

CLS 291 Clinical Hematology 1

جامعة
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Lecture 4

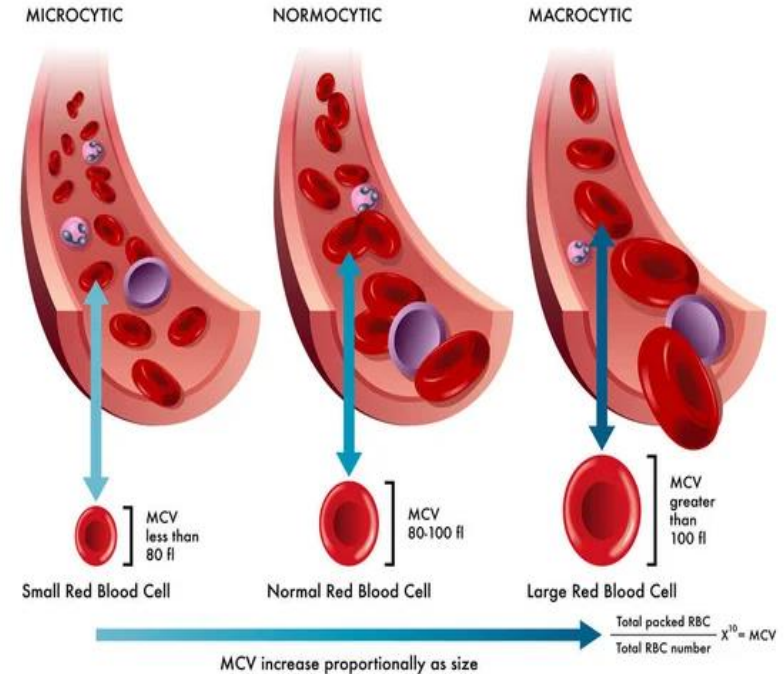
Red Blood Cell Indices

Red cell Blood Cells (RBCs) indices

- Red cell indices traditionally have been the derived parameters of:
 1. **MCV:** Mean Cell Volume.
 2. **MCH:** Mean Cell Hemoglobin.
 3. **MCHC:** Mean Cell Hemoglobin Concentration.
 4. **RDW:** Red Cell Distribution Width.
- These indices can provide a basis for classifying anemias.

1. Mean cell volume (MCV)

- Mean cell volume (MCV) is the average volume of an individual RBC.
- MCV is correlated with RBC size.
- Normal range
 - Men and women 80 - 100 femtoliters (fl)
- Calculation
 - It can be calculated from Hct (or PCV) and the RBC count as follows:
$$\text{MCV in fl} = \frac{\text{Hct [\%]}}{\text{RBC [in } \times 10^{12}/\text{L]}} \times 10$$
 - E.g: $\frac{48}{4.5} \times 10 = 106.6 \text{ fl}$ (what does this result mean?)



MCV (Mean Corpuscular Volume) is the measure of the average RBC volume and RBC size. This red cell indices allow the classification of anaemia. The value of MCV increases proportionally with the size of the RBCs (ie bigger the cell size → the higher the MCV value)

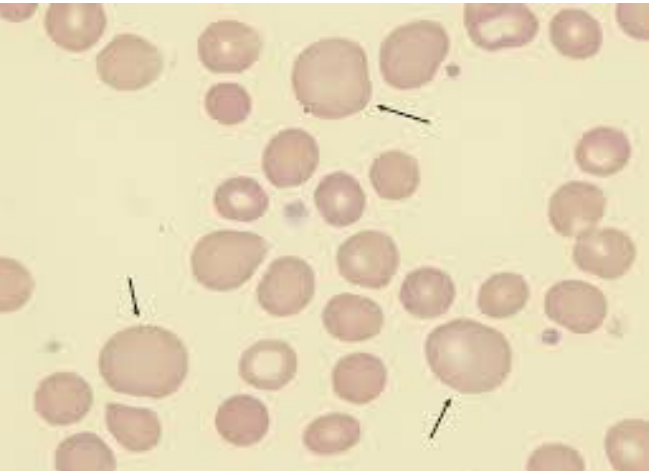
1. Mean cell volume (MCV)

- Anisocytosis (aniso-unequal) is a term that describes the variation in the size of red cells.

