Packed Cell Volume & RBCs Indices

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Packed Cell Volume (PCV)

- The red blood cells form about 45% of the blood volume.
- The volume of the blood occupied by the red cells is called packed cell volume [haematocrit].

The word **Haematocrit** is a latin word which means blood volume.
- (Haemato → blood /Crit → volume).
• Why do We Measure PCV?
• It is simple screeing test for anaemia and polythysemia.
• It can also be used as a rough guide to the accuracy of haemoglobin measurements (as the PCV should be about 3 times of the haemoglobin value)
• PCV is also used for the calculation of red cells indices (absolute values).
PCV Measurement Methods

• There are 3 methods to measure PCV:
  1) Micro-method.
  2) Macro-method.
  3) Electronic-method.

**Micro-hematocrit method**

• **Principle**
  • The blood (mixed with anticoagulant) is placed in a long capillary tube.
  • Then centrifuged in a microhaematocrit centrifuge.
  • The level reached by the column of erythrocytes is read with a scale reader.
  • This method is most probably used in routine work.
Materials

- Microhae
- Scale read
- Capillary heparin (i.e., dipotassium tubes are used)
- Long fine needles
- Filter-paper
- Soft wax (lamp)
- Sterile block
- 70% Ethanol
Interpretation of the result

- The PCV is higher in males than females
- PCV is low in anaemias
- PCV is high in polycythaemia and dehydration
- What happens to PCV immediately after blood loss?
Red Cell Indices

- These are values derived from the measured values of PCV, Hb and RBCs count. Indices can also be directly measured using automated haematological analyzers.
- They indicate red cell volume (MCV), red cell Hb content (MCH) and red cells Hb conc. (MCHC).
- These values are of clinical importance particularly in classification of anaemias.
• The precision and accuracy of the indices depend on those of the primary methods from which they are calculated.

• **Mean Cell Volume (MCV):**
  • Indicates the volume of a single red cell measured in femtolitres (fl).
  • It is calculated using the following formula:

\[
MCV = \frac{PCV \times 10}{\text{RBCs count (in million)}}
\]
Ex. If the PCV= 45 and the RBCs count = 5 mill.

MCV= \((45 \times 10) \div 5 = 90 \text{ fl}\)

**Mean Cell Haemoglobin (MCH):**
- Indicates the Hb content of a single red cell measured picograms (pg).
- Can be calculated if the Hb and RBCs count are known using the following formula:

\[
\text{MCH} = \frac{\text{Hb (g/dl) } \times 10}{\text{RBCs count (mill.)}}
\]

Ex. Hb= 15 g/dl and RBCs count= 5:
- MCH= \((15 \times 10) \div 5 = 30 \text{ pg}\)
• **Mean Cell Hb conc. (MCHC):**

• The MCHC is expressed in grams of hemoglobin per deciliter of packed red blood cells.

• This represents measurement of Hb or the ratio of hemoglobin mass to the volume of red cells.
• Can be calculated if Hb (g/dl) and PCV are known using the following formula:

\[ MCHC = \left( \frac{Hb \times 100}{PCV} \right) \text{ g/dl} \]

• Ex. If Hb = 15 g/dl and PCV = 45 %:

\[ MCHC = \frac{15 \times 100}{45} = 33.33 \text{ g/dl} \]
• **Normal values:** similar in men and women

• MCV : 92 ± 9 fl

• MCH: 29.5 ± 2.5 pg

• MCHC: 33 ± 1.5 g/dl

- high MCV: macrocytic cells.
- normal MCV: normocytic cells.
- low MCV: microcytic cells.
- normal MCH: normochromic cells.
- low MCH: hypochromic cells.
**Clinical significance of red cell indices:**

- MCV, MCH, and MCHC reflect average values and may not adequately describe blood samples when mixed populations of cells are present.
- In some anaemias dimorphic red cell population of both hypochromic and normochromic cells may be present, yet the indices may be normochromic and normocytic.
• MCV divides the anaemia into microcytic, normocytic and macrocytic

• In the newborn for a few weeks the MCV is high but in infancy it is low (e.g. 70 fL at 1 year of age) and rises slowly throughout childhood to the normal adult range.

• In normal pregnancy there is a slight rise in MCV, even in the absence of other causes of macrocytosis (e.g. folate deficiency).
• In anemias in which hemoglobin synthesis is impaired, such as iron deficiency anemia, hemoglobin mass per red cell decreases with a resultant decrease in MCH.
THANK YOU