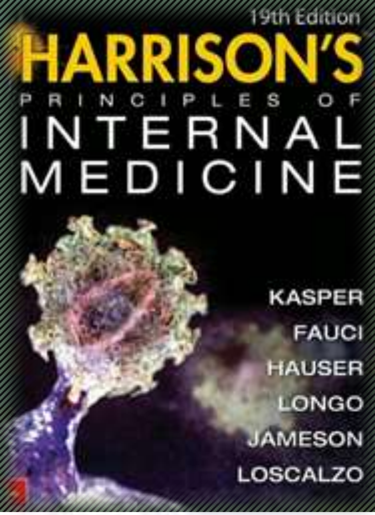

In The Name Of God

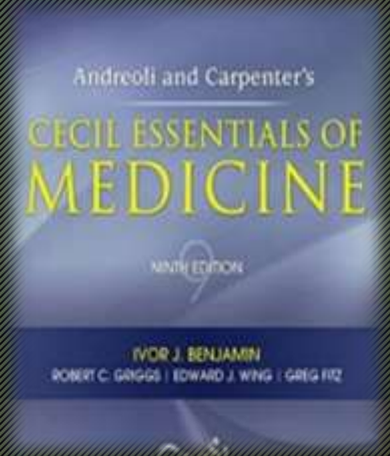
ANEMIA

Present By: Mohadeseh Aghasi

m.aghasi@yahoo.com

Insta: Draghasi.diet





Female
Weakness
Pica
Hair loss

CBC

HEMATO[illegible]Y (CBC) - BLOOD

Test	Result	Reference Intervals	Unit
WBC	8.8	4.5-11.0	x 1000
RBC	4.57	4.0-5.2	x 1000000
HGB	14.0	12-16	g/dl
HCT	41.8	36-46	%
MCV	91.5	80-100	fl
MCH	30.6	26-34	Pg
MCHC	33.5	31-37	%
PLT	269	140-400	x 1000
RDW-SD	40.9	36.4 - 46.3	fl
RDW-CV	12.2	11.6 - 14.4	%
PDW	17.7	9.9 - 15.4	fl
MPV	12.7	9.4 - 12.4	fl

WBC DIFFERENTIAL	
Neutrophil	50
Lymphocyte	40
Monocyte	8
Eos	2
Band	-
Baso	-
Meta	-
Myelocyte	-
Pro-Myelocyte	-
Blasts	-
Others	-
Nrbc/100 wbc	-
-	
-	

RBC MORPHOLOGY
Unremarkable morphology of RBC
-
-
-
-

Checked By : F. Estaji

Released By : N. Haj Sadeghi , M D

No.558, West Taleghani St. Tehran, Iran
Tel: 62974
www.danesh-lab.com
خیابان طالقانی غربی، بین وصال و فریمان، پلاک 558
تلفن: 021-62974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Hb

- World Health Organization
women are hemoglobin <1

Normal hematologic parameters in adults

Parameter	Men	Women
Hemoglobin (g/dL)	13.6 to 16.9	11.9 to 14.8
Hematocrit (%)	40 to 50	35 to 43
RBC count (× 10^6/microL)	4.2 to 5.7	3.8 to 5.0
MCV (fL)	82.5 to 98	
MCHC	32.5 to 35.2	
RDW (%)	11.4 to 13.5	
Reticulocyte count (x 10^3/microL or x 10^9/L)	16 to 130	16 to 98
Platelet count (× 10^3/microL)	152 to 324	153 to 361
WBC count (× 10^3/microL)	3.8 to 10.4	

These parameters were determined for approximately 1500 to 2000 individuals ages 20 to 80 (varies slightly by category). Reference ranges may differ depending on the instrument used. Refer to the laboratory-specific reference values provided with the individual's results.

CBC: complete blood count; RBC: red blood cell; MCV: mean corpuscular volume; fL: femtoliter; MCHC: mean corpuscular hemoglobin concentration; RDW: red cell distribution width; WBC: white blood cell.

Data from:
1. *Adeli K, Raizman JE, Chen Y, et al. Complex Biological Profile of Hematologic Markers across Pediatric, Adult, and Geriatric Ages: Establishment of Robust Pediatric and Adult Reference Intervals on the Basis of the Canadian Health Measures Survey. Clinical Chemistry 2015; 61:1075.*
2. *Van den Bossche J, Devreese K, Malfait R, et al. Reference Intervals for a Complete Blood Count Determined on Different Automated Haematology Analysers: Abx Pentra 120 Retic, Coulter Gen-S, Sysmex SE 9500, Abbott Cell Dyn 4000 and Bayer Advia 120. Clin Chem Lab Med 2002; 40:69.*

Causes of lower values

- **Intense physical activity**
- **Pregnancy**
- hemoglobin remains ≥11 g/dL in the first trimester,
- ≥10.5 g/dL in the second trimester,
- and ≥10.5 g/dL in the third trimester

Causes of higher values
(may occasionally mask underlying anemia)

- **Smoking**
- ⬆ levels ... ivery.

  increa...
- **Hemoc...**
- Individu... vomiting or diarrhea... l HCT due to hemoconcentration.
- **High altitude**

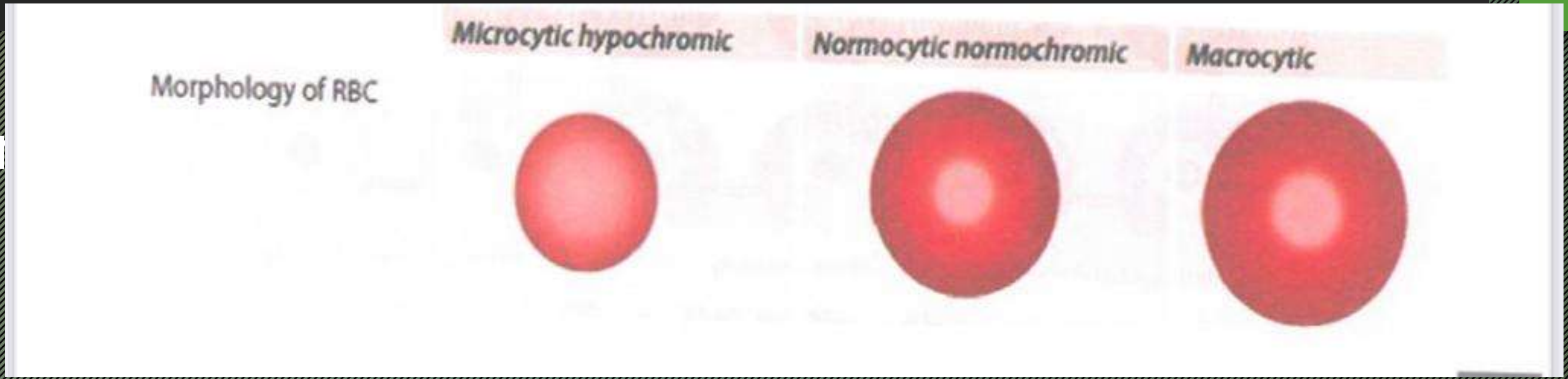
Case:
Male, wt: 70 kg, Hb: 17, HCT: 50%,
Intake:1000cc

Diagnosis & treatment?

Case:
Male, wt: 70 kg, Hb: 17, HCT: 50%, Intake:1000cc

Diagnosis & treatment?

