

Dopamine

Dopamine is made in the “pleasure center of the brain” and helps to pull information together from many sources to create the big picture. It is responsible for movement, memory, attention, problem-solving, desire, and motivation.

Low Dopamine:

Low Dopamine is associated with poor focus, depression, fatigue, and brain fog.

Treatment:

Amino Acid Precursors such as 500-1,000 mg of **L-tyrosine** can be given each day to increase the synthesis of norepinephrine, epinephrine, and dopamine. Phenylalanine and tyrosine are the amino acid precursors of the neurotransmitters norepinephrine, epinephrine and dopamine.

By improving the rate of neurotransmitter synthesis, tyrosine stimulates the central nervous system. It appears to function as an adaptogen, relieving physical symptoms of stress such as mood swings. Chronically stressed individuals may not efficiently convert phenylalanine to tyrosine, making supplementation with tyrosine desirable.

Tyrosine is a precursor for thyroid hormone (thyroxine) and melanin. Melanin is the pigment responsible for skin and hair color and protection from harmful ultraviolet rays. In addition, tyrosine stimulates growth hormone and is involved in adrenal and pituitary function. Tyrosine is a powerful antioxidant, scavenging and neutralizing free radicals and inhibiting fat oxidation. Phenylalanine is sometimes used along with the cofactors vitamin B6, niacin, folate, and vitamin C when patients are sensitive to tyrosine.

Make sure patient has adequate iron stores because iron is a cofactor in dopamine synthesis.

If DOPAMINE is LOW, consider amino acid precursors.

If DOPAMINE is HIGH, consider potent antioxidants, vitamin C, minerals, and copper.

High Dopamine:

High dopamine levels may be seen in patients with feelings of mania, aggressiveness, irritability and anger. High dopamine can be deleterious to the brain and may be a result of inadequate cofactors such as Vitamin C and copper.

Treatment:

Antioxidant Protection is needed when neurotransmitter levels are very high to protect the brain from damage. Natural products able to up-regulate glutathione and antioxidant capacity include broccoli extract, turmeric, green tea catechins, resveratrol, and black pepper extract.

These agents turn on the genes that tell the body to make more glutathione. They activate the Nrf2 genetic pathway which helps produce important antioxidants such as glutathione and superoxide dismutase (SOD) and detoxification enzymes such as glutathione-S transferase.

Activating this genetic pathway also reduces inflammatory factors such as NF-kB. One capsule a day is generally recommended and would give doses of 30 mg of glucoraphanin from broccoli extract, 200 mg turmeric, 200 mg green tea extract, 2 mg pepper extract, 50 mg pterostilbene (like resveratrol).

Multi-Mineral formula with Copper is needed to optimize neurotransmitter synthesis. Copper helps convert dopamine to norepinephrine.

Vitamin C:

Vitamin C (ascorbic acid) has numerous biological functions but is recommended here because it is a cofactor in the conversion of dopamine to norepinephrine. A typical dose is 1000 mg a day. Vitamin C is essential for the synthesis of collagen and glycosaminoglycans which are the building materials of all connective tissues, such as skin, blood vessels, tendons, joint cartilage, and bone. As such, vitamin C is essential for normal wound healing and capillary health.

Other Testing to Consider:

1. Nutrient Minerals
2. Adrenal Stress Test
3. Amino Acids
4. Oxidative Stress Profile

Norepinephrine

Norepinephrine, or **noradrenaline**, is involved in attention and impulsivity. It has a vital role in the “fight or flight” response. It is released from the adrenal medulla or from neurons. Certain antidepressants target norepinephrine.

Low Norepinephrine:

Low levels are associated with fatigue, poor focus, depression, sleep disturbance, adrenal exhaustion, and weakness.

Treatment:

Amino Acid Precursors in the form of 500-1,000 mg of L-tyrosine may be given each day to increase the synthesis of norepinephrine, epinephrine, and dopamine. Phenylalanine and tyrosine are the amino acid precursors of the neurotransmitters norepinephrine, epinephrine and dopamine. By improving the rate of neurotransmitter synthesis, tyrosine stimulates the central nervous system. It appears to function as an adaptogen, relieving physical symptoms of stress such as mood swings.

