Comprehensive Neurotransmitter; urine

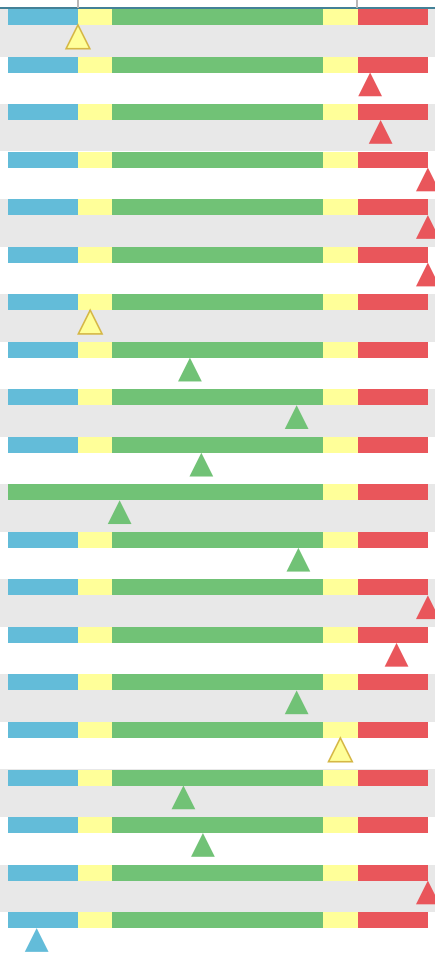
Order: 999999-9999

Client #: 12345
Doctor: Sample Doctor
3755 Illinois Ave.
St. Charles, IL 60174 U.S.A.

Patient: Sample Patient
Id: 999999
Age: 30
Sex: Female
Body Mass Index (BMI): 29

Sample Collection	Date/Time
Date Collected	01/08/2020
Wake Up Time	08:50
Collection Period	2nd morning void
Date Received	01/10/2020
Date Reported	01/17/2020

Analyte	Result	Unit per Creatinine	L WRI H	Reference Interval
Phenethylamine (PEA)	32	nmol/g		32 – 84
Tyrosine	94	µmol/g		32 – 80
Tyramine	5.3	µmol/g		2.0 – 4.0
Dopamine	40300	µg/g		125 – 250
3,4-Dihydroxyphenylacetic acid (DOPAC)	392600	µg/g		390 – 1500
3-Methoxytyramine (3-MT)	7320	nmol/g		90 – 210
Norepinephrine	22.7	µg/g		22 – 50
Normetanephrine	144	µg/g		85 – 300
Epinephrine	5.8	µg/g		1.6 – 8.3
Metanephrine	72	µg/g		45 – 119
Norepinephrine / Epinephrine ratio	3.9			< 13
Tryptamine	0.63	µmol/g		0.20 – 0.90
Serotonin	429	µg/g		60 – 125
5-Hydroxyindoleacetic acid (5-HIAA)	12420	µg/g		2000 – 8000
Glutamate	28	µmol/g		12.0 – 45.0
Gamma-aminobutyrate (GABA)	4.8	µmol/g		2.0 – 5.6
Glycine	875	µmol/g		450 – 2200
Histamine	22	µg/g		14 – 44
Taurine	2499	µmol/g		320 – 1000
Creatinine	12.3	mg/dL		30 – 225



Neurotransmitter Comments:

- Urinary neurotransmitter levels provide an overall assessment of the body's ability to make and break down neurotransmitters and are representative of whole body levels. Neurotransmitters are secreted all through the body, in neurons of both the central and peripheral nervous systems. The enzymes, cofactors and precursors in neurotransmitter metabolism in general are the same in the periphery and in the central nervous system. Therefore, alterations in urinary neurotransmitter levels assessed in urine provide important clinical information, and may be associated with many symptoms including cognitive and mood concerns, diminished drive, fatigue and sleep difficulties, cravings, addictions and pain.
- Tyrosine is the non-essential amino acid precursor for dopamine, norepinephrine and epinephrine. Increased tyrosine may exacerbate migraine headaches and hyperthyroid conditions. Elevated tyrosine levels may occur due to supplementation (phenylalanine or tyrosine), heritable enzyme defects, or liver disease. Tyrosine hydroxylase converts tyrosine into the dopamine precursor L-DOPA; BH4, Vitamin D and iron are cofactors for that enzymatic activity.