MCV/MCH/MCHC

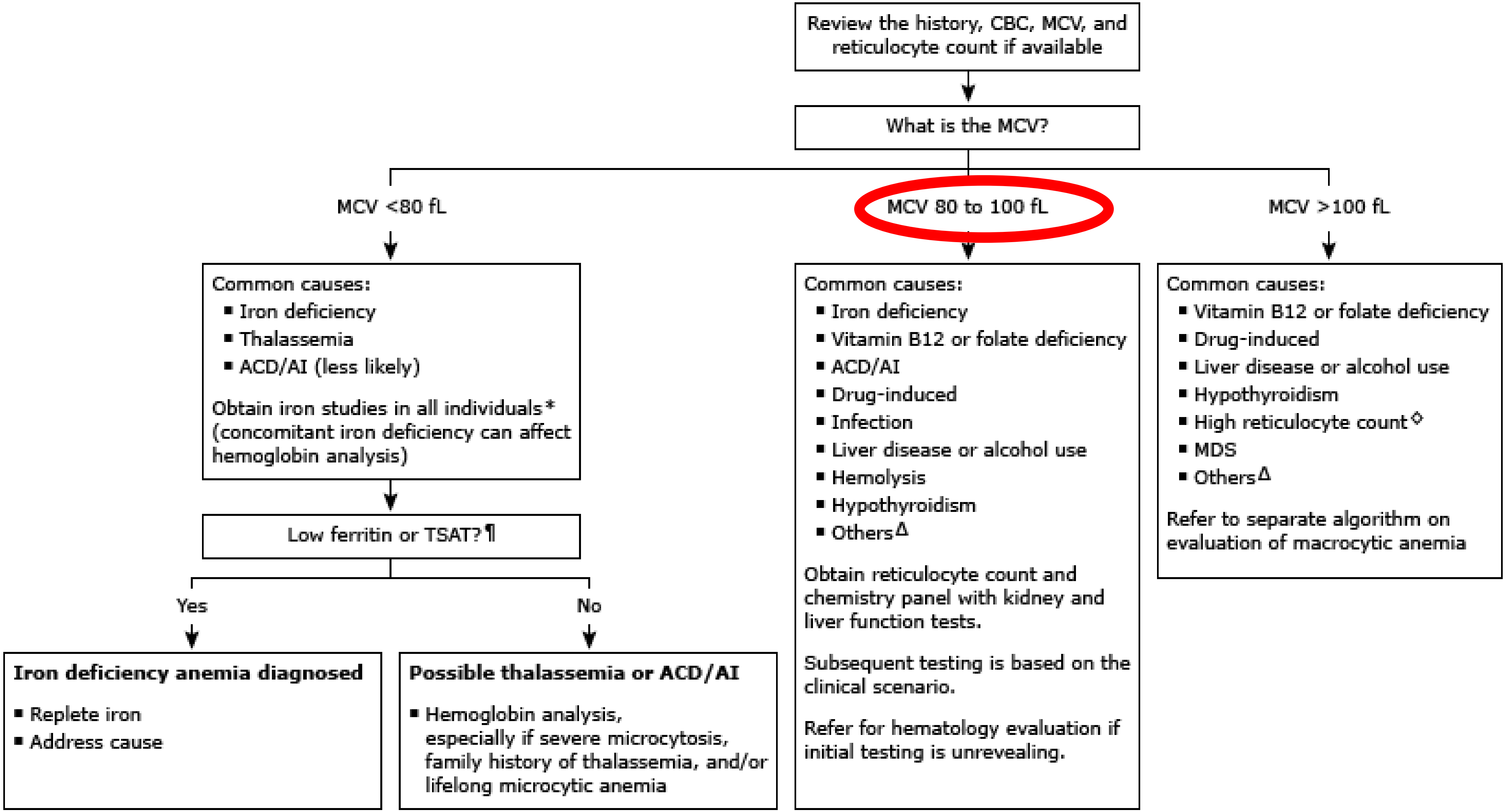


- Mean corpuscular
  the RBCs

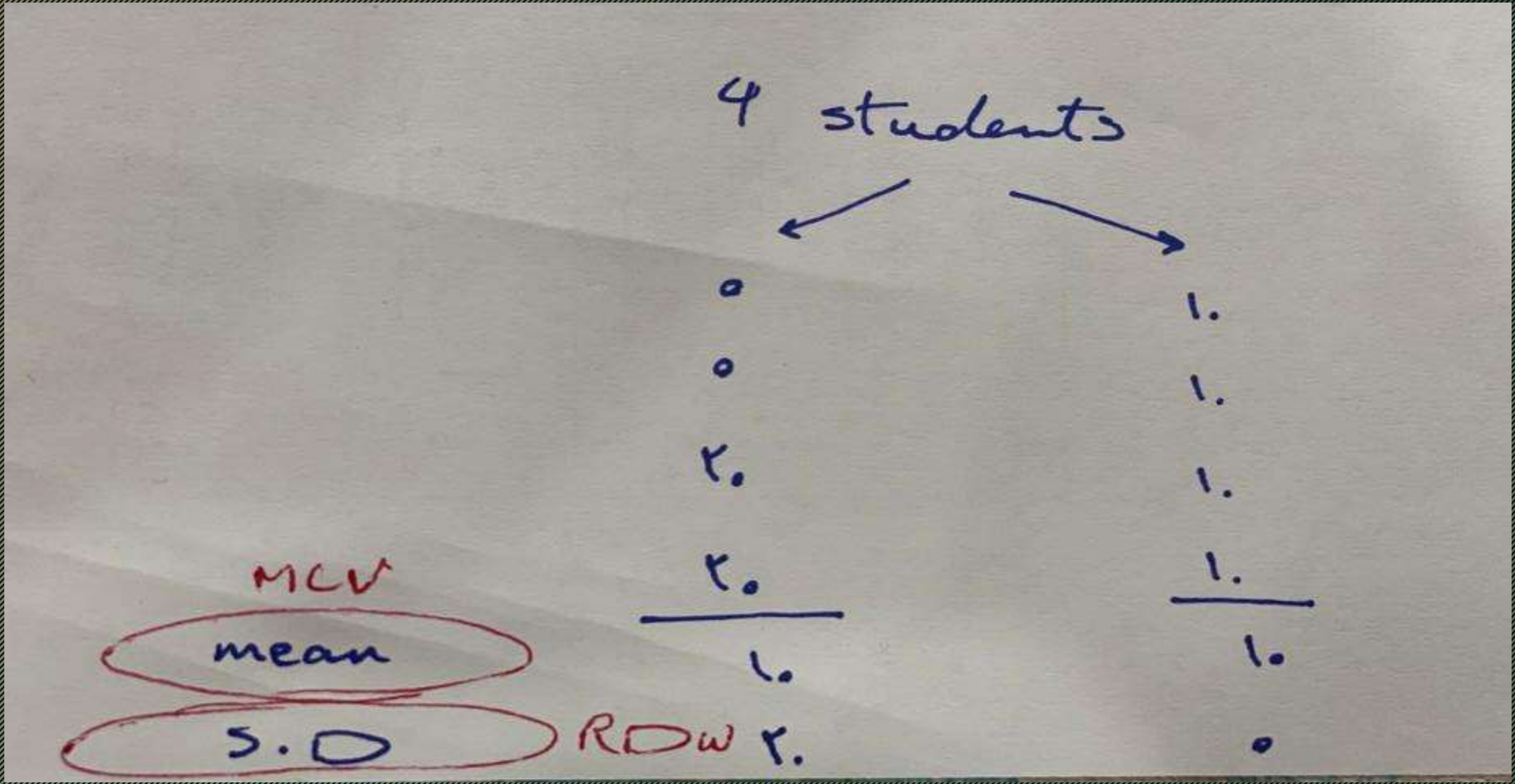
- MCH(30±3): Mean corpuscular hemoglobin (MCH) is the average hemoglobin content in a RBC

- MCHC (33±2%) Mean corpuscular hemoglobin concentration (MCHC) is the average hemoglobin concentration per RBC

Anemia evaluation in outpatients (nonpregnant adults)



RDW: 11.5-14.5



- the degree of anisocytosis on the peripheral blood smear
- A high RDW implies a large variation in RBC sizes (IDA)
- and a low RDW implies a more homogeneous population of RBCs (Thalasemia)
- high RDW can be seen in a number of anemias,
- including iron deficiency, vitamin B12 or folate deficiency, myelodysplastic syndrome (MDS), and hemoglobinopathies, as well as in patients with anemia who have received transfusions

Very low MCV

- Iron deficiency and thalassemia are the most likely causes of a very low MCV (<80 fL).

- Case:
- Hb:7 MCV: 65 MCH: 21
- RDW: 12% ?
- DRW: 28% ?

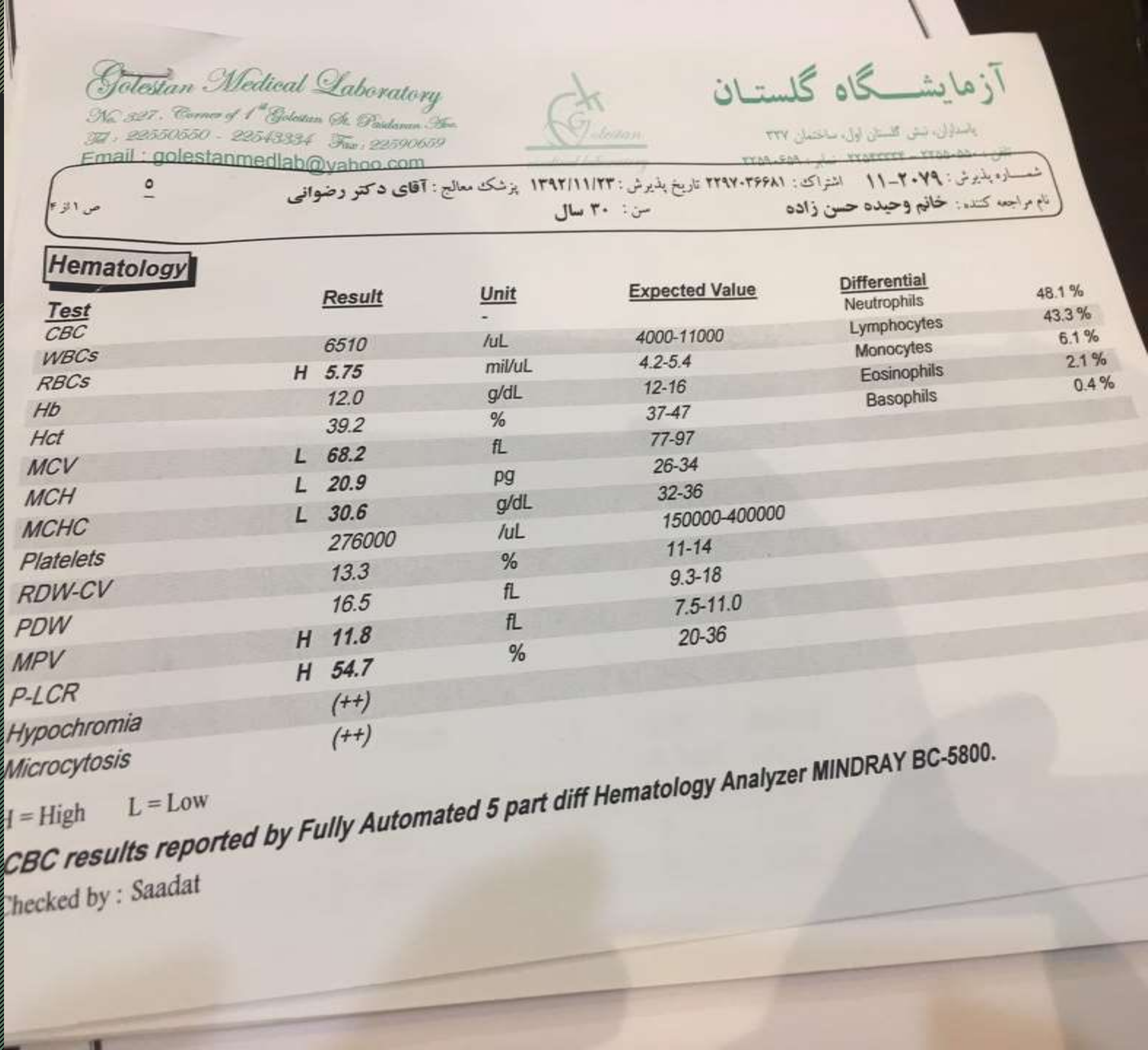
Case:
Female, Hb: 11.5, MCV: 75, MCH: 25

Diagnosis & treatment?

IDA or Thalasemia

- Mentzer index is useful in predicting the likelihood of thalassemia trait versus iron deficiency.
- If the ratio of MCV / RBC is less than 13, thalassemia is more likely than iron deficiency

IDA or Thalasemia?



Golestan Medical Laboratory
آزمایشـــگاه گلستـان

No. 327, Corner of 1st Golestan St. Pasdaran Ave.
Tel: 22550550 - 22543334 Fax: 22590659
Email: golestanmedlab@yahoo.com

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نام مراجعه کننده : خانم وحیده حسن زاده سن : ۳۰ سال

Hematology

Test		Result	Unit	Expected Value
CBC			-	
WBCs		6510	/uL	4000-11000
RBCs	H	5.75	mil/uL	4.2-5.4
Hb		12.0	g/dL	12-16
Hct		39.2	%	37-47
MCV	L	68.2	fL	77-97
MCH	L	20.9	pg	26-34
MCHC	L	30.6	g/dL	32-36
Platelets		276000	/uL	150000-400000
RDW-CV		13.3	%	11-14
PDW		16.5	fL	9.3-18
MPV	H	11.8	fL	7.5-11.0
P-LCR	H	54.7	%	20-36
Hypochromia		(++)		
Microcytosis		(++)		

Differential	
Neutrophils	48.1 %
Lymphocytes	43.3 %
Monocytes	6.1 %
Eosinophils	2.1 %
Basophils	0.4 %

H = High L = Low

CBC results reported by Fully Automated 5 part diff Hematology Analyzer MINDRAY BC-5800.

Checked by : Saadat

CAUSES AND RISK FACTORS FOR IRON DEFICIENCY

- blood loss
- dietary intake
- reduced absorption

- Overt bleeding is obvious and not difficult for the clinician to recognize, often by history alone:
- Traumatic hemorrhage
- Heavy menstrual bleeding
- Hematuria
- Hemoptysis
- Pregnancy and delivery

- Typical iron loss during pregnancy has been estimated at approximately 1000 mg for pregnancy, delivery, and nursing. Menstrual blood losses account for approximately 1 mg of iron loss per day

بیشترین میزان نیاز به آهن: شیرخواری

بارداری: ۳ماهه دوم و سوم بارداری

IDA in pregnancy

- should have prompt testing for iron deficiency because it is the most common cause of nonphysiologic anemia in pregnancy.
- Microcytosis may be present, but microcytosis is a late finding of iron deficiency and may also be caused by thalassemia.
- Thus, the absence of microcytosis does not eliminate the possibility of iron deficiency and the presence of microcytosis does not confirm it

- For most women, iron deficiency can be assessed with a
- ferritin level
- (TSAT) or other testing.

ferritin level <30 ng/mL (<30 mcg/L) or a TSAT <20 percent is sufficient for diagnosis of iron deficiency,

and a ferritin level ≥30 ng/mL is sufficient to exclude iron deficiency if there are no comorbidities

Prevention of iron deficiency

- supplemental oral iron to all pregnant women to compensate for the increased iron demands during pregnancy and delivery
- CDC: recommends that all pregnant women begin a 30 mg/day iron supplement at the first prenatal visit
- approximately to the amount of iron in most iron-containing prenatal vitamins

- women who are intolerant of the iron in prenatal vitamins,

it may be possible to take prenatal vitamins without iron and to supplement with oral iron supplements on an every-other-day basis (typical dose, 60 mg once every other day


femibion
Pregnancy + Lactation
2
femibion
Healthy Pregnancy
1

Oral iron products

Drug		Elemental iron content (mg iron per mg tablet or per mL liquid)*
Ferrous fumarate (Contains 33% elemental iron per mg of mineral salt)		
		29.5 mg/90 mg
	Ferrimin 150	150 mg elemental iror
	Ferretts, Ferrocite, Hemocyte	106 mg/324 or 325 m
Ferrous gluconate (Contains approximately 10 to 14% elemental iron per mg of mineral salt)	▪ Tablets	
	Fergon, Ferrotabs	27 mg/240 mg
	Various over-the-counter and store-brand products with "iron" in the name	28 mg/256 mg or 38 n 325 mg