Chronically stressed individuals may not efficiently convert phenylalanine to tyrosine, making supplementation with tyrosine desirable. Tyrosine is a precursor for thyroid hormone (thyroxine) and melanin. Melanin is the pigment responsible for skin and hair color and protection from harmful ultraviolet rays. In addition, tyrosine stimulates growth hormone and is involved in adrenal and pituitary function.

Tyrosine is a powerful antioxidant, scavenging and neutralizing free radicals and inhibiting fat oxidation. Phenylalanine is sometimes used along with the cofactors vitamin B6, folate, and vitamin C when patients are sensitive to tyrosine. Make sure patient has adequate iron stores because iron is a cofactor in norepinephrine synthesis.

Copper and **Vitamin C** are needed to convert dopamine to norepinephrine.

Adrenal Glandular Support is often used to naturally enhance cortisol production. The adrenal glands are needed for proper catecholamine production (dopamine, norepinephrine, and epinephrine). Formulas that contain adrenal glandulars and herbs support healthy adrenal function. They may be taken at the recommended dosage, twice daily, usually 250-500 mg of adrenal powder/day.

Adaptogenic Adrenal Herbs help regulate adrenal function; either to calm adrenals or raise adrenal activity, depending on the individual. Examples of these natural agents include ginseng, eleuthero, licorice, schisandra, and rhodiola. These herbs have been shown to support the body’s natural stress mechanisms and restore balance. Other nutrients that support adrenal health include vitamin C, zinc, and B vitamins. Lifestyle modifications are often necessary to successfully heal the adrenals (rest, vacations, naps, meditation, and yoga, for example).

High Norepinephrine:

This can be indicative of **methylation defects**. A high level of norepinephrine can cause one to feel anxious, irritable, aggressive, and can contribute to insomnia. It is associated with the stress response and the “fight or flight” reaction to stress.

If NOREPINEPHRINE is LOW, consider amino acid precursors, copper, Vitamin C and adrenal support.

If NOREPINEPHRINE is HIGH, consider potent antioxidants, methylation cofactors and stress reduction.

Other Testing to Consider:

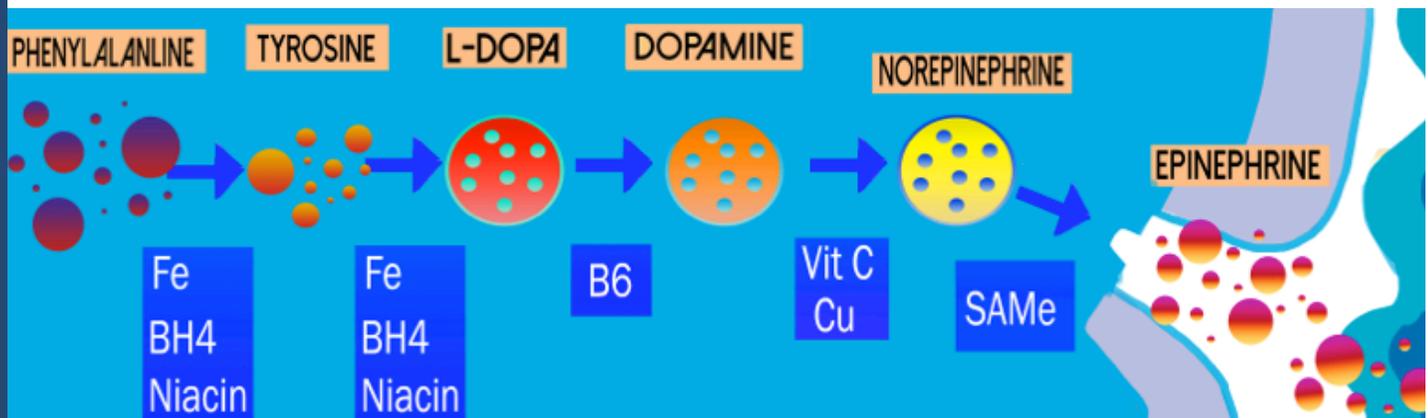
1. Amino Acids
2. Adrenal Stress Test
3. Oxidative Stress Profile
4. B Vitamins

Norepinephrine

Treatment:

Antioxidant Protection is needed when neurotransmitter levels are very high to protect the brain from damage. Natural products able to up-regulate glutathione and antioxidant capacity include broccoli extract, turmeric, green tea catechins, resveratrol, and black pepper extract. These agents turn on the genes that tell the body to make more glutathione. They activate the Nrf2 genetic pathway which helps produce important antioxidants such as glutathione and superoxide dismutase (SOD) and detoxification enzymes such as glutathione-S transferase. Activating this genetic pathway also reduces inflammatory factors such as NF-kB. One capsule a day is generally recommended and would give doses of 30 mg of glucoraphanin from broccoli extract, 200 mg turmeric, 200 mg green tea extract, 2 mg pepper extract, 50 mg pterostilbene (resveratrol-like).

