



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 4, pp. 16575-16577, April, 2017

**International Journal of
Recent Scientific
Research**

DOI: 10.24327/IJRSR

Research Article

INTERPRETATION OF ESR AND BLOOD VISCOSITY

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DOI: <http://dx.doi.org/10.24327/ijrsr.2017.0804.0175>

ARTICLE INFO

Article History:

Received 17th January, 2017
Received in revised form 21st
February, 2017
Accepted 05th March, 2017
Published online 28th April, 2017

Key Words:

Blood viscosity, erythrocyte sedimentation rate, plasma viscosity, fibrinogen.

ABSTRACT

The aim of the experiment is to compare the blood viscosity levels in different kinds of patients by studying the erythrocyte sedimentation rate. To determine the cardiovascular risk factors linked independently to blood viscosity. Blood viscosity is a measure of resistance of blood to flow, which is described as thickness and stickiness of blood. Increased amount of RBC in blood causes relative increase in blood viscosity. Both RBC deform ability and plasma proteins have a role to play in erythrocyte aggregation. The rate of sedimentation in a period of one hour called ESR and also Biernack test. It is a common haematological non specific indicator of inflammation. To perform the test, non clotting blood is placed in a vertical tube (Westergren) and ESR is measured and reported in units of mm/hr. It reflects the extent of systematic inflammation The reason behind this experiment is to create awareness about the unknown cardiovascular diseases which can be determined by the erythrocyte sedimentation rate.

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INTRODUCTION

Blood viscosity is an intrinsic resistance of blood as it flows through blood vessels and its mainly determined by the shear rate of the flow, the volume fraction of red blood cells, the concentration of plasma proteins namely fibrinogen, red blood cell aggregation and red cell deformation². Blood viscosity, plasma viscosity, haematocrit tests are important determinants of blood flow theology and hence may have roles in cardiovascular diseases and mortality in samples of general population⁴ Certain factors such as red blood cell factors, plasma proteins and blood volume are common to both erythrocyte sedimentation rate and plasma viscosity. It is found that a direct logarithmic line exists between erythrocyte sedimentation rate and plasma fibrinogen concentration.³ Erythrocyte sedimentation rate is the oldest acute phase index. The phenomenon was described by John hunter and applied as a laboratory test by Edmund Biernack⁹. It is one of the most commonly requested laboratory tests prescribed by physicians. It's rate is dependent on various physiological and pathological factors including haemoglobin concentration, ratio of plasma proteins, serum lipid concentration and plasma pH.⁸ Blood viscosity causes blood stagnation and subsequent pathological thrombotic events, resulting in the development of ischemic stroke¹.

The rate of sedimentation in a period of one hour called ESR and also Biernack test. It is a common hematologic non specific

indicator of inflammation. To perform the test, non clotting blood is placed in a vertical tube (Westergren) and ESR is measured and reported in units of mm/hr.⁷ It reflects the extent of systematic inflammation. An elevated ESR is often observed in cases of infection, malignancy, auto immune diseases.⁶ ESR test mainly measures the plasma viscosity by assessing the tendency for red blood cells to aggregate band fall through the variably viscous plasma. Sedimentation rate is often and significantly affected by many factors:

1. Plasma albumin concentration.
2. Size, shape and number of red blood cells
3. Non acute phase reaction proteins, in particular normal and abnormal immunoglobins.⁵ Fibrinogen, the most abundant acute phase reactant, has the greatest effect on the elevation of ESR in comparison to other acute phase proteins¹⁰. The protein factors which increase include fibrinogen, alpha proteins (alpha-1-antitrypsin, alpha -1 anti chymotrypsin and alpha -1 acid glycoprotein) and the second, third and fourth components of complement.¹²

ESR has various clinical applications such as

1. Rheumatoid Arthritis (RA) and Other Autoimmune Conditions
2. Temporal Arteritis and Polymyalgia Rheumatica
3. Multiple Myeloma and Other Paraproteins¹¹

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MATERIALS AND METHODOLOGY

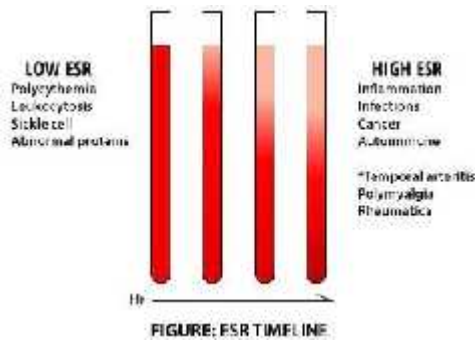
ESR values of 100 patients were obtained from Saveetha dental college and hospitals, Poonamallee, Chennai - 77 and an observational study was done according to their age and sex. The different kinds of patients were analysed and the ESR was determined according to their diseases.

