

Iron Overload - Part Six

The next patient is a 43-year-old male. His only complaints were skin related. He had a history of minor eczema, psoriasis, and occasional muscle soreness and fatigue after exercise.

Marker	Value	Functional Range	Lab Range
Glucose	93	75 - 90	65 - 99
Hemoglobin A1c	5.7	4.4 - 5.4	4.8 - 5.6
Uric Acid	5.5	3.7 - 6.0	3.7 - 8.6
BUN	17	13 - 18	6 - 24
Creatinine	1.01	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	17	8 - 19	8 - 19
Sodium	141	135 - 140	134 - 144
Potassium	4.2	4.0 - 4.5	3.5 - 5.2
Chloride	99	100 - 106	97 - 108
CO2	24	25 - 30	18 - 29
Calcium	9.2	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.9	3.5 - 4.0	2.5 - 4.5
Magnesium	1.8	2.0 - 2.6	1.6 - 2.3
Protein, total	6.5	6.9 - 7.4	6.0 - 8.5
Albumin	4.5	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	0.9	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	58	42 - 107	39 - 117
LDH	138	140 - 180	121 - 224
AST	22	10 - 30	0 - 40
ALT	25	10 - 29	0 - 44
GGT	19	< 15	0 - 65
TIBC	262	275 - 425	250 - 450
UIBC	69	175 - 350	150 - 375
Iron	193	40 - 135	40 - 155
Iron saturation	74	17 - 45	15 - 55
Ferritin	205	30 - 100	30 - 400
Vitamin B-12	420	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	35.1	35 - 60	30.0 - 100.0
Cholesterol, total	149	150 - 240	100 - 199
Triglycerides	31	50 - 100	0 - 149
HDL	60	55 - 85	> 39
LDL	83	0 - 175	0 - 99
T. Chol / HDL Ratio	2.5	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.52	< 2	< 3.8
CRP-hs	0.94	< 1.0	0.00 - 3.00
Homocysteine	7.9	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	1.420	0.5 – 2.5	0.45 – 4.50
T4, total	5.9	6.0 – 12	4.5 – 12
T3 Uptake	30	30 - 38	24 - 39
T3, Total	88	100 – 180	71 - 180
WBC	3.2	5.0 – 8.0	3.4 – 10.8
RBC	4.79	4.4 – 4.9	4.14 – 5.8
Hemoglobin	14.5	14 - 15	12.6 – 17.7
Hematocrit	43.3	40 - 48	37.5 – 51.0
MCV	90	85 – 92	79 - 97
MCH	30.3	27.7 – 32.0	26.6 – 33.0
MCHC	33.5	32 – 35	31.5 – 35.7
RDW	13.4	11.5 – 15.0	12.3 – 15.4
Platelets	157	150 – 415	150 - 379
Neutrophils	64	40 – 60	
Lymphocytes	26	25 – 40	
Monocytes	7	4.0 – 7.0	
Eosinophils	2	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

So, as you can see, his UIBC was quite low out of the lab range at 69. TIBC was slightly low in the functional range at 262. Serum iron was lab high at 193. Iron saturation was quite high at 74 percent, and his ferritin was functionally high at 205. I'm not going to continue to give you the FeGGT scores here. In almost every case that we're talking about, they are elevated either due to high iron in most cases or a combination of high iron and elevated baseline risk factors.

TESTS	RESULT	FLAG	UNITS	REFERENCE INTERVAL	LAB
Fe+TIBC+Fer					
Iron Bind.Cap. (TIBC)	230	Low	ug/dL	250 – 450	
UIBC	78	Low	ug/dL	150 – 375	01
Iron, Serum	152		ug/dL	40 – 155	01
Iron Saturation	66	High	%	15 – 55	
Ferritin, Serum	450	High	ng/mL	30 – 400	01
Fructosamine	243		umol/L	0 – 285	02
Published reference interval for apparently healthy subjects between age 20 and 60 is 205 – 285 umol/L and in a poorly controlled diabetic population is 228 – 563 umol/L with a mean of 396 umol/L.					
Soluble Transferrin Receptor	11.4	Low	nmol/L	12.2 – 27.3	02

So, this is the first retest. As you can see, it definitely illustrates the importance of retesting. Iron saturation is a little lower, but ferritin is significantly higher. It's 450 now. It was in the 200s last time. UIBC is about the same, still very low, and then soluble transferrin receptor is lab low, clearly supporting the diagnosis of iron overload.

