Neurotransmitters 101

What are Neurotransmitters?

Neurotransmitters are chemicals produced from certain amino acids. They are found in neurons (brain cells) and are used to transmit information from one nerve cell to another. Simply put, an electrical impulse travels down the axon of the neuron. When the impulse reaches the terminal end of the neuron, the neuron releases neurotransmitters. These neurotransmitters cross the space between the neurons called the synapse, and bind with receptors on the connecting neuron. Neurotransmitters that do not bind with the receptors are reabsorbed by the original neuron, or inactivated. This movement of neurotransmitters between neurons is one of the mechanisms controlling brain activity.

The Importance of Balanced Neurotransmitters

Neurotransmitters define our moods, actions, and health. The importance of neurotransmitters transcends their role in the brain. Organs throughout the body are connected to the brain via a vast network of neurons. The brain uses neurotransmitters to tell the heart to beat, the lungs to breathe, and the intestines to digest. This is known as the autonomic nervous system. Nowhere in nature does there exist another class of molecules with such importance and biological influence as the neurotransmitters. To reiterate, basic knowledge of the excitatory vs. inhibitory concept of neurotransmission is key to understanding the nervous system. A balance between the levels of inhibitory and excitatory neurotransmitters is necessary for optimal health. The list of clinical problems associated with neurotransmitters is long and continues to grow as researchers establish important links between the scientific and clinical effects of neurotransmitters.

Some of the most significant clinical issues linked to neurotransmitter imbalances are: anxiousness, appetite control, attention issues, developmental delays, behavioral problems, low mood, fatigue, libido, women's issues, headaches, mood disorders, sleep disorders, weight issues, and many more. A balanced nervous system is necessary to maintain optimal health. When the critical balance between the excitatory and inhibitory systems is lost, it creates a situation that increases the likelihood of a neurotransmitter-related condition developing.

A healthy nervous system is characterized by meeting two basic criteria. Number one, it must have sufficient supplies of the necessary neurotransmitters. Secondly, the excitatory and inhibitory systems must work together in a manner that delivers signals appropriately. The second criterion is quite dependent upon the first, in that the supply of neurotransmitters primarily dictates excitatory/inhibitory balance. **Many neurotransmitter-related conditions are believed to be the result of insufficient neurotransmitter supplies.** To illustrate this point, consider the following: A gas line that runs from a propane tank to a furnace. In this case, the gas line is a chain of neurons, or circuit, and the gas running through the line is a hypothetical supply of neurotransmitters. When the gas line is full and functioning at its peak, the furnace runs at optimum efficiency, keeping the house warm throughout the coldest winter nights.

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However, if the supply of gas running through the line starts to dwindle, the furnace loses efficiency or might stop functioning altogether, leaving the house at the mercy of old man winter. The same logic applies to neurotransmission. Without enough neurotransmitters in the system, whether excitatory or inhibitory, the system as a whole does not function properly. This creates a situation ripe for the onset of disease.

Similarly, neurotransmitter-related conditions can manifest due to an imbalance between the excitatory and inhibitory systems. Consider another situation. The fear response in humans is controlled in an area of the brain called the amygdala. An individual who visually interprets a somewhat stressful, but non-threatening situation sends an excitatory neurotransmitter signal from the eyes to the amygdala. If this individual has a healthy nervous system, inhibitory neurotransmitters will filter out the excitatory message, thereby preventing an unnecessary fearful response to the non-threatening situation. If the individual has a compromised inhibitory system, the excitatory stimulus will override the weak inhibitory message, thereby activating an unnecessary fear response.

What Causes Neurotransmitter Imbalances?

Medical research has shown that many factors associated with today's fast-paced lifestyle can be linked to imbalances in neurotransmitter and hormone levels. **Of the many factors affecting neurotransmitter balance, four stand out as the most prevalent. These four include chronic stress, diet, neurotoxin exposure, and genetics.**

Chronic stress is the primary contributor to neurotransmitter imbalance. Stress, both emotional and physical, can cause neurons to excrete large amounts of neurotransmitters to help us cope with the situation. Acute stress is generally tolerated very well, and doesn't cause significant neurotransmitter imbalances. In contrast, chronic or day-in-day-out stress, from things like a busy career, a stressed relationship, or a bacterial or viral infection, will tax the nervous system, and over time, deplete neurotransmitter supplies.

