

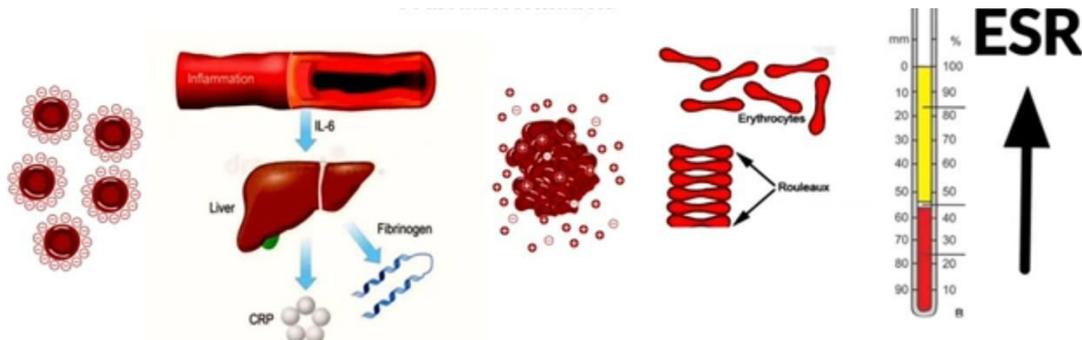
Erythrocyte Sedimentation Rate (ESR)

It is a common hematological test for nonspecific detection of inflammation that may be caused by infection, some cancers and certain autoimmune diseases. Can be defined as a measurement of the rate at which the RBCs (erythrocytes) settle down at the bottom of test tube that contains anticoagulated blood.

Principle of ESR:

If anticoagulated blood is allowed to stand undisturbed

- 1- the red cells will gradually settle to the bottom of the container leaving a clear layer of plasma.
- 2- RBCs possess a **net negative charges** and when suspended in normal plasma. Changes in the proportion and concentration of the plasma proteins, particularly macro-molecules like fibrinogen and globulin reduce the zeta potential (negative charge), increasing in the sedimentation.



Why is ESR test done?

- 1- To determine the presence of an inflammatory reaction in the body in response to infections, injury, or autoimmune disease.
- 2- To monitor the progression of the inflammatory disease and evaluate its response to the treatment.

If high ESR value:

- 1- Inflammatory disease such as (arthritis, vasculitis)
- 2- Infections like (pneumonia, pelvic inflammatory disease, appendicitis, skin and bone infection).
- 3- Autoimmune disease like (systemic lupus erythematosus [SLE], or rheumatoid arthritis)
- 4- Chronic kidney disease
- 5- Cancer



Low ESR:

- 1- Polycythaemia.
- 2- Hypofibrinogenaemia.
- 3- Congestive heart failure.
- 4- Sickle cell disease
- 5- Severe liver disease

Methods:

Two methods have been commonly used for measurement of the ESR:

- 1- Westergren ESR.
- 2- Wintrobe ESR.

Westergren method:

