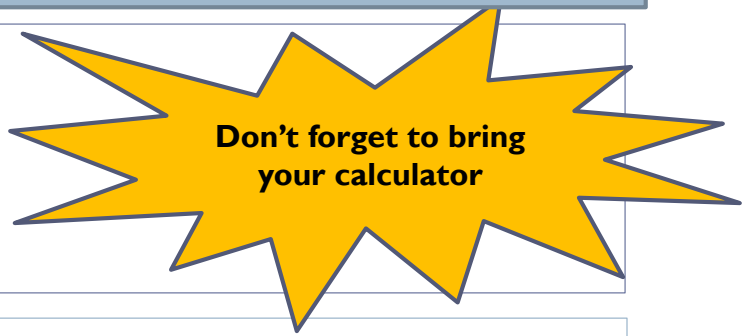
PHYSIOLOGY PRACTICAL REVISION

- The exam is more likely to be short answers questions, no experiments will be performed.
- • you're going to need them for simple calculations of red blood indices(MCV,MCH,MCHC), which are important to know different types of anemia. Remember their units.
- Understanding blood groups is very important. • Remember the normal values and the related clinical conditions.
- identify WBCs under the microscope, identify their function.
- This revision is not sufficiently enough, you have to read the teamwork's lectures or the handouts.

Red : important
Green: only found in males' slides.
Purple: only found in females' slides.
Gray: notes.



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من كلام الدكاترة ان شاء الله بتجي معادلة تحلوها وتقارنوها مع النتائج الطبيعية وتحددوا نوع الانيميا

Red Blood Indices (team work 435)

In males slides:
MCV is from 78-98 fl
MCHC is from 32-36

	Definition	The calculation of Red Blood Indices	Higher than average	Average (normal value)	Lower than average
Mean cell volume (MCV)	The average volume of red blood cell measured in femtoliters (fl)	$MCV = \frac{PCV \times 10}{RBC\ count}$ PCV = packed cell volume	RBC are large in size and they are called Macrocytes. Cause : Vit B12 or Folic deficiency	77-98 µm3 (fl)	RBC are small in size and they are called Microcytes Cause : Iron deficiency
Mean cell hemoglobin (MCH)	The average weight of Hb in red blood cells cell measured in picograms (pg).	$MCH = \frac{Hb \times 10}{RBC\ count}$ Hb = hemoglobin concentration	RBCs are Hyperchromic	27-32 pg	RBCs Are Hypochromic
Mean cell Hb concentration (MCHC)	Concentration of Hb (hemoglobin) per 100 ml of RBC measured in grams/deciliters (g/dl).	$MCHC = \frac{Hb \times 100}{PCV}$ PCV = packed cell volume Hb=hemoglobin concentration	-	30-36 g/dl	Iron deficiency Anemia

Example : **An examination of the blood of 2 adult males (A and B) provided the following data:**

	SUBJECT "A"	SUBJECT "B"
RBC COUNT	3.6 X 10^6 / mm^3	2.5 X 10^6 / mm^3
Hb Concentration	7.2 g/dl	8 g/dl
Packed Cell Volume	25%	25%

A) **Calculate MCV, MCH and MCHC for each of these subjects.**

SUBJECT "A"	SUBJECT "B"
MCV = 25 x 10 /3.6 = 69.4 fl	MCV = 25 x 10 /2.5 = 100 fl
MCH = 7.2 x 10 / 3.6 = 20 pg	MCH = 8 x 10 / 2.5 = 32 pg
MCHC = 7.2 x 100 / 25 = 28.8 g/dl	MCHC = 8 x 100 / 25 = 32 g/dl

B) **What are the abnormalities encountered in these men. What are the possible causes of these abnormalities?.**

Subject "A" ➔ Microcytic hypochromic anaemia (Iron deficiency anaemia)
Subject "B" ➔ Macrocytic normochromic anaemia (Megaloblastic anaemia or Pernicious anaemia)

Don't forget to bring your calculator

Normal value + Clinical applications:

