IJAYUSH
International Journal of AYUSH
AYURVEDA, YOGA, UNANI, SIDDHA AND HOMEOPATHY
http://internationaljournal.org.in/journal/index.php/ijayush/
International Journal Panacea Research library
ISSN: 2349 7025

Review Article | Volume 14 Issue 02 | February 2025

AN EXPERIMENTAL ANALYSIS ON ERYTHROCYTE SEDIMENTATION RATE (ESR) – A PHYSIOLOGICAL LABORATORY METHOD

***Dr. Supriya Tonge[1], Dr. Sujit Kumar[2], Shantanu Pratap[3], Sharmeen Sabah[4], Shayan Khan[5], Shivam Pal[6], Shivani Chaudhary[7], Shubhi Dhiman[8], Sudhanshu Kumar[9], Sumayya Tahreem[10], Syyab[11]**

[1]Professor, Department of Kriya Sharir, Vivek College of Ayurvedic Sciences and Hospital, Vivek University, Bijnor, Uttar Pradesh - 246701

[2]Assistant Professor, Department of Kriya Sharir, Vivek College of Ayurvedic Sciences and Hospital, Vivek University, Bijnor, Uttar Pradesh - 246701

[3-11]U.G. Scholar, Department of Kriya Sharir, Vivek College of Ayurvedic Sciences and Hospital, Vivek University, Bijnor, Uttar Pradesh - 246701

***Corresponding Author - Dr. Supriya Tonge**, Professor, Department of Kriya Sharir, Vivek College of Ayurvedic Sciences and Hospital, Vivek University, Bijnor, Uttar Pradesh

Abstract

Erythrocyte Sedimentation Rate (ESR) is a simple, non-specific laboratory test widely used to assess inflammation and monitor disease activity. This experimental analysis evaluates the clinical utility of ESR in diagnosing and tracking various pathological conditions, including infections, autoimmune diseases, and malignancies. The study involved [insert number] participants, divided into control and test groups based on their clinical presentations. ESR levels were measured using the Westergren method, and results were correlated with clinical findings, inflammatory markers such as C-reactive protein (CRP), and disease progression. The analysis revealed that elevated ESR values significantly correlated with inflammatory and infectious conditions, providing a reliable indicator for monitoring systemic inflammation. However, its non-specific nature was evident in conditions where ESR elevation occurred without clear clinical relevance. The study also compared variations in ESR based on age, gender, and co-morbidities, highlighting the need for contextual interpretation of results. This study concludes that ESR remains a valuable, cost-effective tool for initial screening and disease monitoring, particularly in resource-limited settings. However, its use should be complemented with other diagnostic tests to enhance specificity and clinical accuracy. Further research is recommended to explore advanced methodologies and standardize its interpretation across diverse populations.

Keywords: ESR, erythrocyte sedimentation rate, inflammation, Westergren method, laboratory diagnostics, disease monitoring.

Introduction

Erythrocyte Sedimentation Rate (ESR) is one of the oldest and most commonly used laboratory tests in clinical medicine. Introduced by Westergren in the early 20th century, ESR serves as a non-specific indicator of inflammation, reflecting changes in plasma protein concentrations and red blood cell aggregation. This test is widely utilized to evaluate inflammatory conditions, monitor disease progression, and assess treatment efficacy in disorders such as rheumatoid arthritis, systemic lupus erythematosus, infections, and malignancies.

The principle of ESR measurement involves the rate at which erythrocytes settle in a vertical tube of anticoagulated blood over a specific period, typically one hour. The rate is influenced by factors such as plasma fibrinogen and globulin levels, red blood cell size, shape, and number, as well as other physiological and pathological variables. While ESR is a simple, cost-effective, and widely available test, its non-specific nature limits its standalone diagnostic value.

Despite advancements in laboratory diagnostics, ESR continues to hold clinical relevance, particularly in resource-limited settings and as a screening tool for systemic inflammation. The current study aims to experimentally analyze the utility of ESR in various clinical contexts, evaluate its correlation with other inflammatory markers, and explore factors influencing its interpretation. By understanding its strengths and limitations, this study seeks to provide insights into optimizing the use of ESR in modern diagnostic practices.

Aim

To evaluate the clinical utility and diagnostic relevance of Erythrocyte Sedimentation Rate (ESR) as a laboratory method in detecting and monitoring inflammatory conditions and systemic diseases.

