

## Original Research Article

# Evaluation of micro-ESR method with Westergren method for determination of erythrocyte sedimentation rate

Kamal Preet\*, Vyankatesh T. Anchinmane, Shilpa Sankhe

Department of Pathology, SLBS Government Medical College and Hospital, Mandi at Ner Chowk, Himachal Pradesh, India

**Received:** 27 November 2017

**Accepted:** 29 December 2017

**\*Correspondence:**

Dr. Kamal Preet,

E-mail: [kamalpreet.15@gmail.com](mailto:kamalpreet.15@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** Erythrocyte sedimentation rate (ESR) test provides valuable information in screening, diagnosis, as well as monitoring disease activity and therapeutic response in numerous health conditions. The most commonly used method for determination of ESR is Westergren method, which is time-consuming and requires a large amount of blood sample. There are several other methods, like Micro-ESR method which overcome the limitations of conventional Westergren method, hence the present study was performed to compare results of Westergren method with Micro-ESR method for determination of ESR.

**Methods:** In the present study, blood samples from 100 patients were processed for ESR determination by Westergren method and Micro-ESR method. The results obtained were compared using Pearson's correlation test.

**Results:** The Westergren method was the reference method and the Micro-ESR method was testing method. The comparison was done between Micro-ESR method results (X-axis) and results of Westergren method (Y-axis). The slope of the regression line using linear regression was 1.010 with a y-intercept of -0.788. Statistical analysis demonstrated significant correlation of results of Micro-ESR method with Westergren method ( $r = 0.9977$ ).

**Conclusions:** Micro-ESR is a reliable and precise method for ESR measurement. The Micro-ESR method is simple to perform and requires very small volume of blood (0.2ml) as compared to conventional Westergren method. It can be potential useful tool in performing ESR determination especially for the patients with limitation of blood availability as pediatric patients and very old patients.

**Keywords:** ESR, Micro-ESR method, Westergren method

### INTRODUCTION

Erythrocyte sedimentation rate is one of the most commonly ordered laboratory investigations. Although this test is a non-specific parameter for the presence of disease, it helps clinicians in diagnosis and follow-up of many conditions including malignancies. The recommended method for ESR determination is Westergren method. Although this method is widely used, it is a time-consuming procedure and requires relatively large volume of blood.<sup>1</sup> Hence it is especially

troublesome for critically ill patients who require multiple samplings, infants and neonates. Thus, reliable, faster and accurate test methodologies for ESR determination are the need of hour.

To overcome the drawbacks of conventional Westergren method, several new techniques and methods have been developed, such as Micro-ESR method, centrifugation method, automatic ESR analyzer method etc.<sup>1-4</sup> This study was carried out to compare Westergren method with Micro-ESR method.

## METHODS

This study was a prospective comparative analysis, carried out at a tertiary care hospital. The blood samples received from 100 patients were utilized for ESR determination by Westergren method as well as Micro-ESR method. For the conventional Westergren method, at the time of blood sampling, 1.6cc of patient's whole blood was gently mixed with 0.4cc of 3.8% sodium citrate. Anticoagulated blood was sucked into glass Westergren pipettes and fixed in vertical position in a stand for 1hour. The ESR was estimated by measuring the column of plasma at the top of pipette in millimeter per hour as the base unit.<sup>5</sup> Simultaneously, along with Westergren method, all the blood samples were processed by Micro-ESR method as well. One drop of 3.8% sodium citrate was placed on a clean glass slide, using a dropper. Then, four drops of blood were mixed with it, thus maintaining a ratio of 4:1 of blood and anticoagulant. A glass capillary tube of 75mm length and 1.2mm internal diameter was placed on the slide at an angle of 45°. By virtue of capillary action, blood rose through the tube. After a rise of 70mm, the tube was repositioned perpendicularly and sealed at both ends with seal paste and kept in vertical position (90°) for 1hour. At the end

of 1hour, the height of plasma and the total height of blood column in the capillary tube were measured. ESR value was obtained by applying multiplication of 200 to the ratio of height of plasma to the height of blood column in the capillary.<sup>1,2</sup>

The statistical analysis was done by Pearson's Correlation test, using Westergren method as Gold Standard.<sup>2</sup>

## RESULTS

The 100 patients included in the present study had age range between 22 to 65years. Of the samples, 60% (60/100) were from patients of 50years or younger whereas 40% (40/100) were from patients older than 50years. All the blood samples were analyzed for ESR by both Westergren method and Micro-ESR method. The ESR values for all the samples ranged from 8-87mm using Westergren method and 8-88mm using the Micro-ESR method. The Mean, Median and SD for Westergren method were 43.09, 44 and 18.04 respectively and for Micro-ESR method was 42.74, 43, and 18.27 respectively (Table 1).

