



Diseases of Blood-erythrocytes(red cells)

Lect(3)

Erythropoietin:

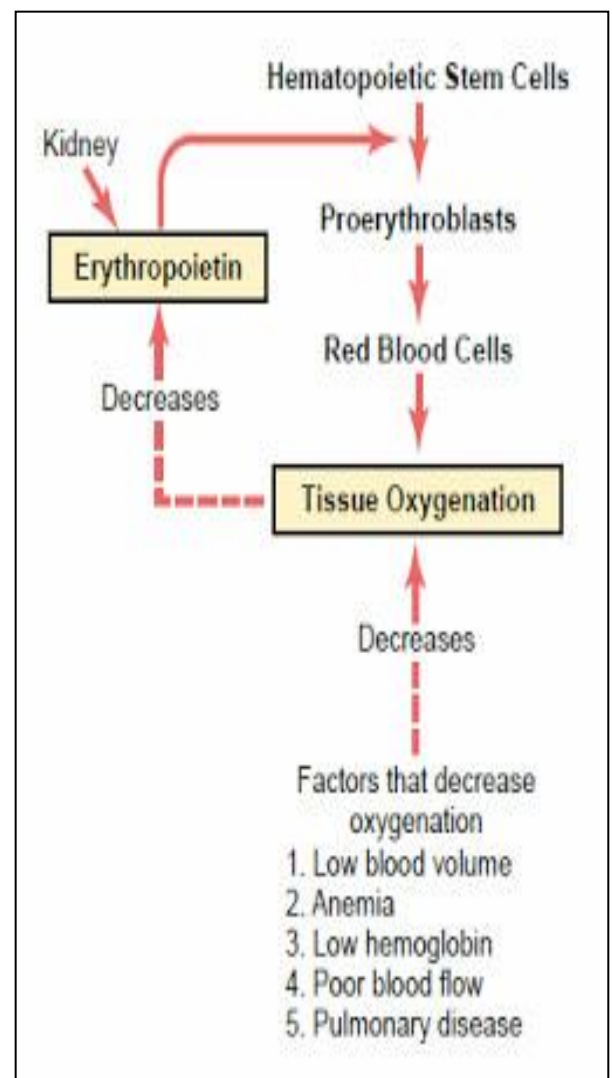
Erythropoietin is a glycoprotein hormone produced by the per tubular capillary endothelium of the kidney in response to reduced oxygen tension (hypoxia). Erythropoietin's action principal site of is the bone marrow. The effects of erythropoietin include stimulation of growth and differentiation of both erythrocyte and platelet progenitors and erythrocyte precursors. hematocrit, total red blood cell (RBC) numbers, and platelet count.

Note:

1-In case of chronic renal failure in dogs, anemia is a common sequel as they cannot produce EPO elsewhere.

2-In bone marrow, EPO stimulates committed stem cells to increase their mitotic activity for a more rapid production and release of reticulocytes and mature erythrocytes into the circulation. EPO has a life span of less than one day

3-It is a continuous process. Many nutrients are required for this notably, Vit B12, folic acid, amino acids and iron.





Anemia:

Is defined as a decrease in the hematocrit (HCT) or Packed cell volume (PCV) , erythrocyte count, and hemoglobin concentration (Hb). There are two types of anemia:

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1-Relative anemia is not associated with a true reduction in the total red blood cell (RBC) mass, but rather is caused by a dilutional effect that can be observed after aggressive fluid therapy or other cause of increased plasma volume.

2-Absolute anemia is considered a true reduction in the total RBC mass.

Are useful in classifying anemia as either regenerative or nonregenerative. Also, both reticulocyte count and RBC morphology are very important in determining if an anemia is regenerative or nonregenerative.

Etiology of anemia:

1-Iron deficiency anemia

The small animals dog and cat are external blood loss. Although dietary deficiency is a major cause of iron deficiency anemia in humans, this is rarely a factor in small animals except in extreme cases of inadequate nutrition. Although there are many potential causes of chronic blood loss, gastrointestinal (GI) hemorrhage is the most common. Internal blood loss typically does not result in iron-lacking anemia because the iron can be reabsorbed from the site of hemorrhage.

2-Immune-mediated hemolytic anemia (IMHA)

Is typically a regenerative anemia that develops when the animal produces antibody against proteins on the surface of its own erythrocytes or erythrocyte precursors (antibodies against erythrocyte precursors can result in a nonregenerative anemia). This antibody bound to the surface of the erythrocyte leads to destruction of the red cell through complement-mediated lysis and phagocytosis by splenic or hepatic macrophages.



3-Aplastic anemia

Is caused by decreased to absent erythropoiesis, granulopoiesis, and thrombopoiesis due to bone marrow suppression.

