NutriPATH
Integrative Pathology Services
P: 1300 688 522
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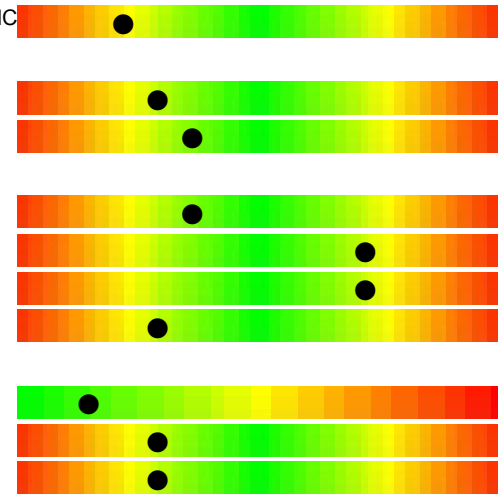
A: PO Box 442 Ashburton VIC 3142

TEST PATIENT
Sample Test Name
Sex : F
Date Collected : 00-00-0000
111 TEST ROAD TEST SUBURB
LAB ID: 00000000 UR#:0000000

TEST PHYSICIAN
DR JOHN DOE
111 CLINIC STREET
CLINIC SUBURB VIC 3000

INTEGRATIVE MEDICINE

URINE, SPOT	Result	Range	Units
Intermediate Neurotransmitter Profile			
Glycine, Urine	**48.0**	43.0 - 173	mmol/molC
Inhibitory Neurotransmitters			
SEROTONIN Urine	**73.3**	50.0 - 250.0	ug/gCR
GABA, Urine	**271.0**	150.0 - 700.0	ug/gCR
Excitatory Neurotansmitters			
DOPAMINE, Urine	**160.0**	100.0 - 350.0	ug/gCR
NORADRENALIN (Nor-Epinephrine)	**63.4**	13.0 - 70.0	ug/gCR
ADRENALIN (Epinephrine)	**18.4**	3.0 - 20.0	ug/gCR
GLUTAMATE Urine	**3.7**	2.0 - 12.0	ug/gCR
Adrenal Adaptation Index			
Noradrenalin/Adrenalin Ratio	**3.4**	< 10.0	RATIO
Histamine, Urine	**11.0**	7.6 - 35.4	ug/gCR
PhenylEthylamine PEA	**7.4**	3.6 - 38.8	ug/gCR



Optimal Ranges Table

Biomarker	Adult Optimal Range (>11 Yrs)	
Serotonin	200 - 415	ug/gCr
GABA	600 - 1100	ug/gCr
DOPAMINE	250 - 400	ug/gCr
Noradrenaline	30 - 50	ug/gCr
Adrenaline	10 - 15	ug/gCr
Glutamate	5 - 10	ug/gCr

There are multiple factors that play roles in neurotransmitter levels (Lifestyle, receptors, meds, supplements, diet, stress, etc).
The optimal reference ranges stated above have been determined/derived statistically from historical patient data.
Historically, these levels were achieved in the majority of patients as they experienced symptom relief or improvement.

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COMMUNICATION SYSTEM MODEL (CSM)

THE CSM AND YOUR PATIENT

The Communication System Management Model is designed to give you an analysis of neurotransmitter and adrenal hormone values and an observation of how they affect one another. This approach targets the underlying cause of chronic symptoms by addressing the root imbalance. In the next section, we will observe trends in the lab values, correlating those with the symptoms that were marked by the patient.

ADRENAL INFLUENCES
Although the patient chose to only test neurotransmitter levels, an adrenal panel is suggested should any of the following symptoms arise: allergies, symptoms of hypoglycemia (shakiness when a meal is skipped), decreased stamina, fatigue, insulin resistance (sugar cravings, fatigue, abdominal weight gain, poor sleep), decreased libido, stress, salt cravings, which are all related to low adrenal function.