TESTS	RESULT	FLAG	UNITS	REFERENCE INTERVAL	LAB
Fe+TIBC+Fer					
Iron Bind.Cap. (TIBC)	253		ug/dL	250 - 450	
UIBC	148	Low	ug/dL	150 - 375	01
Iron, Serum	105		ug/dL	40 - 155	01
Iron Saturation	42		%	15 - 55	
Ferritin, Serum	160		ng/mL	30 - 400	01
Soluble Transferrin Receptor	10.3	Low	nmol/L	12.2 - 27.3	02

Here is the retest after the first blood donation. Many of his numbers did improve. The ferritin dropped to 160. Iron saturation dropped down to 42. UIBC was still low but better, but as you can see, the soluble transferrin receptor is still out of the lab range and actually a little bit worse than it was originally. His hemoglobin, not shown here, was still 14, so there is plenty of room to continue with phlebotomy.

Marker	Value	Functional Range	Lab Range
Glucose	85	75 - 90	65 - 99
Hemoglobin A1c	5.3	4.4 - 5.4	4.8 - 5.6
Uric Acid	5.5	3.7 - 6.0	3.7 - 8.6
BUN	6	13 - 18	6 - 24
Creatinine	0.97	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	6	8 - 19	8 - 19
Sodium	136	135 - 140	134 - 144
Potassium	4.0	4.0 - 4.5	3.5 - 5.2
Chloride	96	100 - 106	97 - 108
CO2	28	25 - 30	18 - 29
Calcium	9.1	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.2	3.5 - 4.0	2.5 - 4.5
Magnesium	1.7	2.0 - 2.6	1.6 - 2.3
Protein, total	6.4	6.9 - 7.4	6.0 - 8.5
Albumin	4.4	4.0 - 5.0	3.5 - 5.5
Globulin	2.0	2.4 - 2.8	1.5 - 4.5
A/G ratio	2.2	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	0.5	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	36	42 - 107	39 - 117
LDH	129	140 - 180	121 - 224
AST	27	10 - 30	0 - 40
ALT	19	10 - 29	0 - 44
GGT	13	< 15	0 - 65
TIBC	319	275 - 425	250 - 450
UIBC	201	175 - 350	150 - 375
Iron	118	40 - 135	40 - 155
Iron saturation	37	17 - 45	15 - 55
Ferritin	511	30 - 100	30 - 400
Vitamin B-12	988	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	31.3	35 - 60	30.0 - 100.0
Cholesterol, total	149	150 - 240	100 - 199
Triglycerides	90	50 - 100	0 - 149
HDL	57	55 - 85	> 39
LDL	1.3	0 - 175	0 - 99
T. Chol / HDL Ratio	2.6	< 3	0 - 5.0
Triglycerides / HDL Ratio	1.58	< 2	< 3.8
CRP-hs	0.2	< 1.0	0.00 - 3.00
Homocysteine	7.0	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	2.010	0.5 – 2.5	0.45 - 4.50
T4, total	8.0	6.0 – 12	4.5 - 12
T3 Uptake	26	30 - 38	24 - 39
T3, Total	124	100 – 180	71 - 180
Copper	83		72 - 166
Zinc	100		56 - 134
Zinc / Copper Ratio	1.20	> 0.85	
Serum Methylmalonic Acid (MMA)	153	0 - 325	0 - 378
WBC	3.6	5.0 – 8.0	3.4 - 10.8
RBC	4.76	4.4 – 4.9	4.14 - 5.8
Hemoglobin	14.3	14 - 15	12.6 - 17.7
Hematocrit	42.8	40 - 48	37.5 - 51.0
MCV	90	85 – 92	79 - 97
MCH	30.0	27.7 – 32.0	26.6 - 33.0
MCHC	33.4	32 – 35	31.5 - 35.7
RDW	12.9	11.5 – 15.0	12.3 - 15.4
Platelets	237	150 – 415	150 - 379
Neutrophils	53	40 – 60	
Lymphocytes	27	25 – 40	
Monocytes	13	4.0 – 7.0	
Eosinophils	6	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

