

Blood Chemistry Review II - Part Two

The next patient is a 45-year-old male with chief complaint of a metallic taste on his tongue and a green-yellow discoloration on his tongue. Yes, those were the only reasons he was coming to see me. This is definitely not my typical patient. He didn't complain of any other symptoms.

Marker	Value	Functional Range	Lab Range
Glucose	79	75 - 90	65 - 99
Hemoglobin A1c	5.3	4.8 - 5.4	4.8 - 5.6
Uric Acid	4.2	3.7 - 6.0	3.7 - 8.6
BUN	16	13 - 18	6 - 24
Creatinine	0.70	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	23	8 - 19	9 - 20
Sodium	141	134 - 140	134 - 144
Potassium	4.0	4.0 - 4.5	3.5 - 5.2
Chloride	100	100 - 106	97 - 108
CO2	27	25 - 30	18 - 29
Calcium	9.3	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.7	3.5 - 4.0	2.5 - 4.5
Magnesium	2.1	2.0 - 2.6	1.6 - 2.3
Protein, total	7.0	6.9 - 7.4	6.0 - 8.5
Albumin	4.8	4.0 - 5.0	3.5 - 5.5
Globulin	2.2	2.4 - 2.8	1.5 - 4.5
A/G ratio	2.2	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	0.4	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	70	42 - 107	39 - 117
LDH	159	140 - 180	121 - 224
AST	22	10 - 30	0 - 40
ALT	15	10 - 29	0 - 44
GGT	7	0 - 40	0 - 65
TIBC	307	250 - 350	250 - 450
UIBC	218	150 - 375	111 - 343
Iron	89	85 - 135	38 - 169
Iron saturation	29	15 - 45	15 - 55
Ferritin	180	30 - 150	30 - 400
Vitamin B-12	1051	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	41.9	35 - 60	30.0 - 100.0
Cholesterol, total	205	150 - 240	100 - 199
Triglycerides	48	50 - 100	0 - 149
HDL	73	55 - 85	> 39
LDL	122	0 - 175	0 - 99
T. Chol / HDL Ratio	2.8	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.66	< 2	< 3.8
CRP-hs	0.95	< 1.0	0.00 - 3.00
Homocysteine	8.0	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	1.800	0.5 – 2.5	0.45 - 4.50
T4, total	7.3	6.0 – 12	4.5 - 12
T3 Uptake	33	30 - 38	24 - 39
T3, Total	100	100 – 180	71 - 180
Copper	95		72 - 166
Zinc	145		56 - 134
Zinc / Copper Ratio	1.53	> 0.85	
Serum Methylmalonic Acid (MMA)	107	0 - 325	0 - 378
WBC	4.6	5.0 – 8.0	3.4 - 10.8
RBC	4.56	4.4 – 4.9	4.14 - 5.8
Hemoglobin	14.6	14 - 15	12.6 - 17.7
Hematocrit	42.6	40 - 48	37.5 - 51.0
MCV	93	85 – 92	79 - 97
MCH	32.0	27.7 – 32.0	26.6 - 33.0
MCHC	34.3	32 – 35	31.5 - 35.7
RDW	13.7	11.5 – 15.0	12.3 - 15.4
Platelets	232	150 – 415	150 - 379
Neutrophils	58	40 – 60	
Lymphocytes	31	25 – 40	
Monocytes	9	4.0 – 7.0	
Eosinophils	2	0.0 – 3.0	
Basophils	0	0.0 – 3.0	

We did blood work, and creatinine is low at 0.7. The most common cause of this is decreased muscle mass, as you'll recall, and this low creatinine is causing a high BUN-to-creatinine ratio. This guy was mostly sedentary. He was a computer programmer. He didn't exercise or do strength training. He was not really muscular at all, so that was probably the cause of the low creatinine.

A few markers out of the functional range. Ferritin is 180. That is borderline high, maybe nonpathological, but it could indicate excess iron storage or inflammation. Other iron markers are normal, so I would guess inflammation based on this. Serum B12 is high at 1,051, and this patient was not supplementing, but he was eating organ meats and shellfish regularly throughout the week, and this could explain why zinc is also high at 145. I don't think that is cause for concern in this particular case. Remember that the lab ranges are usually just a 95 percent reference range based on population values, not necessarily reflective of optimal values. In particular with B12, it is not toxic at all, so if you see a mildly elevated B12, and the person is eating a lot of organ meats, that is the most likely cause. If you see elevated B12 and there is no supplementation and no intake of high B12 foods, that is when you would want to consider looking at a B12 metabolism issue and looking for active B12 deficiency, even in the face of normal serum B12.

