LAB4

Red Blood Cell Indices

The red cell indices define the size and Hb content of the RBC and consist of the mean corpuscular volume (MCV), the mean corpuscular hemoglobin concentration (MCHC), and the mean corpuscular hemoglobin (MCH).

The RBC indices are used in differentiating anemias. When they are used together with an examination of the erythrocytes on the stained smear, a clear picture of RBC morphology may be ascertained.

**Hematocrit**

Hematocrit is the ratio of the total volume of RBC‘s to that of whole blood expressed as percentage (%) (Whole blood = total volume of cells + plasma).

For example, a hematocrit value of 40% means that there are 40 milliliters of red blood cells in 100 milliliters of blood.

**Note:** *The second synonym for hematocrit is PCV (Packed Cell Volume). *

**Principle**

The procedure is easy to perform, whole blood is centrifuged in a narrow tube (capillary tube), cellular elements will be separated from the plasma, after centrifugation blood will be separated into 3 layers :

***(1) Bottom layer contains packed RBC’s***

***(2) Middle layer contains WBC’s and Platelets (Buffy coat )***

***(3) Upper plasma layer.***

**Method (microhaematocrate method)**

Fill the capillary tube with blood by capillary attraction.

Seal with the clay the end of the capillary tube.

Place and position the capillary tube in the centrifuge.

Centrifuge for 15 minutes at 4000 g, so that additional centrifugation does not pack the red blood cells more.

**Note:** *Adequate centrifugation time and speed are important for accurate hematocrit because cells should be packed so that additional centrifugation does not alter or reduce HCT reading.*

**Sources of Error:**

Inadequate mixing of the blood.

Hemolysis of blood sample (due to improper collection, delay in processing) will cause erroneously decreased HCT.

Failre to centrifuge long enough

Excess EDETA cause decrease in PCV due to RBCs shrinkage

Improper reading of the column lengths.

Plasma trapping is still one of the causes of erroneously increased HCT results.

**Note:** *trapped plasma is usually 5% of PCV value so we can calculate true PCV as follow:*

*True PCV = calculated PCV - 5% of PCV value*

**Calculations**

**Calculation of PCV**

The height of the RBC column, and the total column should be measured with the aid of a ruler in cm and mm, then divide the RBC column height over the total column height (total height = RBC column + buffy coat + plasma column)

**Calculation of Hb from HCT**

Hb conc. = (Normal Hb X Calculated HCT) / Normal HCT

**Mean corpuscular volume (MCV)**

Mean Cell (Corpuscular) Volume, is the average volume of red cells. This parameter is useful in classifying anemia‘s into:

Microcytic, normocytic, and macrocytic.

MCV is calculated from the hematocrit (HCT), and the Red Blood Cells Count (RBC count).

MCV = (HCT / RBC) X 10

The results of MCV are expressed in femtoliters (fl).

**Note:** *the automated hematology analyzers measure (not calculating) MCV, and then calculating the HCT from MCV and Total RBC count.*

**Mean corpuscular hemoglobin (MCH)**

Mean Cell Hemoglobin, is the hemoglobin content in the average red blood cell, or in other words, the average weight of hemoglobin per RBC.

It is calculated from the hemoglobin concentration (Hb), and the total RBC count.

MCH = (Hb / RBC) X 10

Results of MCH are expressed in picograms (pg)..

**Macrocytic red cells** have higher MCH, because they are larger and contain more hemoglobin.

**Microcytic red cells** have lower MCH, because they are smaller and contain less hemoglobin.

**Mean corpuscular hemoglobin concentration (MCHC)**

Mean Cell Hemoglobin Concentration, is the average hemoglobin concentration in 100 cc red blood cells. It indicates the average weight of hemoglobin as compared to the cell size. It correlates with the degree of hemoglobinization of the red cells on the peripheral blood film.

MCHC is calculated from the hematocrit and hemoglobin as follow:

MCHC = (Hb / HCT) X 100

Results of MCHC are expressed in percentage (%) or gm/dl.

If results are within this range, it is said that red cells are Normochromic.

If results are less than normal, red cells are said to be Hypochromic, which is seen in microcytic hypochromic anemias e.g. iron deficiency anemia.