Here's a 32-year-old male with pernicious anemia and persistent GI issues. Note that the only marker that was out of range was ferritin, which was 511, and that is outside of the lab range. His C-reactive protein is normal, but it's still possible that this could be inflammation. A normal CRP does not rule out inflammation. In some cases, you'll see it only in other markers such as ferritin or interleukin-6, for example. In this case, you really have to retest to get a better picture.

TESTS	RESULT	FLAG	UNITS	REFERENCE INTERVAL	LAB
Fe+TIBC+Fer					
Iron Bind.Cap. (TIBC)	268		ug/dL	250 - 450	
UIBC	181		ug/dL	150 - 375	01
Iron, Serum	87		ug/dL	40 - 155	01
Iron Saturation	32		%	15 - 55	
Ferritin, Serum	459	High	ng/mL	30 - 400	01
Soluble Transferrin Receptor	13.1		nmol/L	12.2 - 27.3	02

We did a 30-day Paleo challenge with him as part of our initial onboarding, and his symptoms subsided significantly, but when we retested his iron levels, his ferritin was still quite high at 459, and his soluble transferrin receptor was low-normal at 13.1, so this would lead me to suspect iron overload instead of inflammation as the cause of elevated ferritin.

TESTS	RESULT	FLAG	UNITS	REFERENCE INTERVAL	LAB
Fe+TIBC+Fer					
Iron Bind.Cap. (TIBC)	338		ug/dL	250 - 450	
UIBC	276		ug/dL	150 - 375	01
Iron, Serum	62		ug/dL	40 - 155	01
Iron Saturation	18		%	15 - 55	
Ferritin, Serum	295		ng/mL	30 - 400	01

Here is his retest after his first blood donation. Ferritin dropped 200 points, or 150 points from the last reading to 295. Iron saturation is now pretty low at 18 percent. You'd need to check the hemoglobin and also pay attention to iron saturation. If you did another blood donation, and his hemoglobin was lowish, and iron saturation is 18 percent, you'd probably put him into near-iron deficiency or iron deficiency. You may need to look at other strategies such as apolactoferrin and limiting higher iron food sources for dropping the patient's iron level or just wait a week or two before another blood donation.

Specimen Details			
Collected	Type	Source	
T15264-CA1000	9/21/2015 1548	Blood	
Ferritin Final result			
Test:	Ferritin	ID:	T15264-CA1000
Collected:	9/21/2015 1548	Received:	9/21/2015 1556
Resulting Lab:	T		
Analyte		Value	Ref. Range
FERRITIN SERUM		133	20-200 ng/mL
Resulting Lab:	T		
Iron/TIBC Panel Final result			
Test:	Iron/TIBC Panel	ID:	T15264-CA1000
Collected:	9/21/2015 1548	Received:	9/21/2015 1556
Resulting Lab:	T		
Analyte		Value	Ref. Range
IRON		172 (H)	37-170 ug/dL
TOTAL IRON BINDING		203 (L)	250-450 ug/dL
TRANSFERRIN SAT		85 (H)	15-50 %
Resulting Lab:	T		

This is a 57-year-old female. Her chief complaint was overweight, panic attacks, anxiety, depression, insomnia, and fatigue. Check out how high her iron saturation is. It's 85 percent. This patient was homozygous for the C282Y mutation, so that's classic hereditary hemochromatosis. Unfortunately, neither the patient nor the previous doctor took it seriously enough. She was actually diagnosed, which, as you know, is rare. She and the doctor didn't really take appropriate action, so these were her levels when she came to see me. Unfortunately, this is really all too common. According to the Iron Disorders Institute, a substantial percentage of patients with iron overload and their doctors don't take it seriously and don't treat it aggressively enough.