Total cholesterol is 205. HDL is 73, so the ratio is below 3, which is optimal. White blood cell count is slightly below the functional range at 4.6. MCV is slightly above. Again, these probably alone don't comprise a pattern, but monocytes of 9 in addition to ferritin and the white blood cells being slightly off could all be an indicator of some kind of immune dysregulation or inflammation.

Consistent with his few complaints, there is not a lot here to go on. You would follow up on homocysteine, run urine MMA and FIGLU, and look for a source of inflammation.

The next patient is a 42-year-old male. Chief complaints were mold sensitivity, urinary retention, bloating, gas, and constipation, diagnosed as SIBO.

Marker	Value	Functional Range	Lab Range
Glucose	95	75 - 90	65 - 99
Hemoglobin A1c	5.3	4.4 - 5.4	4.8 - 5.6
Uric Acid	2.5	3.7 - 6.0	3.7 - 8.6
BUN	18	13 - 18	6 - 24
Creatinine	0.69	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	26	8 - 19	9 - 20
eGFR if Non-African American	117		> 59
eGFR if African American	135		> 59
Sodium	141	135 - 140	134 - 144
Potassium	4.4	4.0 - 4.5	3.5 - 5.2
Chloride	104	100 - 106	97 - 108
CO2	22	25 - 30	18 - 29
Calcium	9.7	9.2 - 10.1	8.7 - 10.2
Parathyroid Hormone, Intact	35	15 - 60	15 - 65
Phosphorus	3.3	3.0 - 4.0	2.5 - 4.5
Magnesium	2.1	2.0 - 2.6	1.6 - 2.3
Protein, total	6.6	6.9 - 7.4	6.0 - 8.5
Albumin	4.6	4.0 - 5.0	3.5 - 5.5
Globulin	2.0	2.4 - 2.8	1.5 - 4.5
A/G ratio	2.3	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	0.6	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	64	42 - 107	39 - 117
LDH	110	140 - 180	121 - 224
AST	17	0 - 25	0 - 40
ALT	18	0 - 26	0 - 44
GGT	14	0 - 29	0 - 65
TIBC	286	275 - 425	250 - 450
UIBC	199	175 - 350	111 - 343
Iron	87	40 - 135	38 - 169
Iron saturation	30	17 - 45	15 - 55
Ferritin	271	30 - 200	30 - 400
Vitamin B-12	>1999	450 - 2000	211 - 946
Folate, Serum	20.0	> 5.0	> 3.0
Calcitriol (1,25 di-OH Vitamin D)	81.3	19.9 - 79.3	19.9 - 79.3
Vitamin D, 25-hydroxy	62.1	35 - 60	30.0 - 100.0
Cholesterol, total	142	150 - 220	100 - 199
Triglycerides	46	50 - 100	0 - 149
HDL	71	55 - 85	> 39
LDL	62	0 - 140	0 - 99
T. Chol / HDL Ratio	2.0	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.65	< 2	< 3.8

Marker	Value	Functional Range	Lab Range
CRP-hs	0.09	< 1.0	0.00 - 3.00
Homocysteine	4.8	< 7.0	0.0 - 15.0
TSH	1.980	0.5 - 2.0	0.45 - 4.50
T4, total	7.8	6.0 - 12	4.5 - 12
T3 Uptake	35	30 - 38	24 - 39
T3, Total	71	100 - 180	71 - 180
T3, Free	2.5	2.5 - 4.0	2 - 4.4
T4, Free	1.23	1 - 1.5	0.82 - 1.77
Reverse T3	15.4	9 - 21	9.2 - 24.1
Thyroid - TPO Ab	<6		0 - 34
Thyroid - TGA	<1.0		0 - 0.9
Copper	79	81 - 157	72 - 166
Zinc	84	64 - 126	56 - 134
Zinc / Copper Ratio	1.06	> 0.85	
Serum Methylmalonic Acid (MMA)	89	< 300	0 - 378
WBC	3.5	5.0 - 8.0	3.4 - 10.8
RBC	4.52	4.4 - 4.9	4.14 - 5.8
Hemoglobin	13.8	14 - 15	12.6 - 17.7
Hematocrit	41.7	40 - 48	37.5 - 51.0
MCV	92	85 - 92	79 - 97
MCH	30.5	27.7 - 32.0	26.6 - 33.0
MCHC	33.1	32 - 35	31.5 - 35.7
RDW	12.9	11.5 - 15.0	12.3 - 15.4
Platelets	199	150 - 379	150 - 379
Neutrophils	62	40 - 60	
Lymphocytes	29	25 - 40	
Monocytes	8	4.0 - 7.0	
Eosinophils	1	0.0 - 3.0	
Basophils	0	0.0 - 3.0	

