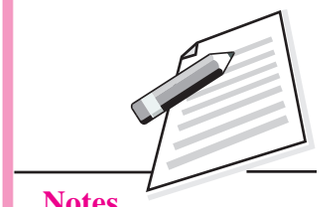


4

HEMATOCRIT

4.1 INTRODUCTION

Hematocrit is a commonly performed investigation in hematological laboratories for evaluation of patients with anemia.

OBJECTIVES

After reading this lesson, you will be able to:

- describe the methods of estimation of hematocrit
- describe the normal value and interpretation of result
- explain the calculation of red cell indices
- classify anemia.

4.2 HEMATOCRIT

Hematocrit or packed cell volume (Hct/PCV) is the volume occupied by red cells after blood is centrifuged at a high speed.

Methods for estimation

Hematocrit is measured by two methods:

- Microhematocrit method
- Automated method

The Macrohematocrit method which was used earlier is not used now.

Microhematocrit method

Sample: Blood collected in EDTA

Equipment required

1. Capillary tubes 75 mm in length with an internal diameter of 1mm.
2. Microhematocrit centrifuge
3. Reading device

Procedure

1. Place the capillary tube in the venous blood sample allowing blood to enter the tube by capillary action. Leave the last 15mm unfilled.
2. Seal the tube with modeling clay. Make sure there is no air trapped between the clay and the column of blood.
3. Place the tube in the microhematocrit centrifuge with the sealed end to the outer rim and centrifuge at 12000g for 5min.
4. Read the result using a microhematocrit reading device.

Fig. 4.1: Capillary tubes (right) and the microhematocrit centrifuge (left)

Fig. 4.2: Filled capillary tubes placed in the centrifuge

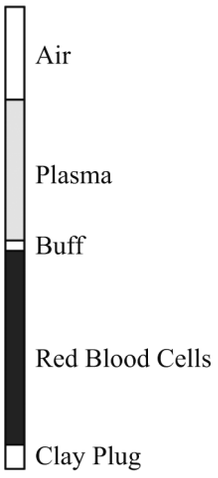


Fig. 4.3: The tube as it appears after centrifugation

Precautions

1. PCV increases with storage so it must be measured within 6 hrs of sample collection.
2. Capillary tubes must be of defined specifications.
3. Centrifuges must be checked at regular intervals for speed and accuracy.

Normal value

Men : 0.45±0.05L/L or 45±5%

Women : 0.41±0.05L/L or 41±5%

Notes

Significance of measuring hematocrit

- it is used as a screening test for anemia.
- along with red cell count and hemoglobin it is used for calculating red cell indices which are essential for classification of anemia.
- it can be used as a reference method for calibrating automated hematology analysers.
- it provides a rough guide to Hb measurement.

Precautions

1. PCV increases with storage so it must be measured within 6 hrs of sample collection.
2. Capillary tubes must be of defined specifications.
3. Centrifuges must be checked at regular intervals for speed and accuracy.

Automated method

This will be discussed in the chapter on automated cell analysers.

Normal value

Men : 0.45±0.05L/L or 45±5%

Women : 0.41±0.05L/L or 41±5%

Reduced Hematocrit is seen in anemia.

Increased hematocrit is seen in polycythemia.

Red cell indices

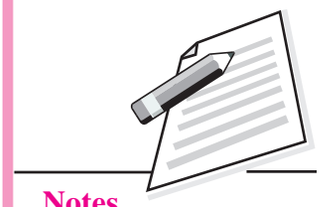
These indices are used in the morphological classification of anemia. They can be calculated manually. However, in most laboratories they are obtained by automated hematology analysers.

The **three indices** are

- Mean Corpuscular Volume (MCV)
- Mean Corpuscular Hemoglobin (MCH)
- Mean Corpuscular Hemoglobin Concentration (MCHC)

Mean corpuscular volume indicates the average volume of each red cell.

$$MCV = \frac{\text{Packed cell volume \%}}{\text{Red cell count (millions/mm}^3\text{)}} \times 10 \text{ femtolitres}$$



Notes

Hematocrit

Normal value 90±10fl

Interpretation: In the presence of anemia if

MCV < 80fl: microcytic anemia

MCV > 100fl: macrocytic anemia

MCV80-100 fl:normocytic anemia

Mean corpuscular hemoglobin reflects the average amount of Hb in each red cell.

$$MCH = \frac{\text{Hemoglobin (g/dl)}}{\text{Red cell count (millions/mm}^3\text{)}} \times 10 \text{ picogram}$$

Normal value: 29.5 ± 2.5pg

Interpretation: In the presence of anemia if

MCH < 27pg: hypochromic anemia

Mean corpuscular hemoglobin concentration is the average concentration of Hb in a given volume of packed red cells

$$MCHC = \frac{\text{Hb (g/dl)}}{\text{PCV (\%)}} \times 100 \text{ g/dl}$$

Normal value: 33±1.5g/dl

Limitation of red cell indices: These are mean values and cannot express the variation that occurs within a population. They may be normal if the number of abnormal cells is small. If two populations of cells are present eg microcytic and macrocytic, the indices can again be normal.

Use of red cell indices: They are used in the classification of anemias.

Anemia: This is defined as a decrease in the red cell mass to adequately deliver oxygen to peripheral tissues. To establish the presence of anemia in the laboratory we can use Hb, hematocrit or packed cell volume and the red cell count. Because it is the easiest to measure, hemoglobin is the most frequently used parameter to detect anemia. Though the parameters can be measured manually it is best to measure them on an automated analyser.

Classification of anemia

I. **Morphological classification:** Anemia is classified on morphological grounds into three groups

Notes

- Microcytic hypochromic anemia MCV<80fl,MCH<27pg
- Macrocytic anemia MCV>100fl
- Normocytic,normochromic anemia MCV80-100fl, MCH27-32pg

Advantages of morphological classification

1. It is of practical, clinical value. Each subtype is associated with distinct causes and thus narrows the probable diagnosis.
2. It allows a comprehensive laboratory approach to be followed to reach a definitive diagnosis.
3. The initial step in making the classification depends on readily available laboratory tests.

II. Kinetic classification: Divides anemias into 2 groups:

(a) Impaired erythrocyte production

(b) Increased erythrocyte production

The causes of each are given below

Impaired production

Iron deficiency anemia

Anemia of chronic disease

Hypoplastic anemia

Anemia due to infiltrative disorders

Megaloblastic anemia

Thalassemia

Increased production

Hemolytic anemia

Treated nutritional anemia

INTEXT QUESTIONS 4.1

1. Calculate the MCV in this patient with Hct of 45% and red cell count of 5×10^{12}/L
2. If the Hb of this patient is 8g/dl, what will be the morphological subtype of anemia
3. The Hb of a male patient is 15g/dl and the red cell count is $5x10^{12}$/L. Calculate the MCH.

WHAT HAVE YOU LEARNT

- **Hematocrit** is a commonly performed investigation. It is used to **screen for anemia** and for **calculation of red cell indices**. Three red cell indices can be calculated from Hb, Hct and red cell count. These are **MCV, MCH and MCHC**. The red cell indices are helpful in the **classification of anemia on morphological grounds.**

TERMINAL QUESTIONS

1. Classify anemia
2. Describe the methods of Hematocrit measurement

ANSWERS TO INTEXT QUESTIONS

4.1

1. 90 fl
2. Normocytic
3. 30 pg