Ferrous sulfate (Generally contains 20 to 30% elemental iron per mg of mineral salt but can vary by manufacturer)	▪ Liquids	Multiple concentrations exist; check packaging closely
		15 mg/1 mL ("drops," "solution")
		44 mg/5 mL ("elixir," "liquid")
		60 mg/5 mL ("syrup")
	▪ Tablets	
	Feosol original	65 mg/200 mg
	Ferro-Bob, FerrouSul	65 mg/325 mg
Polysaccharide-iron complex (PIC) (Also available as PIC plus folic acid and PIC plus folic acid and vitamin B12)	▪ Liquids	
	NovaFerrum	15 mg/1 mL ("drops")
	NovaFerrum 125	125 mg/5 mL ("liquid")
	▪ Capsules	
	EZFE 200, Ferrex 150, Ferric-X 150, iFerex 150, Myferon 150, NovaFerrum 50, Nu-Iron 150, PIC 200, Poly-Iron 150	The number in the name is the mg of elemental iron (eg, NovaFerrum 50 contains 50 mg elemental iron per capsule)

Prevention of iron deficiency

- Prenatal vitamins with iron are used to prevent iron deficiency that may occur due to the increased iron demands of pregnancy

Treatment of iron deficiency

- **First trimester** – In the first trimester, we use oral iron (typical dose, one tablet containing 60 mg of elemental iron every other day or on Monday, Wednesday, and Friday

- **Second and third trimesters** – For certain women, intravenous iron may be appropriate or preferred

cannot absorb oral iron

those who do not have the expected increase in hemoglobin level with oral ir

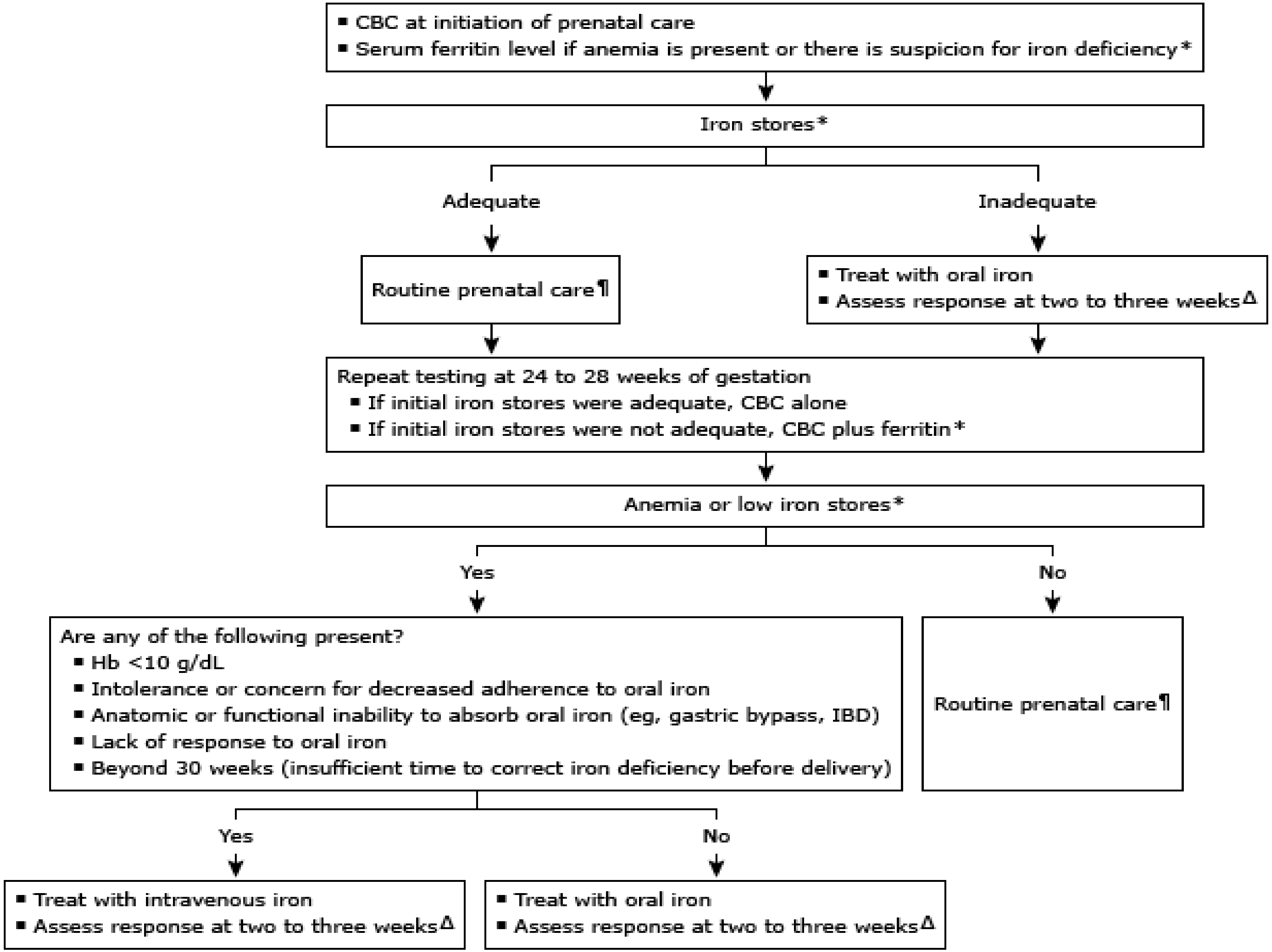
those with severe iron deficiency anemia (eg, hemoglobin level of 8 to 10 g/dL

those started on iron in the third trimester (after week 30, when there may be insufficient time to replete iron stores with oral iron


Venofer®
Iron sucrose
fer saccharose
Hierro sacarosa
100 mg
Ampoules
intravenous
iron therapy
Ampoules
thérapie martiale
intraveineuse
Ampollas
terapia intravenosa
de hierro
swissiron
5x5 ml
Venofer
Vifor


ferinject®
ferric carboxymaltose
ferinject® 50 mg iron/ml
solution for injection/infusion
5 vials (2 ml)
One 2 ml vial contains 100 mg iron
Before using check on absence of sediments and observe expiry date.
For administration by IV infusion the solution should be diluted in sterile 0.9% sodium chloride solution.
Use immediately after dilution.
ferinject

Algorithm for evaluating and treating iron deficiency in pregnancy



Diet

- blood loss
- dietary intake
- reduced absorption

- Dietary heme iron (iron from
better absorbed than non-he

Factors influencing the absorption and bioavailability of dietary iron

Absorption of heme iron	
Amount of heme iron, especially in meat	
Content of calcium in the meal (calcium impairs iron absorption)	
Absorption of nonheme iron	
Iron status	
Amount of potentially available nonheme iron	
Balance between positive and negative factors	
Positive factors	
Meat or fish (factors in meat other than heme iron enhance absorption of nonheme iron)	
Negative factors	
Phytate (in bran, oats, rye fiber)	
Polyphenols (in tea, some vegetables and cereals)	
Dietary calcium	
Soy protein	

Nutritional Considerations

a balanced vegetarian diet that includes legumes, fortified or whole grains, dried fruit, nuts, seeds, and green vegetables easily provides adequate iron

Dairy products and eggs are very poor sources of iron and decrease iron absorption

- Caseins from milk and calcium inhibit iron absorption
- Iron status measured as serum ferritin is inversely associated with greater consumption of dairy products in toddlers
- consume dairy products (milk, cheese and other foods made from milk) as a between meal snacK
- Eggs (especially yolks) also appear to inhibit iron absorption (phosvitin)

Nutritional Considerations

Fruits and vegetables aid the absorption of nonheme iron.

Fruits and vegetables contain vitamin C and organic acids (e.g., citric acid) increasing absorption of nonheme iron when consumed in the same meal

Vitamin C degrades with cooking, so consumption of uncooked (or lightly cooked) fruits and vegetables with high vitamin C content

Vitamin A and carotenoids also appear to enhance iron absorption by overcoming the inhibiting effect of polyphenols and phytates (found in whole grains) on iron absorption.

Adding vitamin A to an iron supplement regimen has also been shown to result in greater anemia reduction than iron alone produces

Nutritional Considerations

Tea, coffee, and cocoa should not be consumed with meals if poor iron status is suspected.

Polyphenols and tannins in these beverages inhibit the absorption of nonheme iron. Black tea appears to be the most potent in this regard

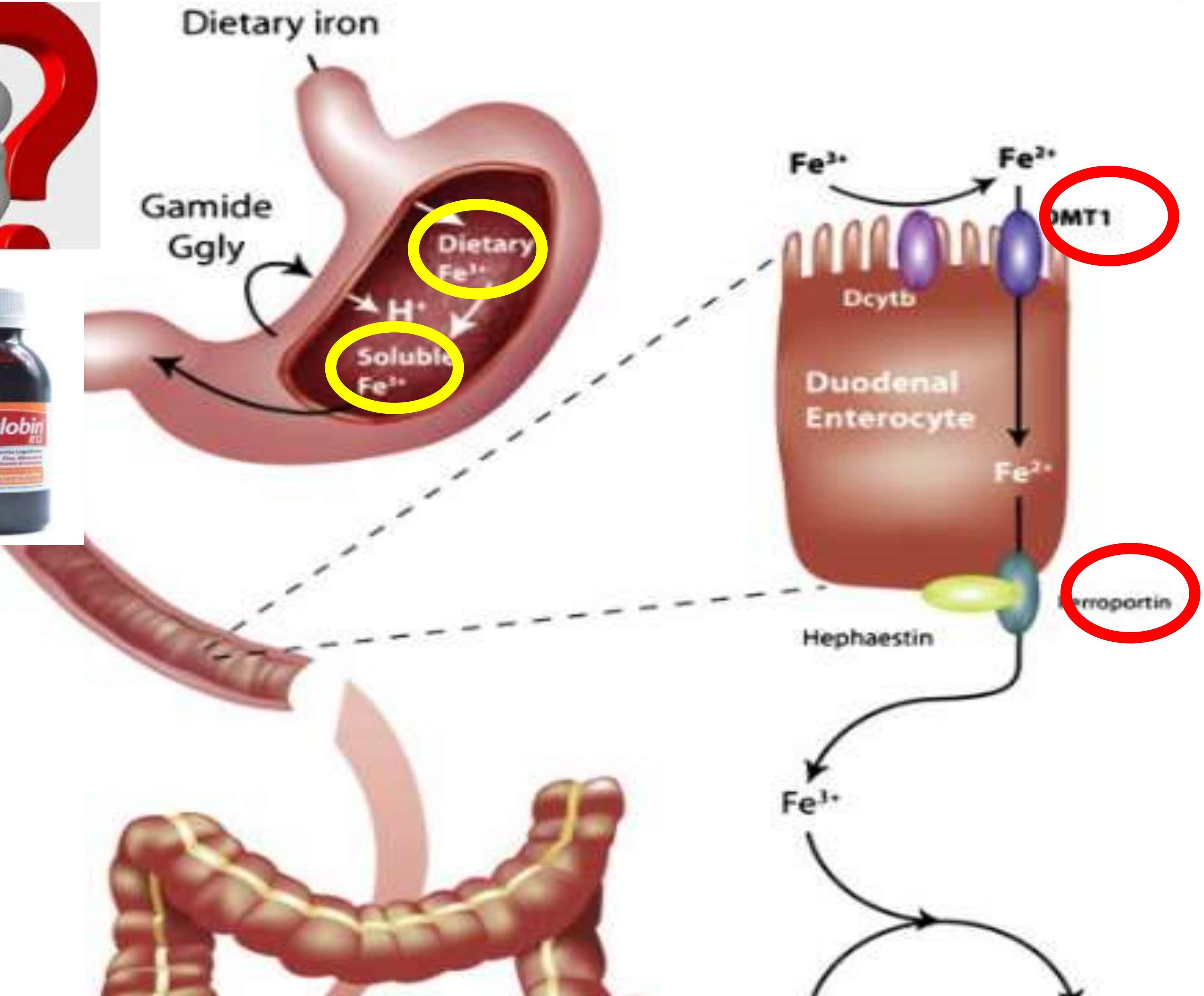
separate tea and coffee drinking from meal times; consumption 1–2 hours later will not inhibit iron absorption