Also note that her ferritin levels are in the normal range. They're a little above what the optimal functional range is, but if you only test ferritin, like a lot of clinicians do, you would have no idea that this patient's iron saturation levels were at 85 percent, which is putting her at significant risk.

This is another issue. I've referred patients out like this to hematologists only to have them sent back to me, told not to worry by the hematologist because their ferritin is normal. They ignore, for whatever reason, the iron saturation level even when it's elevated this high on multiple tests. I think, if you look at the research literature, that's clearly a mistake because iron saturation alone has been associated with increased risk of morbidity and mortality.

Marker	Value	Functional Range	Lab Range
Glucose	82	75 - 90	65 - 99
Hemoglobin A1c	5.2	4.4 - 5.4	4.8 - 5.6
Uric Acid	5.4	3.7 - 6.0	3.7 - 8.6
BUN	18	13 - 18	6 - 24
Creatinine	1.04	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	17	8 - 19	8 - 19
Sodium	141	135 - 140	134 - 144
Potassium	4.4	4.0 - 4.5	3.5 - 5.2
Chloride	100	100 - 106	97 - 108
CO2	28	25 - 30	18 - 29
Calcium	9.5	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.9	3.5 - 4.0	2.5 - 4.5
Magnesium	2.1	2.0 - 2.6	1.6 - 2.3
Protein, total	6.5	6.9 - 7.4	6.0 - 8.5
Albumin	4.5	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	1.1	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	61	42 - 107	39 - 117
LDH	147	140 - 180	121 - 224
AST	22	10 - 30	0 - 40
ALT	19	10 - 29	0 - 44
GGT	13	< 15	0 - 65
TIBC	265	275 - 425	250 - 450
UIBC	37	175 - 350	150 - 375
Iron	228	40 - 135	40 - 155
Iron saturation	86	17 - 45	15 - 55
Ferritin	166	30 - 100	30 - 400
Vitamin B-12	479	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	30.8	35 - 60	30.0 - 100.0
Cholesterol, total	125	150 - 240	100 - 199
Triglycerides	47	50 - 100	0 - 149
HDL	50	55 - 85	> 39
LDL	66	0 - 175	0 - 99
T. Chol / HDL Ratio	2.5	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.94	< 2	< 3.8
CRP-hs	0.48	< 1.0	0.00 - 3.00
Homocysteine	10.2	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	1.160	0.5 – 2.5	0.45 - 4.50
T4, total	7.2	6.0 – 12	4.5 - 12
T3 Uptake	27	30 - 38	24 - 39
T3, Total	114	100 – 180	71 - 180
Copper	84		72 - 166
Zinc	110		56 - 134
Zinc / Copper Ratio	1.31	> 0.85	
Serum Methylmalonic Acid (MMA)	154	0 - 325	0 - 378
WBC	5.1	5.0 – 8.0	3.4 - 10.8
RBC	4.83	4.4 – 4.9	4.14 - 5.8
Hemoglobin	15.5	14 - 15	12.6 - 17.7
Hematocrit	46.9	40 - 48	37.5 - 51.0
MCV	97	85 – 92	79 - 97
MCH	32.1	27.7 – 32.0	26.6 - 33.0
MCHC	33	32 – 35	31.5 - 35.7
RDW	12.7	11.5 – 15.0	12.3 - 15.4
Platelets	178	150 – 415	150 - 379
Neutrophils	42	40 – 60	
Lymphocytes	38	25 – 40	
Monocytes	11	4.0 – 7.0	
Eosinophils	8	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

Here’s another case of very high iron saturation and the lowest UIBC I’ve ever seen at 37 percent. The iron saturation is 86 percent, but again, the ferritin is normal. It’s outside of what is an optimal range, but it’s 166, so it’s normal in the laboratory reference range. This is a 27-year-old male. His chief complaint was getting sick with a GI illness in New Zealand. He took a lot of antibiotics for it and just never felt like he recovered from that.