Methylation Cofactors enhance the conversion from norepinephrine to epinephrine. S-adenosyl-L-methionine (SAME) is the cofactor responsible for moving norepinephrine through its pathway. The active forms of folate (5-MTHF) and vitamin B12 (methylcobalamin) can help support SAME production and its important role in neurotransmitter biochemistry. Trimethylglycine is another supplement used to enhance methylation activity. SAME at 400 mg/day and TMG at 600 mg are typical dosages. Methylation support helps maintain good cardiovascular, cognitive and neurological health, and supports bone and reproductive



Neurotransmitters are synthesized in the neuron from amino acids and vitamin and mineral cofactors. Phenylalanine is converted to tyrosine using iron (Fe), tetrahydrobiopterin (BH4), and niacin. Tyrosine is converted to L-DOPA using the same cofactors and then to dopamine with the help of vitamin B6. Norepinephrine is produced from dopamine with Vitamin C and copper (Cu). Norepinephrine is then converted to epinephrine with the help of SAME. Folate and vitamin C are sometimes used to enhance endogenous levels of BH4. Amino acids, vitamins, and minerals can be used to promote synthesis and clearance of neurotransmitters.

Epinephrine

Epinephrine, or **adrenaline**, is vital for our “fight or flight” response. It is released from the adrenal glands in cases of danger or emergency. It suppresses the adaptive immune system and is therefore used to treat anaphylaxis.

Low Epinephrine:

Low epinephrine is associated with fatigue, poor stress response, decreased focus and concentration.

Treatment:

Amino Acid Precursors such as 500-1,000 mg of **L-tyrosine** can be given each day to increase the synthesis of norepinephrine, epinephrine, and dopamine. Phenylalanine and tyrosine are the amino acid precursors of the neurotransmitters norepinephrine, epinephrine and dopamine. By improving the rate of neurotransmitter synthesis, tyrosine stimulates the central nervous system.

Treatment cont.

It appears to function as an adaptogen, relieving physical symptoms of stress such as mood swings. Chronically stressed individuals may not efficiently convert phenylalanine to tyrosine, making supplementation with tyrosine desirable. Tyrosine is a precursor for thyroid hormone (thyroxine) and melanin. Melanin is the pigment responsible for skin and hair color and protection from harmful ultraviolet rays. In addition, tyrosine stimulates growth hormone and is involved in adrenal and pituitary function. Tyrosine is a powerful antioxidant, scavenging and neutralizing free radicals and inhibiting fat oxidation. Phenylalanine is sometimes used along with the cofactors vitamin B6, folate, and vitamin C when patients are sensitive to tyrosine. Iron stores should be normal as iron is involved in epinephrine synthesis.

SAMe helps convert norepinephrine to epinephrine.

Adrenal Glandular Support is often used to naturally enhance cortisol production. The adrenal glands are needed for proper catecholamine production (dopamine, norepinephrine, and epinephrine). Formulas that contain adrenal glandulars and herbs support healthy adrenal function. They may be taken twice daily at the recommended dosage, resulting in a dose of 250-500 mg adrenal powder/day.

Adaptogenic Adrenal Herbs help regulate adrenal function; either to calm adrenals or raise adrenal activity, depending on the individual. Examples of these natural agents include ginseng, eleuthero, licorice, schisandra, and rhodiola. These herbs have been shown to support the body's natural stress mechanisms and restore balance. Other nutrients that support adrenal health include vitamin C, zinc, and B vitamins. Lifestyle modifications are often necessary to successfully heal the adrenals (rest, meditation, and yoga, for example).

High Epinephrine:

High levels of **epinephrine** are associated with feelings of anxiety, irritability, and aggressiveness. Additionally, high levels of epinephrine can contribute to insomnia.