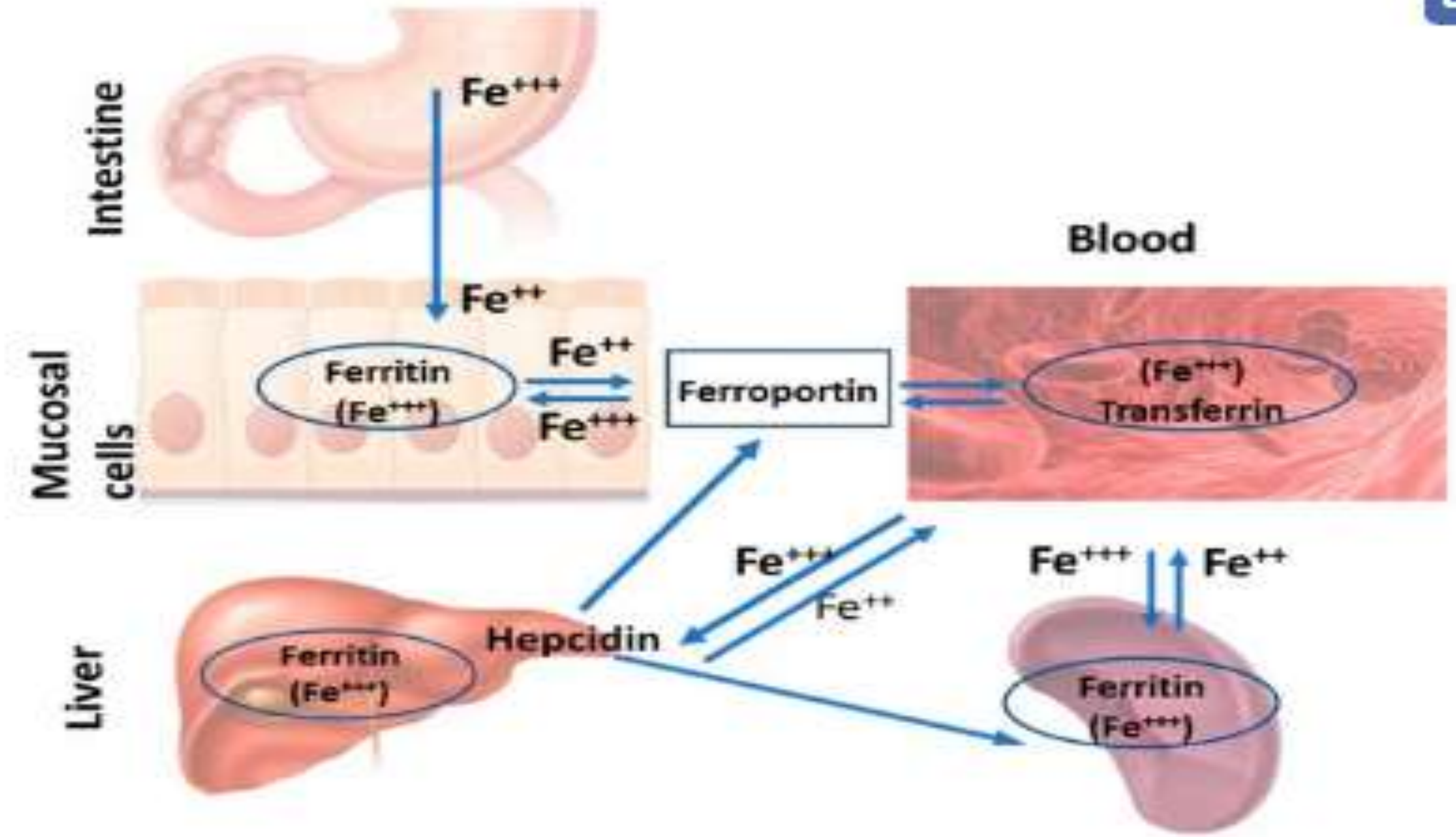
Celiac disease/atrophic gastritis/H. pylori

- Anemia in male or menopause female??

- blood loss
- dietary intake
- reduced absorption


Feroglobin


Dietary iron
Gamide
Ggly
Dietary
Fe³⁺
H⁺
Soluble
Fe³⁺
Fe³⁺
Fe²⁺
DMT1
Dcytb
Duodenal
Enterocyte
Fe²⁺
Ferroportin
Hephaestin
Fe³⁺


Intestine
Fe+++
Fe++
Mucosal cells
Ferritin (Fe+++)
Fe++
Fe+++
Ferroportin
Blood
(Fe+++) Transferrin
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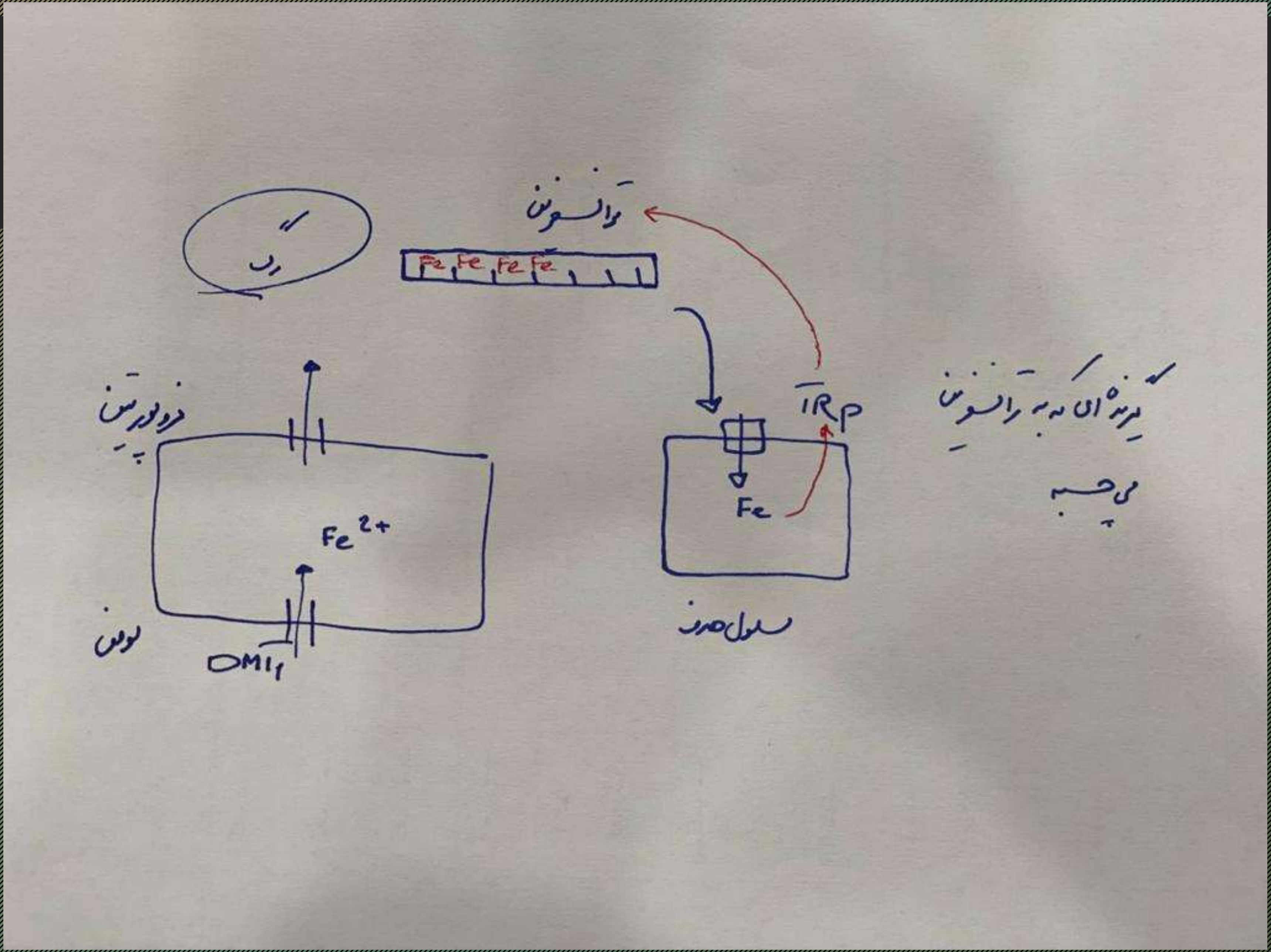
Fe+++
Fe++
Liver
Ferritin (Fe+++)
Hepcidin
Ferritin (Fe+++)


ترانسفرین
Fe Fe Fe Fe
فروپورتین
Fe^{2+}
لومن
DMT1
IRP
Fe
سلول هدف
گیرنده ای که به ترانسفرین
می چسبه

IDA

- SI (Serum iron)?
- Ferritin? Protoporphyrin?
- TIBC?
- TS? Hepcidin?
-
- Ferritin is acute phase protein
  - Ferritin>200
  - Ferritin< 15
  - 15< Ferritin<100

Case: ckd
Ferritin: 120?????

Iron stores
Erythron iron

	Normal	Negative iron balance	Iron-deficient erythropoiesis	Iron-deficiency anemia
Marrow iron stores	1-3+	0-1+	0	0
Serum ferritin (μg/L)	50-200	<20	<15	<15
TIBC (μg/dL)	300-360	>360	>380	>400
SI (μg/dL)	50-150	NL	<50	<30
Saturation (%)	30-50	NL	<20	<10
Marrow sideroblasts (%)	40-60	NL	<10	<10
RBC protoporphyrin (μg/dL)	30-50	NL	>100	>200
RBC morphology	NL	NL	NL	Microcytic/ hypochromic

ضعف و خستگی

Laboratory findings during the development of iron deficiency

	Normal	Iron deficiency without anemia	Iron deficiency with mild anemia	Severe iron deficiency with severe anemia
Hemoglobin	Normal range*	Normal range*	**9 to 12 g/dL (90 to 120 g/L)**	**6 to 7 g/dL (60 to 70 g/L)**
Red blood cell size and appearance	Normal	Normal	**Normal or slight hypochromia (slight decrease in MCHC)**	**Microcytosis (decrease in MCV) and hypochromia (decrease in MCHC)**
Serum ferritin	40 to 200 ng/mL (40 to 200 mcg/L; 89.9 to 449 picoM/L)	**<40 ng/mL¶ (<40 mcg/L; <89.9 picoM/L)**	**<20 ng/mL (<20 mcg/L; <45 picoM/L)**	**<10 ng/mL (<10 mcg/L; <22.5 picoM/L)**
Serum iron	60 to 150 mcg/dL (10.7 to 26.7 microM/L)	60 to 150 mcg/dL (10.7 to 26.7 microM/L)	**<60 mcg/dL (<10.7 microM/L)**	**<40 mcg/dL (<7.1 microM/L**
Total iron-binding capacity (TIBC; transferrin)	300 to 360 mcg/dL (53.7 to 64.4 microM/L)	300 to 390 mcg/dL (53.7 to 69.8 microM/L)	**350 to 400 mcg/dL (62.6 to 71.6 microM/L)**	**>410 mcg/dL (>73.4 microM/L)**
Transferrin saturation (serum iron/TIBC)	20 to 50%	20%	**<15%**	**<10%**
Reticulocyte hemoglobin[1]	30.6 to 35.4 pg	22.3 to 34.7 pg	14.8 to 34.0 pg	Data not available
Bone marrow iron stain	Adequate iron present	**Iron absent**	**Iron absent**	**Iron absent**
Erythrocyte zinc protoporphyrin, ng/mL RBC	30 to 70	30 to 70	**>100**	**100 to 200**

CLINICAL MANIFESTATIONS

- Typical symptoms include
- Fatigue
- Pica (pagophagia, ice craving)
- Restless legs syndrome
- Headache
- Exercise intolerance
- Exertional dyspnea
- Weakness

Findings on examination

- The physical examination in individuals with iron deficiency (with or without anemia) may be normal or it may reveal
following findings

- Pallor
- Dry or rough skin
- Atrophic glossitis with loss of tongue papillae, wh
accompanied by tongue pain or dry mouth

Atrophic glossitis

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UpToDate

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- Cheilosis (also called angular cheilitis
- Koilonychia (spoon nails)
- Alopecia (rare) in especially severe c

Whom to treat

- all patients with iron deficiency anemia and most patients with iron deficiency without anemia should be treated.

