

Blood Chemistry Review I - Part Three

The next patient is a 39-year-old male with chief complaint of poor sleep quality, poor exercise tolerance, low libido, eczema, and pruritis.

Marker	Value	Functional Range	Lab Range
Glucose	97	75 - 90	65 - 99
Hemoglobin A1c	5.3	4.4 - 5.4	4.8 - 5.6
Uric Acid	3.6	3.7 - 6.0	3.7 - 8.6
BUN	16	13 - 18	6 - 20
Creatinine	0.96	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	17	8 - 19	8 - 19
Sodium	139	135 - 140	134 - 144
Potassium	4.7	4.0 - 4.5	3.5 - 5.2
Chloride	97	100 - 106	97 - 108
CO2	24	25 - 30	18 - 29
Calcium	9.3	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.9	3.5 - 4.0	2.5 - 4.5
Magnesium	2.2	2.0 - 2.6	1.6 - 2.3
Protein, total	7.4	6.9 - 7.4	6.0 - 8.5
Albumin	4.8	4.0 - 5.0	3.5 - 5.5
Globulin	2.6	2.4 - 2.8	1.5 - 4.5
A/G ratio	1.8	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	1.6	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	54	42 - 107	39 - 117
LDH	172	140 - 180	121 - 224
AST	23	10 - 30	0 - 40
ALT	17	10 - 29	0 - 44
GGT	13	< 15	0 - 65
TIBC	330	275 - 425	250 - 450
UIBC	255	175 - 350	111 - 343
Iron	75	40 - 135	38 - 169
Iron saturation	23	17 - 45	15 - 55
Ferritin	338	30 - 100	30 - 400
Vitamin B-12	549	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	31.2	35 - 60	30.0 - 100.0
Cholesterol, total	193	150 - 240	100 - 199
Triglycerides	53	50 - 100	0 - 149
HDL	69	55 - 85	> 39
LDL	113	0 - 175	0 - 99
T. Chol / HDL Ratio	2.8	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.77	< 2	< 3.8
CRP-hs	0.26	< 1.0	0.00 - 3.00
Homocysteine	8.5	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	2.350	0.5 – 2.5	0.45 - 4.50
T4, total	7.6	6.0 – 12	4.5 - 12
T3 Uptake	27	30 - 38	24 - 39
T3, Total	120	100 – 180	71 - 180
Copper	86		72 - 166
Zinc	94		56 - 134
Zinc / Copper Ratio	1.09	> 0.85	
Serum Methylmalonic Acid (MMA)	114	< 300	0 - 378
WBC	4.1	5.0 – 8.0	3.4 - 10.8
RBC	5.30	4.4 – 4.9	4.14 - 5.8
Hemoglobin	16.6	14 - 15	12.6 - 17.7
Hematocrit	47	40 - 48	37.5 - 51.0
MCV	89	85 – 92	79 - 97
MCH	31.3	27.7 – 32.0	26.6 - 33.0
MCHC	35.3	32 – 35	31.5 - 35.7
RDW	13.1	11.5 – 15.0	12.3 - 15.4
Platelets	246	150 – 415	150 - 379
Neutrophils	64	40 – 60	
Lymphocytes	22	25 – 40	
Monocytes	8	4.0 – 7.0	
Eosinophils	5	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

Fasting glucose is 97, definitely high-normal. A1c, triglycerides, and HDL, however, are normal. Remember that fasting glucose is highly variable, so you definitely want to retest here and also do postmeal blood glucose and fructosamine. Also recall that usually postmeal blood sugar tends to go out of range first, but in a minority of people, usually men, fasting glucose becomes abnormal first. It may be that all of the other blood sugar markers are normal except for fasting glucose, and that can still be a problem.

Uric acid that is slightly below the lab range is usually nonpathological, but persistent and significantly low uric acid can be indicative of Wilson’s disease—this patient’s serum copper is normal—or Fanconi syndrome, which is a kidney disorder, or alcoholism. Total bilirubin is high. GGT, AST, ALT, and LDH are normal, so I would run direct and indirect bilirubin under the assumption that this is probably Gilbert’s syndrome, since the other gallbladder markers are normal.

