Iron metabolism and anemia

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Anemia

- Decreased O2 carrying capacity of blood

Oxygen content will decrease due to Hb concentration

SaO2 bound saturation normal

PaO2 free partial pressure normal

- Decreased total RBCs mass
- Decreased Hgb, RBCs or Hct indicators

RBCS nuclear scan to measure mass literally

Signs (doc discover during exam) and symptoms (patient complain)

Tired and pale

Dizziness

Dyspnea

Flow murmur low viscosity and flow fast

Causes of Anemia

- Production defect

Bone marrow or kidney damage (EPO) hypothyroidism (hypometabolic) low retic

- Maturation defects

  cytoplasmic : Hgb, globin

  nuclear: B12 and folate deficiency

- Survival defects

Intrinsic defect

- Membrane Spherocytosis

Enzyme G6PD deficiency

Glycolysis :phosphoenol pyruvate to pyruvate 2ATP 2,3BPG increase right shift pyruvate kinase

redox metabolism: glucose 6 p 6 phosphogluconate G6PD NADPH reduced glutathione reduced H2O2

Fenton reaction: FE +2 oxidized converting fe+3 is reduced into Fe +2

hydrogen peroxide hydroxyl radical

- Hgb sickle disease

Extrinsic attack RBCs

- Sequestration (hypersplenism) portal hypertension
- Blood loss acute loss peptic ulcer disease , hemorrhagic shock
- The most common cause of anemia in US is iron deficiency anemia

Causes and diagnosis Iron deficiency anemia

Stomach HCL and VC Fe+3 to Fe +2 (heme iron) duodenum

1. Duodenum enterocytes

stool mucosal ferritin

2. Ferroportin fe+2 to Fe+3 Transferrin in blood erythroid precursor BM
or

3. Liver hepcidin regulator Not absorption or macrophage

Blood loss :

- GIT: peptic ulcer, NSAID, Inflammatory bowel disease ; malignancy would result in Iron deficiency anemia
- mensuration in women

Anemia of chronic inflammation

- Cytokines

  Bone Marrow: insensitive to erthropotein and Suppression

  Erythrocyte: Autolysis and Apoptosis

  Spleen and liver : Storage of iron into ferritin

  .All of these are strategies to prevent bacteria from growth

Iron studies

Ferritin in bone marrow 1Mg 8mg of iron
Low in iron deficiency anemia

Serum iron
Low in iron deficiency anemia
low in chronic deficiency anemia
High in hemochromatosis and sideroblastic anemia