RESULTS

DNA RESULTS:

HFE C282Y AND H63D COMPOUND HETEROZYGOTE

INTERPRETATION:

A DNA sample from this individual was analyzed for two mutations in the HFE gene associated with hereditary hemochromatosis, C282Y and H63D. Polymerase Chain Reaction (PCR) amplification followed by restriction endonuclease digestion with RsaI yields bands of 261, 232, 59, and 29 bp in a C282Y heterozygote; MboI digestion of a PCR amplicon from a H63D heterozygote yields bands of 208, 138 and 70 bp.

When you see iron saturation that high and it persists upon retesting, as it did for this patient, the changes are pretty high that the patient has some kind of genetic iron storage problem. In this case, we did a DNA test, and he was, as you can see, a compound heterozygote for C282Y and H63D. This is associated with significantly higher risk of iron overload than people without any genetic mutations but not to the same extent as C282Y homozygotes, which is the classic form of hereditary hemochromatosis.

TESTS	RESULT	FLAG	UNITS	REFERENCE INTERVAL	LAB
Fe+TIBC+Fer					
Iron Bind.Cap. (TIBC)	242	Low	ug/dL	250 - 450	
UIBC	90	Low	ug/dL	150 - 375	01
Iron, Serum	152		ug/dL	40 - 155	01
Iron Saturation	63	High	%	15 - 55	
Ferritin, Serum	186		ng/mL	30 - 400	01

Here is the first retest after a blood donation. You can see there is a significant improvement. Iron saturation dropped from 86 to 63 percent. Ferritin actually went up a little bit. It was 166. I'm not entirely sure how to explain that. Sometimes you see these strange things in the iron panel that are not totally explicable. UIBC improved from 37 to 90, so it was still quite low, but it's not nearly as low as it was. Total iron-binding capacity is still a little bit low.

At this point, I referred him out to a hematologist for therapeutic or prescription phlebotomy because I thought that we weren't going to be able to get his numbers down into the right place just doing a blood donation every 56 days, and that was evidenced by the ferritin not dropping and, in fact, increasing a little bit. So, this is an example where a patient will probably need therapeutic phlebotomy, not just blood donation.

