Lecture Notes

UJ | SCHOOL OF MED

PHYSIOLOGY

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019

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Blood Cell Morphology

These examples are for you to practice solving blood morphology questions:

1. MCV = 91 fl

   MCH = 31 pg

   MCHC = 34%

RBCs are normocytic and normochromic.

2. MCV = 67 fl

   MCH = 22 pg

   MCHC = 33%

RBCs are microcytic and normochromic.

3. MCV = 67 fl

   MCH = 20 pg

   MCHC = 30%

RBCs are microcytic and hypochromic.

4. MCV = 113 fl

   MCH = 38 pg

   MCHC = 33%

RBCs are macrocytic and normochromic.

5. MCV = 91 fl

   MCH = 26 pg

   MCHC = 29%

RBCs are normocytic and hypochromic.

Anemia

- In general, Anemia is a name given for a group of disorders that are characterized by a quantitative or qualitative deficiencies of the circulation erythrocyte (when your blood lacks enough healthy red blood cells or hemoglobin, i.e. it is either characterized by low RBCs or low hemoglobin)
- Low count of blood cells is called anemia or erythrocytopenia.
- The following graph shows the classification of anemia based on morphology

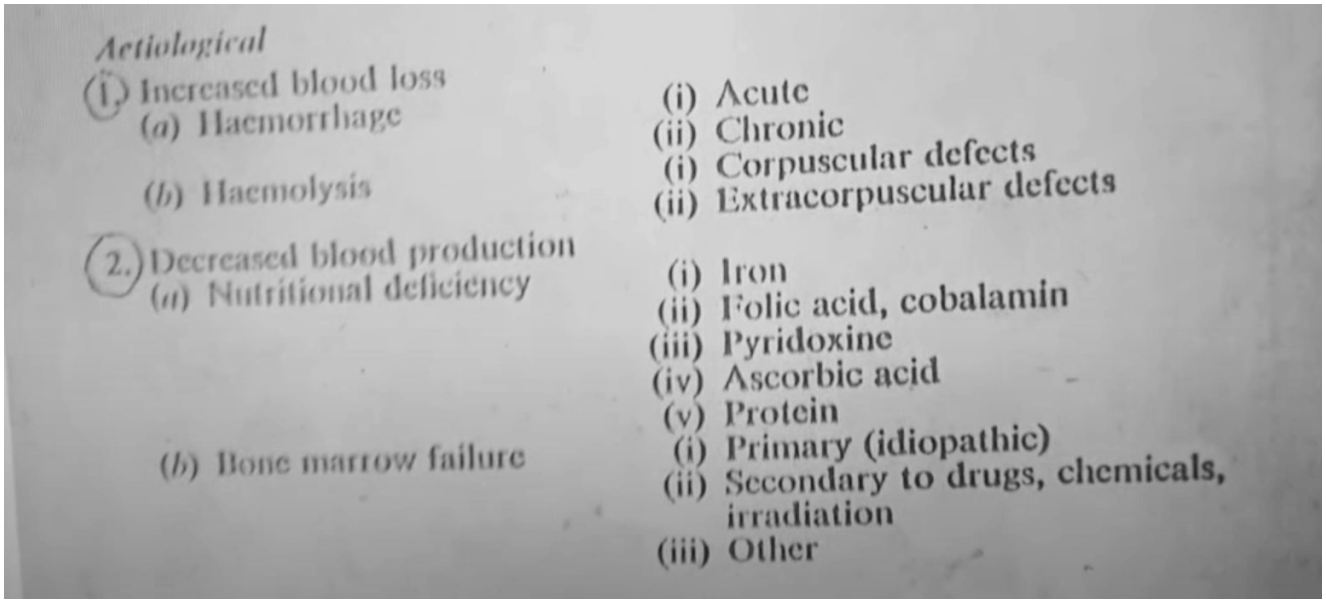
Table 2.2. Classification of anaemias

Morphological	*MCHC (%)*	*MCV (fl)*
1. Normochromic normocytic	32–36	76–96
2. Hypochromic normocytic	32	76–96
3. Hypochromic microcytic	< 32	< 76
4. Macrocytic	Usually normal	> 96
5. Microspherocytic	Usually normal	Normal but diameter reduced