Fasting glucose is 95, which is borderline, but A1c is normal at 5.3, and triglycerides are optimal at 46. Lactate dehydrogenase is lab-low at 110, so blood sugar could be an issue. It is sort of equivocal, so you could do further metabolic testing.

Uric acid is low at 2.5, substantially below the lab range. Clinical hypouricemia is defined as uric acid below 2, so it doesn't quite meet that threshold. That is caused by several rare inherited disorders of purine synthesis and catabolism and, more commonly, by acquired deficiency of xanthine oxidase due to allopurinol therapy or liver disease. It can also show up in diabetes, in pregnancy, and in a high-sodium diet. I would retest this marker, and if it is persistently low, and particularly if it drops below 2, I would refer out for further workup. The strange thing is that hypouricemia is often associated with excess urination, not urinary retention, which was his complaint.

Creatinine is also lab-low here at 0.69. This is again likely decreased muscle mass leading to a high BUN-to-creatinine ratio. Ferritin is functionally high at 271, but iron markers are normal. I would run soluble transferrin receptor because CRP is normal here, so it's not clear whether this is inflammation or excess iron storage.

Serum B12 is high. It's above 1,999. Almost always that will be because of supplementation, and this patient was supplementing. Calcitriol, 1,25 D, is high at 81.3. This is just barely out of the lab range. His 25(OH)D is high-normal at 62. He may just be a strong converter of 25(OH)D into active D. I'm not sure that is really a concern here given that calcitriol is barely elevated.

Total cholesterol is a little on the low side, not really low enough to concern me. It is 142. TSH is normal. T3 is nearly lab-low at 71, and free T3 is borderline low at 2.5, so I'd look at gut, the HPA axis, other nutrient issues here, and other blood chemistry issues. Address those pathologies and then retest.

Serum copper is low-normal. We can't necessarily rely on that being an accurate marker of copper status, but, as I mentioned, the safest bet is usually to just advise intake of copper and zinc-rich foods.

Hemoglobin is functionally low, but no other signs of anemia or B12/folate deficiency because homocysteine is optimal at 4.8, so I don't think that is an issue.

For follow-up, we would retest uric acid, possibly do some more advanced metabolic testing, and then look more closely at thyroid after addressing the pathologies that you identify.

The next patient is a 54-year-old male with chief complaint of IBS. He had loose stools and diarrhea. He described himself as having leaky gut and SIBO despite not having any tests for those conditions. Poor sleep and snoring, low energy, low libido, and high cholesterol.

