Erythrocyte Sedimentation Rate (ESR)

Erythrocyte Sedimentation Rate (ESR, sed rate or “Bieracki reaction”) is a non-specific measure of inflammation that is commonly used as a medical “in vitro” screening test. The test was invented in 1897 by the Polish physician Edmund Biernacki and published in Polish. In 1918 Swedish pathologist Robert Fähræus declared the same and along with Alf Vilhelm Westergren published in English.

Anticoagulated whole blood in tube separates into an upper layer of plasma and lower layer of blood cells because of gravity. Erythrocytes are heavier (their specific density-weight is about 1.090kg/L and suspended in lighter plasma (which specific density-weight is about 1.027kg/L). The distance that cells fall (sedimentate) within a specified time interval (usually 1 hour) is defined as erythrocyte sedimentation rate (ESR). The rate of sedimentation of a single erythrocyte is 0.2 mm/h but in vivo the sedimentation rate is higher, usually 1-2 mm/h.

In normal conditions erythrocytes settle faster because they aggregate (they form stacks called “rouleaux”). ESR depends on the rate of aggregation (groups of 10 erythrocytes settle 1 mm/h, groups of 50,000 erythrocytes settle 75 mm/h).

What factors elevates erythrocytes aggregation (and ESR)?:

↑ Erythrocyte size,
↓ Erythrocyte count,
↑ Concentration of globulins (lipoproteins, glycoproteins, immunoglobulins),
↑ Viscosity of plasma,
↓ Concentration of albumin (after physical exercise, prolonged hunger).

However, the main factor in vivo is a ratio [albumin]/[globulins]. Elevation of globulin concentration and decrease in albumin concentration reduces the electrical load of erythrocytes and increase aggregating ability. ESR is an easy, fast and non-expensive diagnostic method for observation of changes in plasma proteins.

Physiological states of increased ESR:
- After meals,
- After hot baths,
- During menstruation,
- After physical exercises,
- Increases with age.

Pathological states of increased ESR:
- Infectious diseases,
- Neoplastic, invasive tumours,
- Anaemias,
- Chronic and acute diseases of liver,
- Diseases of connective tissues.

Evaluation of ESR.

Elements of ESR set:
1. Plastic tubes with stoppers containing 0.25 mL of 3.1% solution of sodium citrate in transport stand.
2. Glass multiple-use Westergren tubes with a scale ranging from 0 to 160, 180 or 200 mm. Internal diameter is 2.5 mm (+/- 0.1 mm).
3. Sedimentation multiple-use vertical stand with 10 sockets.
4. Sedimentation multiple-use inclined (oblique) stand with 10 sockets (for fast ESR evaluation).

Procedure:
1. Collect approximately 1.2 mL of the venous blood and open the citrate tube.
2. Fill the tube with blood up to the level of 1.25 mL, close the tube firmly and mix.
3. Introduce Westergren tube into opened citrate tube. The blood meniscus should reach “0 mm” level Air bubbles should not be observed.
4. Place Westergren tube into the vertical stand (for an hour) or into the inclined (oblique) stand (for 7 and 10 minutes) and then record the number of mm to which erythrocytes have settled.

Reference values for of ESR:

<table>
<thead>
<tr>
<th>Infants, children</th>
<th>Adult males</th>
<th>Adult females</th>
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<tbody>
<tr>
<td>1 - 2 mm/h.</td>
<td>2 - 6 mm/h (0 – 10 mm/h).</td>
<td>3 - 10 mm/h (0 – 15 mm/h).</td>
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