INE | INSTITUTE OF NUTRITIONAL ENDOCRINOLOGY

Blood Chemistry: CBC - Complete Blood Count and Anemia

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Medical Disclaimer: The information in this presentation is not intended to replace a one-on-one relationship with a qualified health care professional and is not intended as medical advice. It is intended as a sharing of knowledge and information from the research and experience of Dr. Ritamarie Loscalzo, drritamarie.com, and the experts who have contributed. We encourage you to make your own health care decisions based upon your research and in partnership with a qualified health care professional.

CBC - Complete Blood Count

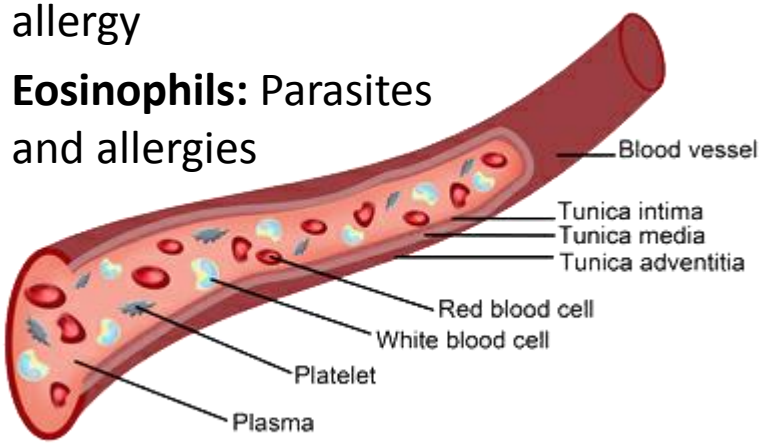
Anemia Markers

- ✓ **RBC:** Red blood cells - carry oxygen
- ✓ **Hemoglobin:** Transports oxygen and gives the red color to blood
- ✓ **Hematocrit:** Percentage of blood made up of red blood cells
- ✓ **MCV: M**ean **C**orpusclar **V**olume - Red blood cell size, as volume
- ✓ **MCH: M**ean **C**orpuscular **H**emoglobin - the average amount of hemoglobin in red blood cells
- ✓ **MCHC: M**ean **C**orpuscular **H**emoglobin **C**oncentration - the average hemoglobin concentration in red blood cells
- ✓ **RDW:** Variation in the size of the RBC's

Platelets: Blood cell particles involved with the forming of blood clots

Immune System Markers

- ✓ **WBC:** White blood cells - primary defense against disease
- ✓ **Neutrophils:** Often elevated in bacterial infection
- ✓ **Lymphocytes:** Often elevated in viral infection
- ✓ **Monocytes:** Second line of defense – elevated in recovery stage and chronic infection
- ✓ **Basophils:** Related to histamines and allergy
- ✓ **Eosinophils:** Parasites and allergies