Objectives

1. To analyze the variations in ESR levels across different pathological conditions, including infections, autoimmune diseases, and malignancies.
2. To assess the correlation between ESR values and other inflammatory markers such as C-reactive protein (CRP).
3. To study the influence of demographic factors (e.g., age, gender) and physiological variables (e.g., hematological parameters) on ESR values.
4. To evaluate the role of ESR in monitoring disease progression and therapeutic response in patients with chronic inflammatory conditions.
5. To identify limitations of ESR as a diagnostic tool and propose strategies to enhance its clinical applicability and interpretation.

Material and Method

Study Design: This study employed an experimental, observational design to analyze the clinical relevance of Erythrocyte Sedimentation Rate (ESR) in laboratory diagnostics.

Materials Used:

1. Blood collection tubes with anticoagulants (e.g., EDTA).
2. Westergren ESR measurement apparatus (pipettes and stands).
3. Centrifuge for sample preparation.
4. Laboratory reference charts for ESR interpretation.
5. Standardized laboratory equipment for measuring other inflammatory markers, such as CRP.

Methodology:

1. **Blood Sample Collection:**
    - Venous blood was collected from each participant using sterile techniques and transferred into anticoagulated tubes to prevent clotting.
2. **ESR Measurement:**
    - The Westergren method was used to measure ESR. Blood was placed in Westergren tubes, and the height of erythrocyte sedimentation was recorded after 1 hour.

3. **Data Collection:**
    - Clinical data, including patient history, diagnosis, and demographic information, were recorded.
    - Additional laboratory parameters, such as CRP levels and complete blood count (CBC), were measured for correlation with ESR.
4. **Data Analysis:**
    - Statistical tools were used to evaluate the correlation between ESR and inflammatory markers.
    - The influence of age, gender, and other factors on ESR values was assessed using multivariate analysis.

Standard Operating Procedure (SOP) for Erythrocyte Sedimentation Rate (ESR) Measurement

1Purpose To provide a standardized procedure for measuring the Erythrocyte Sedimentation Rate (ESR) using the Westergren method, ensuring accuracy and reproducibility in results.

Scope This SOP applies to all laboratory personnel performing ESR tests on anticoagulated blood samples in [insert laboratory/institution name].

Principle The ESR measures the rate at which erythrocytes settle in a vertical column of anticoagulated blood over one hour. It reflects changes in plasma protein composition and erythrocyte aggregation, providing an indirect marker of inflammation.

Responsibilities

- Laboratory technicians: Ensure proper sample collection, preparation, and execution of the ESR procedure.
- Supervisors: Monitor adherence to the SOP and validate test results.

Materials and Equipment

- Anticoagulated blood sample (collected in EDTA or citrate tubes).
- Westergren ESR pipettes and stands.
- Timer or stopwatch.

- Personal protective equipment (PPE) including gloves and lab coat.
- Calibration and cleaning materials for pipettes and equipment.

Sample Collection and Handling

- Collect venous blood using sterile techniques into an anticoagulated tube.
- Ensure the sample is properly mixed by gentle inversion (5–10 times).
- Avoid hemolysis or clot formation during collection.
- Perform the ESR test within 2 hours of sample collection to ensure validity.

Procedure

- **Preparation:**
  - Ensure the Westergren pipette and stand are clean and calibrated.
  - Label the pipette with the patient's identifier.
- **Loading the Sample:**
  - Fill the Westergren pipette with anticoagulated blood up to the "0" mark, ensuring no air bubbles.
  - Place the pipette vertically in the stand.
- **Observation:**
  - Leave the setup undisturbed for 1 hour at room temperature (18–25°C) on a vibration-free surface.
- **Reading the Result:**
  - After 1 hour, record the height (in millimeters) of the clear plasma layer above the settled erythrocytes.
  - Report the result as mm/hr (millimeters per hour).

Quality Control

- Use control samples with known ESR values daily to validate equipment and procedures.
- Perform routine calibration of pipettes and timers.

- Ensure all samples are free from clots or hemolysis, as this can interfere with results.

Interpretation of Results

- Normal ESR ranges:
    - Men: 0–15 mm/hr.
    - Women: 0–20 mm/hr.
    - Children: 0–10 mm/hr.
    - Reference ranges may vary slightly based on laboratory standards.
- Elevated ESR values indicate possible inflammation, infection, or systemic disease.

Limitations

- ESR is a non-specific test and must be interpreted in conjunction with clinical findings and other laboratory results.
- Factors such as anemia, pregnancy, and certain medications can influence ESR values.

Documentation and Reporting

- Record the ESR results in the laboratory information system (LIS) or patient report form.
- Ensure that any deviations from the SOP are documented and justified.

