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PACKED CELL VOLUME (PCV) & MEASUREMENT OF BIOOD INDICES

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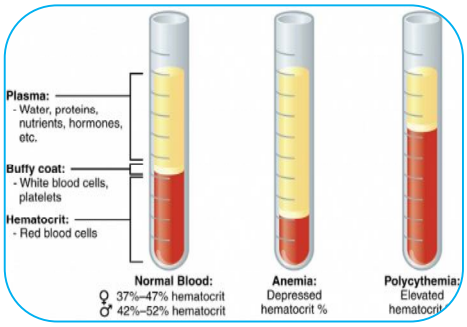
ABSTRACT

Packed cell volume (PCV) is the proportion of blood occupied by RBCs, expressed in percentage. Blood is centrifuged in hematocrit tube and the volume of RBCs packed at the bottom of a hematocrit tube is measured. PCV is also called Hematocritvalue or ErythrocyteVolume Fraction (EVF).

KEYWORDS : *Packed Cell volume (PCV), Blood Indices.*



INTRODUCTION

A. Methods of calculation: Blood mixed with anticoagulants such as ethylenediaminetetraacetic acid (EDTA) or heparin is filled in hematocrit or Wintrobe tube (110 mm long and 3 mm bore) up until 100th mark. Then blood is centrifuged at a speed of 3000 revolutions per minute (rpm) for 30 minutes. While plasma remains on top of cellular pools, RBCs arepacked at the bottom of tube, which yeilds packed cell volume (PCV). In between the RBCS and the plasma, there will be a white buffy coat that is formed by white blood cells and the platelets.

In the laboratories with modern equipmentss, PCV is calculated indirectly by autoanalyzer. It is estimated by multiplying RBC count with mean cell volume. This is because some amount of plasma is always trapped between the RBCs, and accurate value can be obtained only by direct measurement of PCV.

B. Clinical significance of asserting PCV: Calculation of PCV assists;
1. Diagnosis and treatment of anemia
2. Diagnosis and treatment of polycythemia
3. Determination of extent of dehydration and recovery from dehydration aftertreatment
4. Decision of blood transfusion.

C. Variations in pcv:
i. Enhancement of PCV: PCV increases in conditions such as;
1. Polycythemia
2. Dehydration
3. Dengue fever (caused by flavivirus andtransmitted by Aedes aegypti mosquito)

ii. Reduction of PCV: PCV is reduced in conditions such as;

1. Anemia
2. Cirrhosis of liver
3. Pregnancy
4. Hemorrhage due to ectopicpregnancy(Embryo implantation in extra-terine tissues). This condition is characterized by vaginal bleeding.

D. Normal Values of PCV: A slight gender difference exists in normal values as follows;
1. Males = 40% to 45%
2. Females = 38% to 42%

E. Effect ofViscosity on Blood: Viscosity of the blood is directly proportional to the volume of RBCs. The viscosity of entire blood is proportional to 3 times the pressure that is essential to pump entire blood as to pump water through the same blood vessel. If hematocrit enhances to 60 or 70%, which is often seen in polycythemia, blood viscosity can increase by ten fold when compared to water. At this stage, blood flow through blood vessels is reduced to a maximum extent. Other factors that influenceblood viscosity are plasma protein concentration and plasma protein composition. However, the effects of the latter are much less than the effect of hematocrit. The viscosity of blood plasma is approximately 1.5 times that of water.

F. Effect of blood PCV and blood viscosity on vascular resistance and blood flow: One of the important factors in poiselliue's equation is the viscosity of blood. The significance ofviscosity is less on blood flow provided that all other factors remain constant.Generally the viscosity of normal blood is about 3 times greater than that of water. The blood becomes so viscousbecause of more number of suspended red cells in theblood , and each RBC applies fractional drag against adjacent cells and against the wall ofblood vessel.

G. Blood indices: Blood indices are essentially meant for RBCs but not for WBCs and thrombocytes . The Colour , number, shape and volume of the RBCsis directly proportional to quantity of blood. So, these features are termed as blood indices.