Ferritin is high-normal at 338, but other iron markers are normal, so it could be excess iron storage or inflammation. We look at his CRP. It’s normal, but we would need to check soluble transferrin receptor and/or A1 acid glycoprotein. High ferritin is associated with high blood sugar, so a blood donation could help in this situation. Also, his zinc-to-copper ratio is normal, so not a lot of markers for inflammation here that would explain the ferritin elevation on that basis, but it is still possible.

His 25(OH)D is low-normal at 31. We don’t have a parathyroid hormone on this patient, so I would run that. Serum calcium is normal, so that is not helpful in establishing whether there is a biological deficiency in this case.

LDL cholesterol is slightly high at 113, but total cholesterol is 193. Triglycerides are 53, and HDL is 69. It leads to a very good total cholesterol-to-HDL ratio of 2.8, so I'm not worried about that.

Red blood cells and hemoglobin are functionally high, likely dehydration. White blood cells, neutrophils, lymphocytes, monocytes, and eosinophils are all out of the functional range, so it could be some kind of immune challenge or infection. I would check gut tests first and treat for anything there and then consider further testing for viral or bacterial infection if that doesn't normalize things.

The next patient is a 64-year-old female with chief complaint of chronic inflammation affecting her whole body, including joints and tendons; GERD; insomnia; and depression.

Marker	Value	Functional Range	Lab Range
Glucose	87	75 - 90	65 - 99
BUN	21	13 - 18	8 - 27
Creatinine	0.84	0.85 - 1.1	0.57 - 1
BUN/Creatinine Ratio	25	9 - 23	11 - 26
Sodium	141	135 - 140	134 - 144
Potassium	4.1	4.0 - 4.5	3.5 - 5.2
Chloride	101	100 - 106	97 - 108
CO2	22	25 - 30	18 - 29
Calcium	9.3	9.2 - 10.1	8.7 - 10.3
Protein, total	6.6	6.9 - 7.4	6.0 - 8.5
Albumin	4.3	4.0 - 5.0	3.6 - 4.8
Globulin	2.3	2.4 - 2.8	1.5 - 4.5
A/G ratio	1.9	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	0.6	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	79	42 - 107	39 - 117
AST	21	10 - 30	0 - 40
ALT	10	10 - 22	0 - 32
TIBC	265	275 - 425	250 - 450
UIBC	148	175 - 350	118 - 369
Iron	117	40 - 135	27 - 139
Iron saturation	44	17 - 45	15 - 55
Ferritin	105	30 - 100	15 - 150
Vitamin B-12	481	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	52.7	35 - 60	30.0 - 100.0
Cholesterol, total	233	150 - 250	100 - 199
Triglycerides	71	50 - 100	0 - 149
HDL	87	55 - 85	> 39
LDL	132	0 - 175	0 - 99
T. Chol / HDL Ratio	2.7	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.82	< 2	< 3.8
CRP-hs	<0.10	< 1.0	0.00 - 3.00
Homocysteine	9.8	< 7.0	0.0 - 15.0
TSH	3.300	0.5 - 2.5	0.45 - 4.50
T3, Free	3.0	2.5 - 4.0	2 - 4.4
T4, Free	1.25	1 - 1.5	0.82 - 1.77
Serum Methylmalonic Acid (MMA)	114	< 300	0 - 378

Marker	Value	Functional Range	Lab Range
WBC	6.1	5.0 – 8.0	3.4 - 10.8
RBC	4.12	4.4 – 4.9	3.77 - 5.28
Hemoglobin	13.1	13.5 - 14.5	11.1 - 15.9
Hematocrit	39.1	37 - 44	34 - 46.6
MCV	95	85 – 92	79 - 97
MCH	31.8	27.7 – 32.0	26.6 - 33.0
MCHC	33.5	32 – 35	31.5 - 35.7
RDW	14.2	11.5 – 15.0	12.3 - 15.4
Platelets	207	150 – 415	150 - 379
Neutrophils	67	40 – 60	
Lymphocytes	25	25 – 40	
Monocytes	5	4.0 – 7.0	
Eosinophils	2	0.0 – 3.0	
Basophils	1	0.0 – 3.0	
Bilirubin, Direct	0.15		0 - 0.4
Folate(Folic Acid), Serum	>20.0		> 3

At first glance, a lot of markers are out of the functional range, but when we look closer, there are only really a few significant issues. BUN-to-creatinine ratio is slightly high but probably not significant. It's still in the lab range. BUN and creatinine are normal. Sodium, carbon dioxide, total protein, and globulin are all just barely out of the functional range. Again, that is not necessarily a concern.

