Learning Disabilities | About ADHD | ADHD Resources | ADHD Community

---

Source: What Is ADHD? Attention Deficit Diagnosis and Treatment Information