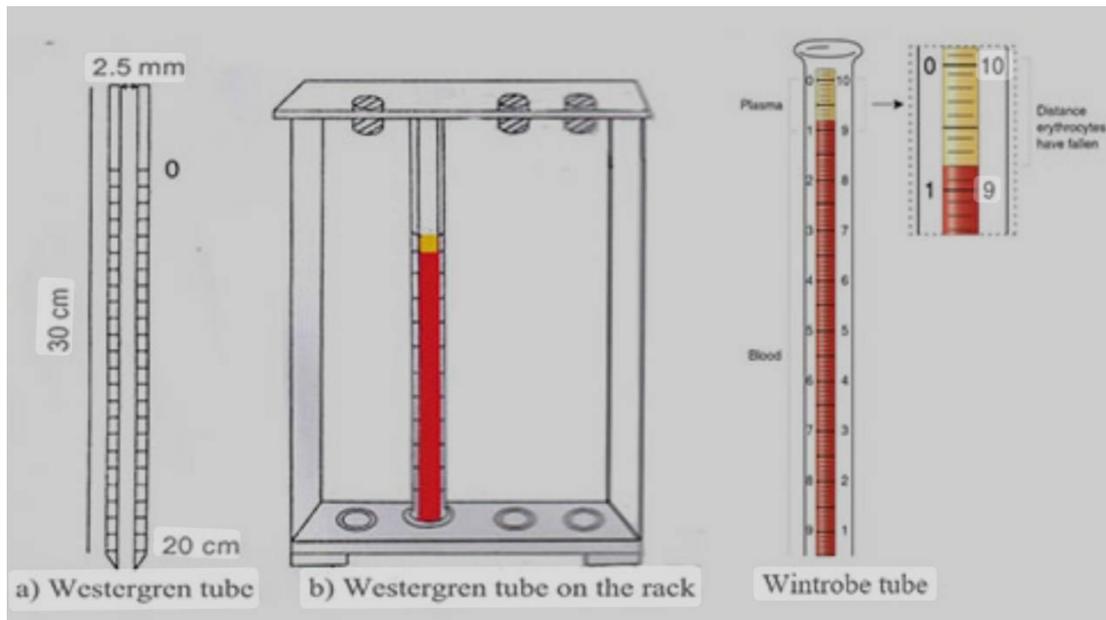
Principle: this test measures the rate settling of red cells in diluted plasma. The reported value is obtained by measuring the drop in the red cells meniscus after 1 Hr.

materials:

- Anticoagulant: 3.2% tri-sodium citrate, add one volume of the anticoagulant to 4 volumes of the blood, directed or from EDTA anticoagulated blood.
- ESR tubes: the recommended tube is a straight glass tube, 30 cm in length, and 2.55 ± 0.15 mm in diameter. The bore must be uniform to 0.05 mm through. It should be scale graduated in mm over the lower 20 cm, from 0 at the top to 200 at the bottom. The tube must be cleaned and dried.

Procedure:

- 1- Fill the Westergren tube with the well mixed blood, to the zero point.
- 2- Place the tube in the rack, in a strictly vertical position under room temperature. Avoid the direct sun light and vibration.
- 3- At 60 min, record the distance of the red cells meniscus in mm and express this as ESR (ESR = X mm/ hour).
- 4-Care should be taken to exclude any Buffy coat from the red cells.



Normal range:

Men = 1 - 7 mm/ hr.

Men (60 years or more) = 2 - 10 mm/ hr.

Women= 2 - 9 mm/ hr

Women (60 years or more)= 5 - 15 mm/hr. 3

FACTORS AFFECTING THE ESR:

1- Effect of plasma proteins:

Changes in plasma proteins occur rapidly following tissue injury or in response to inflammation. Increased concentration of fibrinogen and immune-globulins will increase rouleaux formation and hence the rate of sedimentation. Plasma albumin retards sedimentation of RBCs.

2- The RBC count and number:

The size and the number of the RBCs also effect on the ESR, the cells which show alteration in the size like spherocytes and sickle cells, usually do not exhibit increase rate, unless there is severe anemia. Increased red cells mass, retards the sedimentation rate, e.g. polycythaemia.

3- Technical factors:



- a- The tube should be vertical, and not any vibration can reduce the ESR
- b- Temperature (RT 18-25 C°) higher temperature can cause false high results due to the reduction in the plasma viscosity.
- 4- **Pregnancy:** lead to High ESR values can .
- 5- **Drugs:** like steroids can decrease the ESR values
- 6- Vitamin A and oral contraceptive can increase ESR values.

References:

- 1- Hoffbrand, A. V., & Steensma, D. P. (2019). Hoffbrand's essential haematology. John Wiley & Sons.
- 2- Adewoyin, A. S. (2014). Peripheral blood film-a review. *Annals of Ibadan postgraduate medicine*, 12(2), 71-79.
- 3- Neel, J. A. (2013). Blood smear basics. *NC State college of Veterinary Medicine. North Carolina: Raleigh.*

Karrar Salih Mahdi Ph.D. / Biology