TIBC, UIBC, and ferritin are all just out of the functional range, and iron saturation is close to being out of the functional range, so this could be very, very early stages of iron overload and could probably be easily addressed with one or two blood donations a year.

Total cholesterol is 233, but HDL is high at 87, so that accounts for some of that high total cholesterol. Total cholesterol-to-HDL ratio is 2.7, which is optimal. You may still want to run advanced lipid testing here, but a total cholesterol of 233 with a normal HDL is not usually a concern for a woman, particularly a woman of her age. As we age, cholesterol starts to become more protective.

Homocysteine is 9.8. Serum B12 is normal at 481, although at the low end of the range. Serum folate is quite high at over 20. Serum MMA is normal, so I'd look at FIGLU, urine MMA, and maybe a functional methylation panel.

TSH is high-normal at 3.3, but free T4 and free T3 are normal. Remember that TSH increases with age, and it's not necessarily a pathological increase, so a TSH of 3.3 for an almost 65-year-old woman may very well be normal.

Red blood cells and hemoglobin are very slightly low. Given homocysteine, this suggests the possibility of low active folate or active B12, and again, we're thinking about B12 deficiency with people in this age group. It could be that low B12 and folate are causing the beginnings of

functional anemia because we have red blood cells functionally low at 4.12 and hemoglobin functionally low at 13 with an MCV functionally high at 95.

Neutrophils are slightly high at 67, in a range of 40 to 60, so this could be a reflection of infection. She has GERD and GI issues, so you're of course thinking of H. pylori in this case.

Helicobacter pylori Stool Antigen - 418	
Parameter	Result
Helicobacter Pylori Stool Antigen	
H. pylori Antigen	* Detected *
<p>Helicobacter pylori (H. pylori) is a bacterium which can be found in the stomach mucosa of infected individuals. The infection may produce little or no noticeable symptoms, but can cause gastritis, gastric ulcers, stomach cancer, and other serious pathologies. By neutralizing stomach acid through the destruction of parietal cells in the stomach, H. pylori causes digestive problems, constant acute stress on the hormonal stress response, and can lead to progressively threatening disease conditions unless treated.</p>	
<p>Consult biohealthlab.com's Clinical Resources area for interpretive guidance and clinical training.</p>	

In fact, it was H. pylori for her, so this is a good example of how blood chemistry can actually be helpful in revealing other issues that aren't necessarily related to blood chemistry such as H. pylori. H. pylori in her case was probably causing hypochlorhydria, or low stomach acid, which in turn was contributing to nutrient malabsorption.

The next patient is a 23-year-old female with chief complaint of mild anxiety. She just wanted a general checkup.