Marker	Value	Functional Range	Lab Range
Glucose	87	75 - 90	65 - 99
Hemoglobin A1c	5.8	4.4 - 5.4	4.8 - 5.6
Uric Acid	4.9	3.7 - 6.0	3.7 - 8.6
BUN	12	13 - 18	6 - 24
Creatinine	1.04	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	12	8 - 19	8 - 19
Sodium	141	135 - 140	134 - 144
Potassium	4.1	4.0 - 4.5	3.5 - 5.2
Chloride	100	100 - 106	97 - 108
CO2	24	25 - 30	18 - 29
Calcium	9.1	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.1	3.5 - 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	4.6	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	1.2	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	73	42 - 107	39 - 117
LDH	202	140 - 180	121 - 224
AST	19	10 - 30	0 - 40
ALT	14	10 - 29	0 - 44
GGT	7	< 15	0 - 65
TIBC	348	275 - 425	250 - 450
UIBC	151	175 - 350	150 - 375
Iron	197	40 - 135	40 - 155
Iron saturation	57	17 - 45	15 - 55
Ferritin	13	30 - 100	30 - 400
Vitamin B-12	801	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	37.7	35 - 60	30.0 - 100.0
Cholesterol, total	183	150 - 240	100 - 199
Triglycerides	59	50 - 100	0 - 149
HDL	60	55 - 85	> 39
LDL	111	0 - 175	0 - 99
T. Chol / HDL Ratio	3.1	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.98	< 2	< 3.8
CRP-hs	0.57	< 1.0	0.00 - 3.00
Homocysteine	8.8	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	3.640	0.5 – 2.5	0.45 - 4.50
T4, total	7.3	6.0 – 12	4.5 - 12
T3 Uptake	28	30 - 38	24 - 39
T3, Total	118	100 – 180	71 - 180
WBC	7.2	5.0 – 8.0	3.4 - 10.8
RBC	5.16	4.4 – 4.9	4.14 - 5.8
Hemoglobin	14.9	14 - 15	12.6 - 17.7
Hematocrit	44.8	40 - 48	37.5 - 51.0
MCV	87	85 – 92	79 - 97
MCH	28.9	27.7 – 32.0	26.6 - 33.0
MCHC	33.3	32 – 35	31.5 - 35.7
RDW	14.7	11.5 – 15.0	12.3 - 15.4
Platelets	273	150 – 415	150 - 379
Neutrophils	53	40 – 60	
Lymphocytes	34	25 – 40	
Monocytes	8	4.0 – 7.0	
Eosinophils	5	0.0 – 3.0	
Basophils	0	0.0 – 3.0	

This patient is a 45-year-old male with ulcerative colitis, flaring off and on once to twice a year despite being on mesalamine. He recently had a very severe flare. He has a limited diet, and he was quite underweight. These are strange results given that he has blood in his stool. In those cases, you would typically expect iron deficiency, and indeed, ferritin is low at 13, but then we see some evidence of iron overload with iron saturation at 57 percent and serum iron at 197, which are both out of the lab range. This is a pretty contradictory panel.

TESTS	RESULT	FLAG	UNITS	REFERENCE INTERVAL	LAB
Fe+TIBC+Fer					
Iron Bind.Cap.(TIBC)	330		ug/dL	250 – 450	
UIBC	267		ug/dL	150 – 375	01
Iron, Serum	63		ug/dL	40 – 155	01
Iron Saturation	19		%	15 – 55	
Ferritin, Serum	13	Low	ng/mL	30 – 400	01

As I argued in the first presentation, I think it's crucial to retest the iron panel in almost all cases, and this is a perfect example of why, especially when you see conflicting results like that. This is now making a lot more sense. This is just suggestive of iron deficiency. There is no conflicting data here. We see the ferritin is still low at 13. Iron saturation is 19, which is in the lab range but at the bottom end, and this is more consistent with his clinical presentation. This is a patient with IBD and gastrointestinal bleeding. This is more what you would expect in that situation.

I'm not sure why this transient iron overload happens or we see these transitory increases in iron saturation or serum iron that then disappear on retesting. I've talked to some hematologists and

researchers about it, and no one has been able to completely explain it to me in a satisfactory way, but I've seen it enough times to know that retesting makes a lot of sense, especially when there is some contradictory data in the markers.