- Notes on the 1st graph :

a. Normochromic, Normocytic → the size and hemoglobin content of the RBCs are within normal limits, but the problem is in the count (lower than the normal).
b. Hypochromic, Normocytic → the problem is in the content (hemoglobin concentration)
c. Hypochromic, Microcytic → the problem is in both, RBCs' size is smaller than usual, with decreased hemoglobin content.
d. Macrocytic → Unusually large RBCs and the count is low such as in pernicious anemia.
e. Micro-spherocytic → the problem is in the shape of the cells. It's a hereditary rare disorder where RBCs look like spheres, leading to premature breakdown of red blood cells.

- The following graph shows the classification of anemia based on Etiology (causes)



- Notes on the 2nd graph :

a. Increased blood loss, which could be caused by (acute or chronic) hemorrhage or Hemolysis.
b. Hemolysis causes corpuscular defects which either affects the cells themselves or the medium of the cells (plasma , extra corpuscular defects).
c. Decreased blood production is either because of nutritional deficiency (Iron , folic acid , cobalamin, Pyridoxine, ascorbic acid & protein) OR because of bone marrow failure (primary, or secondary to drugs, chemicals & irradiation).

Effects of anemia on the circulatory system

- In severe anemia the blood viscosity may fall to as low as 1.5 times that of water rather than the normal value of approximately 3 times the viscosity of water.
- The greatly decreased viscosity decreases the resistance to the blood flow in the peripheral vessels so that far greater than normal quantities of blood returns to the heart.

- Moreover, hypoxia due to diminished transport of oxygen by the blood, causes the tissue vessels to dilate, allowing further increase in the return of blood to the heart, increasing the cardiac output to a still higher level. (+ an increase in the heart rate)
- Thus, one of the major effects of anemia is greatly increased workload on the heart.
- Consequently, during exercise, which greatly increases tissue demand for oxygen, extreme tissue hypoxia results, and acute cardiac failure often ensues.

Classification of erythrocytosis (polycythemia)

- It's an increase in the number of the RBCs in the circulation.

Relative erythrocytosis

Results from dehydration, in which the plasma volume decreases so the total volume of blood decreases, while the RBCs count is still the same (normal) . As a result, the RBCs concentration increases relatively to the volume of the blood. This case usually occurs during fasting.

True erythrocytosis (which is further divided into)

a. With increased erythropoietin → physiologically due to high altitude or drugs such as Cobalt and androgens.
b. With low or normal erythropoietin (polycythemia vera) → because of cancer.

Effects of polycythemia on the circulatory system

1. The greatly increased viscosity of the blood in polycythemia, increases the workload on the heart.
2. The flow of blood through the vessels is often very sluggish.
3. It is obvious that increasing the viscosity tends to decrease the rate of venous return to the heart.
4. On the other hand, the blood volume is greatly increased in polycythemia, which tends to increase the venous return to the heart.
5. The blood passes sluggishly through the skin capillaries, a larger than normal proportion of the hemoglobin is deoxygenated. The bluish color of this deoxygenated hemoglobin masks the red color of the oxygenated hemoglobin. Therefore, a person with polycythemia ordinarily has a ruddy complexion but often with a bluish (cyanotic) color to the skin.

Extra :

1. Not all RBCs of a polycythemia patient are oxygenated because there are too many of them (can reach 7- 8 million/ml).

2. In both cases, anemia and polycythemia, the heart work is increased but due to different causes, and this may lead to heart failure. In polycythemia, increased blood volume causes increased venous return and heart load. Whereas, in anemia decreased resistance due to decreased RBCs and vasodilation is what increases the venous return.

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