H. Differentbloodindices: Blood indices include:
1. Mean corpuscular volume (MCV)
2. Mean corpuscular hemoglobin (MCH)
3. Mean (MCHC)
4. Corpuscular hemoglobin concentration
5. Color Index (CI)

1. Mean Corpuscular Volume (MCV): The average volume of a single RBC, expressed in cubic microns (cu μ)' is termed 'MCV'. Normal value of MCV is 90 cu μ (78 to 90 cu μ). Normocytic RBC are those that have normal MCV values, and RBCs are considered microcytic when MCV decreases. Inboth pernicious anemia and megaloblastic anemia, RBCs are macrocytic, whereas RBCs are microcytic in case of iron deficiency.

2. Mean Corpuscular Hemoglobin (MCH): MCH is the quantity of hemoglobin present in a single RBC. It is expressed in microgram or picogram (pg). Normal value of MCH is 30 pg.

3. Mean Corpuscular Hemoglobin Concentration (MCHC): MCHC is the concentration ofhemoglobin in RBC. Precisely, it is the amount of hemoglobin in one RBC normalized to the volume of one RBC that is expressed as percentage. This is the most important measured and absolute value is usefulin the diagnosis of anemia. Normal value of MCHC is 30%, and ranges from 30% to 38%. When MCHC is normal, the RBCs are called normochromic. When the MCHC decreases, RBCsare considered

hypochromic. In pernicious anemia and megaloblastic anemia, RBCs are macrocytic and normochromic or hypochromic. In iron deficiency anemia, RBCs are microcytic and hypochromicHisow single RBC cannot be hyperchromic because the amount of hemoglobin cannot increase beyond normal.

4. Color Index (CI): Color index is the ratio between thehemoglobin percent and the RBCs percentage in the blood. Actually, it is the average hemoglobin content in one cell of a patient compared to the average hemoglobin content in one cell of a normal person. Normal color index is 1.0 (0.8 to 1.2). Although used widely in olden days, it is very useful in determining the type of anemia. The CI increases in macrocytic anemia and megaloblastic anemia, while decresses in iron deficiency anemia. It is normal in normocytic normochromic anemia.

I. Estimation of blood indices: Blood indices are estimated with the help of different formulas. These estimating needs values hemoglobin content, RBC count as well as PCV. For example values from the blood of a male subjected are

Example:-Estimate MCV, MCH, MCH Cand colour index given below?
Hemoglobin (Hb) content:15 g/dl.; RBC count : 5 millions /cu mm. and PCV: 40 %
MCV = PCV/RBC
= 40/5 ×10
= 80 Cu micron.
MCH = Hb/RBC
=15/5 × 10
I = 30 pg
MCHC = Hb/PCV
= 15/40 ×100
= 37.5%
CI = Hb/RBC
Hb% =Hb content in the subject/Hb content in normal person × 100
= 8 g/dl /15 g/ dl × 100
= 53.3 %
RBC % =RBC count in the subject /RBC count in the normal person ×100
= 5/5 × 100
= 100 %
CI % = Hb % / RBC %
= 53.3 / 100
= 0.53

Results:
MCV = 80 Cu micron.(Normal = 78-90 Cu micron)
MCH = 30 pg.(Normal = 27-32 pg)
MCHC = 37.5 %.(Normal = 30-38 %)
CI = 0.53.(Normal = 0.8-1.2)
The results of these indices show that these blood indices are normal in this person regarding MCV,MCH,MCHC, whereas low CI occurs during iron deficiency anemia.

J. Clinical significance of blood indices: Blood indices show diagnostic importance in determining the type of anemia.

1. Clinical significance of MCV: An MCV test gives an indication about the average size of RBCs. The movement of oxygen occursthrough RBCs from lungs to every cell of the body. Human or animal cell requires oxygen for growth and reproduction as well as health status.

2. Clinical significance of MCH: MCH indicates the amount of Hb present in each RBC. Blood is red in colour because of the presence of Hbin RBCs. Hb receives oxygen from lungs and transport to the oxygen to the body.Hb plays role in removing carbon dioxide from the body.

3. Clinical significance of MCHC: MCHC test is a original part of complete blood count (CBC) that is prefer during blood analysis. MCHC value is also required to determine severity as well as cause of anemia.

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