INHIBITORY NEUROTRANSMITTERS
The patient has indicated problems with SLEEP on the questionnaire.
Although serotonin is within normal range, serotonin function may not be optimal to support proper sleep. Serotonin is the biochemical precursor to melatonin, another very important sleep hormone. GABA levels must also be adequate since serotonin serves as a modulator for GABA at the receptor level. That is, without adequate GABA, serotonin cannot function optimally. Most of the new generation sleep medications are GABA receptor agonists. In cases of SAD (seasonal affective disorder), serotonin is being utilized at a much higher rate to produce melatonin due to the shorter days and less daylight. Serotonin stores deplete more quickly during the winter months. Serotonin support in this patient, as well as melatonin support, may be warranted. Individuals with thyrotoxicosis often present hypermetabolic features; therefore, consider assessing thyroid hormone levels.

Patient indicated symptoms of ANXIETY, NERVOUSNESS, and IRRITABILITY.
These symptoms are often the result of decreased inhibitory neurotransmission and/or excess excitatory neurotransmission. Additionally, in the presence of up-regulated adrenal function, anxiety, irritability, and/or nervousness may also be present; therefore, consider assessing adrenal hormone levels. As the main inhibitory neurotransmitters, GABA, glycine, and serotonin function to promote calm and prevent over excitation. As GABA is the primary inhibitory neurotransmitter, it can be thought of as "the great balancer" of the nervous system. Also, serotonin often functions as a modulator of GABA activity. Low serotonin or depletion of GABA alone may cause anxiety. Research indicates that inositol and glycine supplementation may be beneficial for those suffering from anxiety, especially acute anxiety and panic disorders.
Avoid supporting excitatory neurotransmitter function before restoring serotonin and GABA levels. When up-regulated, thyroid hormones may also generate feelings of nervousness, irritability, and anxiety for the patient; therefore, consider a comprehensive thyroid hormone assessment.
Patient checked FATIGUE/DECREASED STAMINA on the questionnaire.
Chronic fatigue can be caused by numerous conditions, the most common of which are
1) inadequate sleep (consider sleep pathologies),
2) low or high blood sugar,
3) hypothyroidism, and

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4) adrenal fatigue, usually demonstrated by inadequate cortisol, particularly low morning levels (87% of patients indicating fatigue of moderate or severe intensity measure low a.m. cortisol). Low stores of excitatory neurotransmitters, such as norepinephrine, epinephrine, and glutamate, can also influence energy levels. Other reasons for fatigue involve inadequate dietary protein or B vitamins, dysregulation of mitochondrial function, anemia, depression, acute or chronic illnesses, heavy metal toxicity as well as acute and chronic environmental toxins, and certainly many medications. Assessment of thyroid, iron status, blood sugar, diet and adrenal function are all warranted.

EXCITATORY NEUROTRANSMITTERS

Patient indicated LOW LIBIDO on symptom questionnaire.
Though many neurotransmitters are involved in libido, the most significant are dopamine and serotonin. Optimal dopamine is one of the most obvious requirements. Low dopamine undermines libido; 67% of those who marked moderate or severe in this category measure low or low-normal dopamine. Low libido is also commonly observed in patients on SSRI medications. This may be because as serotonin rises, we often see dopamine decrease reflecting this inverse relationship. Supplemental melatonin, on the other hand, has been shown to have a positive effect on libido. Testosterone is also well-known to support libido and assessment is warranted. Another contributing factor to low libido is adrenal insufficiency with low DHEA. DHEA is the precursor to adrenal sex steroids and when depleted, causes deficiencies of androgens and estrogens, leading to low libido. 62% of this patient population has low DHEA. Of course, medications, illness and psychosocial or emotional conditions should be ruled out as causative as well.