- The cause of iron deficiency also must be identified and addressed, especially in adults with new onset iron deficiency.

- A healthy diet provides sufficient iron for physiologic needs but cannot correct iron deficiency

Oral versus IV iron

- generally treat patients who have uncomplicated iron deficiency anemia with oral iron due to the ease of administration
- We often use IV iron when treating pregnant women and individuals with inflamematory bowel disease, gastric surgery, or chronic kidney disease

Adverse effects of oral iron

- Gastrointestinal side effects are extremely common with oral iron administration.
- Strategies to reduce these effects :

➢ Increasing the interval to every other day if not done already.

➢ Making dietary modifications (taking iron with food or milk), although this may reduce absorption

➢ Switching to a formulation with a lower amount of elemental iron

- Once a tolerated dose is found, the patient can sometimes increase the dose slowly as tolerated
- As noted above, for many populations, another option is switching to IV iron.
- Use of IV iron eliminates all of the gastrointestinal side effects of iron, which are due to direct effects of iron on the intestinal mucosa.

- If the patient switches to IV iron, oral iron should be discontinued

RESPONSE TO IRON SUPPLEMENTATION

- The patient will note an improved feeling of well-being within the first few days of treatment
- If restless legs syndrome accompanies documented iron deficiency, the overwhelming majority will experience complete or near complete relief within 72 hours of the infusion, often on the first night thereafteroll.
- The hemoglobin concentration will rise slowly, usually beginning after approximately one to two weeks of treatment, and will rise approximately 2 g/dL over the ensuing three weeks.

- The hemoglobin deficit should be halved by approximately one month, and the hemoglobin level should return to normal by six to

Table A. Suggested scheme for daily iron supplementation in infants and young children aged 6–23 months

TARGET GROUP	**Infants and young children (6–23 months of age)**
SUPPLEMENT COMPOSITION	10–12.5 mg elemental iron[a]
SUPPLEMENT FORM	Drops/syrups
FREQUENCY	Daily
DURATION	Three consecutive months in a year
SETTINGS	Where the prevalence of anaemia in infar ren is 40% or higher[b]

[a] 10–12.5 mg of elemental iron equals 50–62.5 mg of ferrous sulfate heptahydrat ous fumarate or 83.3–104.2 mg of ferrous gluconate.

[b] In the absence of prevalence data in this group, consider proxies for high risk of anaemia. For the most recent estimates, visit the WHO-hosted Vitamin and Mineral Nutrition Information System (VMNIS) *(7)*.

Table B. Suggested scheme for daily iron supplementation in children aged 24–59 months

TARGET GROUP	**Preschool-age children (24–59 months of age)**
SUPPLEMENT COMPOSITION	30 mg elemental iron[a]
SUPPLEMENT FORM	Drops/syrups/tablets
FREQUENCY	Daily
DURATION	Three consecutive months in a year
SETTINGS	Where the prevalence of anaemia in infants a or higher[b]

[a] 30 mg of elemental iron equals 150 mg of ferrous sulfate heptahydrate, 90 mg of ferrous fumarate or 250 mg of ferrous gluconate.

[b] In the absence of prevalence data in this group, consider proxies for high risk of anaemia. For the most recent estimates, visit the WHO-hosted Vitamin and Mineral Nutrition Information System (VMNIS) *(7)*.

Table C. Suggested scheme for daily iron supplementation in school-age children (5–12 years of age)

TARGET GROUP	**School-age children (5–12 years of age)**
SUPPLEMENT COMPOSITION	30–60 mg elemental iron[a]
SUPPLEMENT FORM	Tablets or capsules
FREQUENCY	Daily
DURATION	Three consecutive months in a year
SETTINGS	Where the prevalence of anaemia in infants and young children is 40% or higher[b]

[a] 30–60 mg of elemental iron equals 150–300 mg of ferrous sulfate heptahydrate, 90–180 mg of ferrous fumarate or 250–500 mg of ferrous gluconate.

[b] In the absence of prevalence data in this group, consider proxies for high risk of anaemia. For the most recent estimates, visit the WHO-hosted Vitamin and Mineral Nutrition Information System (VMNIS) *(7)*.

Age groups	Indications for supplementation	Dosage schedule	Duration
Low-birth-weight infants	Universal supplementation	Iron: 2 mg/kg body weight/day	From 2 months of age up to 23 months of age
Children from 6 to 23 months of age	Where the diet does not include foods fortified with iron or where anaemia prevalence is above 40%	Iron: 2 mg/kg body weight/day	From 6 months of age up to 23 months of age
Children from 24 to 59 months of age	Where anaemia prevalence is above 40 %	Iron: 2 mg/kg body weight/day up to 30 mg	3 months
School-aged children (above 60 months)	Where anaemia prevalence is above 40 %	Iron: 30 mg/day Folic acid: 250 µg/day	3 months
Women of childbearing age	Where anaemia prevalence is above 40 %	Iron: 60 mg/day Folic acid: 400 µg/day	3 months
Pregnant women	Universal supplementation	Iron: 60 mg/day Folic acid: 400 µg/day	As soon as possible after gestation starts - no later than the 3rd month - and continuing for the rest of pregnancy
Lactating women	Where anaemia prevalence is above 40 %	Iron: 60 mg/day Folic acid: 400 µg/day	3 months post-partum

Strategies for Increasing Dietary and Supplemental Iron

Strategy	Action
Increase iron through cooking.	Use cast Iron skillets for acidic food preparation, such as tomato sauce. Iron will leech out of the iron skillet into the food.
Increase iron through consumption with a source of vitamin C.	Drink orange juice with food sources of iron, such as spinach.
Increase iron through consumption of foods with higher iron bioavailability.	Lean meats contain highly absorbable iron.
Increase the use of high-iron foods in the diet.	Find acceptable ways to prepare spinach, use blackstrap molasses or include beans.
Increase iron intake through the use of iron-fortified foods.	Read ingredient labels for iron fortification of cereals and other products.
Increase iron absorption through proper supplementation.	Take an iron supplement at a different time than other mineral supplements or multivitamin-mineral preparations to avoid competitive absorption. Take supplements with a vitamin C source and preferably on an empty stomach. Continue vitamin administration and reduce negative side effects of constipation and cramping through alternative actions.


NATURAL WORLD
EASY IRON
28mg Iron Bis-Glycinate
30 CAPSULES


SiderAl
FORTE
PharmaNutra


BioSyent
FeraMAX 100
فِرامکس ۱۰۰
Polysaccharide-iron complex
ناموجود
30 Capsules
۳۰ کپسول

DIFFERENTIAL DIAGNOSIS

IDA or Thalassemia

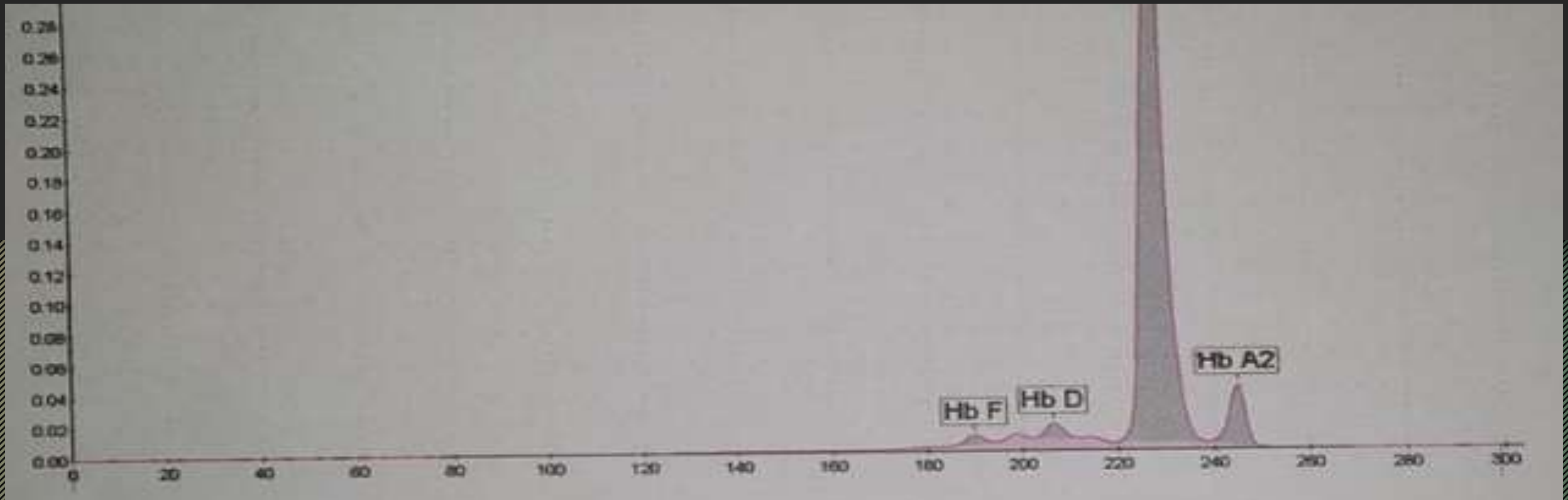
	IDA	Thalassemia
RBC	↓	NL
MCV	↓	↓
RDW	↑	NL OR
Ferritin	↓	NL OR ↑

MI

DF=MCV-RBC-(5 × Hb)-3.4

-: Thalassemia

+: IDA



Conc.: 12.5 g/dl

Name	%	Normal Values %
Hb F	1.0	
Hb D	1.4	
Hb E	91.0	
Hb A2	6.6	

- Thalassemia+ ID???

Hematology

Test		Result	Unit	Expected Value
CBC			-	
WBCs		6510	/uL	4000-11000
RBCs	H	5.75	mil/uL	4.2-5.4
Hb		12.0	g/dL	12-16
Hct		39.2	%	37-47
MCV	L	68.2	fL	77-97
MCH	L	20.9	pg	26-34
MCHC	L	30.6	g/dL	32-36
Platelets		276000	/uL	150000-400000
RDW-CV		13.3	%	11-14
PDW		16.5	fL	9.3-18
MPV	H	11.8	fL	7.5-11.0
P-LCR	H	54.7	%	20-36
Hypochromia		(++)		
Microcytosis		(++)		

Differential	
Neutrophils	48.1 %
Lymphocytes	43.3 %
Monocytes	6.1 %
Eosinophils	2.1 %
Basophils	0.4 %

H = High L = Low

CBC results reported by Fully Automated 5 part diff Hematology Analyzer MINDRAY BC-5800.