Notes:
Results are creatinine corrected to account for urine dilution variations. Creatinine is not meant to be used as an indicator of renal function.
RI= Reference Interval, L (blue)= Low (below RI), WRI (green)= Within RI (optimal), WRI (yellow)= Within RI (not optimal), H (red)= High (above RI)
Methodology: LCMS QQQ,Creatinine by Jaffe Reaction

- Tyramine is a trace amine derived directly from tyrosine by a B6-dependent enzyme. Elevated levels of tyrosine may increase tyramine levels, especially when metabolism to dopamine is compromised. Trace amines (tryptamine, tyramine, PEA) may have stimulant effects at high levels. Foodstuffs such as hard cheeses and red wines contain large amounts of tyramine. If tyramine is high, but dopamine is low, the enzymes of dopamine synthesis (folates, vitamins B3, D, zinc, molybdenum, iron cofactors) may be inhibited. Tyramine is normally metabolized by MAO; low enzyme activity may increase tyramine levels. Vitamin B2 may increase the activity of MAO enzymes.
- Elevated dopamine may be associated with increased worry, distrust of others and decreased ability to interact socially and is often found in patients with attention deficits and hyperactivity. Medications that may increase dopamine levels include L-dopa, methyldopa, select antidepressants and some ADD/ADHD medications. L-theanine may modulate catecholamine effects. Metabolism requires vitamins B2, B3, SAMe, magnesium, and iron, while conversion to norepinephrine requires vitamin C, copper and vitamin B3.
- DOPAC may be high if dopamine is also high. Ask about use of L-DOPA. DOPAC is the primary metabolite of dopamine formed by MAO activity. MAO-A activity may increase due to oxidative stress. An elevated DOPAC level can indicate increased dopamine breakdown, leading to increased levels of free radicals. The oxidative stress can affect neurotransmitter pathways. Antioxidants (selenium, pycnogenol, curcumin, berberine), and Vitamin B12 may ameliorate heightened MAO activity. DOPAC may also be high with acute stress or the use of reserpine or other dopamine reuptake inhibitors. Low activity of COMT may also increase DOPAC (and decrease 3MT). Check 3MT for that pattern. SAMe and Mg are essential for normal methylation and COMT activity. The Plasma Methylation Profile might be considered to evaluate methylation issues.
- 3-MT may be increased if dopamine is high; rule out use of L-DOPA. 3-MT is formed by direct metabolism of dopamine by COMT. Very high levels of 3-MT may have stimulatory effects. 3-MT levels may increase during acute stress. Herbicides, such as paraquat, have been shown to increase 3-MT levels in animals. Consumption of foods rich in catecholamines (bananas, pineapple, walnuts) may acutely increase urinary levels of 3-MT. Deficiency or inhibition of MAO may increase 3-MT levels. MAO may be inhibited by cigarette smoke or medications such as monoamine oxidase inhibitors. Vitamins C, B2, B3, SAMe, magnesium, copper and iron are required for optimal dopamine metabolism.
- Note: Markedly elevated levels of 3-MT may be associated with dopamine-secreting pheochromocytomas and paragangliomas. In some paraganglioma cases, only 3-MT is elevated. Plasma levels should always be used to confirm results if catecholamine-producing tumors are suspected.