Of the patient population who indicated moderate to severe focus problems, 71% demonstrate low or low-normal dopamine. When POOR FOCUS is a symptom, use concurrent inhibitory support (to prevent over-excitation) with catecholamine pathway support to rebuild dopamine to restore focus and directed attention. Poor focus and memory issues can also be related to chronic stress and adrenal dysfunction. Decreased thyroid function is known to impede cognitive function; therefore, consider assessing thyroid hormone levels.

Patient indicated POOR MEMORY.
Memory is dependent upon balance among many central neurotransmitters. Adequate glutamate is required for learning and memory; 60% of patients marking moderate or severe memory issues have low/low normal glutamate. Adequate dopamine is also necessary; low levels can impair working memory, in particular. 70% have low or low-normal dopamine. Norepinephrine is also required-both short-term memory and long-term memory depend on adequate NE levels. Acetylcholine is a primary neurotransmitter for the laying down of memory traces and, though not measured, can be supported by increasing dietary choline or supplementing with phosphatidylcholine or DMAE. Serotonin is also required for proper memory (acute tryptophan depletion can directly impair memory). There is evidence in the literature, however, that extreme excesses of norepinephrine, glutamate and serotonin can also impair memory. Additionally, chronic elevations of cortisol damage the hippocampus, center for short-term memory. DHEA should be repleted when low, since it is known to be neuroprotective to the hippocampus. Balance, then, among the neurochemicals, is of utmost importance for establishment and maintenance of memory. Decreased thyroid function is known to impede cognitive function; therefore, consider assessing thyroid hormone levels.

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Stress has system-wide effects on the body's communication system. Chronic stress can become cumulative and may have an especially deleterious effect over time. The perception of stress stimulates immediate release of epinephrine and norepinephrine, followed shortly by release of cortisol and DHEA. The effects of these hormones are beneficial in a short-term, life-threatening situation. Chronic stress, however, generates a cascade of effects. Prolonged stress leads to elevated levels of norepinephrine and epinephrine and decreased turnover in the synaptic space, with chronically high cortisol levels. DHEA levels rise initially but soon decrease. This is significant because DHEA plays a role in protecting nerves from the neurotoxic effects of glucocorticoids, benefiting stress tolerance and resilience. Low levels of DHEA have been associated with chronic illnesses ranging from CFIDS to depression to rheumatoid conditions. Continuously elevated cortisol levels contribute to the aging process and are associated with declining immune function. An increased cortisol/DHEA ratio is specifically thought to interfere with T-cell immunity.

Elevated cortisol may damage the overall regulation of the Communication System by interrupting the natural mechanisms of recovery. In addition, elevated cortisol is associated with promoting insulin resistance and weight gain. GABA is the primary inhibitory neurotransmitter. GABA's regulating and calming role is supported by adequate serotonin. Initially, GABA will make a compensatory rise to counter excitatory hormones and neurotransmitters. However, over time, a toll may be taken on GABA stores leading to a state of deficiency. When this happens, feelings of stress and anxiety may not be alleviated. Supporting both GABA and serotonin is recommended.

Avoid supporting excitatory neurotransmitters, even when decreased, before replenishing serotonin and GABA. DHEA support may also be considered.

An adrenal hormone assessment is highly recommended due to the presence of stress.

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Summary/Recommendations

Patient is in: Initial Phase

INHIBITORY NEUROTRANSMITTERS
SEROTONIN
Serotonin is within reference range. Generally regarded as the happiness molecule, serotonin has calming effects and contributes to the feelings of well-being. Serotonin elevates mood, decreases anxiety, appetite, and libido, improves sleep and memory, eases depression, and helps regulate body temperature. Most of serotonin in the human body is produced in the gastrointestinal tract, where it stimulates gut motility.

GABA
GABA is within the reference range. The brain's major inhibitory neurotransmitter GABA functions as the off switch in the brain. GABA is essential to limiting excitation so that input signals are balanced and not overdone. GABA prevents anxiety, improves mood, promotes sleep, lowers blood pressure, acts as a muscle relaxant, aids in formation and storage of fear memories, increases insulin secretion and decreases blood glucose levels.