Treatment:

Phosphatidylserine is a fat-soluble phospholipid found in high concentrations in the brain and nervous tissue. Phosphatidylserine is used to support memory and cognitive function in individuals with mild to moderate age-associated memory loss. 100 mg, twice a day, is a usual dose.

Phosphatidylserine has been reported to maintain the structure and function of brain cells, as well as improve memory, learning, concentration, word recall, and mood in persons with dementia or decreased cognitive function. Phosphatidylserine is a precursor for nerve cell function and helps to support normal cognitive and nervous system function.

Ashwagandha (*Withania somnifera*) is an adaptogenic herb used to help relax and calm the adrenal glands. 500 mg of ashwagandha with 25 mg of withanoloids (used to standardize the extract) may be taken twice a day.

During chronic stress, ashwagandha is able to support normal thyroid and gonadal function and also act as a primary agent to restore proper function of the hypothalamic-pituitary-adrenal axis. Ashwagandha also works synergistically with other plant adaptogens to support brain function, the immune system and a healthy metabolism.

If EPINEPHRINE is LOW, consider amino acid precursors, cofactors, and adrenal support.

If EPINEPHRINE is HIGH, consider phosphatidylserine, ashwagandha, and stress relief.

Other Testing to Consider:

1. Adrenal Stress Test
2. Amino Acids
3. Oxidative Stress Profile

Serotonin



Serotonin is important in many processes in the body: mood, sleep, emesis, sexuality, blood pressure control, and appetite. It is involved in depression, migraine headache, bipolar disorder, and anxiety.

Low Serotonin:

Low levels of **serotonin** are associated with depression, insomnia and heightened pain response. Low levels can cause one to feel more anxious. Low levels may be caused by inflammation, poor tryptophan status, or long-term use of medications that deplete serotonin.

Treatment:

5-Hydroxytryptophan (5-HTP) is the amino acid precursor to serotonin, the chemical messenger that affects emotions, behavior, appetite, and sleep. 5-HTP at a dose of 100-200 mg may be given before bed. Higher doses are sometimes used for more severe symptoms. 5-HTP can be taken in the morning to control anxiety. Controlled Release 5-HTP products are available and allow for 5-HTP release slowly and steadily over a period of time. 5-HTP is an amino acid derived from plant sources that naturally increases the body's level of serotonin. Today's stress-filled lifestyles and dietary practices may negatively affect how the body produces and clears serotonin. 5-HTP can help promote a more positive outlook and greater appetite control. L-tryptophan is the amino acid precursor of 5-HTP and may be used with cofactors to produce serotonin, except in cases of inflammation.

Cofactors such as folate, vitamin C, niacin, and vitamin B6 can promote synthesis of serotonin from L-tryptophan. Make sure patient has adequate iron stores because iron is a cofactor in serotonin synthesis.

If SEROTONIN is LOW, consider 5-HTP and cofactors.

If SEROTONIN is HIGH, consider SAME, antioxidants, stress reduction, and investigate gut dysbiosis.

High Serotonin:

High levels of **serotonin** are associated with feeling overly stimulated, anxious, and an inability to concentrate. High levels might be caused by stress, SSRIs (selective serotonin reuptake inhibitors), or gut dysbiosis. Consistently high levels of serotonin can be neurotoxic.

Treatment:

S-adenosyl-L-methionine (SAME) is the cofactor responsible for clearing serotonin from the body. SAME and TMG (trimethylglycine) are naturally occurring substances that contribute to methylation, a process essential for the synthesis of neurotransmitters, proteins, nucleic acids, and phospholipids. SAME at 400 mg/day and TMG at 600 mg are typical daily dosages. The SS isomer of SAME is preferred because it is the active form used more readily by the body. SAME supports glutathione production, liver health, joint comfort, and healthy mood. TMG is an especially important methyl donor involved in the metabolism of homocysteine and the formation of SAME. TMG ultimately supports cardiovascular and neurological health, as well as normal cell-life regulation. The active forms of folate (5-MTHF) and vitamin B12 (methylcobalamin) can help support SAME production and its important role in neurotransmitter biochemistry.