- Low range norepinephrine may be associated with depression and mood changes as well as fatigue, difficulty concentrating, decreased ability to stay focused on tasks and diminished sense of personal/professional drive. Norepinephrine is converted from dopamine requiring vitamin C, copper and B3, and L-tyrosine is an amino acid precursor. L-theanine and Mucuna pruriens may modulate norepinephrine effects.
- Elevated serotonin may be associated with symptoms of, increased anxiety, agitation and diarrhea (IBS-like symptoms). Serotonin levels may be increased by low protein or high-carbohydrate meals, insulin, and tryptophan or 5-HTP supplementation. Many mood altering medications, including SSRIs and SNRIs, may influence serotonin levels. L-theanine may affect serotonin function.
- Clinically the urine levels 5-HIAA provide an indicator of serotonin synthesis, and serotonin metabolism by MAO-A. Elevated levels of 5-HIAA may simply be associated with high serotonin; consider if patient supplements with tryptophan and/or 5-HTP. Some medications as well as dietary consumption of foods rich in serotonin (plantain, pineapple, banana, kiwi fruit, plums, tomatoes, walnuts and hickory nuts) may elevate levels of 5-HIAA. It is recommended to avoid these foods for 3 days prior to sample collection. Excessive 5-HIAA has been found in some patients with celiac disease, metabolic syndrome, and chronic renal insufficiency. MAO-A activity may increase due to oxidative stress. Antioxidants (selenium, pycnogenol, curcumin, berberine), and Vitamin B12 may help normalize MAO activity.
- Upper range GABA may contribute to difficulty concentrating, diminished memory, dampened mood and decreased cognitive processing as well as fatigue, decreased exercise endurance, sleepiness and an inability to feel alert. L-theanine may modulate the effects of GABA.Upper range levels of GABA may be associated with bacterial overgrowth (i.e. urinary tract infection or gastrointestinal dysbiosis).
- Taurine is an essential amino acid that may have inhibitory effects on CNS neurons. High urinary levels of taurine may be associated with stress reactions, depression, autism and psychosis. Symptoms may include apathy, sleep changes, irritability, recklessness, poor concentration, aches and pains, or social withdrawal. Patients with Cushing's syndrome (high cortisol) may have elevated urinary taurine levels. Urinary taurine levels may be high with acute or chronic kidney damage, inherited kidney disorders, liver inflammation, or gastrointestinal dysbiotic bacterial or yeast over growth. Oral supplementation may raise taurine levels; taurine is an ingredient in many "energy drinks". High taurine levels may compete with glycine N-methyl-D-aspartate receptors (NMDR). Chronically high taurine excretion may deplete intracellular magnesium and calcium.
- Considerations to address the demonstrated imbalances beyond the identified co-factors and amino acid precursors may include dosage adjustments if indicated, as well as nervine and adaptogenic herbs, methylation support, vitamin D, and gastrointestinal health optimization.