Marker	Value	Functional Range	Lab Range
Glucose	92	75 - 90	65 - 99
Hemoglobin A1c	5.5	4.4 - 5.4	4.8 - 5.6
Uric Acid	6.3	3.7 - 6.0	3.7 - 8.6
BUN	20	13 - 18	6 - 24
Creatinine	0.94	0.85 - 1.1	0.76 - 1.27
BUN/Creatinine Ratio	21	8 - 19	8 - 19
Sodium	142	135 - 140	134 - 144
Potassium	3.9	4.0 - 4.5	3.5 - 5.2
Chloride	101	100 - 108	97 - 108
CO2	25	25 - 30	18 - 29
Calcium	9.6	9.2 - 10.1	8.7 - 10.2
Phosphorus	3.2	3.5 - 4.0	2.5 - 4.5
Magnesium	2.3	2.0 - 2.6	1.6 - 2.3
Protein, total	6.7	6.9 - 7.4	6.0 - 8.5
Albumin	4.6	4.0 - 5.0	3.5 - 5.5
Globulin	2.1	2.4 - 2.8	1.5 - 4.5
A/G ratio	2.2	1.5 - 2.0	1.1 - 2.5
Bilirubin, total	1.1	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	48	42 - 107	39 - 117
LDH	150	140 - 180	121 - 224
AST	81	10 - 30	0 - 40
ALT	48	10 - 29	0 - 44
GGT	15	< 15	0 - 65
TIBC	321	275 - 425	250 - 450
UIBC	161	175 - 350	150 - 375
Iron	180	40 - 135	40 - 155
Iron saturation	50	17 - 45	15 - 55
Ferritin	70	30 - 100	30 - 400
Vitamin B-12	460	450 - 2000	211 - 946
Vitamin D, 25-hydroxy	76.1	35 - 60	30.0 - 100.0
Cholesterol, total	186	150 - 240	100 - 199
Triglycerides	46	50 - 100	0 - 149
HDL	99	55 - 85	> 39
LDL	78	0 - 175	0 - 99
T. Chol / HDL Ratio	1.9	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.46	< 2	< 3.8
CRP-hs	0.96	< 1.0	0.00 - 3.00
Homocysteine	11.5	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	4	0.5 – 2.5	0.45 - 4.50
T4, total	6.5	6.0 – 12	4.5 - 12
T3 Uptake	32	30 - 38	24 - 39
T3, Total	93	100 – 180	71 - 180
WBC	3.8	5.0 – 8.0	3.4 - 10.8
RBC	4.84	4.4 – 4.9	4.14 - 5.8
Hemoglobin	15.3	14 - 15	12.6 - 17.7
Hematocrit	44.7	40 - 48	37.5 - 51.0
MCV	92	85 – 92	79 - 97
MCH	31.6	27.7 – 32.0	26.6 - 33.0
MCHC	34.2	32 – 35	31.5 - 35.7
RDW	14.9	11.5 – 15.0	12.3 - 15.4
Platelets	245	150 – 415	150 - 379
Neutrophils	56	40 – 60	
Lymphocytes	23	25 – 40	
Monocytes	13	4.0 – 7.0	
Eosinophils	7	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

Here's a 59-year-old male with the main goal of improving general health and optimizing biomarkers. He didn't really have a lot of symptoms except for low libido, and then he had low testosterone. He wanted to improve his blood sugar control. For iron, his serum iron was elevated at 160. As you know, that's the least sensitive marker for iron overload, but interestingly enough, it was the only one here that was elevated out of the lab range. Iron saturation was 50 percent, which is above the functional range. Other markers were normal, but his AST and ALT were elevated. Note that his AST was significantly more elevated than his ALT, and as you probably know from medical school, an AST-to-ALT ratio of 2:1 or more is indicative of alcoholic liver disease. That's not the case, actually, here. It's under 2:1, and it wasn't the case that this patient was drinking a lot of alcohol. In fact, he didn't drink alcohol at all.

TESTS	RESULT	FLAG	UNITS	REFERENCE INTERVAL	LAB
Fe+TIBC+Fer					
Iron Bind.Cap. (TIBC)	302		ug/dL	250 - 450	
UIBC	141	Low	ug/dL	150 - 375	01
Iron, Serum	161	High	ug/dL	40 - 155	01
Iron Saturation	53		%	15 - 55	
Ferritin, Serum	91		ng/mL	30 - 400	01

Here is the retest. Serum iron and UIBC are out of range. Ferritin is in the normal range. Iron saturation is high in the functional range at 53 percent and almost out of the lab range. However, since ferritin is low, it's likely that the ALT and AST are elevated for reasons other than iron overload. We're not seeing really significant iron overload here that would probably explain the elevated AST and ALT.