Symptoms of Anemia

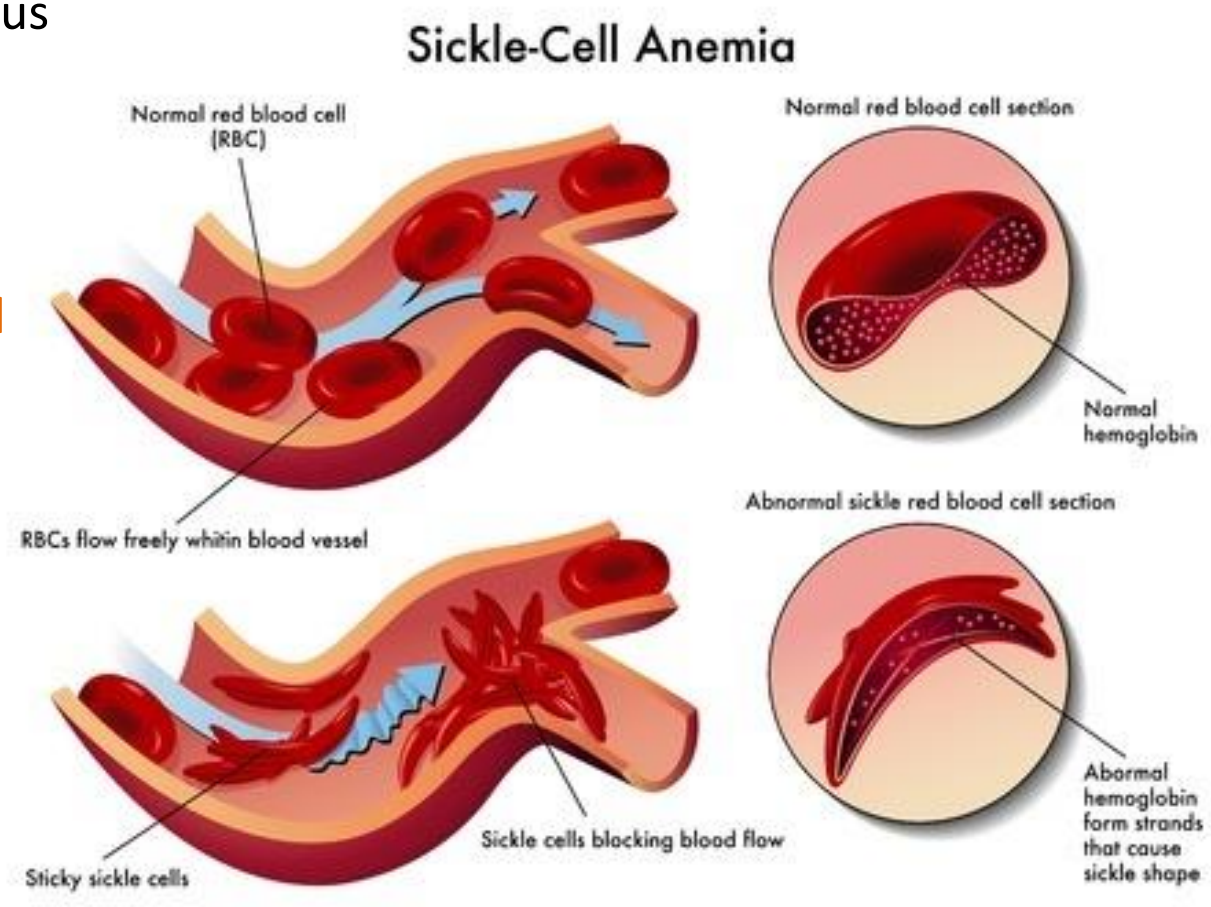
- ✓ Fatigue
- ✓ Weakness
- ✓ Headache
- ✓ Shortness of breath after exercise
- ✓ Chest pain
- ✓ Pounding in ears
- ✓ Brittle nails
- ✓ Pallor
- ✓ Palpitations
- ✓ Dizziness
- ✓ Cold hands and feet

Causes of Anemia

- ✓ Insufficient dietary iron
- ✓ Insufficient dietary folate
- ✓ Insufficient dietary B12 or autoimmune disease resulting in poor absorption
- ✓ Malabsorption
- ✓ Essential fatty acid deficiency
- ✓ Low stomach acid
- ✓ Heavy menstrual bleeding
- ✓ Internal bleeding - ulcers, polyps, hemorrhoids, inflammatory bowel disease, cancer
- ✓ Pregnancy
- ✓ Worms and parasites
- ✓ Autoimmune disease
- ✓ Heart disease
- ✓ Chronic viral or bacterial infections
- ✓ Medications, i.e. NSAIDS
- ✓ Kidney disease
- ✓ Serious illness

Types of Anemia

- ✓ Iron deficiency
- ✓ B12 deficiency/pernicious
- ✓ Folate deficiency
- ✓ Vitamin B6 deficiency
- ✓ **Serious disease - needs to be evaluated**
- ✓ Chronic disease
- ✓ **Internal bleeding (iron)**
- ✓ Hemolytic anemia
- ✓ Aplastic anemia
- ✓ Protein depletion
- ✓ Liver disease
- ✓ Polycythemia
- ✓ Hemochromatosis