	High number	Low number
RBCs Normal value : 4.7-5.6x 10^6/µl **HB** normal value : **13-18g/dl**	○ Low oxygen tension in the blood:(hypoxia) • Congenital heart disease • Cor pulmonale • Pulmonary fibrosis ○ Dehydration (as : severe diarrhea). ○ Renal (kidney) disease with high erythropoietin production. ○ POLYCYTHEMIA: increase in RBCs no	○ Blood loss : due to : Anemia or Hemorrhage. ○ Bone marrow failure (exp: from radiation, toxin, fibrosis, tumor). ○ Erythropoietin deficiency (secondary to renal disease). ○ Hemolysis (RBC destruction). ○ ANAEMIA : Reduced ability of blood to carry Oxygen due to either decreased red blood cell count and/or haemoglobin concentration.
Leukocyte Normal value : 4-11x 10^3/µl	Called : Leukocytosis may indicate : • Infectious diseases. • Inflammatory disease (as : rheumatoid arthritis or allergy). • Leukemia. • Severe emotional or physical stress. • Tissue damage (burns).	called : Leukopenia may indicate • Bone marrow failure (exp: due to infection, tumor or fibrosis). • Presence of cytotoxic substance. • Autoimmune/collagen-vascular diseases (as : lupus erythematosus). • Disease of the liver or spleen. • Radiation exposure.
Platelets Normal value : 150-400x 10^3/µl	Called : Thrombocytosis may indicate Chronic myeloid leukemia.	Called : Thrombocytopenia may indicate : • A plastic anemia. • Chemotherapy.
Packed Cell Volume (PCV) or Hematocrit (35-54)%	• Dehydration : due to : Burns , Diarrhea • Polycythemia Vera. • Low oxygen tension due to : smoking , congenital heart disease, living at high altitudes	• Anemia (various types). • Blood loss (hemorrhage). • Bone marrow failure due to radiation, toxin, fibrosis, tumor). • Hemolysis(RBC's destruction)related to transfusion reaction. • Leukemia.

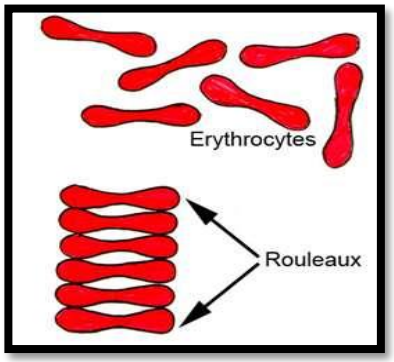
- PCV : The ratio of packed blood cells volume to plasma (ratio of RBC's to plasma)

***Plasma:** has anticoagulants.
***Serum:** Without anticoagulants

Erythrocyte Sedimentation Rate (ESR)

(سرعة الترسيب)

- **ESR**: Is the rate at which **red blood cells** sediment in a period of 1 hour.
- It is controlled by the balance between plasma protein (fibrinogen), and the negative charge of the erythrocytes.



Normal ESR range :

Male → 3-5mm\1st hour , 7-15 mm\2nd hour

Female → slightly higher than 7 mm due to less RBC

Moderately elevated ESR occurs :

- Infections, Inflammation , Anemia , Malignancies , Pregnancy , old age.

A very high ESR associated with :

- multiple myeloma , polymyalgia Rheumatic , temporal arteritis

Clinical application of ESR :

- Nonspecific test : a nonspecific marker of inflammation and is affected by other factors
- Prognostic not diagnostic.
- Monitor disease activity and response to therapy.
- ESR results must be used along with other clinical findings.

C-reactive protein & ESR

- C-reactive protein is an acute phase protien produced by the liver during an inflammatory reaction.
- Since C-reactive protein levels in the blood rise more quickly after the inflammatory or infective process begins, ESR is often replaced with C-reactive protein measurement.

QUESTIONS AND PROBLEMS

1- What is the clinical importance of knowing the red blood cell indices?

- They help to determine the type of anemia a patient is suffering from.

2- Discuss briefly the etiological classification of Anemia?