A specific amount of diluted, unclotted blood is placed in a special narrow tube and left undisturbed for exactly one hour. The red cells settle towards the bottom of the tube, and the pale yellow liquid (plasma) rises to the top. After 60 minutes, measurements are taken of the distance the red cells traveled to settle at the bottom of the tube.

Stages in erythrocyte sedimentation

There are 3 stages in erythrocyte sedimentation

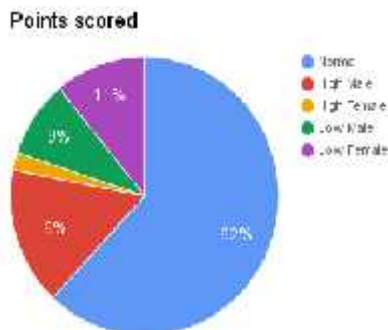
- Stage 1: Rouleaux formation - First 10 minutes
- Stage 2: Sedimentation or settling stage - 40 mins
- Stage 3: Packing stage - 10 minutes (sedimentation slows and cells start to pack at the bottom of the tube)



RESULTS

A physician can use ESR to monitor a person with associated diseases. When the disease worsens, the ESR increases, when it improves, ESR decreases.

- Men under 50 years old: < 15 mm/hr
- Men over 50 years old: < 20 mm/hr
- Women under 50 years old: < 20 mm/hr
- Women over 50 years old: < 30 mm/hr
- Newborn: 0-2 mm/hr
- Newborn to puberty: 3-13 mm/hr.



From this study, we can see that 62 patients are normal who are diagnosed normal

- 16 males and 2 females with high values who are diagnosed with either rheumatoid arthritis, polymyalgia rheumatica or hyperfibrinogenemia.
- 9 males and 11 females with low values who are diagnosed with polycythemic, sickle cell anaemia or hypofibrinogenemia

DISCUSSION

ESR and C-reactive protein (CRP) are both markers of inflammation. Generally, ESR does not change as rapidly as CRP does, either at the start of inflammation or as it resolves. Since CRP does not get affected by many factors as ESR gets, it is considered a better marker of inflammation. However, because ESR is an easily performed test, many health practitioners still use ESR as an initial test when they think a patient is suffering from inflammation.

If the ESR is elevated, it is typically a result of two types of proteins, globulins or fibrinogen. Depending on the tested person's medical history, signs, symptoms and what the health practitioner suspects is the cause, he or she may then order a fibrinogen level, a clotting protein that is another marker of inflammation and a serum protein electrophoresis to determine which of these (or both) is causing the elevated ESR.

From this study, we can analyse that Patients with a very high ESR usually are the ones who suffer from diseases such as a severe infection, indicating increase in globulins, polymyalgia rheumatica or temporal arteritis. A health practitioner will typically use other follow-up tests, such as blood cultures, depending on the person's symptoms which help to determine the disease better. People with multiple myeloma or Waldenstrom's macroglobulinemia (tumors that make large amounts of immunoglobulins) typically have very high ESRs even if they don't have inflammation. Patients with low ESR can be seen with conditions that inhibit the normal sedimentation of red blood cells, such as a high red blood cell count (polycythemia), significantly high white blood cell count (leukocytosis), and some protein abnormalities. Some changes in red cell shape (such as sickle cells in sickle cell anemia) also lower the ESR. When monitoring a condition over time, rising ESRs may indicate increasing inflammation or a poor response to a therapy; normal or decreasing ESRs may indicate an appropriate response to treatment.

Drugs such as dextran, methyl dopa, oral contraceptives, penicillamine procainamide, theophylline, and vitamin A help to increase ESR, while aspirin, cortisone, and quinine play a role in decreasing the ESR. This was an observational study done to understand the various types of cardiovascular diseases present in patients and how the ESR of the patient also helps to analyse and study the disease in depth. Larger studies with wider range of patients will be required in the future to reaffirm the finding of this study.

CONCLUSION

This study helps us to understand the underlying mechanisms of the various cardiovascular diseases present in the patients. Erythrocyte sedimentation rate, which is a simple test done in the laboratory can efficiently determine even the diseases which had been unknown or undetected in patients.

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How to cite this article:

Prerna Jain and Gayatri Devi R.2017, Interpretation of ESR and Blood Viscosity. *Int J Recent Sci Res.* 8(4), pp. 16575-16577.
DOI: <http://dx.doi.org/10.24327/ijrsr.2017.0804.0175>
