***Robbins Summary***

***Disorders of red cells can result in:***

1. **Anemia** (common): a state of red cell deficiency or reduction in the oxygen-transporting capacity of blood which stems from a decrease in red cell mass to subnormal levels
2. **Polycythemia** (less common) : an increase in red cells also known as erthrocytosis.

***Anemia:***

**Can be classified on the basis of the causes to:**

1. Decreased red cell production
2. Increased red cell destruction or loss by either: a) bleeding(hemorrhage) b)hemolysis

**In anemias caused by increased destruction of red cells** :With the exception of anemias caused by chronic renal failure or chronic inflammation ,the decrease in tissue oxygen tension that accompanies anemia triggers increased production of the growth factor(hormone) erythropoietin from cells in the kidney. This in turn drives a compensatory hyperplasia of erythroid precursors in the bone marrow and in severe anemias the appearance of extramedullary hematopoiesis (the liver ,spleen ,and lymph nodes). The rise in marrow output is signaled by the appearance of **increased of newly formed red cells (reticulocytes).**

**In anemias caused by decreased production of red cells** (aregenerative anemia): these anemias are associated with **subnormal levels of reticulocytes.**

**Anemias can also be classified on the basis of red cell morphology (shape/ size/ color):**

Macro/microcytic…..hypo/hyperchromic……etc

***Quantitative tests used in diagnosing anemia:***

1. **Mean cell volume** (MCV): the average volume per red cell ,expressed in femtoliters (cubic microns)
2. **Mean cell hemoglobin** (MCH): the average mass of hemoglobin per red cell, expressed in pictograms.
3. **Mean cell hemoglobin concentration** (MCHC): the average concentration of hemoglobin in a given volume of packed red cells ( hematocrit) ,expressed in grams per deciliter.
4. **Red cell distribution width** (RDW): the coefficient of variation of red cell volume.
5. **Iron indices** (serum iron, serum iron binding capacity, transferrin saturation , and serum ferritin concentration) to distinguish between anemias caused by iron deficiency , chronic disease , and thalassemia.
6. **Plasma unconjugated bilirubin , haptoglobin , and lactate dehydrogenase** levels which are abnormal in hemolytic anemia.
7. **Serum and red cell folate and B12 concentration** which are low in megaloblastic anemia.
8. **Hemoglobin electrophoresis** to detect abnormal hemoglobin
9. **Coombs test** to detect antibodies or complement on red cell in suspected cases of immunohemolytic anemia

When **anemia is the only disorder** a person is suffering ,tests are usually performed on the **peripheral blood** to establish the cause . by contrast, when anemia occurs **along with thrombocytopenia and/or granulocytopenia** , it is much more likely to be associated with marrow aplasia or infiltration ; in such cases , a **marrow examination** is usually needed.

***The deficient O2 carrying capacity is partially compensated for by adaptations such as :***

1. Increase in erythropoietin secretion in cases of hemolytic anemias.
2. Increase in plasma volume
3. Increase in Cardiac output
4. Increase in Respiratory rate
5. increase in levels of red cell 2,3 diphosphoglycerate.

These adaptations are sufficient to overcome mild to moderate anemia in healthy persons , but are less effective in those with compromised pulmonary or cardiac function.

***Anemia symptoms:***

Acute symptoms: shortness of breath / organ failure/ shock

Chronic symptoms:

1. pallor
2. fatigue
3. lassitude
4. hyperbilirubinemia jaundice and pigment gallstones in hemolytic anemia as a result of increased rate of hemoglobin turnover.
5. Anemias that stem from ineffective erythropoiesis (premature death of erythroid progenitors in the marrow) are associated with inappropriate increase of iron absorption from the gut (iron overload or secondary hemochromatosis) which damages the heart, endocrine organs.
6. Congenital anemias such as thalassemia if left untreated leads to : growth retardation , and bone deformities due to reactive marrow hyperplasia.

**Done by: Fekra ……….good luck !!!**