GLYCINE
Glycine is low. Glycine plays a dual role as a neurotransmitter and a building block of proteins. Glycine serves as an anti-inflammatory agent, calms aggression, improves sleep quality, regulates locomotion, stabilizes blood sugar, and modulates excitatory signals in the brain. Clinically, lower glycine levels are suspected in anxiety.
TREATMENT: Glycine supplementation, B6, Serine support, B6 and MTHF may all support the production of glycine.

EXCITATORY NEUROTRANSMITTERS
GLUTAMATE
Glutamate is low. The brain's major excitatory neurotransmitter glutamate functions as the "on" switch in the brain. Glutamate regulates appetite, thinking, increases gut motility, optimizes learning, modulates memory, improves libido, and decreases sleep. Low urinary glutamate levels have been reported in patients with migraines (Ragginer et al., 2012). Clinically, lower glutamate levels may contribute to agitation, depression, chronic fatigue, lack of concentration, low energy levels, and sleep difficulties.
TREATMENT: L-glutamine may be beneficial to restore glutamate to normal values.

HISTAMINE
Histamine is within reference range. Histamine plays a dual role in the body as a neurotransmitter and a modulator of the immune system. Histamine has anti-pain properties, plays a neuroprotective role in the brain, and contributes to optimal maintenance of cognition and memory. Histamine stimulates wakefulness and decreases sleep, stimulates gastric acid production, increases metabolism, suppresses appetite, and prevents weight gain. Histamine is a potent vasodilator and a pro-inflammatory agent.

PEA
PEA is within reference range. PEA, also known as phenethylamine, promotes energy, elevates mood, and regulates attention. PEA also contributes to aggression, serves as a biomarker for ADHD, and prolongs the signaling of dopamine, norepinephrine, and serotonin.

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DOPAMINE
Dopamine is within reference range. Dopamine improves attention, focus, and motivation, helps with decision making, modulates movement control, promotes lactation, increases blood pressure, urine output and sodium excretion, and allows for feelings of reward and pleasure. Additionally, dopamine plays a central role in the etiology of addiction. Dopamine also serves as the parent precursor to norepinephrine and epinephrine.

NOREPINEPHRINE
Norepinephrine is high-normal. Norepinephrine functions both as a neurotransmitter and a hormone,
participating in the body's "fight or flight" response. Norepinephrine increases alertness, focuses attention, fine-tunes vigilance, increases blood pressure, heart rate, and blood sugar, reduces digestive activity, pain and sleep, prevents bladder emptying through bladder sphincter constriction, and regulates body temperature. Norepinephrine is very similar in structure and physiological effects to epinephrine. The adrenal gland produces approximately 20% of norepinephrine with 80% produced by the sympathetic nerve fibers. High urinary norepinephrine is suspected to contribute to aggression, depression, high blood pressure, hyperactivity, immune stress, insulin resistance, irritability, and sleep difficulties (Vincent et al., 2004). Research also shows that urinary norepinephrine levels are increased in patients with abdominal obesity (Landsberg et al., 1991), attention deficit disorder (Faraone et al., 2014), anxiety and depression (Hughes et al., 2004), bipolar disorder (Koslow et al., 1983), hyperglycemia (Troisi et al., 1991), hyper-insulinemia (Troisi et al., 1991), obstructive sleep apnea (Kheirandish-Gozal et al., 2013), post-traumatic stress disorder (Yehuda et al., 1992), and stress (Holzman et al., 2009;Fujiwara et al., 2004).
TREATMENT: Medications that may raise norepinephrine levels include but are not limited to: selective norepinephrine reuptake inhibitors (SNRIs - antidepressant/antianxiety medications), monoamine oxidase inhibitors, vasodilating drugs (e.g. alpha blockers), anesthetic gases (e.g. halothane), and illicit drugs like cocaine and amphetamines. Cofactor support with magnesium and SAMe to promote metabolism may be beneficial. Testing for levels of copper and zinc may be helpful to make sure that sufficient levels of these elements are present to properly metabolize norepinephrine.
EPINEPHRINE
Epinephrine is high-normal (>80th percentile). Epinephrine, also called adrenalin, functions both as a neurotransmitter and a hormone, participating in the body's "fight or flight" response. Epinephrine increases alertness, focuses attention, fine-tunes vigilance, increases blood pressure, heart rate, and blood glucose, reduces digestive activity, pain and sleep, prevents bladder emptying, and regulates body temperature. The majority of catecholamines produced by the adrenal glands are epinephrine. Research shows that urinary epinephrine levels are increased in patients with attention deficit disorder (Faraone et al., 2014), anxiety and depression (Hughes et al., 2004), bipolar disorder (Koslow et al., 1983), hyperglycemia (Troisi et al., 1991), hyperinsulemia (Troisi et al., 1991), obstructive sleep apnea (Kheirandish-Gozal et al., 2013), post-traumatic stress disorder (Yehuda et al., 1992), and stress (Holzman et al., 2009;Fujiwara et al., 2004).
TREATMENT: Testing for levels of copper and zinc may be helpful to make sure that sufficient levels of these elements are present to properly metabolize epinephrine. Consider supporting HPA axis dysfunction.

