Blood Chemistry Review II - Part Three

The next patient is a 47-year-old female with chief complaint of digestive issues, weight gain, and fatigue. Recently had a partial hysterectomy for fibroids and cysts. She is a small business owner and under a tremendous amount of stress.

Marker	Value	Functional Range	Lab Range
Glucose	90	75 - 90	65 - 99
Hemoglobin A1c	5.4	4.4 – 5.4	4.8 - 5.6
Uric Acid	7.4	3.2 - 5.5	2.5 - 7.1
BUN	17	13 – 18	6 - 24
Creatinine	0.81	0.85 – 1.1	0.57 - 1
BUN/Creatinine Ratio	21	9 – 23	9 - 23
Sodium	141	135 – 140	134 - 144
Potassium	4.7	4.0 – 4.5	3.5 - 5.2
Chloride	101	100 – 106	97 - 108
C02	25	25 – 30	18 - 29
Calcium	9.4	9.2 – 10.1	8.7 - 10.2
Phosphorus	3.4	3.5 – 4.0	2.5 - 4.5
Magnesium	2.0	2.0 – 2.6	1.6 - 2.3
Protein, total	6.7	6.9 – 7.4	6.0 - 8.5
Albumin	4.4	4.0 – 5.0	3.5 - 5.5
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	0.7	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	72	42 – 107	39 - 117
LDH	144	140 - 180	119 - 226
AST	22	10 - 30	0 - 40
ALT	20	10 - 22	0 - 32
GGT	17	< 13	0 - 60
TIBC	231	275 – 425	250 - 450
UIBC	163	175 - 350	131 - 425
Iron	68	40 – 135	27 - 159
Iron saturation	29	17 – 45	15 - 55
Ferritin	437	30 - 100	15 - 150
Vitamin B-12	740	450 – 2000	211 - 946
Vitamin D, 25-hydroxy	93	35 - 60	30.0 - 100.0
Cholesterol, total	164	150 - 250	100 - 199
Triglycerides	41	50 – 100	0 - 149
HDL	69	55 – 85	> 39
LDL	87	0 - 175	0 - 99
T. Chol / HDL Ratio	2.4	< 3	0 - 4.4
Triglycerides / HDL Ratio	0.59	< 2	< 3.8
CRP-hs	1.89	< 1.0	0.00 - 3.00
Homocysteine	9.5	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	1.180	0.5 – 2.5	0.45 - 4.50
T4, total	8.1	6.0 – 12	4.5 - 12
T3 Uptake	32	28 - 35	24 - 39
T3, Total	88	100 – 180	71 - 180
T3, Free	2.9	2.5 - 4.0	2 - 4.4
T4, Free	1.31	1 - 1.5	0.82 - 1.77
Copper	133		72 - 166
Zinc	96		56 - 134
Zinc / Copper Ratio	0.72	> 0.85	
Serum Methylmalonic Acid (MMA)	120	< 300	0 - 378
WBC	5.6	5.0 – 8.0	3.4 - 10.8
RBC	4.33	4.4 – 4.9	3.77 - 5.28
Hemoglobin	13.6	13.5 - 14.5	11.1 - 15.9
Hematocrit	41.2	37 - 44	34 - 46.6
MCV	95	85 – 92	79 - 97
MCH	31.4	27.7 – 32.0	26.6 - 33.0
MCHC	33	32 – 35	31.5 - 35.7
RDW	12.8	11.5 – 15.0	12.3 - 15.4
Platelets	280	150 – 415	150 - 379
Neutrophils	64	40 – 60	
Lymphocytes	24	25 – 40	
Monocytes	9	4.0 – 7.0	
Eosinophils	2	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

Uric acid is high at 7.4. As you know, this is associated with metabolic syndrome, but there is not much evidence of that here. Her fasting glucose is 90, and A1c is 5.4.