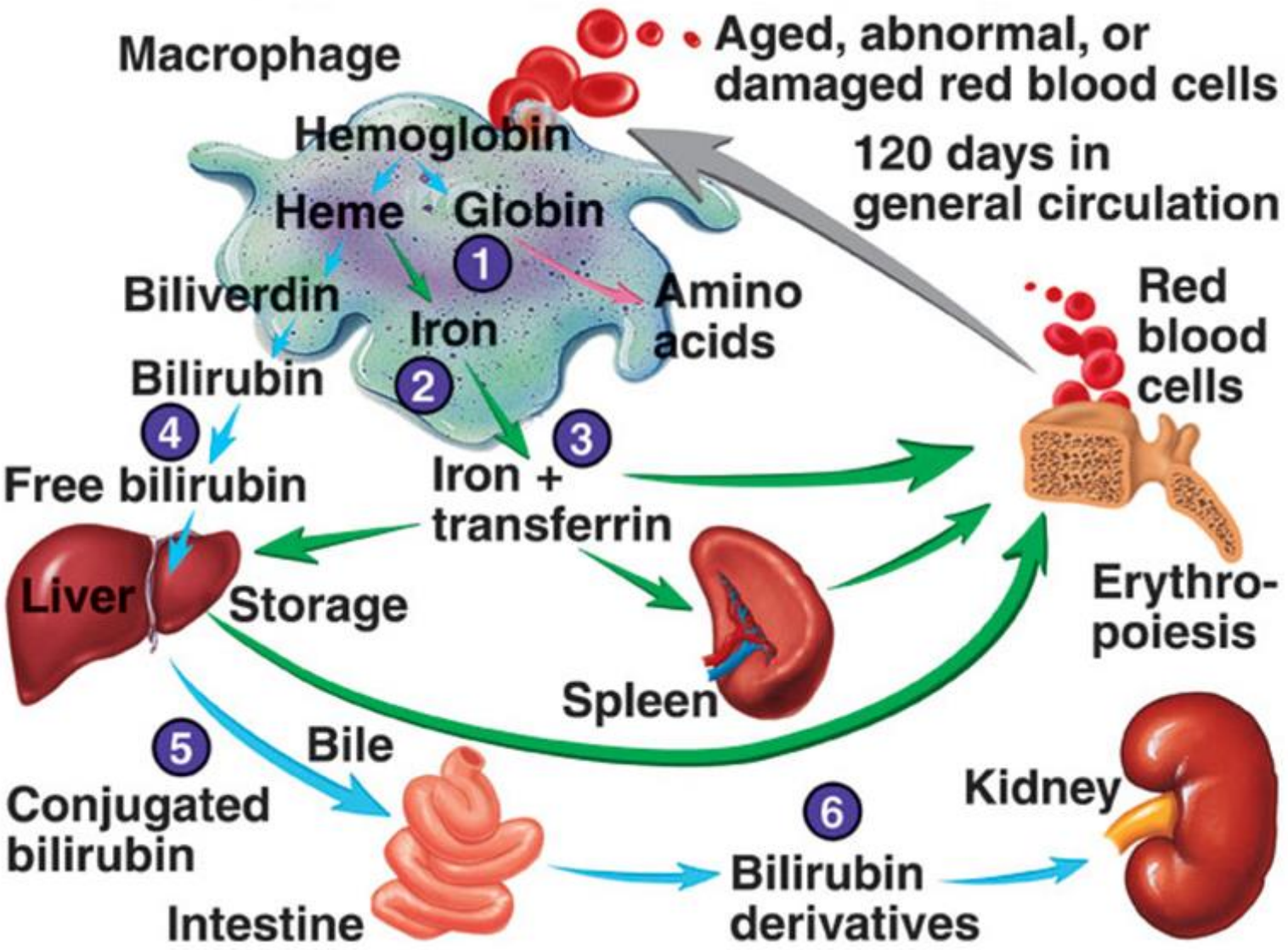
Serum total iron binding capacity (TIBC)
transferrin liver and
Fe+3 (ferric) bone marrow and duodenum
High in serum iron deficiency
Low in chronic inflammation

Iron saturation percentage (transferrin saturation)
Iron/TIBC X100= 33%
Decrease in iron deficiency anemia and increase in iron overload

