MSK- 1 MODULE
SKILL LAB /Physiology PRACTICAL
FIRST YEAR MBBS BATCH 50

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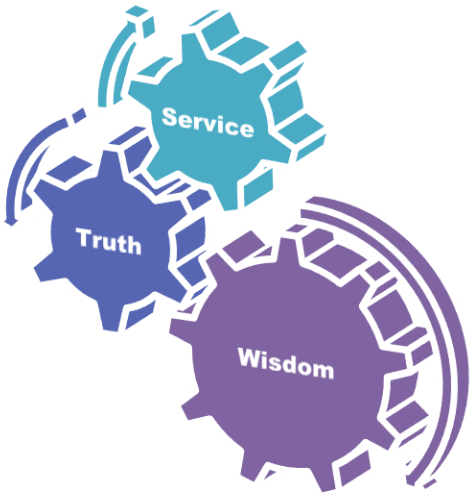
Determination of Erythrocyte Sedimentation Rate(ESR)

Motto



Vision; The Dream/Tomorrow

- To impart evidence based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

LEARNING OBJECTIVES

At the end of skill lab , students must be able to:

- Understand the concept of Erythrocyte Sedimentation Rate.
- Describe clinical importance of Erythrocyte Sedimentation Rate.
- Determine the Erythrocyte Sedimentation Rate.
- Understand physiological and pathological variations in ESR.

INTRODUCTION

- **ESR** is defined as the rate of sedimentation of RBCs in mm/hour in unclotted blood ,when it is allowed to stand.
- Erythrocytes have only a slightly higher density than plasma, they normally settle out of whole blood slowly .

NORMAL RANGE OF ESR

- Normal levels of ESR for men range from:
  0 to 15mm/hour
- Normal levels of ESR for women range from :
  0 to 20mm/hour
- The normal range varies depending on the type of test used.

CLINICAL IMPORTANCE OF ESR

- **Diagnostic value:**
- Clinically, it can be a important diagnostic index as values are significantly elevated in:
- Infection
- Autoimmune diseases
- Inflammatory diseases
- In general ,cells tend to sediment faster when the concentration of plasma proteins increases.

CONTD….

- High plasma proteins favour the stacking of red cells like coins ,called Roulaux phenomenon and hence elevate ESR.
- **Prognostic value:**
- Serial determination is important in assessing the activity of some chronic diseases such as Rheumatoid Arthritis and Tuberculosis:

A gradual fall -------->remission

Rising ESR------->exacerbation of the disease

METHODS OF DETERMINATION OF ESR

- **Principle:**

  RBCs remain uniformly suspended in the plasma of circulating blood .When anticoagulated blood is allowed to stand in a narrow verticle tube ,RBCs being heavier than plasma,settle or sediment towards the bottom of the tube .This rate is recorded at the end of one hour in millimeter(mm) .

- **Two methods:**
  - **Westergren's method**
  - **Wintrobe's method**

WESTERGREN'S METHOD

- **Material and Apparatus:**
- Westergren's tube .Petri dish.3.8% sodium citrate, spirit swab ,disposable syringe.
- **Procedure:**
- Introduce yourself, take consent and explain what you are going to do.
- Add 3.8% sodium citrate in a Petri dish.
- Draw 1.6cc/ml of venous blood under aseptic measures and transfer this blood to the Petri dish and mix the contents gently.

CONTD…

- Draw blood in westergren's tube exactly upto the zero mark after placing finger tip over the top of westergren's tube to control the flow of blood in or out of it
- Place the tube vertically in the ESR stand by firmly pressing its lower end into the rubber cushion while keeping your finger over the westergren's tube rack and leave it undisturbed.

CONTD….