Anemia Blood Markers #1

- ✓ **RBC:** (3.9 - 4.5 female, 4.2 - 4.9 male)
- ✓ **Hemoglobin:** (13.5 - 14.5 female, 14 - 15 male)
- ✓ **Hematocrit:** (37 - 44 female, 40 - 48 male) % of RBCs in plasma
- ✓ **MCV:** (82 - 89.9 microns)
- ✓ **MCH:** (27 - 32) Average weight of Hb in RBC (hemoglobin*10/RBC)
- ✓ **MCHC:** (32 - 35) Average hemoglobin in RBC (hemoglobin /hematocrit)
- ✓ **RDW:** Possibly earliest sign (11.7 - 13)
- ✓ **Reticulocyte Count:** Immature RBCs (.5 - 2.5 female, .5 - 1.5 male)

Anemia Blood Markers #2

- ✓ **Iron:** (85 - 130 ug/dl)
- ✓ **Ferritin:** (40 - 70 ng/ml)
  - protein-bound form of iron
- ✓ **Transferrin:** main protein in the blood that binds to iron and transports it throughout the body.
- ✓ **Total Iron Binding Capacity (TIBC):** (250 - 350) - available transferrin to bind iron
- ✓ **Transferrin Saturation:** (12 - 45 female, 15 - 50 male) Iron/TIBC * 100 – how much iron is actually bound to transferrin

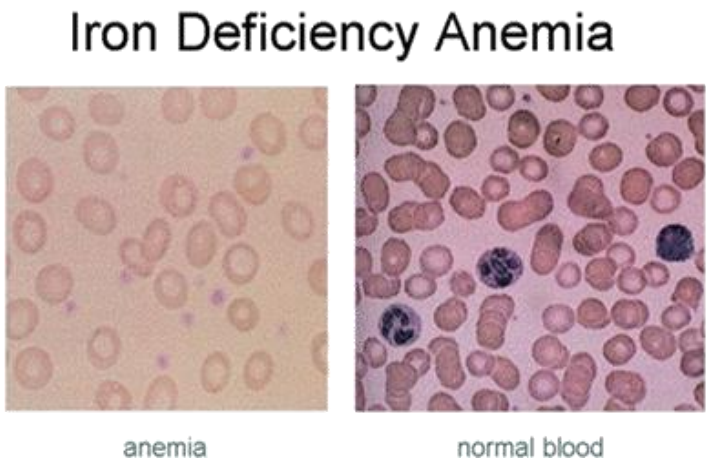
Stages of Iron Deficiency Anemia

1: Decreased Iron Stores

- ✓ Decreased Ferritin
- ✓ Normal Serum Iron
- ✓ Normal Transferrin
- ✓ Normal MCV
- ✓ Normal Hemoglobin

2: Decreased Iron

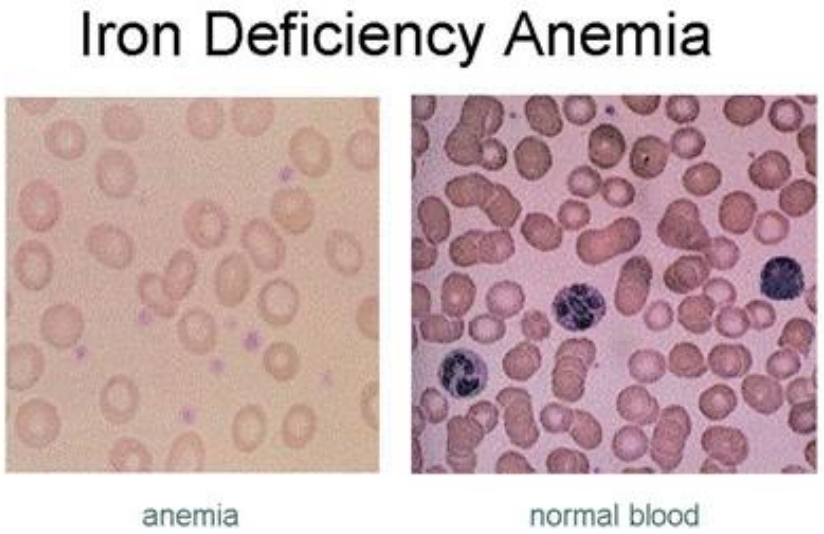
- ✓ Decreased Ferritin
- ✓ Decreased Serum Iron
- ✓ Increased Transferrin
- ✓ Normal MCV
- ✓ Normal or low Hemoglobin