Marker	Value	Functional Range	Lab Range
Glucose	93	75 - 90	65 - 99
Hemoglobin A1c	5.2	4.4 - 5.4	4.8 - 5.6
Uric Acid	5.5	3.2 - 5.5	2.5 - 7.1
BUN	8	13 - 18	6 - 20
Creatinine	0.66	0.7 - 1.0	0.57 - 1
BUN/Creatinine Ratio	12	9 - 23	8 - 20
eGFR if Non-African American	125		> 59
eGFR if African American	144		> 59
Sodium	138	135 - 140	134 - 144
Potassium	3.9	4.0 - 4.5	3.5 - 5.2
Chloride	98	100 - 106	97 - 108
CO2	23	25 - 30	18 - 29
Calcium	9.7	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.3	3.0 - 4.0	2.5 - 4.5
Magnesium	2.0	2.0 - 2.6	1.6 - 2.3
Protein, total	7.2	6.9 - 7.4	6.0 - 8.5
Albumin	4.7	4.0 - 5.0	3.5 - 5.5
Globulin	2.5	2.4 - 2.8	1.5 - 4.5
A/G ratio	1.9	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	0.7	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	60	42 - 107	39 - 117
LDH	136	140 - 180	119 - 226
AST	15	10 - 23	0 - 40
ALT	12	10 - 20	0 - 32
GGT	14	5 - 21	0 - 60
TIBC	342	275 - 425	250 - 450
UIBC	192	175 - 350	131 - 425
Iron	150	40 - 135	27 - 159
Iron saturation	44	17 - 45	15 - 55
Ferritin	39	30 - 100	15 - 150
Vitamin B-12	310	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	30.2	35 - 60	30.0 - 100.0
Cholesterol, total	162	150 - 250	100 - 199
Triglycerides	70	50 - 100	0 - 149
HDL	58	55 - 85	> 39
LDL	90	0 - 175	0 - 99
T. Chol / HDL Ratio	2.8	< 3	0 - 4.4
Triglycerides / HDL Ratio	1.21	< 2	< 3.8

Marker	Value	Functional Range	Lab Range
CRP-hs	1.49	< 1.0	0.00 - 3.00
Homocysteine	9.6	< 7.0	0.0 - 15.0
TSH	0.769	0.5 - 2.5	0.45 - 4.50
T4, total	10.4	6.0 - 12	4.5 - 12
T3 Uptake	30	28 - 35	24 - 39
T3, Total	99	100 - 180	71 - 180
Copper	119	81 - 157	72 - 166
Zinc	77	64 - 126	56 - 134
Zinc / Copper Ratio	0.65	> 0.85	
Serum Methylmalonic Acid (MMA)	97	< 300	0 - 378
WBC	6.6	5.0 - 8.0	3.4 - 10.8
RBC	4.92	4.4 - 4.9	3.77 - 5.28
Hemoglobin	14.4	13.5 - 14.5	11.1 - 15.9
Hematocrit	42.7	37 - 44	34 - 46.6
MCV	87	85 - 92	79 - 97
MCH	29.3	27.7 - 32.0	26.6 - 33.0
MCHC	33.7	32 - 35	31.5 - 35.7
RDW	13.0	11.5 - 15.0	12.3 - 15.4
Platelets	331	150 - 415	150 - 379
Neutrophils	66	40 - 60	
Lymphocytes	25	25 - 40	
Monocytes	7	4.0 - 7.0	
Eosinophils	2	0.0 - 3.0	
Basophils	0	0.0 - 3.0	

Fasting glucose was 93. A level like that could indicate dysglycemia if other markers are off, or it could be completely normal. In her case, her A1c is good at 5.2. Uric acid is normal. Triglycerides are normal at 70, and her postmeal blood sugar was normal, so I don't think there was a problem.

A few markers are out of the functional range, but only a couple that are signaling a possible issue to follow up on. B12 is borderline low at 310, and homocysteine is borderline high at 9.6. Serum MMA is normal, but even though they are thought to be equivalent in the scientific literature, I've found in my experience that urine MMA is more sensitive for B12 deficiency and often correlates better with homocysteine. You would want to look at urine MMA as well as FIGLU on the urine organic acids profile to determine the cause of the elevated homocysteine.

Her 25(OH)D is almost out of the lab range at 30.2. You would want to run PTH, which we didn't have for this patient, or supplement perhaps with cod liver oil to bring it up a little bit. CRP is 1.49, which is slightly out of the optimal range. Remember that CRP has very high intraindividual variation, and it can be increased by something as simple as a common cold. If it is mildly elevated such as this, it may be indicative of an issue you need to address, but it may also be transient. In this case, though, zinc-to-copper ratio is also low, which suggests that there may be a problem with inflammation.

In this case, I would focus on B12 and folate deficiency as a possible cause of high homocysteine and then determine whether inflammation is an issue with further testing. Look at gut, HPA axis, and other issues, and then address vitamin D by either supplementing or running PTH. Calcium is normal, so that is not a help in this particular situation.

Okay, that's it for part one. We'll be back next week with part two and more case studies.