- Leave the tube undisturbed for one hour and then note the length of the column of clear plasma at the top of RBCs at the end of first hour.
- Record the value of ESR as:

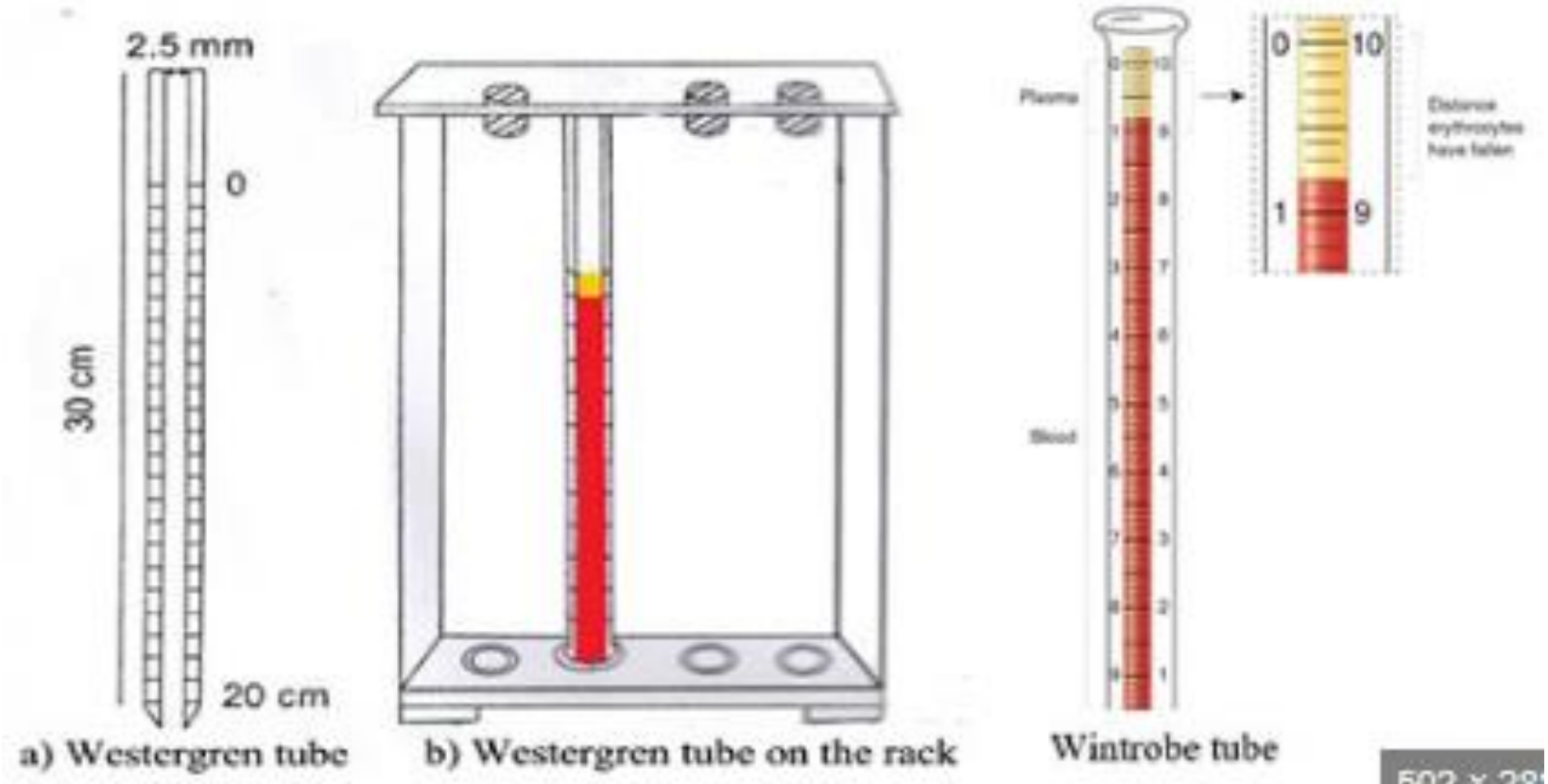
  ESR=-----mm after first hour

- Normal values:

  Males:3 to 9 mm after 1st hour.

  Females:5 to 12 mm after 1st hour.

MATERIAL AND INSTRUMENTS



Reference:www.onlinebiologynotes.com/erythrocyte-sedimentation-rate-esr-principle-method-procedure-and-clinical-application/https

PRECAUTIONS

- The tube should be absolutely vertical.
- Avoid air bubbles in the column of blood.
- Avoid clotting of blood while mixing anticoagulant.
- The westergren's tube must be filled upto mark zero.