Stages of Iron Deficiency Anemia

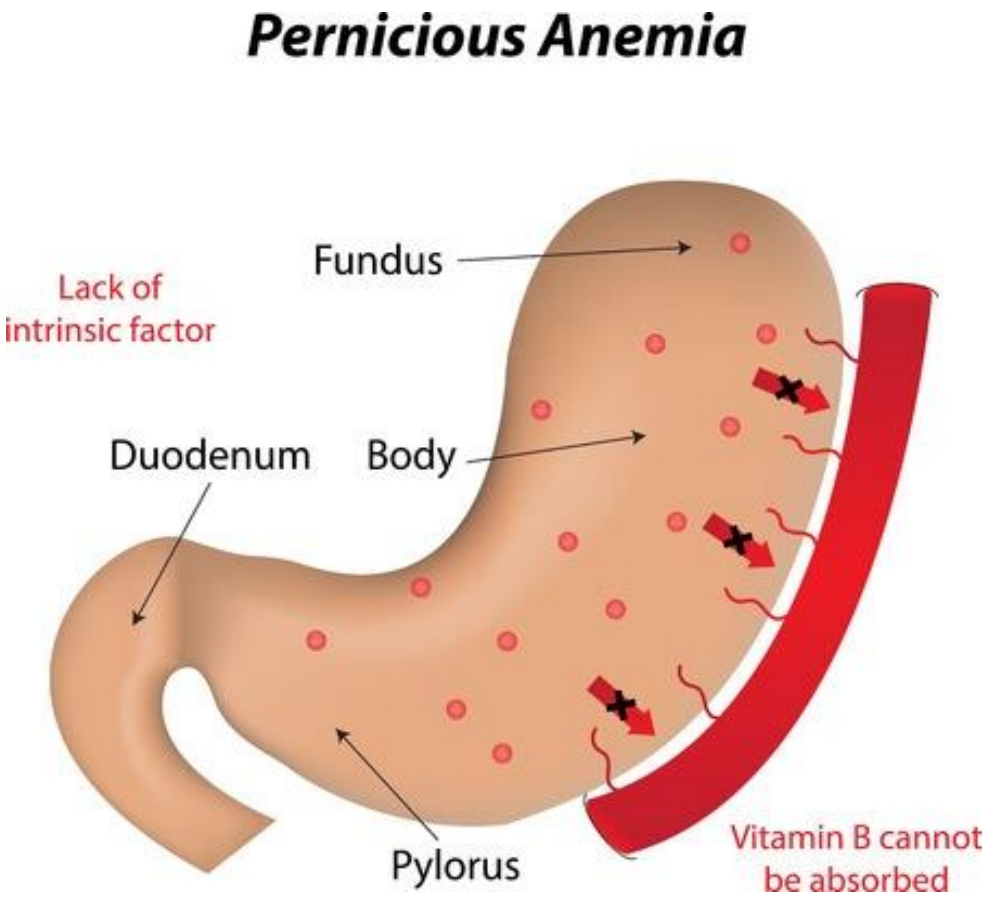
3: Iron Deficiency Anemia

- ✓ Decreased Hemoglobin
- ✓ Decreased Hematocrit
- ✓ Decreased RBC
- ✓ Decreased MCV
- ✓ Decreased MCH
- ✓ Decreased MCHC
- ✓ Decreased Iron, Serum
- ✓ Decreased Ferritin
- ✓ Decreased to Normal Iron Saturation
- ✓ Increased TIBC
- ✓ Increased Transferrin