Retesting is an important part of this process. NT levels need to be monitored. Retesting for this patient is recommended in 6 weeks.

Additional Recommendations

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*** It is recommended that all patients on a program to balance HPA axis function should also supplement with B complex, a multi-mineral and multi-vitamin as well as EPA/DHA.**

Disclaimers
*** These products are not intended to diagnose, treat, cure, or prevent any disease.**
***The statements above are recommendations to the clinician. All final therapeutic decisions are the responsibility of the treating physician.**
*** Please call Nutripath on 1300 688 522 with your technical and clinical questions.**
For further reading and references, please refer to Nutripath's Technical guide and Clinical guide.
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Neuroendocrine Comments

CORTISOL
To downregulate Cortisol (If Cortisol is High): Phosphatidyl Serine, DHEA, Choline, Inositol, Adaptogenic Herbs e.g. Siberian Ginseng, Withania, Vit C, Magnesium, Vit B

To upregulate Cortisol(If Cortisol is low): Adaptogens e.g. Ginseng, Withania, assess and balance hormone imbalance, insulin sensitivity, hydrocortisone, DHEA, Magnesium, Vit B, Assess and correct hormonal balance, insulin sensitivity

DHEA
DHEA, Adaptogen e.g. Siberian Ginseng, Withania, and adrenal support e.g. ginseng, Activated B3

Methyl Cofactors
Vit B6, Activated B6, SAMe, Methionine, Folinic Acid, TMG, DMG

Melatonin
Melatonin, passionflower, Hops, Adenosine, Kava

Based on your test results, your practitioner will advise upon natural supplementation of specific formulary.

SEROTONIN (Inhibitory Neurotransmitter) LEVELS WITHIN RANGE:
Serotonin levels may be within range, however, if the patient is exhibiting symptoms you may wish to consider that the reported reference range is not optimal for this patient. Optimal Serotonin levels are levels at which serotonin can effectively counterbalance elevated excitatory neurotransmitters (esp Dopamine and Norepinephrine). Even if Serotonin is above the observed reference range but is not proportional to (or able to control) elevations in the catecholamines, then more Serotonin support is needed.

GABA (Inhibitory Neurotransmitter) LEVELS NORMAL:
GABA levels may be within normal range, however, if the patient symptoms of anxiety and insomnia, consider that the normal reference range is not optimal for this individual. Biochemical individuality is no more evident than in the CNS. For this reason, clinical observation must be valued as a primary aspect of treatment.

Tests ordered: INEUM