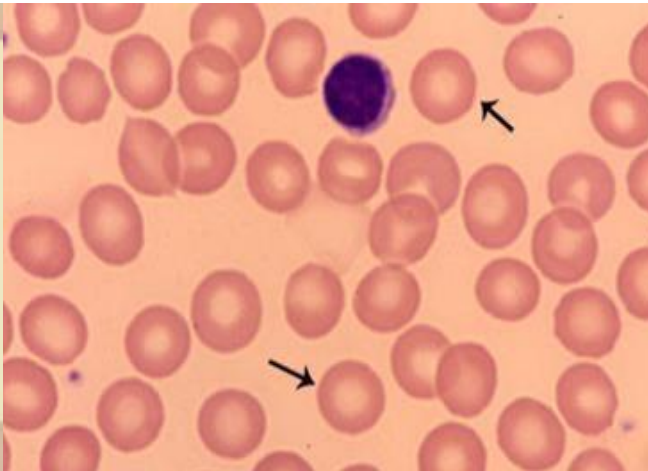
Indication of MCV result value:

- Normal MCV = normocytic RBCs.
- Low MCV = microcytic RBCs.
- High MCV = macrocytic RBCs.

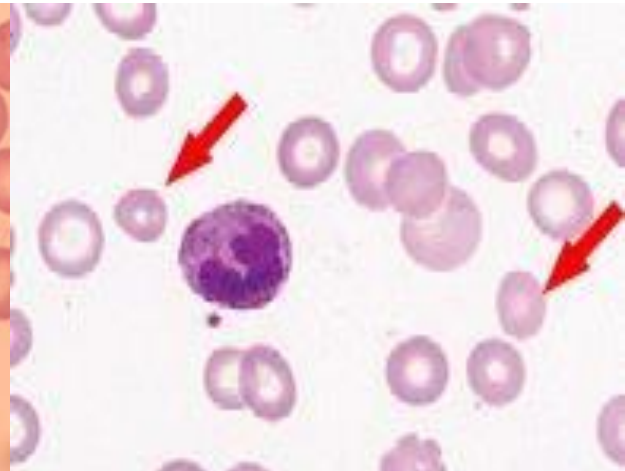
Macrocytic RBCs



Normocytic RBCs



Microcytic RBCs



2. Mean cell hemoglobin (MCH)

- Mean cell hemoglobin (MCH) is the average weight of hemoglobin in an individual RBC.
- Normal range
 - Men and women 28 – 34 picograms (pg).

- Calculation :

- $$\text{MCH in pg} = \frac{\text{Hb [g/dl]}}{\text{RBC [x10}^{\wedge}12/\text{L]}} \times 10$$

- Example:

- $$\text{MCH} = \frac{12.5}{4.1} \times 10 = 30.5 \text{ pg}$$



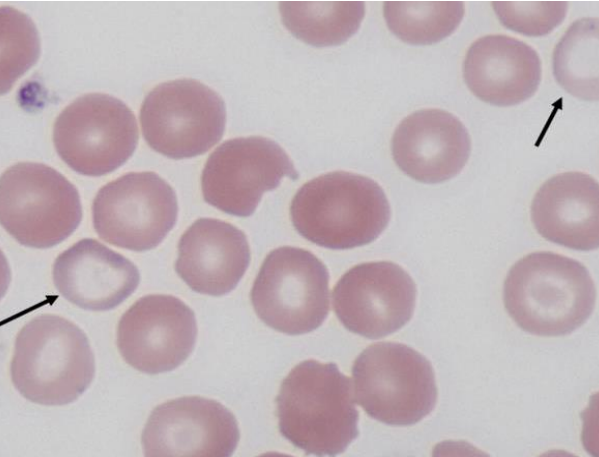
The color of the Red Blood Cells change based on the hemoglobin content in the RBC.

2. Mean cell hemoglobin (MCH)

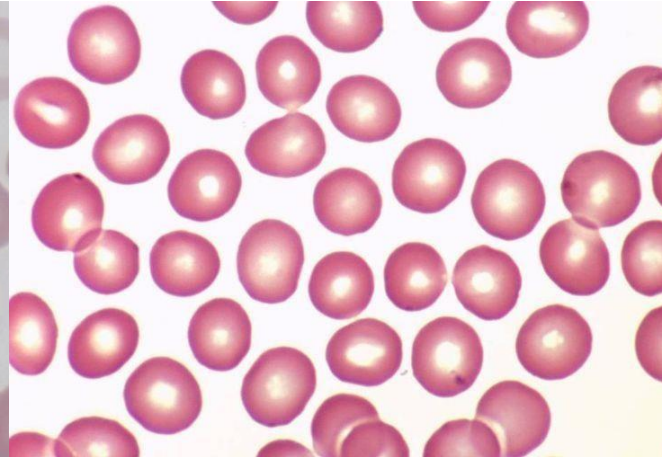
Interpretation:

- **Normal MCH:** normochromic RBC. (normal color)
- **Low MCH:** hypochromic RBC. (faint color)
- **High MCH:** hyperchromic RBC. (highly pigmented RBCs)