B12 /Folate & Pernicious Anemia

- ✓ Decreased Hemoglobin
- ✓ Decreased Hematocrit
- ✓ Decreased RBC
- ✓ Increased MCV
- ✓ Increased MCH
- ✓ Increased MCHC
- ✓ Normal Iron, Serum (or low if co-existing iron deficiency)
- ✓ Normal TIBC
- ✓ Normal Transferrin
- ✓ Normal Intrinsic Factor Antibody *(+ = Pernicious)



Anemia in Serious Illness

Similar pattern to Iron Deficiency Anemia except:

- **TIBC and Transferrin** may be normal to increased
- Distinguished by symptoms and other findings
- Includes
  - Chronic disease
  - Internal bleeding (iron)
  - Hemolytic anemia
  - Protein depletion
  - Liver disease
  - Kidney failure

SERIOUS and NEEDS to be Diagnosed by a Medical Practitioner

Anemias of Excess

Serious conditions requiring attention from a health care provider

Polycythemia

- ✓ RBC = Increased
- ✓ HCT = Increased
- ✓ HGB = Increased
- ✓ MCV = Normal to Decreased
- ✓ MCH = Normal to Decreased
- ✓ MCHC = Normal to Decreased
- ✓ Serum Iron = Normal to Decreased
- ✓ Total Bilirubin = Increased
- ✓ Alkaline Phosphatase = Elevated
- ✓ Basophils = Increased
- ✓ Total WBC = Increased
- ✓ Uric Acid = Increased

***Slightly elevated RBC in absence of other signs is probably due to dehydration*

Hemochromatosis

- ✓ RBC = Normal
- ✓ HCT = Normal
- ✓ HGB = Normal
- ✓ MCV = Decreased
- ✓ MCH = Decreased
- ✓ MCHC = Decreased
- ✓ Serum Iron = Increased
- ✓ Iron Saturation = Significantly Increased
- ✓ TIBC = Decreased
- ✓ Ferritin = Significantly
- ✓ Transferrin = Normal or Decreased Slightly
- ✓ SGOT = Normal or Increased

CBC Anemia Case 1: Iron Deficiency

	CBC MARKERS						
49	WBC		4.0	10.5	5.0	8.0	5.6
50	RBC (Female)	-	3.9	5.1	3.9	4.5	3.9
51	RBC (Male)	-	3.9	5.1	4.2	4.9	
52	Hemoglobin (Female)	gm/dl	12.0	16.0	13.5	14.5	11
53	Hemoglobin (Male)	gm/dl	12.0	16.0	14.0	15.0	
54	Hematocrit (Female)	%	36.0	48.2	37.0	44.0	32.9
55	Hematocrit (Male)	%	36.0	48.2	40.0	48.0	
56	MCV	cu microns	82.0	103.0	85.0	92.0	84
57	MCH	g/cu microns	27.0	34.0	27.0	32.0	28.3
58	MCHC	g/cu microns	30.9	35.4	32.0	35.0	33.5
59	RDW	%	10.8	14.8	0.0	13.0	14.4
30	Iron, serum	ug/dl	40.0	180.0	85.0	130.0	67
80	Iron Saturation (calc) - Female	iron serum/TIBC			12.0	45.0	
81	Iron Saturation (calc) - Male	iron serum/TIBC			15.0	50.0	0
82	TIBC	ug/dl	250.0	390.0	250.0	350.0	
83	Transferrin	mg/dl			200.0	360.0	
84	Ferritin (pre-menopause)	-	33.0	236.0	10.0	122.0	
85	Ferritin (post-menopause)	-	33.0	236.0	10.0	263.0	

Follow-up Testing

- Vitamin B6 needed to make hemoglobin.
- Vitamin B6 increases the amount of oxygen carried by hemoglobin.
- Vitamin B6 deficiency can result in anemia similar to iron deficiency anemia.