WINTROBE'S METHOD

- **Apparatus and Material:**
- Disposable syringe and needle ,sterilized cotton swab, container with double oxalate mixture ,pasteur pipette with a thin long nozzle and wintrobe's tube.
- **Markings on wintrobe's tube and uses:**
- It is graduated 0 to 10cm from above downwards on one side(for ESR)and 10 to 0cm on the other side for hematocrit.
- **uses**:

Used for determination of ESR.

Used for determination of PCV or hematocrit.

PROCEDURE

- Draw 2 ml of venous blood under aseptic technique and transfer it to a container containing anticoagulant.
- Mix the contents gently but well by inverting the container a few times or by swirling it. Don't shake ,as it will cause frothing.
- Using the pasteur pipette ,fill the wintrobe's tube from below upwards .Ensure that there are no air bubbles.
- Transfer the tube to its stand and adjust the screws so that it remain vertical.

CONTD….

- Leave the tube undisturbed in this position for one hour ,at the end of which read the mm of clear plasma above the red cells.
- Normal value

Males:2 to 8mm after 1st hour

Females:4 to 10mm after 1st hour

FACTORS AFFECTING ESR

Technical and Mechanical factors:

- Length of tube
- Diameter of the bore(if less than 2mm).
- Type of anticoagulant used(liquid anticoagulant gives higher values).

Physiological factors:

- The red cell count ,their size and their shape.
- Raised body temperature.
- Viscosity of plasma.
- Tendency to rouleaux formation.

VARIATIONS IN ESR

- **Physiological causes of variation in ESR**:
- **Age**: low in infants ----->polycythemia

Gradually increases in adults.

- **Sex**: higher in females----->low hematocrit
- **High altitude:** ------>polycythemia----->higher ESR.
- **Pregnancy:** hemodilution and increased fibrinogen: albumin ratio-----> increased rouleaux formation-----> elevated ESR.
- **Body temperature**: increase temperature---->decrease blood viscosity----->increase ESR.

PATHOLOGICAL CAUSES OF INCREASED ESR

- All acute and chronic infections.
- All anemias except spherocytosis ,sickle cell anemia and pernicious anemia.
- Bone disease like osteomyelitis.
- Connective tissue disease like systemic lupus erythematosus.
- Malignant diseases or cancers for example carcinoma of breast and leukemias.
- Trauma and surgery.

CAUSES OF PATHOLOGICAL DECREASE IN ESR

- Polycythemia.
- Anemias like spherocytosis ,sickle cell anemia and pernicious anemia.
- Afibrinogenemia .
- Severe allergic reactions.

QUESTIONS

Q. No. 1:Why do the red cells settle down in a sample of anticoagulated blood?

Answer: Since the blood is not moving ,red cells settle down because they are heavier than the plasma in which they are suspended.

QUESTIONS

(Continued)

Q. No. 2:What are advantages and disadvantages of Westergren's method?

Answer: Advantages: This method is more sensitive since tube is sufficiently long and its diameter is also larger. The higher sensitivity and longer tube is important in cases where ESR is high(80mm).

Disadvantages: The citrate solution dilutes the red cells which by itself tends to raise ESR.

QUESTIONS

Question 3:Why is ESR reading taken after one hour?

Answer: The reason for this is that more than 90 to 95% red cells settle down by the end of this time. After one hour the rate of sedimentation does not significantly affect the ESR.

MCQs

1.The normal range of ESR in males by westergren's method is:

a) 2 to 10mm after 1st hour

b) 3 to 9mm after 1st hour

c) 5 to 12mm after 1st hour

d) 2 to 8mm after 1st hour

e) 4 to 10mm after 1st hour

Answer:

b) 3 to 9mm after 1st hour

MCQs

2.A 25 years old pregnant female came for routine checkup. Her physical examination is normal .All labs are within normal range except elevated ESR. The mostly like cause of this elevated ESR is:

a) Hemodilution
b) Hemoconcentration
c) Decreased fibrinogen :albumin ratio
d) Increased albumin :fibrinogen ratio
e) Decreased blood volume

Answer :a)hemodilution

LEARNING RESOURCES

- Practical physiology 1st year MBBS by DR Saqib Sohail.
- Guyton and hall textbook of medical physiology 14th edition.
- Google images.

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