Antioxidant Protection is needed when neurotransmitter levels are very high to protect the brain from damage. Natural products able to up-regulate glutathione and antioxidant capacity include broccoli extract, turmeric, green tea catechins, resveratrol, and black pepper extract. These agents turn on the genes that tell the body to make more glutathione. They activate the Nrf2 genetic pathway which helps produce important antioxidants such as glutathione and superoxide dismutase (SOD) and detoxification enzymes such as glutathione-S transferase. Activating this genetic pathway also reduces inflammatory factors such as NF-kB. One capsule a day is generally recommended and would give doses of 30 mg of glucoraphanin from broccoli extract, 200 mg turmeric, 200 mg green tea extract, 2 mg pepper extract, 50 mg pterostilbene (resveratrol-like).

Other Testing to Consider:

1. Amino Acids
2. Stool Test
3. B Vitamins

GABA



GABA increases the production of brain waves related to a relaxed, yet mentally focused state, while decreasing brain waves associated with hyperactivity, nervousness, and fleeting thoughts.

Low GABA:

Low levels of gamma-aminobutyric acid (GABA) are associated with anxiety, tension headaches, inability to focus, attention deficit/hyperactivity disorder, obsessive thoughts and irritability.

Treatment:

Calming Formulas, designed to control excess catecholamine production and up-regulate inhibitory neurotransmitters, can promote a calm, relaxed, physiological and emotional state. Calming formulas may contain magnesium, L-theanine, taurine, inositol, and GABA. This type of formula is typically given in the morning to balance neurotransmitters and the dose can be doubled if symptoms continue.

Inositol is a precursor for the second-messenger phosphatidylinositol system, and may be therapeutic in depression, obsessive-compulsive disorder, and panic. Taurine is thought of as neuroprotective and stabilizes cell membranes in the heart and brain. L-Theanine is notable for its ability to relax the mind without inducing drowsiness and may also support nerve health and cognition. Magnesium is sometimes referred to as the relaxation mineral and supplementation has been shown to support a healthy mood, including during the menstrual cycle, when mood changes are common. Example dosages are: 75 mg magnesium, 50 mg L-theanine, 500 mg taurine, 2 mg inositol, and 100 mg GABA.

GABA cream helps calm the brain's excitatory system. One pump of cream can be used as needed for anxiety, before bed for sleep, or in the morning to aid focus and concentration. L-theanine is also an anxiolytic amino acid that can be applied topically. GABA and L-theanine are two substances that are prominent in the literature as potential treatments for anxiety and depression. Topical delivery of GABA and L-theanine allows the nutrients to enter the bloodstream directly bypassing the liver.

Cofactors such as folate, vitamin B6, and magnesium are required in the production of GABA from L-histidine.

High GABA:

High levels of GABA are associated with lethargy. GABA will often go up as a compensatory mechanism to protect the brain from perceived stress. Vitamin B6 helps to metabolize GABA.

Treatment:

Glycine is a precursor in the production of GABA. Glycine can be taken in gram quantities (1-5g) before bed to support GABA pathways. Glycine is a nonessential amino acid used by the body to build proteins, make DNA, and collagen, as well as produce glutathione and carry out detoxification. Vitamin B6 aids in the utilization of glycine. Glycine and vitamin B6 are necessary for prostate health.

Antioxidant Protection is needed when neurotransmitter levels are very high to protect the brain from damage. Natural products able to up-regulate glutathione and antioxidant capacity include broccoli extract, turmeric, green tea catechins, resveratrol, and black pepper extract. These agents turn on the genes that tell the body to make more glutathione. They activate the Nrf2 genetic pathway which helps produce important antioxidants such as glutathione and superoxide dismutase (SOD) and detoxification enzymes such as glutathione-S transferase. Activating this genetic pathway also reduces inflammatory factors such as NF-kB. One capsule a day is generally recommended and would give doses of 30 mg of glucoraphanin from broccoli extract, 200 mg turmeric, 200 mg green tea extract, 2 mg pepper extract, and 50 mg pterostilbene (resveratrol-like).

If GABA is LOW, consider GABA cream, cofactors, and calming formulas that decrease catecholamines and increase inhibitory neurotransmitters.

If GABA is HIGH, consider glycine, B6, and potent antioxidants.

Other Testing to Consider:

1. Amino Acids
2. Adrenal Stress Test
3. Oxidative Stress Profile