Marker	Value	Functional Range	Lab Range
Glucose	81	75 - 90	65 - 99
Hemoglobin A1c	5.4	4.8 - 5.4	4.8 - 5.6
Uric Acid	5.5	3.7 - 6.0	3.7 - 8.6
BUN	19	13 - 18	6 - 24
Creatinine	1.18	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	16	8 - 19	9 - 20
Sodium	140	134 - 140	134 - 144
Potassium	4.4	4.0 - 4.5	3.5 - 5.2
Chloride	99	100 - 106	97 - 108
CO2	26	25 - 30	18 - 29
Calcium	9.4	9.2 - 10.1	8.7 - 10.2
Phosphorus	2.9	3.5 - 4.0	2.5 - 4.5
Magnesium	2.1	2.0 - 2.6	1.6 - 2.3
Protein, total	6.6	6.9 - 7.4	6.0 - 8.5
Albumin	4.5	4.0 - 5.0	3.5 - 5.5
Globulin	2.1	2.4 - 2.8	1.5 - 4.5
A/G ratio	2.1	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	0.8	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	59	42 - 107	39 - 117
LDH	141	140 - 180	121 - 224
AST	16	10 - 30	0 - 40
ALT	21	10 - 29	0 - 44
GGT	9	0 - 40	0 - 65
TIBC	245	250 - 350	250 - 450
UIBC	98	150 - 375	111 - 343
Iron	147	85 - 135	38 - 169
Iron saturation	60	15 - 45	15 - 55
Ferritin	277	30 - 150	30 - 400
Vitamin B-12	515	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	55.2	35 - 60	30.0 - 100.0
Cholesterol, total	242	150 - 240	100 - 199
Triglycerides	88	50 - 100	0 - 149
HDL	78	55 - 85	> 39
LDL	146	0 - 175	0 - 99
T. Chol / HDL Ratio	3.1	< 3	0 - 5.0
Triglycerides / HDL Ratio	1.13	< 2	< 3.8
CRP-hs	0.24	< 1.0	0.00 - 3.00
Homocysteine	15.4	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	2.310	0.5 – 2.5	0.45 - 4.50
T4, total	7.3	6.0 – 12	4.5 - 12
T3 Uptake	30	30 - 38	24 - 39
T3, Total	116	100 – 180	71 - 180
Copper	86		72 - 166
Zinc	64		56 - 134
Zinc / Copper Ratio	0.74	> 0.85	
Serum Methylmalonic Acid (MMA)	184	0 - 325	0 - 378
WBC	4.2	5.0 – 8.0	3.4 - 10.8
RBC	4.95	4.4 – 4.9	4.14 - 5.8
Hemoglobin	14.9	14 - 15	12.6 - 17.7
Hematocrit	43.9	40 - 48	37.5 - 51.0
MCV	89	85 – 92	79 - 97
MCH	30.1	27.7 – 32.0	26.6 - 33.0
MCHC	33.9	32 – 35	31.5 - 35.7
RDW	13.1	11.5 – 15.0	12.3 - 15.4
Platelets	203	150 – 415	150 - 379
Neutrophils	38	40 – 60	
Lymphocytes	43	25 – 40	
Monocytes	14	4.0 – 7.0	
Eosinophils	4	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

A number of markers were out of the functional range on the top of the first page here, but none of these are likely to be significant. The patient does have iron overload. Iron saturation was 60 percent. TIBC was 245. UIBC was 98. Serum iron was 147, and ferritin was 277. All of those, except for serum iron and ferritin, were out of the lab range.

Total cholesterol was 242, and HDL was 78. The ratio is 3.1, but since total cholesterol is creeping up, I might do some additional lab work there, lipid testing for LDL-P and Lp(a)-P. Homocysteine is lab-high at 15.4, but serum B12 is normal, and serum MMA is normal, so I'd look at urine MMA and FIGLU as a starting point.

Zinc-to-copper ratio is slightly low at 0.74. It could be an indicator of inflammation along with ferritin being elevated. Sometimes when you see elevated ferritin it can be because of iron storage and inflammation, and that may be true in this case.

Red blood cells are very slightly high in the functional range, probably a non-issue. Neutrophils, lymphocytes, monocytes, and eosinophils are all a bit off in the functional range. It could be a sign of immune dysregulation, either autoimmunity or maybe viral reactivation.

For follow-up, we would look at lipids, iron retest, MMA, and FIGLU, and then check for a source of inflammation and immune dysregulation.

The next patient is a 62-year-old female with chief complaint of brain fog, insomnia, chronic pain, and fatigue.