- a. Infectious agents
- b. Irradiation
- c. Certain toxicoses
- d. Drugs (e.g., estrogen, phenylbutazone, chlormphenicol)

4-Anemia of chronic disease

Also known as *anemia of inflammatory disease*, is a common anemia that develops secondary to a variety of chronic diseases in both dogs and cats. Excess cytokines released in inflammation, decreased erythropoietin production and efficacy, and decreased utilization of iron stores are all recognized to be involved in the development of the disorder. A variety of infectious, inflammatory, and neoplastic diseases can result in anemia of chronic disease.

5-Microangiopathic hemolytic anemia

Is the destruction of erythrocytes resulting from the narrowing or obstruction of small blood vessels. This small vessel pathology causes lysis of RBCs as they pass through the affected vessel and can lead to anemia.

6-Vitamin-deficiency anemia

May occur when vitamin B12 and folate are deficient. These two vitamins are needed to make red blood cells. Conditions leading to anemia caused by vitamin deficiency include:

- 1-Megaloblastic anemia: Vitamin B12 or folate or both are deficient
- 2-Pernicious anemia: Poor vitamin B12 absorption caused by conditions such as Crohn's disease, an intestinal parasite infection, surgical removal of part of the stomach or intestine, or infection with HIV
- 3-Dietary deficiency: Eating little or no meat may cause a lack of vitamin B12, while overcooking or eating too few vegetables may cause a folate deficiency.
- 4-Other causes of vitamin deficiency: pregnancy, certain medications, alcohol abuse, intestinal diseases such as celiac disease



7-Chronic kidney disease

Chronic kidney disease can result in an anemia through multiple mechanisms

- **Decreased erythropoietin production:** This is one of the main mechanisms contributing to the anemia associated with chronic kidney disease (failure). Erythropoietin is produced in renal interstitial cells.
- **Suppression of erythropoiesis:** This can occur due to uremic toxins, which can inhibit erythropoiesis or inhibit the action of erythropoietin on erythroid progenitors.
- **Decreased RBC lifespan:** Uremic toxins can reduce RBC lifespan (extravascular hemolysis). However, due to concurrent suppression or erythropoietin deficiency, the anemia is usually non-regenerative.
- **Hemorrhage:** Animals with uremia frequently suffer from oral and gastrointestinal ulcers which can cause chronic hemorrhage. Iron deficiency may ensue in severely affected animals. However, the anemia is not typically (but can be) regenerative due to the abovementioned reasons.

8-Endocrine disease

Endocrine disorders, such as hypothyroidism and hypoadrenocorticism, can produce a mild to moderate normocytic normochromic anemia. This is thought to be due to a generalized decrease in metabolism, although there may be an element of anemia of inflammatory disease. .

9-Infectious agent

Various types of infectious agents can cause anemia through multiple mechanisms, including extravascular hemolysis (with or without) intravascular hemolysis, and decreased erythropoiesis (direct inhibition of erythropoiesis by the organism or indirect suppression through inflammatory cytokines or anemia of inflammatory disease).

Erythroparasites: Some species of *Babesia* spp, and *Anaplasma* spp, *Theileria* spp. These parasitize RBC causing premature removal from the circulation (extravascular



hemolysis). Secondary immune-mediated removal by macrophages can contribute to the anemia.

Viruses: e.g. Equine infectious anemia can induce an extravascular hemolysis (immune-mediated, presumptive) as well as a suppression anemia (bone marrow suppression). Feline leukemia virus can induce a non-regenerative anemia due to infection of progenitors in marrow.

Bacteria: Any type of bacterial infection can cause a non-regenerative anemia due to inflammatory cytokines (anemia of inflammatory disease) if they cause systemic inflammation. Specific bacteria can also induce a hemolytic anemia, including *Leptospira* and *Clostridia*. The latter can release toxins which are hemolysins, that can cause intravascular hemolysis, e.g. *Clostridium hemolyticum*. Infection with some forms of *Escherichia coli* (0103:H12) can cause hemolysis as a consequence of hemolytic-uremic syndrome. This is rare in animals and has been reported in a mare with a uterine infection with the causative organism.

Reference Values for Laboratory Animals(NORMAL HEMATOLOGY VALUES)

	Dog	Cat	Rhesus	Baboon	Swine	Sheep	Cow	Rabbit	G Pig
PCV (%)	29-55	25-41	26-48	33-43	32-50	24-45	24-48	30-50	37-48
Hgb (g/dl)	14.2-19.2	14.2-19.2	8.8-16.5	10.9-14.3	10-16	8-16	8-15	10-15	11-15