TYPES OF ANEMIA		CAUSE
Hemorrhagic Anemia		Loss of blood
Aplastic Anemia		Bone marrow suppression by drugs or radiations etc.
Hemolytic Anemia		Increased destruction of RBCs such as sickle cell disease
Nutritional Anemia	**Macrocytic normochromic anemia**	**Megaloblastic anemia** : Deficiency of folic acid, Vitamin B12
		Pernicious anemia : Malabsorption of Vit 12 due to lacking of intrinsic factor in the stomach
	Microcytic Hypochromic anemia	Deficiency of Iron
Microcytic Hypochromic non-nutritional anemia		Thalassemia

3- What is meant by rouleaux formation?

- When red blood cells are stacked together in long chains because of their biconcave disc like surfaces sticking to each other, it is called Rouleaux formation.

4- Why does rapid rouleaux formation increase the E.S.R.?

- Rouleaux formation becomes rapid when plasma protein concentration is high and because of this E.S.R. also becomes increased.

WBC

Never Let Monkey Eat Banana
Neutrophil , Lymphocyte , Monocyte , Eosinophil , Basophil
Most common → less common

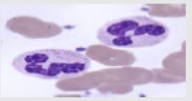
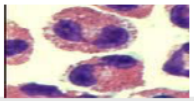
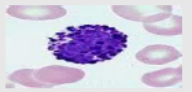
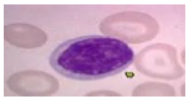
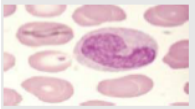
Differential Leukocyte Count (DLC) ?

- a routine test in hospitals which determine the percentage of each type of white blood cells in the total leucocyte population.

granules contain Heparin (an anticoagulant).
and Histamine, which increases the permeability of capillary walls.

Stains are used:

1. Leishman's stain
2. Wright's stain

	WBCs	Percentage of leukocytes	Increased percentage indicates	Cytoplasm morphology	Nucleus morphology	Microscopic picture
Granular	Neutrophil	The most common type: 50-70%	acute bacterial or fungal infections	Small purple/pink stained granules (neutrophilic)	Segmented, 2-5 lobed	
	Eosinophil	Less common: 1-3%	parasitic infections and allergies	Bright red granules (eosinophilic)	Bi-lobed purplish	
	Basophil	The rarest of WBCs: 0.4-1%	allergies and malignancies.	Large, blue granules (basophilic)	Bi-lobed, hidden behind the large granules	
Agranular	Lymphocyte * The smallest leukocyte.	Second common cell: 25-35%	acute viral infections (infectious mononucleosis) and malignancies.	Light blue, no granules. The nucleus occupies most of the volume of the cell, leaving only a thin rim of the cytoplasm around it.	Single large Oval purple	
	Monocyte * The largest of all blood cells.	Third common cell: 4-6%	chronic infections	Basophilic, no granules	Large, horseshoe-shaped (kidney-like)	

The diagram above from 435

Blood Groups and Rhesus system

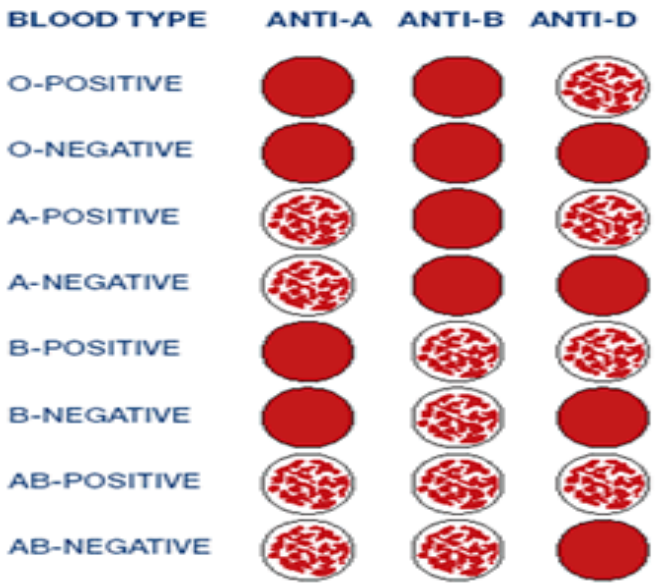
Antigen is what makes these blood types different ; they're the cells identification tag