Checked by : Saadat

Blood Biochemistry

Test	Result	Unit	Method	Expected Value
Iron	99	ug/dL	Ferrozine	40-140
TIBC	271	ug/dL	Persipitant	Adult female: 250-425 First Trimester :235-410 Second Trimester: 302-519 Third Trimester: 380-597
Ferritin	66.7	ng/ml	ELISA	Premenopause : 8-150 Postmenopause : 25-230

Results reported by Hitachi 902 Roche Diagnostics GmbH.

Checked by : Khodaparast

Chromatography

Test		Result	Unit	Method	Expected Value
Hb.Electerophoresis		:	S.Quant	LPLC	
Hb.F		0.5	%	LPLC	Less than 2.0
Hb.A2	H	4.2	%	LPLC	1.5 - 3.5
Hb.A	L	95.3	%	LPLC	96 - 98.5

IDA Vs ACD

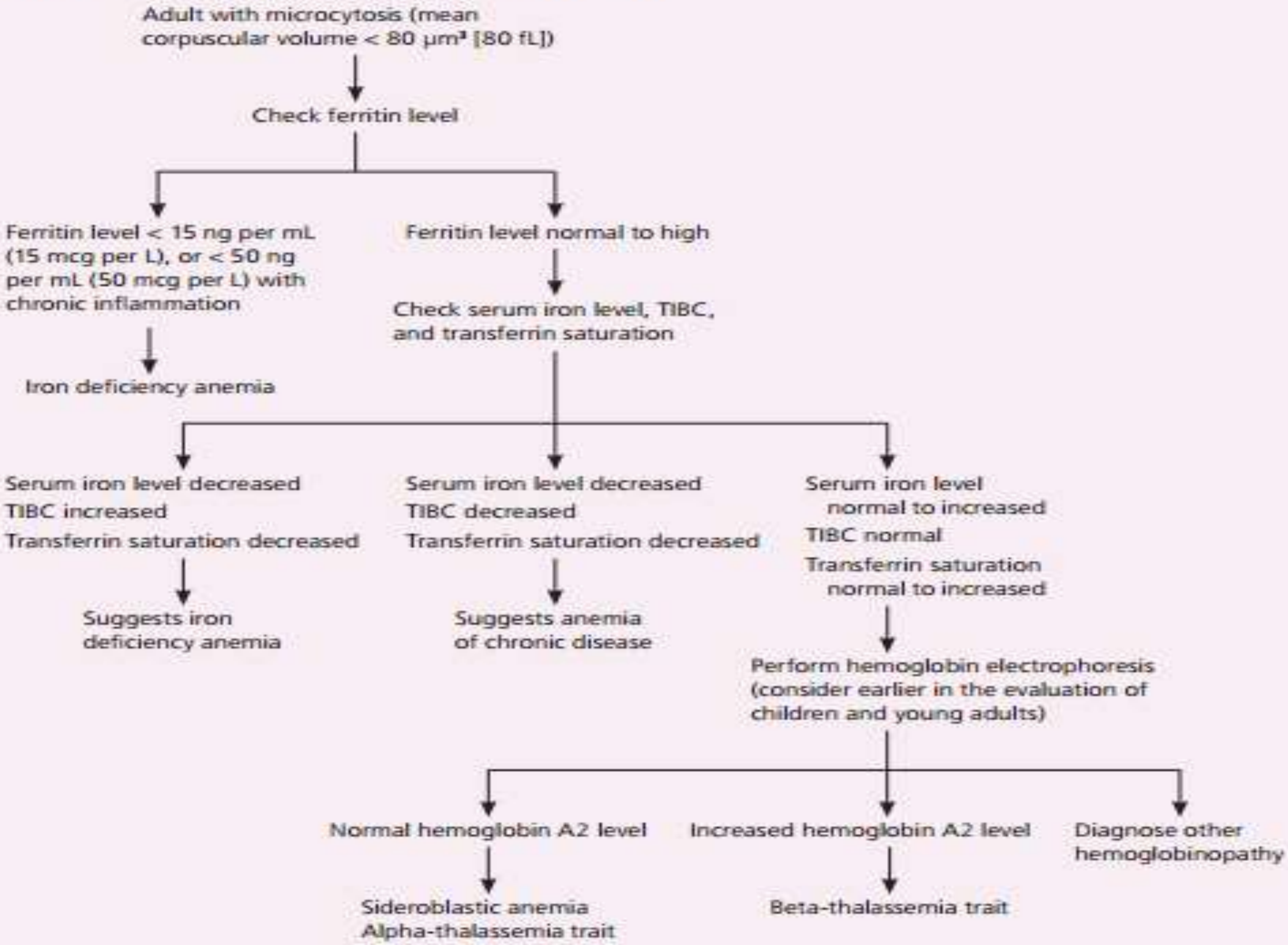
- patients with ACD/AI may have microcytic or normocytic anemia with a low serum iron and low transferrin (or TIBC)

- The best test: ferritin

Iron parameter	IDA	ACD
Serum iron	↓	↓
TIBC	↑	↓
Serum ferritin	↓	↑
Serum sTfR	↑	N

Female, 40years old, RA
Which one is correct?
Hb: 11.5
MCV: 85
Mcv: 77
Mcv: 105

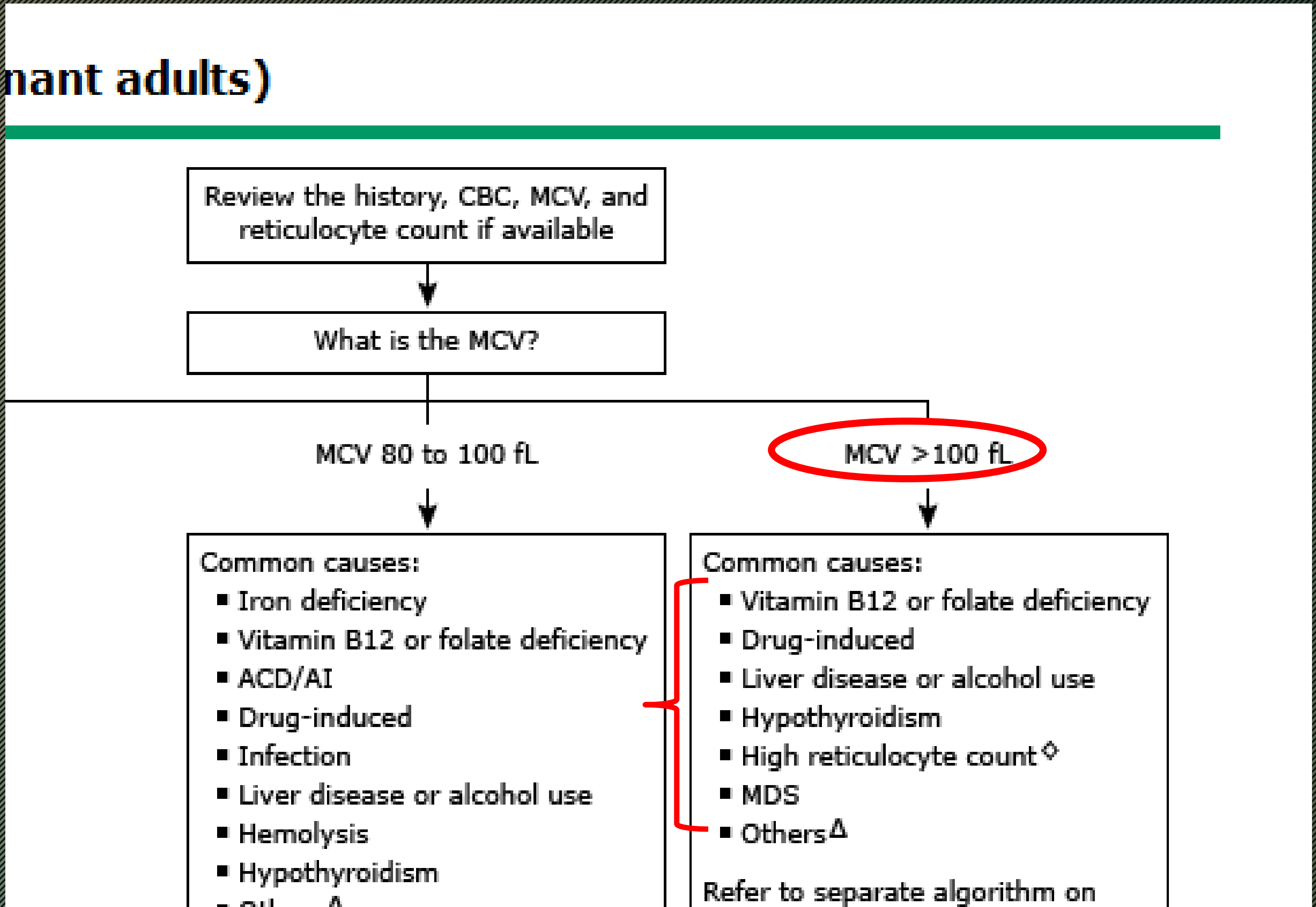
Diagnosing the Cause of Microcytosis



شاخص‌های آزمایشگاهی	آنمی فقر آهن	تالاسمی	آنمی سیدروبلاست	آنمی بیماری مزمن
لام محیطی	میکرو/ هیپو	میکرو/ هیپو با سلول هدف	متغیر	طبیعی گاهی میکرو /هایپو
SI	↓	N تا ↑	N تا ↑	↓
TIBC	↑	N	N	↓
T sat (اشباع) ترانسفرین	↓	N تا ↑	N تا ↑	↓
Ferritin	↓	N تا ↑	N تا ↑	↑
Hb الگوی	N	Abnormal*	N	N

* در بتا تالاسمی غیرطبیعی است ولی در آلفا تالاسمی ممکن است نرمال باشد.

Macrocytosis (high MCV)



Macrocytosis (high MCV)

- ↑ MCV & ↑ RDW ⟶ MEGALO
- ↑ MCV & NL RDW ⟶ MACRO

- Vitamin B12 and folate deficiencies are often considered together, although folate deficiency has become less common in individuals who are living in developed countries and consuming a normal diet

Table 19.8 Food Sources of Vitamin B_{12}

Food	Vitamin B_{12} (μg)
Beef liver—1 ounce	32
Clams—1 ounce	16
Oysters—1 ounce	14
Brewer's yeast—2 T	3.0
Lobster—3 ounces	3.0
Pot roast—3 ounces	3.0
Yogurt—1 cup	1

Source: Adapted from: the USDA Agricultural Handbook Series. Available at http://www.usda.gov

Table 19.9 Food Sources of Folate

Food	Folate (μg)
Asparagus—1 cup	263
Spinach (cooked)—1 cup	262
Cooked peas or lentils—½ cup	180
Romaine lettuce—1.5 cups	115
Tortilla—1 item	90

Source: Adapted from: the USDA Agricultural Handbook Series. Available at http://www.usda.gov

Vitamin B12 deficiency

Decreased intake (eg, reduced intake of animal products, strict vegan diet, breastfeeding by a vitamin B12-deficient mother).

Decreased absorption (eg, gastrectomy, bariatric surgery, Crohn disease, celiac disease, pancreatic insufficiency, bacterial overgrowth, gastric atrophy associated with aging).

Medications and drugs that interfere with absorption or stability (eg, metformin, histamine receptor antagonists, proton pump inhibitors, nitrous oxide)

Other autoimmune conditions, such as thyroid disease or vitiligo, in individuals with pernicious anemia.