Marker	Value	Functional Range	Lab Range
Glucose	99	75 - 90	65 - 99
Hemoglobin A1c	5.3	4.4 - 5.4	4.8 - 5.6
Uric Acid	3.3	3.2 - 5.5	2.5 - 7.1
BUN	22	13 - 18	8 - 27
Creatinine	0.71	0.85 - 1.1	0.57 - 1
BUN/Creatinine Ratio	31	9 - 23	11 - 26
Sodium	144	135 - 140	134 - 144
Potassium	4.5	4.0 - 4.5	3.5 - 5.2
Chloride	102	100 - 106	97 - 108
CO2	27	25 - 30	18 - 29
Calcium	10.1	9.2 - 10.1	8.7 - 10.3
Phosphorus	3.8	3.5 - 4.0	2.5 - 4.5
Magnesium	2.1	2.0 - 2.6	1.6 - 2.3
Protein, total	6.9	6.9 - 7.4	6.0 - 8.5
Albumin	4.7	4.0 - 5.0	3.6 - 4.8
Globulin	2.2	2.4 - 2.8	1.5 - 4.5
A/G ratio	2.1	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	0.8	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	57	42 - 107	39 - 117
LDH	155	140 - 180	119 - 226
AST	19	10 - 30	0 - 40
ALT	21	10 - 22	0 - 32
GGT	12	< 15	0 - 60
TIBC	330	275 - 425	250 - 450
UIBC	223	175 - 350	118 - 369
Iron	107	40 - 135	27 - 139
Iron saturation	32	17 - 45	15 - 55
Ferritin	73	30 - 100	15 - 150
Vitamin B-12	1287	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	45.1	35 - 60	30.0 - 100.0
Cholesterol, total	220	150 - 250	100 - 199
Triglycerides	94	50 - 100	0 - 149
HDL	81	55 - 85	> 39
LDL	120	0 - 175	0 - 99
T. Chol / HDL Ratio	2.7	< 3	0 - 4.4
Triglycerides / HDL Ratio	1.16	< 2	< 3.8
CRP-hs	0.33	< 1.0	0.00 - 3.00
Homocysteine	6.1	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	4.440	0.5 – 2.5	0.45 - 4.50
T4, total	8.0	6.0 – 12	4.5 - 12.0
T3 Uptake	27	28 - 35	24 - 39
T3, Total	117	100 – 180	71 - 180
T3, Free	3.1	2.5 - 4.0	2 - 4.4
T4, Free	1.28	1 - 1.5	0.82 - 1.77
Thyroid – TPO Ab	12		0 - 34
Thyroid – TGA	<1.0		0 - 0.9
Copper	112		72 - 166
Zinc	100		56 - 134
Zinc / Copper Ratio	0.89	> 0.85	
Serum Methylmalonic Acid (MMA)	139	< 300	0 - 378
WBC	6.0	5.0 – 8.0	3.4 - 10.8
RBC	4.71	4.4 – 4.9	3.77 - 5.28
Hemoglobin	14.6	13.5 - 14.5	11.1 - 15.9
Hematocrit	43.1	37 - 44	34.0 - 46.6
MCV	92	85 – 92	79 - 97
MCH	31.0	27.7 – 32.0	26.6 - 33.0
MCHC	33.9	32 – 35	31.5 - 35.7
RDW	13.1	11.5 – 15.0	12.3 - 15.4
Platelets	303	150 – 415	150 - 379
Neutrophils	54	40 – 60	
Lymphocytes	36	25 – 40	
Monocytes	8	4.0 – 7.0	
Eosinophils	1	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

Fasting glucose is 99, which is nearly out of the lab range. Triglycerides are 94, so creeping up there, high-normal. A1c is normal at 5.3. I'd do postmeal glucose testing and then the more advanced workup with True Health Diagnostics*.

<* **Note:** True Health Diagnostics is no longer in business. See [this post](#) for the latest updates.>

BUN is borderline high, and creatinine is borderline low, and this is leading to an elevated BUN-to-creatinine ratio of 31, which is quite high. When it gets that high, you want to check for gastrointestinal bleeding because it can be a marker for that, as you recall.

Sodium, globulin, and albumin-to-globulin ratio are functionally out of the range, but I don't think that is significant. B12 is high at 1,287. The patient was supplementing at the time of this test.

Total cholesterol was 220. LDL was 120. HDL was 81. Total cholesterol-to-HDL ratio was 2.7, which is optimal. Given that the patient is a female, and she is 62, I'm not concerned about that total cholesterol level. As patients age, total cholesterol starts to become more protective, and for women, it is an even weaker risk factor than it is for men, but you could do the True Health Diagnostics panel for additional info here.

TSH is 4.4, so that is nearly out of the lab range, but her free T3 is 3.1, which is optimal. She is on Synthroid, and she has a history of hypothyroidism, so you could retest TSH a couple times over the next few months. Remember that TSH increases as we age, so if her free T3 is above 3 and in an optimal range, I probably would not treat this patient solely on the basis of slightly high TSH and certainly not right away before addressing other mechanisms.

Hemoglobin is just one-tenth of a point out of the functional range. Monocytes are just one point out of the functional range. I don't think that is significant.

For follow-up, we would be looking at blood sugar, metabolic testing, and more advanced testing with True Health Diagnostics* or something similar, possibly an advanced lipid panel. If you're already going to do the True Health Diagnostics*, that is part of it. Then additional thyroid testing after you address the mechanisms.

<* **Note:** *True Health Diagnostics is no longer in business. See [this post](#) for the latest updates.*>