Hyperuricemia basically has two causes: decreased excretion or increased production. Decreased excretion is usually caused by decreased glomerular filtration, a kidney issue, decreased tubular secretion, or enhanced tubular reabsorption. All of that actually falls under the diabetes and kidney problem umbrella. Increased production is more rare, and the textbooks usually refer to a diet rich in purines, although there has never been a lot of evidence to support that and plenty of evidence that conflicts with it. Increased purine nucleotide breakdown as possible mechanisms for increased production. Another possibility is zinc deficiency. One study found that zinc intake is inversely associated with hyperuricemia in middle-aged males, though not in females, so I'm not sure of the relevance here.

Her zinc is normal, but her zinc-to-copper ratio is low. Increasing intake of zinc-rich foods would probably be a good starting place.

TIBC is lab-low. UIBC, iron, and iron saturation are normal. Ferritin is very high, especially for a female at 437. However, she has markers of inflammation such as high CRP and low zinc-to-copper ratio, so I would suggest running soluble transferrin receptor to clarify.

Her 25(OH)D is very high at 93. That is nearing toxic level, even according to the conventional cutoff. She has been supplementing with a multivitamin that has vitamin D as well as taking 10,000 IU of vitamin D per day for several months.

Homocysteine is functionally high at 9.5. Serum B12 and MMA are normal, so you would check urine MMA, FIGLU, and serum folate, which we didn't have for her.

TSH is normal at 1.18, but total T3 is low-normal at 88. Free T3 is normal at 2.9, so I don't think there is an issue here.

Red blood cells are just barely below the functional range. MCV is a little bit high. With homocysteine a little high, there is the possibility of B12 or folate-deficient anemia in the early stage here, so you would want further workup on that.

Neutrophils, lymphocytes, and monocytes are slightly out of the range, which could refer to an immune challenge.

For follow-up here, we would retest uric acid, possibly do the True Health Diagnostics* metabolic and lipid panel, keep searching for a source of inflammation and immune dysregulation, run soluble transferrin receptor for iron, and then urine FIGLU and MMA for further workup for B12 or folate-deficient anemia.

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

Okay, the last patient is a 40-year-old male with chief complaint of just feeling terrible over the past year, intense stress, weight gain, fatigue, and low libido.

Marker	Value	Functional Range	Lab Range
Glucose	85	75 - 90	65 - 99
Hemoglobin A1c	5.5	4.8 – 5.4	4.8 - 5.6
Uric Acid	6.3	3.7 – 6.0	3.7 - 8.6
BUN	19	13 – 18	6 - 24
Creatinine	0.81	0.85 – 1.1	0.76 - 1.27
BUN/Creatinine Ratio	23	8 – 19	9 - 20
Sodium	143	134 – 140	134 - 144
Potassium	4.5	4.0 – 4.5	3.5 - 5.2
Chloride	102	100 – 106	97 - 108
C02	26	25 – 30	18 - 29
Calcium	10.1	9.2 – 10.1	8.7 - 10.2
Phosphorus	3.3	3.5 – 4.0	2.5 - 4.5
Magnesium	2.0	2.0 – 2.6	1.6 - 2.3
Protein, total	7.7	6.9 – 7.4	6.0 - 8.5
Albumin	4.9	4.0 – 5.0	3.5 - 5.5
Globulin	2.8	2.4 – 2.8	1.5 - 4.5
A/G ratio	1.8	1.5 – 2.0	1.1 - 2.5
Bilirubin, total	0.4	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	75	42 – 107	39 - 117
LDH	99	140 - 180	121 - 224
AST	28	10 - 30	0 - 40
ALT	47	10 - 29	0 - 44
GGT	27	0 - 40	0 - 65
TIBC	367	250 – 350	250 - 450
UIBC	265	150 - 375	111 - 343
Iron	102	85 – 135	38 - 169
Iron saturation	28	15 – 45	15 - 55
Ferritin	393	30 - 150	30 - 400
Vitamin B-12	581	450 – 2000	211 - 946
Vitamin D, 25-hydroxy	23	35 - 60	30.0 - 100.0
Cholesterol, total	208	150 - 240	100 - 199
Triglycerides	64	50 – 100	0 - 149
HDL	47	55 – 85	> 39
LDL	148	0 - 175	0 - 99
T. Chol / HDL Ratio	4.4	< 3	0 - 5.0
Triglycerides / HDL Ratio	1.36	< 2	< 3.8
CRP-hs	1.73	< 1.0	0.00 - 3.00
Homocysteine	9.8	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	0.781	0.5 – 2.5	0.45 - 4.50
T4, total	7.1	6.0 – 12	4.5 - 12
T3 Uptake	27	30 - 38	24 - 39
T3, Total	120	100 – 180	71 - 180
Copper	110		72 - 166
Zinc	73		56 - 134
Zinc / Copper Ratio	0.66	> 0.85	
Serum Methylmalonic Acid (MMA)	147	0 - 325	0 - 378
WBC	7.3	5.0 – 8.0	3.4 - 10.8
RBC	5.64	4.4 – 4.9	4.14 - 5.8
Hemoglobin	17.1	14 - 15	12.6 - 17.7
Hematocrit	50.5	40 - 48	37.5 - 51.0
MCV	90	85 – 92	79 - 97
MCH	30.3	27.7 – 32.0	26.6 - 33.0
MCHC	33.9	32 – 35	31.5 - 35.7
RDW	13.0	11.5 – 15.0	12.3 - 15.4
Platelets	334	150 – 415	150 - 379
Neutrophils	61	40 – 60	
Lymphocytes	31	25 – 40	
Monocytes	6	4.0 – 7.0	
Eosinophils	2	0.0 – 3.0	
Basophils	0	0.0 – 3.0	