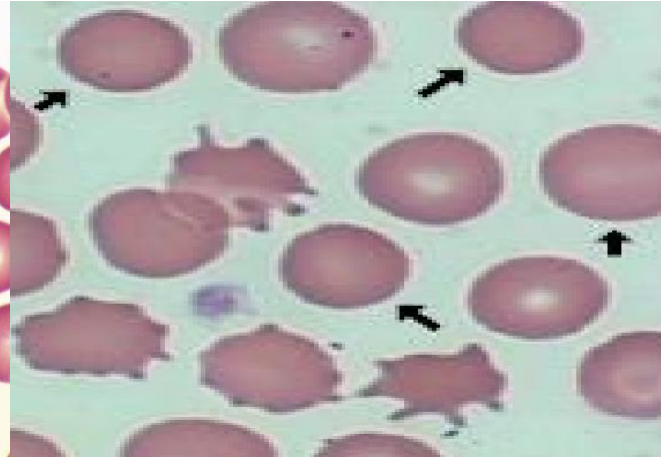
Hypochromic RBCs






Normochromic RBCs



Hyperchromic RBCs



2. Mean cell hemoglobin (MCH)

Hyperchromic	Normochromic	Hypochromic
		
MCH: >31 pg/cell	MCH: 27-31 pg/cell	MCH: <27 pg/cell

→ MCH decreases inversely proportional to the size of the central pale

3. Mean cell hemoglobin concentration (MCHC)

- Mean cell hemoglobin concentration (MCHC) is the ratio of hemoglobin mass to cell volume.
- Normal range
 - Men and women 32 – 36 g/dl.
- Calculation
 - **MCHC** is the only measurement that can be obtained with **reasonable accuracy** by manual methods because this is derived from Hb and PCV (Hct) as the following:

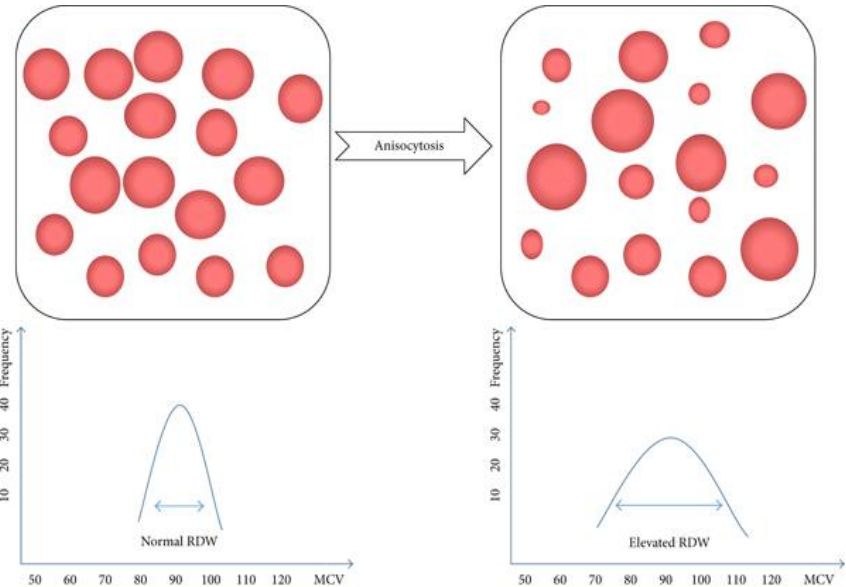
- $$\text{MCHC in g/dl} = \frac{\text{Hb [g/dl]}}{\text{Hematocrit (\%)}} \times 100$$

- **Example:**

- $$\text{MCHC} = \frac{12.5}{37} \times 100 = 33.7 \text{ g/dl}$$

4. Red cell distribution width (RDW)

- Red cell distribution width (RDW) is a parameter that measures variation in red blood cell size.
- RDW is related to variation in red cell size (anisocytosis).
- Normal range
 - 11.5 – 14.5 %



- Importance (comparing with MCV)
- RDW, along with MCV, is helpful in narrowing the cause of anemia.

Summary

	Definition	Manual Calculation	Normal Range
Mean corpuscular volume (MCV)	Average volume of an individual RBCAnalyzer: Measures directly <i>or</i>	$(\text{Hct [\%]}/\text{RBC}) \times 10$	80-100 fL
Mean corpuscular hemoglobin (MCH)	Average weight of hemoglobin in an individual RBCAnalyzer: Measures directly <i>or</i>	$(\text{Hgb [g/dL]}/\text{RBC}) \times 10$	28-34 pg
Mean corpuscular hemoglobin concentration (MCHC)	Ratio of hemoglobin mass to the cell volume	$(\text{Hgb [g/dL]}/\text{Hct [\%]}) \times 100$	32-36 g/dL
Red cell distribution width (RDW)	Variation of RBC volume used to help identify the presence of anisocytosis Analyzer calculation = $\frac{\text{Standard Deviation of MCV}}{\text{Mean MCV}} \times 100$		11.5%-14.5%