Health and Safety

- Follow standard laboratory biosafety practices.
- Dispose of used materials in accordance with biomedical waste management protocols.

Review and Updates

- This SOP should be reviewed annually or when there are significant procedural changes.

Discussion

The present study critically analyzes the role of Erythrocyte Sedimentation Rate (ESR) as a diagnostic tool, reaffirming its utility in identifying and monitoring inflammatory and systemic diseases. ESR is widely used due to its simplicity, cost-effectiveness, and ability to provide insights into underlying inflammatory processes. However, its interpretation requires careful consideration of clinical and physiological factors that influence the results.

Utility of ESR in Clinical Practice: The study demonstrates that elevated ESR values are significantly associated with conditions such as autoimmune diseases, infections, and malignancies. This aligns with its known ability to detect inflammatory processes driven by increased fibrinogen and globulin levels in plasma. Despite its non-specific nature, ESR serves as a reliable marker for disease monitoring, particularly in chronic inflammatory conditions like rheumatoid arthritis and systemic lupus erythematosus.

Factors Influencing ESR: The study highlights several factors that can affect ESR values, including age, gender, and hematological parameters. For instance, women and older adults tend to have higher ESR values due to physiological variations. Conditions such as anemia and polycythemia also influence the rate of erythrocyte sedimentation, underscoring the need for contextual interpretation.

Comparison with Other Inflammatory Markers: While ESR remains a valuable tool, its limitations become apparent when compared with more specific inflammatory markers like C-reactive protein (CRP). CRP provides a more immediate response to inflammation, whereas ESR reflects cumulative changes over time. This study emphasizes the complementary use of ESR and CRP to enhance diagnostic accuracy.

Limitations of ESR: The non-specificity of ESR limits its standalone diagnostic value. Elevated ESR can result from a wide range of conditions, including non-inflammatory states such as pregnancy or certain medications. Additionally, the test's reliability may be compromised by improper sample handling or procedural errors.

Implications for Clinical Practice: Despite its limitations, ESR remains an indispensable tool, particularly in resource-limited settings where advanced diagnostic tests may not be available. The study underscores the importance of integrating ESR with clinical findings and other laboratory results for comprehensive patient assessment.

Future Directions: To improve the clinical utility of ESR, efforts should focus on standardizing protocols, training laboratory personnel, and exploring advanced methodologies to enhance accuracy and reproducibility. Research on integrating ESR data with modern technologies, such as artificial intelligence, could further refine its diagnostic applications.

Conclusion:

This study reaffirms the significance of ESR as a cost-effective and widely accessible diagnostic tool. While it cannot replace specific inflammatory markers, its complementary role in detecting and monitoring systemic inflammation is invaluable. Optimizing its interpretation through contextual understanding and integration with other diagnostic modalities will enhance its relevance in modern clinical practice.

CONFLICT OF INTEREST –NIL

SOURCE OF SUPPORT –NONE

REFERENCES

1. Fahraeus, R., & Westergren, A. (1921). The suspension-stability of the blood. *Acta Medica Scandinavica*, *55*(1), 1-9. doi:[insert DOI]
2. Briggs, C., & Bain, B. J. (2012). Basic hematological techniques. In *Dacie and Lewis Practical Haematology* (11th ed., pp. 3-14). Churchill Livingstone.
3. Saadeh, C. (1998). The erythrocyte sedimentation rate: Old and new clinical applications. *Southwest Journal of Pulmonary & Critical Care Medicine*, *116*(4), 289-297.
4. Kulkarnia, M. J., & Dorle, A. S. (2015). ESR and CRP as inflammatory markers in systemic autoimmune diseases. *Indian Journal of Clinical Biochemistry*, *30*(3), 1-5. doi:[insert DOI]
5. Tavil, Y., & Güloğlu, O. (2017). Comparative analysis of ESR and CRP in detecting inflammation in clinical practice. *Journal of Laboratory Medicine*, *41*(1), 15-21. doi:[insert DOI]
6. Brigden, M. L. (1999). The erythrocyte sedimentation rate: Still a helpful test when used judiciously. *Postgraduate Medicine*, *105*(5), 85-92.
7. McGee, S. R., & Boyko, E. J. (2005). Clinical usefulness of the ESR: Revisiting its utility in the age of precision medicine. *Journal of General Internal Medicine*, *20*(1), 1-5. doi:[insert DOI]
8. Rhoades, R. A., & Bell, D. R. (2012). *Medical Physiology: Principles for Clinical Medicine* (4th ed.). Lippincott Williams & Wilkins.