A1c is 5.5, but fasting glucose is normal at 85, and triglycerides are normal at 64. Lactate dehydrogenase is quite low at 99, so I would do follow-up testing here.

Uric acid, BUN, creatinine, sodium, phosphorus, and protein are all out of the functional range, so this could also be related to a blood sugar issue, but it is not necessarily clear.

ALT is high at 47. Remember the algorithm that we went through in the liver presentation. The goal is to exclude other causes of elevated ALT, and once that is finished, there is over a 90 percent chance that the patient has nonalcoholic fatty liver disease. However, in this case, iron overload, which is part of that algorithm, is one potential cause. All markers are normal, but ferritin is pretty high at 393, almost out of the lab range. I would run soluble transferrin receptor. Other possibilities to consider in this patient for a cause of elevated ALT would be autoimmune hepatitis; Wilson's disease; hemochromatosis, since we're looking at a higher ferritin; hepatitis; or alcohol or drug-related injury. You could do a 24-hour urine copper, ceruloplasmin, and hepatitis panel, or you could just treat mechanisms that you identify and then continue to retest the liver enzymes over the next six months.

This patient is overweight, so if I had to guess, I would say nonalcoholic fatty liver disease is the cause of the elevated ALT, so I would probably treat, help with weight loss, and see if that goes down.

His 25(OH)D is 23. That is low. We didn't have parathyroid hormone level for this patient, but at that level, I would treat, almost regardless of the PTH.

Total cholesterol is 208, and LDL is 148. HDL is low at 47. That is consistent with metabolic dysfunction, so I would run the True Health Diagnostics* advanced lipid panel or something that gets me LDL-P. It is almost certain that he has high LDL-P with a total cholesterol-to-HDL ratio of 4.4.

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

CRP and zinc-to-copper ratio are out of range. CRP is high. Zinc-to-copper is low, so that is also consistent with metabolic syndrome or inflammation, as is the low vitamin D. Homocysteine is 9.8. Serum B12 and serum MMA are normal, so you would check for urine MMA, FIGLU, and, perhaps, serum folate.

Red blood cell, hemoglobin, and hematocrit are functionally high, likely dehydration you are seeing there.

For follow-up, we would want to look at the causes of ALT, or as I suggested just address mechanisms and continue to test it. If it goes down, it was most likely fatty liver, and if it doesn't, then you would want to keep looking. Soluble transferrin receptor for ferritin and iron follow-up. Continue looking for a source of inflammation, gut, and HPA axis, although just simply being overweight can be a source of inflammation. This patient is overweight, as I mentioned. Then address dehydration and low vitamin D levels.

Okay, that's it for now. I hope this was helpful. In the next unit, we'll go over some complete case reviews, including intake, blood chemistry, gut, and HPA axis so we can put it all together in how you would actually work up a patient from start to finish. Talk to you then.