Folate deficiency

- ✓Increased requirements due to pregnancy, hemolytic anemia.
- ✓Decreased intake, especially in individuals with excessive alcohol use and corresponding reductions in dietary intake of folate-rich foods such as fresh vegetables and fortified grains.
- ✓Residence in a place where routine folate supplementation of foods does not occur.
- ✓Decreased absorption in the setting of gastric bypass surgery.
- ✓Loss during hemodialysis (along with other water-soluble vitamins)
- ✓Medications and drugs that interfere with metabolism (eg, methotrexate, sulfasalazine)

Overview of evaluation

- In countries in which dietary deficiency is less of a concern, vitamin B12 and/or folate deficiency may be suspected in a patient with one or more of the following
- Unexplained anemia, macrocytosis (mean corpuscular volume [MCV] >100 fL), pancytopenia, or hypersegmented neutrophils
- Unexplained neurologic or psychiatric symptoms.
- Strict vegan diet or conditions that may interfere with absorption.
- Certain autoimmune disorders such as thyroiditis or vitiligo, or those taking chronic metformin therapy.
- Gastrointestinal symptoms such as sore tongue, anorexia, or diarrhea

- For an individual with suspected vitamin B12 or folate deficiency, the history should include questions about previously diagnosed associated conditions, particularly celiac disease or inflammatory bowel disease; bariatric, gastric, or intestinal surgery; reduced dietary intake (eg, vegan or vegetarian diet, lack of fresh vegetables); alcohol use (as an independent cause of macrocytic anemia and as a possible predictor of reduced dietary intake); and any symptoms, including subtle neurologic or psychiatric symptoms, such as those described above

- The MCV does not help distinguish vitamin B12 deficiency from folate deficiency.
- Further, if a patient has concomitant microcytosis due to iron deficiency or thalassemia, the macrocytosis may be masked on a CBC because the MCV reflects the average volume of all RBCs.
- However, in this instance (combined macrocytosis and microcytosis), the red cell distribution width (RDW) may be increased

Serum vitamin B12 and folate levels

- For individuals with typical findings on the CBC and a low reticulocyte count, the only initial testing needed is a serum vitamin B12 and folate level
- We often omit the folate level if the individual is consuming a normal diet containing folate-supplemented grains and has normal gastrointestinal anatomy and function, as folate deficiency in these individuals is rare
- We test both vitamin B12 and folate levels in individuals with gastrointestinal conditions, excess alcohol use, or dietary patterns known to cause both deficiencies

- Periodic monitoring of vitamin B12 levels may be appropriate in individuals with intestinal disorders that might affect absorption of vitamin B12, including celiac disease, inflammatory bowel disease, small intestinal bacterial overgrowth, ileal resection, radiation enteritis, and chronic metformin therapy

- Typical values for vitamin B12 are as follows:
  - Deficient: <200 pg/mL
  - Borderline: 200 to 300 pg/mL
  - Normal: >300 pg/mL
- Typical values for folate are as follows:
  - Deficient: <2 ng/mL
  - Borderline: 2 to 4 ng/mL
  - Normal: >4 ng/mL

Additional testing for selected individuals

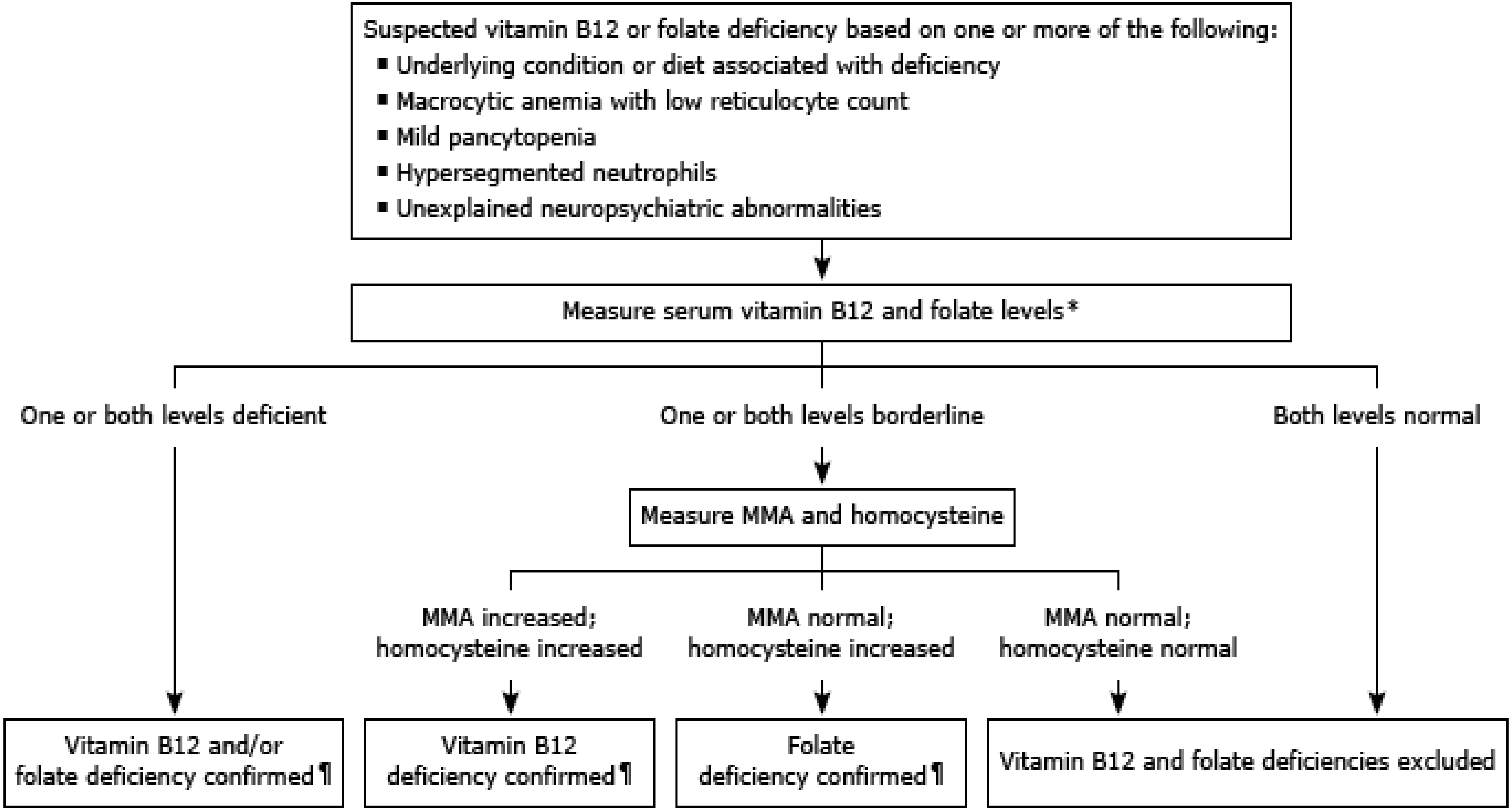
- **Metabolite testing (MMA and homocysteine)**
- The normal ranges for MMA and homocysteine are laboratory-dependent; laboratory-specific and assay-specific cutoffs should be used. Examples of typical normal ranges are: MMA 70 to 270 nmol/L; homocysteine 5 to 15 micromol/L. Interpretation is as follows:

MMA and homocysteine normal – No deficiency of vitamin B12 or folate

MMA and homocysteine elevated – Deficiency of vitamin B12 (does not eliminate the possibility of folate deficiency).

MMA normal, homocysteine elevated – No deficiency of vitamin B12. Consistent with deficiency of folate.

Diagnostic testing for suspected vitamin B12 or folate deficiency



Treatment of vitamin B12 deficiency

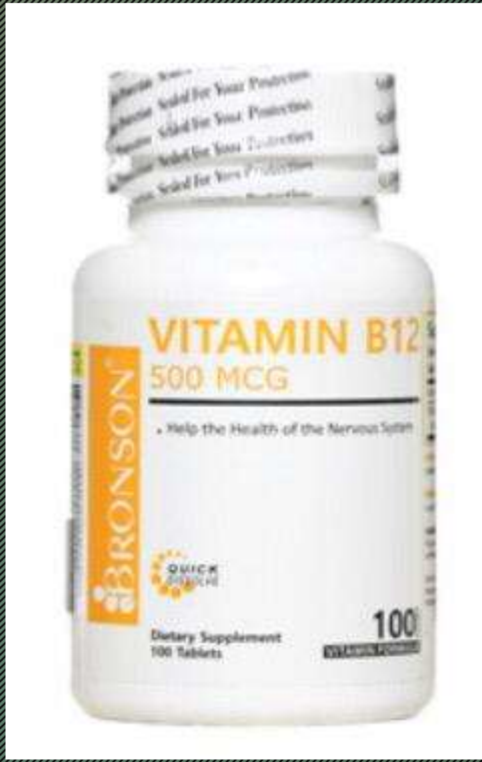
- **Parenteral** — The typical dose for children is 50 to 100 mcg parenterally once per week until the deficiency is corrected and then once per month (cyanocobalamin) or once every other month (hydroxocobalamin); oral doses in children are not well established.

- The typical dose for adults is 1000 mcg parenterally once per week until the deficiency is corrected and then once per month (cyanocobalamin) or once every other month (hydroxocobalamin).

- **Oral** – In adults with normal absorption, oral dosing is equally effective at a dose of 1000 mcg orally once per day.

- For individuals with impaired absorption of vitamin B12, therapy with very high oral doses of oral vitamin B12 (eg, 1000 to 2000 mcg daily) will be effective as long as the dose is high enough to provide absorption via a mechanism that does not require intrinsic factor or a functioning terminal ileum (ie, passive diffusion/mass action)


HealthAid
Vitamin B12
1000µg


BRONSON
VITAMIN B12
500 MCG
Dietary Supplement
100 Tablets
100


RAHA Healthtech
Dietary Supplement
Vitamin B12
2500 mcg
Orally Disintegrating Tablets (ODT)
60
ویتامین ب

Treatment of folate deficiency

- Folate deficiency is typically treated with oral folic acid (1 to 5mg daily)
- This dose is usually sufficient even if malabsorption is present, because it is considerably in excess of the 200 mcg (0.2 mg) recommended dietary allowance mg daily)

- For those with a reversible cause of deficiency, therapy is generally given for one to four months or until there is laboratory evidence of hematologic recovery


مکمل رژیمی-غذایی
۱۰۰ قرص
فولیک اسید ۱
هر قرص حاوی :
۱ میلی گرم فولیک اسید
SDA


۳۰ قرص
توصیه شده جهت دوران پیش از بارداری،
حین بارداری و شیردهی
مکمل تغذیه‌ای
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Apovital
Folsäure 800
Mit 800 µg Folsäure
Für Frauen im gebärfähigen Alter
und Schwangere
Folatspiegel bei
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- Intravenous folic acid may be appropriate in certain settings, such as individuals who are unable to take an oral medication (eg, due to vomiting or those who have severe or symptomatic anemia due to folate deficiency and hence have a more urgent need for rapid correction

It is important to be aware that administration of folic acid can partially reverse some of the hematologic abnormalities associated with vitamin B12 deficiency; however, the neurologic manifestations of vitamin B12 deficiency are not treated by folic acid.