Rh is misnomer **and it refers** to the presence or absence of the D antigen on the red blood cell there is D (+) , No D (-)

O- : universal donor

AB + : universal receiver

Blood type	Antigens on blood cells	Anibodies made by the immune system	Can donate blood to	Can receive blood from
O-	None	Anti-A, Anti-B, Anti-Rh	All blood types	O- only
O+	Rh	Anti-A, Anti-B	Any Rh+ blood types	O- or O+
A-	A	Anti-B, Anti-Rh	Any A or AB	O or A-
A+	A, Rh	Anti-B	A+ or AB+	Any O or A
B-	B	Anti-A, Anti-Rh	Any B or AB	B- or O-
B+	B, Rh	Anti-A	B+ or AB	Any O or B
AB-	A, B	Anti-Rh	Any AB	Any Rh-
AB+	A, B, Rh	None	AB+	All blood types



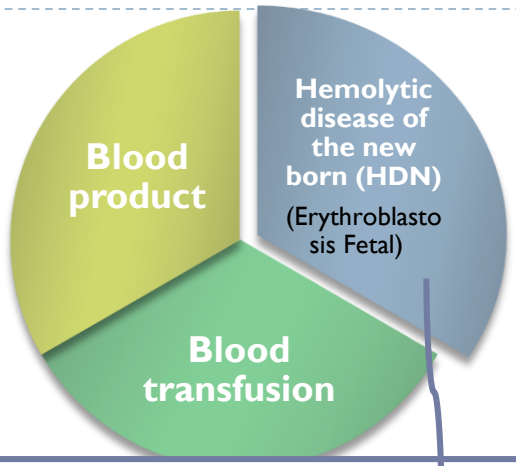
- Agglutination : Ag A + Anti A = positive reaction
- Agglutination : Ag B + Anti B = positive reaction
- No clumping : no ag A /B = negative reaction

- The most common form is **ABO incompatibility**, which is usually not very severe.
- The least common form is **Rh incompatibility**

- O+ is the most common in Saudi Arabia AB- least common in Saudi Arabia

Clinical Applications

- **Important in the following condition :**



Clotting Time	Bleeding Time
It is rough measure of all intrinsic clotting factors (monitoring anti-coagulant therapy)	It is The time taking for bleeding to stop (time for a platelet plug to form).
Time : 2-7 in glass tube : 5-15	2-5min (some says 2-7)

HDN

- It is a blood disorder in a fetus or newborn infant when a mother and her unborn baby have different blood types (called "incompatibility").
- Mother produces antibodies to Rh (D) antigen. after the labor because the mother's blood will be mixed with baby's blood ,
- So the Antibody will attack the developing baby's red blood cells (2nd baby with Rh+)
- **Prevention** : mother is given (Rhogam) anti-D antibodies after birth of Rh positive baby (After 1st baby)
- **Treatment of baby with incompatibility :**
  - **•Mild :** Drugs used to treat allergic reactions (antihistamines)
  - •Drugs used to treat swelling and allergies (steroids)
  - •Feeding and fluids (hydration)
  - •Fluids given through a vein (intravenously)
  - •Light therapy using bilirubin lights
  - •Medicines to raise blood pressure if it drops too low
  - **•Sever :** exchange transfusion after birth or intrauterine transfusion before birth

Mother is Rh- father is Rh+ (Rh+ is more dominant) : baby is RH+

Clotting time is used in :

- **•Used :** in diagnosis of hemophilia.
- **•Clinical significance of the clotting time:** Before surgery , Diagnosis of bleeding disorders **prolong the bleeding time: due to**
  - Platelet dysfunction.
  - Blood vessel wall disorders.
  - Von Willebrand Disease.
  - Thrombocytopenia.
  - Vitamin K deficiency.
  - Medications such as : Aspirin.