CBC Anemia Case 2

3		Units	PATHOLOGICAL RANGE	FUNCTIONAL RANGE	12/22/09
4	**Markers**				
23	Iron	ug/dl	40-180	85-130	16
24	TIBC	ud/dl	250-390	250-350	
25	Ferritin (pre-menopause)	-	33-236	10-122	
26	Ferritin (post-menopause)	-	33-236	10-263	
27	Hgb (Female)	gm/dl	12-16	13.5-14.5	11.3
28	Hgb (Male)	gm/dl	12-16	14-15	-
29	Hct (Female)	%	36-48.2	37-44	33
30	Hct (Male)	%	36-48.2	40-48	-
31	RBC (Female)	-	3.9-5.1	3.9-4.5	3.79
32	RBC (Male)	-	3.9-5.1	4.2-4.9	-
33	MCV	cu microns	82-103	85-92	87
34	MCH	g/cu microns	27-34	27-32	29.9
35	MCHC	g/cu microns	30.9-35.4	32-35	34.2
36	RDW	%	10.8-14.8	<13	16.2
37	Platelets	-	150,000-400,000	150,000-450,000	238,000

- Iron deficiency – check ferritin.
- Suspected B12 anemia, too, because MCV is not decreased as it should be with such low iron.

CBC Anemia Case 3

3		Units	PATHOLOGICAL RANGE		FUNCTIONAL RANGE		CURRENT
4	CATEGORIES		Min	Max	Min	Max	XX/XX/10
48	CBC MARKERS						
49	WBC		4.0	10.5	5.0	8.0	3.5
50	RBC (Female)	-	3.9	5.1	3.9	4.5	4.49
51	RBC (Male)	-	3.9	5.1	4.2	4.9	
52	Hemoglobin (Female)	gm/dl	12.0	16.0	13.5	14.5	14.2
53	Hemoglobin (Male)	gm/dl	12.0	16.0	14.0	15.0	
54	Hematocrit (Female)	%	36.0	48.2	37.0	44.0	39.8
55	Hematocrit (Male)	%	36.0	48.2	40.0	48.0	
56	MCV	cu microns	82.0	103.0	85.0	92.0	89
57	MCH	g/cu microns	27.0	34.0	27.0	32.0	31.6
58	MCHC	g/cu microns	30.9	35.4	32.0	35.0	35.7
59	RDW	%	10.8	14.8	0.0	13.0	13.2
60	Platelets	(K)	150.0	400.0	150.0	450.0	190
30	Iron, serum	ug/dl	40.0	180.0	85.0	130.0	125

- Monitor RDW and check serum ferritin.

CBC Anemia Case 4

48	CBC MARKERS						
49	WBC		4.0	10.5	5.0	8.0	3.3
50	RBC (Female)	-	3.9	5.1	3.9	4.5	4.41
51	RBC (Male)	-	3.9	5.1	4.2	4.9	
52	Hemoglobin (Female)	gm/dl	12.0	16.0	13.5	14.5	14.3
53	Hemoglobin (Male)	gm/dl	12.0	16.0	14.0	15.0	
54	Hematocrit (Female)	%	36.0	48.2	37.0	44.0	41.1
55	Hematocrit (Male)	%	36.0	48.2	40.0	48.0	
56	MCV	cu microns	82.0	103.0	85.0	92.0	93
57	MCH	g/cu microns	27.0	34.0	27.0	32.0	32.3
58	MCHC	g/cu microns	30.9	35.4	32.0	35.0	34.7
59	RDW	%	10.8	14.8	0.0	13.0	13.2
60	Platelets	(K)	150.0	400.0	150.0	450.0	200
30	Iron, serum	ug/dl	40.0	180.0	85.0	130.0	169

- Probable B12 anemia.
- Iron excess with possible immune impairment.