Thus, administration of folic acid to an individual with vitamin B12 deficiency can potentially mask untreated vitamin B12 deficiency or even worsen the neurologic complications

- Laboratory markers improve in the following time scales

➢ Hemolysis markers – Day 1 to 2

➢ Reticulocytosis – Day 3 to 4

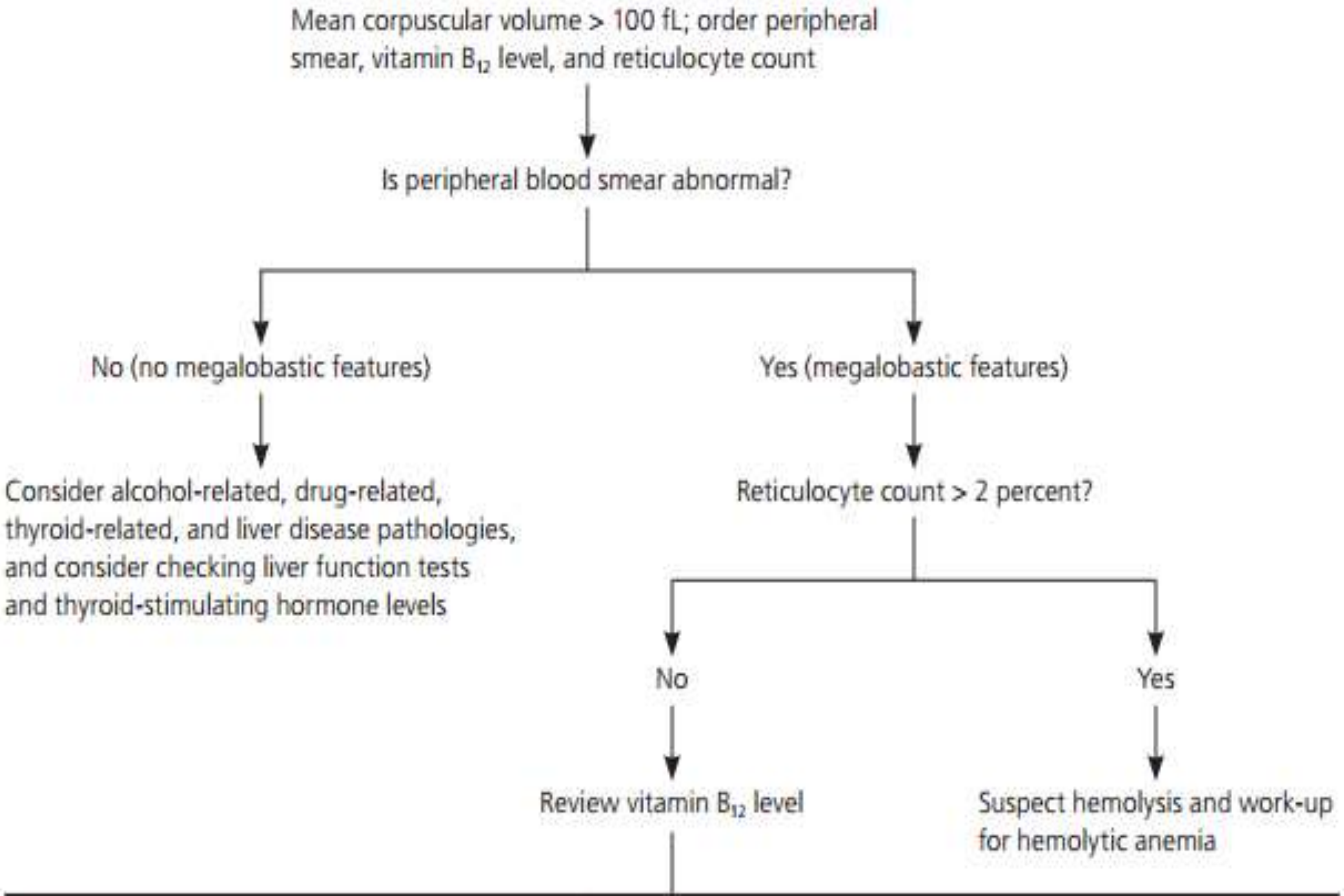
➢ Anemia – Week 1 to 2 (initial improvement) and week 4 to 8 (normalization)

➢ Hypersegmented neutrophils – Day 10 to 14

➢ Leukopenia and/or thrombocytopenia – Week 2 to 4

- Folic acid, folinic acid, and 5-MTHF are all effective in treating folate deficiency
- Folinic acid is typically used to prevent toxicities of methotrexate and to potentiate cytotoxicity of fluorouracil (FU) in chemotherapy regimens for colon cancer.

Macrocytosis
Evaluation of Macrocytic Anemia



- An MCV value >115 fL is more specific to vitamin B12 or folate deficiency than other conditions in the differential diagnosis such as hypothyroidism or myelodysplastic syndrome.

Normocytic (normal MCV)

- A normal MCV (80 to 100 fL) is the most common finding in anemic men and postmenopausal women.
- Normocytic anemias can be more challenging to evaluate than anemias with an MCV that is obviously low or high. Causes are more numerous and may be multifactorial, an underlying condition may not be apparent, and other findings may be nonspecific

- Often normocytic anemia is associated with a slightly elevated RDW, and the reticulocyte count is not substantially increased (and may be decreased).
- An increased RDW may indicate a population of microcytic or macrocytic RBCs that is too small to shift the MCV out of the normal range, or combined microcytic and macrocytic processes, such as iron deficiency plus vitamin B12 or folate deficiency

Causes

- **Nutrient deficiency**
- **Multiple causes:** deficiency of vitamin B12 and iron in an individual with celiac disease or autoimmune gastritis
- **ACD/AI**
- **CKD**
- **HF**
- **Early blood loss:** Blood loss that has not yet caused iron deficiency

Case1

- Male, RBC: 5.8
- WBC: 11.5
- PLT: 500
- HB: 18
- HCT: 55%
- Diagnosis & treatment?

case2

- Female,
- Hb: 17
- Hct: 47%
- MCV: 85
- MCH: 28
- Wbc: 7.1
- Plt: 150

Case3

- Male
- RBC: 5.7
- Hb: 12
- Mcv: 68.2
- MCH: 20.9

Case4

- Male with neurophathy
- DH: omeprazole
- Hb: 14
- MCV: 110

Case5

- Female
- HB: 13
- HCT: 40%
- Ferritin: 14
- TIBC: 390

Low MCV
(<80 fL)

Distinguish between iron deficiency and thalassemia

Obtain:

- Iron
- TIBC
- Ferritin

Determine source of bleeding if unexplained iron deficiency present[§]

Correct iron deficiency prior to assessing for suspected thalassemia

Normal MCV
(80 to 100 fL)

Assess for anemia of chronic disease and for blood loss

Obtain:

- Iron, TIBC, ferritin
- Liver biochemical tests
- BUN, creatinine
- C-reactive protein, ESR

Determine source of bleeding if unexplained iron deficiency present[§]

Normal/high reticulocyte count, assess for hemolysis

Obtain:

- Total and indirect bilirubin
- LDH
- Haptoglobin
- Direct antiglobulin (Coombs) test

Request hematologic consultation to evaluate anemia associated with low to absent reticulocyte count or new-onset hemolysis

High MCV
(>100 fL)

Assess for alcohol, hemolysis, and nutrient deficiency

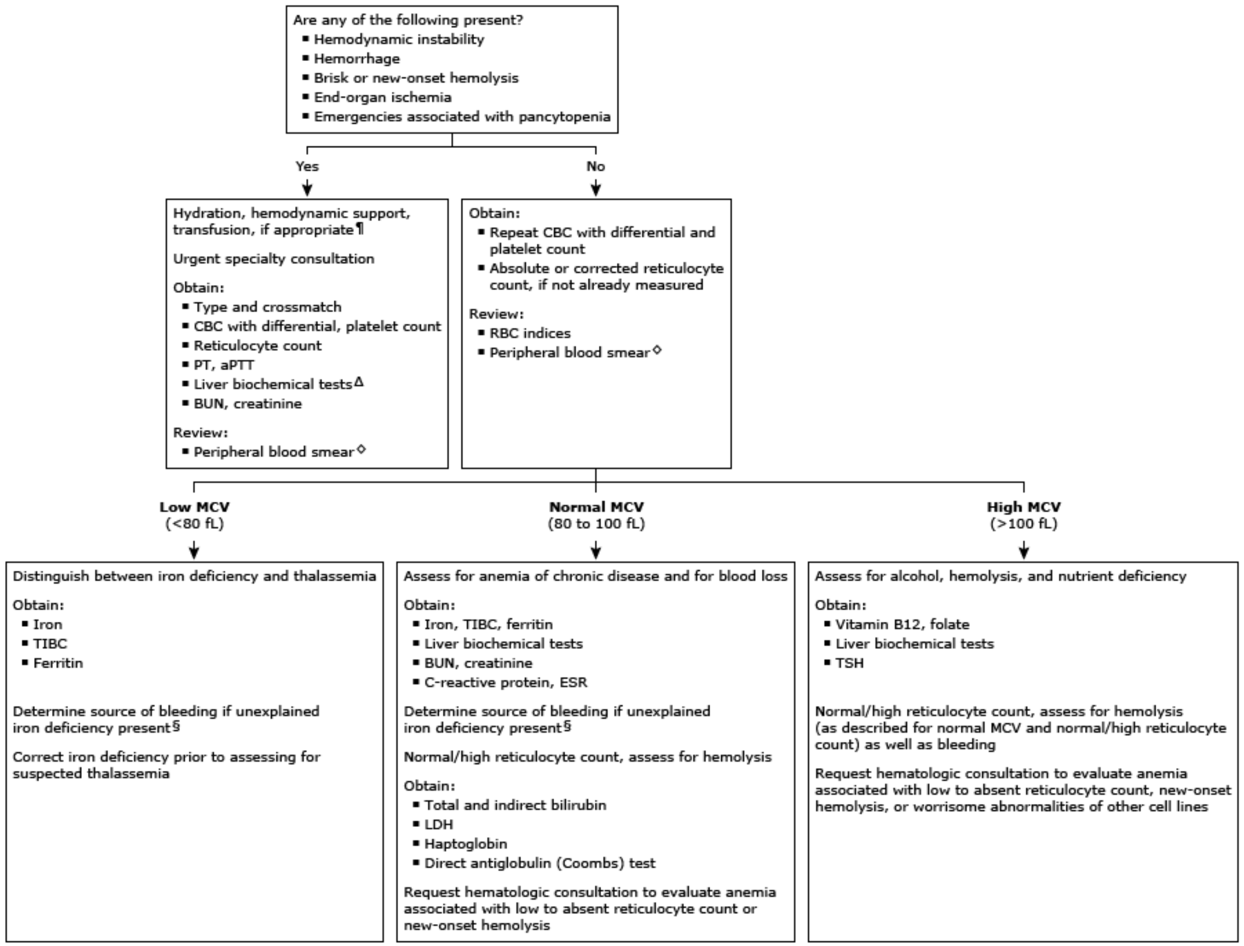
Obtain:

- Vitamin B12, folate
- Liver biochemical tests
- TSH

Normal/high reticulocyte count, assess for hemolysis (as described for normal MCV and normal/high reticulocyte count) as well as bleeding

Request hematologic consultation to evaluate anemia associated with low to absent reticulocyte count, new-onset hemolysis, or worrisome abnormalities of other cell lines

Initial evaluation of low hemoglobin, hematocrit in adults*



This algorithm is intended for use with additional UpToDate content on anemia.

CBC: complete blood count; PT: prothrombin time; aPTT: activated partial thromboplastin time; BUN: blood urea nitrogen; RBC: red blood cell; MCV: mean corpuscular volume; TIBC: total iron binding capacity; ESR: erythrocyte sedimentation rate; LDH: lactate dehydrogenase; TSH: thyroid-stimulating hormone.

* Reference values for RBC parameters depend on age, sex, and other factors. Interpretation of a specific abnormal test result should be based upon the reference range reported by the laboratory.

¶ Life-saving interventions should not be delayed while awaiting the results of diagnostic testing.

Δ Liver biochemical tests include total and indirect bilirubin, alanine aminotransferase, and aspartate aminotransferase.

◊ Review of the peripheral blood smear by an experienced individual may identify abnormalities not detected by automated machines but is not required in all patients.

§ Common sources are menstrual and occult gastrointestinal bleeding.

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THE END