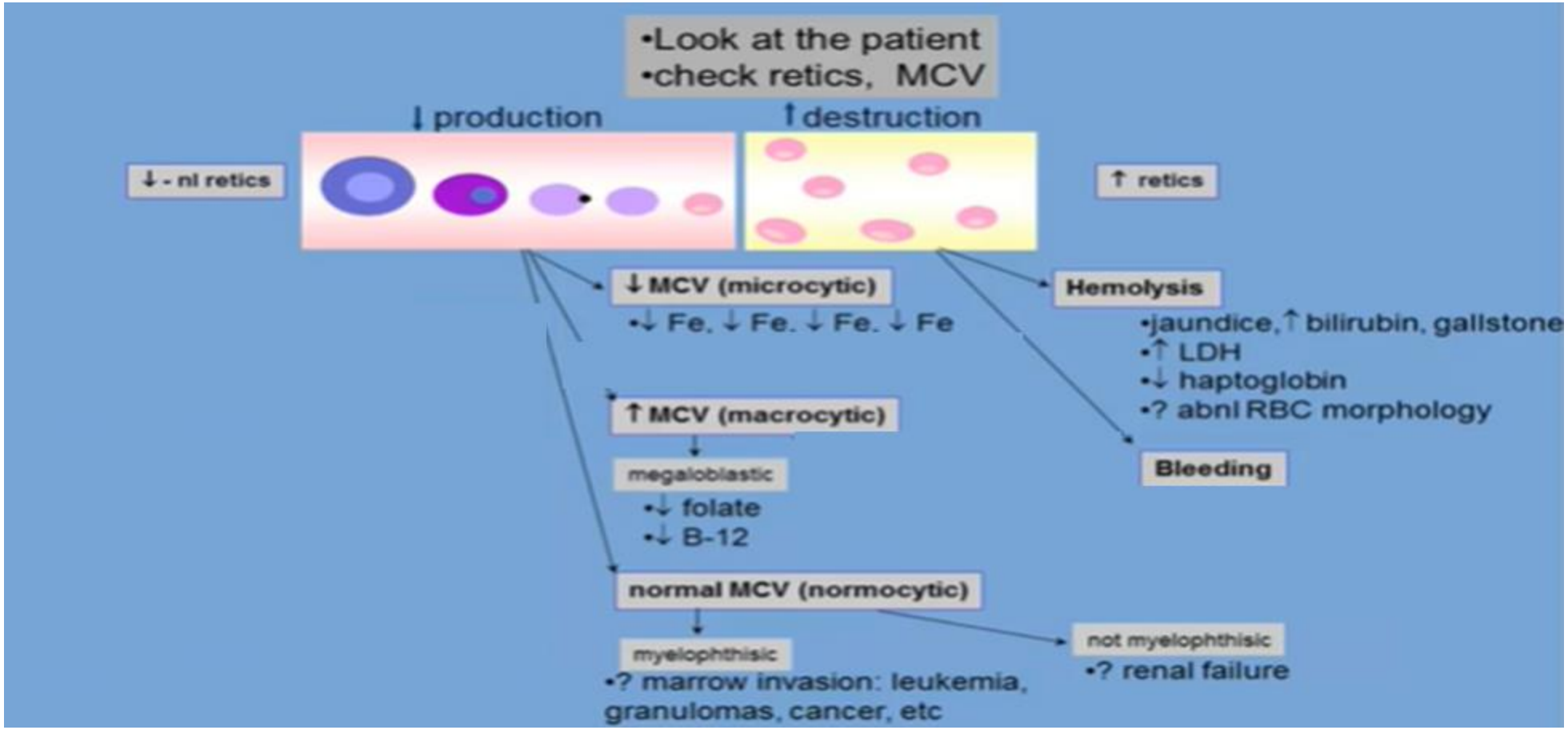
Soluble transferrin receptors (STFR) concentration
Increase in iron deficiency anemia
Normal in chronic inflammatory disease

Features of Hemolysis

	***Extra*vascular**	***BOTH***	***Intra*vascular**
acute		• Reticulocytosis • Hyperbilirubinemia (indirect) • ↑ LDH • ↓ haptoglobin	• Free hemoglobin in plasma • Hemoglobinuria • Hemosiderinuria
chronic		•BM erythroid hyperplasia • ↑ folate requirement • gall stones (bilirubin)	• Fe deficiency


Macrophage
Aged, abnormal, or damaged red blood cells
Hemoglobin
120 days in general circulation
Heme
Globin
1
Biliverdin
Iron
Amino acids
Red blood cells
Bilirubin
2
4
3
Free bilirubin
Iron + transferrin
Liver
Storage
Erythro-poiesis
Spleen
5
Bile
Conjugated bilirubin
6
Kidney
Intestine
Bilirubin derivatives

How to approach Differential diagnosis of anemia



65 yr old woman with fatigue, wt loss, and night sweats.

Test ordered	Result	Units	Ref range
Hemoglobin	6.8L	g/dL	13-18
Hematocrit	22L	%	37-55
Reticulocytes	0.3L	%	0.4-1.5
MCV	93	fL	78-93
Bilirubin, total	1.2	mg/dL	0.2-1.2
Bilirubin, dir.	0.1	mg/dL	0.1-0.3
LDH	230	U/L	100-230
Haptoglobin	200	mg/dL	30-200

5 Year old boy noted by his new pediatrician to be mildly icteric. Mom says: "he's got his father's coloring."

Test ordered	Result	Units	Ref range
Hemoglobin	11.5L	g/dL	13-18
Hematocrit	35L	%	37-55
Reticulocytes	5H	%	0.4-1.5
MCV	89	fL	78-93
Bilirubin, total	1.6H	mg/dL	0.2-1.2
Bilirubin, dir.	0.3	mg/dL	0.1-0.3
LDH	380H	U/L	100-230
Haptoglobin	10L	mg/dL	30-200