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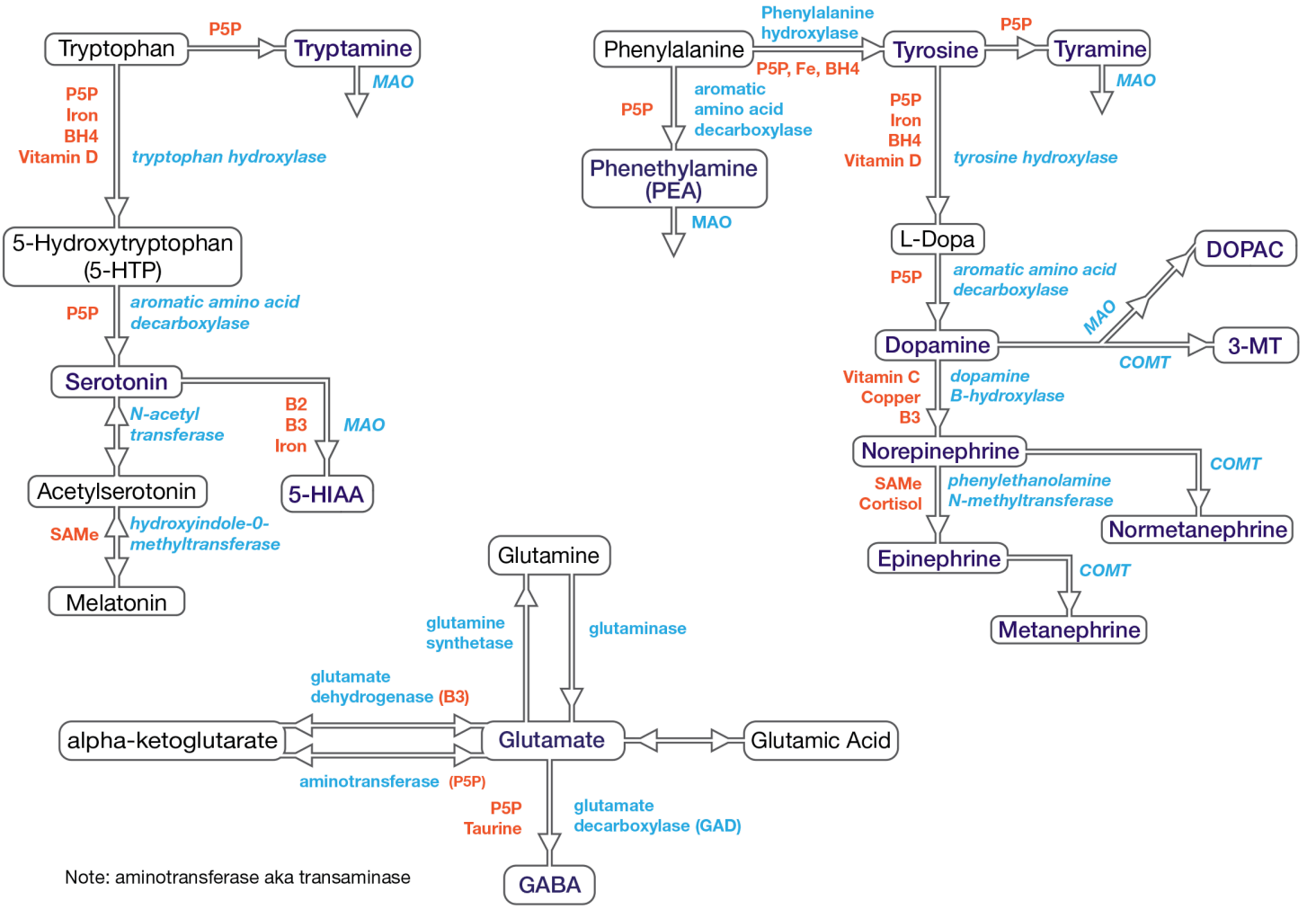
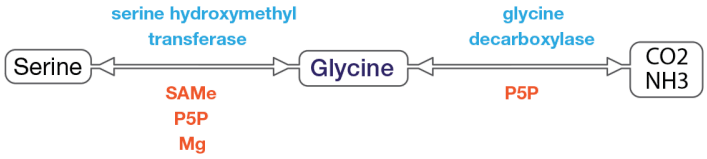
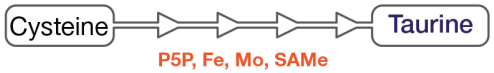
Neurotransmitter Pathways



"glycine cleavage system"





KEY

MAO = monoamine oxidase
Cofactors for *MAO*: **B2, B3, P5P, Fe, Mg**
COMT = catechol-o-methyl-transferase
Cofactors for *COMT*: **SAMe, Mg**
P5P = (pyridoxal-5-phosphate) activated form of vitamin B6
BH4 = (tetrahydrobiopterin)
Endogenous levels can be supported with SAMe, vitamin B3, C, Mo, Zn
MTHF = (methyltetrahydrofolate) active form of folate.
SAMe = endogenous levels can be supported with Mg, MTHF, and methylcobalamin supplementation.

Cofactors = Enzymes =