

Lec 2

→ always followed by hypoxia

Anemia = ↓ O₂ carrying capacity of blood

2° to ↓ in red cell mass

→ lead to Tissue hypoxia

Measure by Hematocrit g/dl
[Hb] %

triggers production of Erythropoietin → Activates erythropoiesis in BM

compensatory erythroid hyperplasia in Bone Marrow

Acute Anemia

production ↑ by (5X) or more
in healthy people

Severe cases

- will cause:
out of the bone marrow
Extramedullary hematopoiesis
in 2° hematopoietic organs
(spleen, liver & lymph nodes)

Exceptions

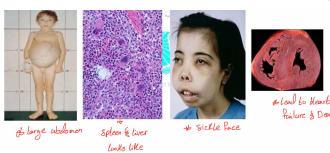
Anemia of renal failure

as the kidney is the organ
responsible for EPO production

Anemia of chronic
inflammation

with cytokines interfere
with iron metabolism &
↓ the ability of erythropoietin
to stimulate RBC's
production.

High erythropoietin levels on the long run causes
condition called extramedullary hematopoiesis
(production of RBCs out of bone marrow (like
spleen, liver, or even lymph nodes and causes
hyper trophy in those organs))



→ RBC indices

- Can be directly measured, or automated
- Slight variation is present between labs, geographic areas

Can be affected by

Sex	Age	race	Mobility status
[Hb] for	Neonates have	African Americans	
H > F	Higher Hb levels	have lower Hb	↓ physical activity
↓ Due to Androgens	↓ lower level during Menstruation	Age or $\frac{1}{[Hb]}$ levels compared	[Hb]
		to others	Activity or [Hb]

* Reticulocyte: immature RBC

↳ Can be used to distinguish between:

larger than mature	Hemolytic Anemia	Regenerative Anemia
RBC & slightly Blue	↑ destruction of RBCs	Bone Marrow fails to produce an adequate # of RBCs
Reticulocyte	High Reticulocyte count	Low reticulocyte count

clinical Features of Anemia

general

- Dizziness due to hypotension
- Fatigue due to hypoxia
- Pallor obvious when examining the conjunctiva, nail beds, sclera of the eye.
- Headache

- Adaptive changes: (with prolonged hypoxia)
 - Tachycardia
 - Tachypnoea → ↑ rate ↓ time
 - Increased heart cell 2,3-diphosphoglycerate facilitates the delivery of O₂ (This molecule binds to hemoglobin and, in doing so, effectively displaces oxygen molecules, making it easier for hemoglobin to unload oxygen where it's needed most)

* if patient has Heart or lung diseases

symptoms will be worse

chronic hemolytic Anemia

jaundice



pigmented gall bladder



red urine

(as Hb is red)

Special

extra medullary
hematopoiesis

splenomegaly

hepatomegaly

classification of anemia
according to

Cause

Blood loss Diminished RBC production + destruction (Hemolytic Anemia)
(↓ RBC production) → BM problem

- Iron deficiency anemia
- Anemia of chronic inflammation
- Megaloblastic anemia
- Aplastic anemia
- Pure red cell aplasia
- Myelophthistic anemia
- Myelodysplastic syndrome
- Anemia of renal failure
- Anemia of hypothyroidism

Extrinsic intrinsic
infection Antibody Mechanical RBC abnormalities
Hereditary Acquired
Membrane Enzyme Ig abnormalities peroxysomal
Nocturnal hematuria

(MCV) size

reflect content of Hb

Microcytic Normocytic Macrocytic

I RBC = diameter of stem cell

disease & defect in maturation

color (Hct)

Hyperchromic Hypochromic

vs white

normochromic

shape

Anisopeliosis
spherocytes

sickle

schistocytes

High Abnormal shape

RBC distribution width

reflects impaired Hb synthesis

Heme (iron) or Globulin deficiency

Anemia caused by Blood loss

- sudden & fast

- could cause brain

Acute

& major organ tissue

necrosis tending to death

Hypovolemia

(↓ intravascular volume)

* if loss is $> 20\%$ of

Blood volume \Rightarrow pt might have

Hypovolemic shock & die

* If pt survived Blood loss Body responds by

stay (2-3 days) \rightarrow ① shifting fluid from interstitial \rightarrow intravascular
causing dilutional anemia & worse hypoxia
 \hookrightarrow ↓ [Hb] after bleeding has stopped

needs (5-7 days) \rightarrow ② \oplus EPO secretion \rightarrow ③ BII
activating erythropoiesis

hemorrhage site

internal

- iron is restored

from Extravasated

External &

GIT

- iron is lost

iron deficiency
is only in this
case in Acute blood
loss

RBCs & used again
in erythropoiesis

* which complicates Anemia

iron $\xrightarrow{\text{easy to}}$ lost
 \downarrow hard to
get

- from gradual loss

of blood \rightarrow small amounts

over extended

period

Chronic

occurs when

The rate of RBC loss $>$ regeneration rate

* Mostly occurs in

also

Gastrointestinal diseases

- peptic ulcers

- hemorrhoids

- colon cancer

- small bowel inflammation

Excessive Menstruation

\leftarrow result in \downarrow

Iron deficiency Hypochromic & microcytic anemia
(always) low reticulocytes

\leftarrow The Anemia for this type is called:

Normochromic Normocytic with reticulocytosis

Normal Hb content Normal RBC size

↑ in reticulocytes (Bone marrow is active)

\downarrow

(Body reaction to deal with blood loss & Anemia)