Second, **poor dietary habits** can contribute to neurotransmitter imbalances, especially if the poor diet is combined with high stress. The production of neurotransmitters depends on adequate levels of amino acid precursors. Diets low in protein may limit the supplies of these amino acids. This will decrease neurotransmitter levels. Other dietary factors can also contribute to imbalances. For example, high glycemic carbohydrates, when consumed in excess may cause neurotransmitter deficiencies by increasing the excretion of neurotransmitters.

Another dietary influence concerns appropriate fat intake. Our brain cell membranes are composed primarily of lipids, or fats. Omega-3 fatty acids stabilize these membranes and are required for proper brain cell function. Diets low in these fatty acids can compromise the integrity of the neurons themselves and lead to faulty neurotransmission. These important dietary fats can be obtained by eating foods rich in omega-3 fatty acids like nuts, seeds, and fish.

The third major contributor to neurotransmitter imbalances is **neurological toxins**. Many chemicals, such as industrial solvents, pesticides, and heavy metals, are neurotoxic. Some of these chemical toxins are lipid-soluble. Since the brain is composed mainly of lipids, many toxins find their way past the blood-brain barrier and into brain cells. Once a toxin has bound to or is inside the brain cell, it can cause significant imbalances in neurochemical activity. Neurotoxin exposure can destroy the individual neuron and extreme cases cause death. Unfortunately, the brain is limited in its ability to replace damaged brain cells with new brain cells. It is also difficult to remove some toxins once they have entered the brain.

The last major influence of neurotransmitter imbalance is **genetics.** Some individuals are metabolically predisposed to neurotransmitter deficiencies or excesses. This also can make them more susceptible to neurotransmitter-related disorders, such as depression and Attention deficit/hyperactivity disorder, which are found to run in families.
The combined effect of chronic stress, poor diet, neurotoxins, and genetics is that neurotransmitter-related conditions develop.

Testing & Assessing Neurotransmitters Imbalances

Our path to restoring communication within the nervous system begins with testing neurotransmitter levels. Once imbalances are identified, programs can be developed that specifically target those imbalances. Challenging symptoms such as low mood, anxious and sleep difficulties are incredibly complex, and fall under the control of many different neurotransmitters and hormones. Neurotransmitter testing allows us to pinpoint which of the many parameters related to a condition may be responsible. When interpreting the results of a neurotransmitter lab test, it is important to consider both the absolute value of the parameters evaluated as well as the relative excitatory/inhibitory balance of the system as a whole.

At **Boulder Natural Medicine Clinic**, we have lab test kits that assess neurotransmitters, neuromodulators, and amino acids with clinical relevance. We can offer testing for 10 different hormones, including sex steroids, adrenal hormones, and thyroid hormones. Hormone tests are done utilizing saliva, serum, or whole blood as the biological sample. With so many parameters to choose from, selecting the appropriate test panel can be confusing however a discussion with Dr Flatland will simplify the process.

Neurotransmitter testing is simple, affordable, and only requires urine collection. Occasionally, Dr Flatland may need to do a different amino acid panel, which can be done with a simple blood draw at the office. For urine collection, patients typically collect specimens at home and mail them directly to the lab. The sample itself is a single-point, AM collection. We ask patients to collect the second urine void of the day, typically 2-3 hours after waking. The second void is a representation of neurotransmitter activity while awake, whereas the first urine void after waking represents neurotransmitter activity throughout the nighttime. Timing the collection around the body's natural peaks is important in determining what the body is capable of producing.

Second, morning collection avoids factors such as exercise, caffeine, morning commute traffic, meals, and other kinds of stress that can affect neurotransmitter levels.
Baseline testing is recommended for all neurotransmitter-related conditions for several reasons. First, it reveals imbalances that may be present in the nervous system, thereby establishing a quantitative need for intervention. Symptoms alone often do not provide the information needed to effectively target the underlying neurotransmitter imbalances. With neurotransmitter data in hand, Dr Flatland can choose products that target neurotransmitter imbalances.

Finally, the baseline test provides an important reference point to monitor the effects of therapy. Retests can be compared to baseline data to evaluate progress made in the restoration process. In addition to baseline testing, periodic retesting is used to indicate a need for change in a patient's dosing regimen.

When a patient's specimen is received, the laboratory will process the sample and a lab report will be generated. The report contains values for each neurotransmitter and hormone requested, as well as ranges for comparison. Lastly, each report contains an individualized protocol designed to address imbalances.

Getting Started

If you would like to discuss neurotransmitter testing, lab costs, or believe you would be a good candidate for testing, we also offer an in-office questionnaire to help identify neurotransmitter imbalances.

Thank you and go in good health!