**Table 1: Measurement of central tendency and variation for methods of ESR determination.**

Method	N	Range	Mean	Median	SD
Westergren method	100	8-87mm	43.09	44	18.04
Micro-ESR method	100	8-88mm	42.74	43	18.27

SD= Standard Deviation

With the Pearson's Correlation test, results of Micro-ESR method (X axis) compared with Westergren method (Y axis) showed Correlation Coefficient  $r = 0.9977$ , Slope

1.10 and y intercept of -0.788. Pearson's Correlation Coefficient was 0.9977, indicating good correlation for ESR results of Micro-ESR method with ESR results of Westergren method (Table 2).

**Table 2: Linear regression analysis for methods of ESR determination.**

Reference method	Testing method	Correlation (r)	Slope	Y- intercept
Westergren method	Micro-ESR method	0.9977	1.010	-0.788

## DISCUSSION

ESR is one of the oldest and simplest laboratory tests. Although it's a non-specific marker of inflammation, it is used in combination with patient's clinical history and physical examination, which aids in diagnosis, management, and follow-up of different auto-immune diseases, acute and chronic infections and tumors.<sup>6,7</sup>

ESR was invented by Edmund Biernacki in 1897. It was modified and popularized by Fahraeus, Westergren, Wintrobe and others. Hence the method came to be known as Fahraeus-Westergren Method and later on

simply as Westergren Method. In 1993, the International Council for Standardization in Hematology (ICSH) adopted Westergren Method as the reference method for ESR measurement.

In 2011, ICSH and Clinical and Laboratory Standards Institute (CLSI) confirmed the Westergren Method as gold standard method for ESR evaluation.<sup>2,8,9</sup> The basic Principle of ESR is that RBCs normally settle quite slowly when anti coagulated blood is placed in a vertical column. This occurs due to repulsion of RBCs from each other by virtue of negative charge present on their surface (Zeta potential) and large surface area to volume ratio.<sup>6,10</sup>

Westergren Method is easy to perform and is inexpensive. However, this test has some demerits as it requires large volume of blood (1.6ml) and at least 1 hour testing time. The results may be inaccurate if the tube is not kept straight up or there is error in reading the meniscus level or local site temperature correlation is not done.<sup>11,12</sup> Also, since this method is an open method, therefore technicians have direct contact with blood specimen, which may lead to exposure to diseases like Hepatitis and HIV etc.<sup>13</sup>

In view of limitations of Westergren Method, various alternate methods have been introduced from time to time. One of such methods is Micro-ESR method which was first described by Stuart et al.<sup>14</sup> This method requires very small quantity of blood (0.2ml) as it employs glass column of 75mm or 230mm in length and 1mm internal diameter.<sup>1,2,15-17</sup>

This study observed that usage of Micro-ESR technique provides very good correlation ( $r=0.9977$ ) with conventional Westergren method. The result accuracy of this method is acceptable. Similar results have also been obtained by West BA et al and Adhikari BC et al in the past.<sup>1,2</sup> Limitations of this study are that no strict inclusion and exclusion criteria were implemented and Micro-ESR method was carried out only once on each blood specimen and hence reproducibility of results cannot be commented upon.

Also, this method also has certain disadvantages like biohazard risk as the original Westergren method. The present study shows very impressive correlation and agreement of Micro-ESR method with conventional Westergren method. However, more studies are required to assess reproducibility and validity of Micro-ESR test.

## CONCLUSION

Capillary tube based Micro-ESR method is precise, cost effective and patient compliant method for ESR determination. In view of very good correlation with conventional standardized Westergren method, the Micro-ESR method can be an effective and inexpensive substitute for Westergren method. This method is specially recommended in Pediatric patients, patients with poor veins and where repeated sampling is indicated, as it requires very small volume of blood.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. West BA, Tabansi PN, Ugwu RO, Eneh AU. The predictive value of Micro-erythrocyte sedimentation rate in neonatal sepsis in a low resource country. *Pediatr Therapeut.* 2012;S2:002.

2. Adhikari BC, Patra S, Chanda C, Shrivastava RK. Erythrocyte sedimentation rate, measurement by capillary tube method, (Micro-ESR)-best method for neonate and small children. *J Med Sci Clin Res.* 2017;05(05):22135-7.
3. Shelat SG, Chacosky D, Shibutani S. Differences in erythrocyte sedimentation rates using the Westergren method and a centrifugation method. *Am J Clin Pathol.* 2008;130:127-30.
4. Subramanian A, Rangarajan K, Pandey RM, Gandhi JS, Sharma V, Bhoi SK. Evaluation of an automated erythrocyte sedimentation rate analyzer as compared to the Westergren manual method in measurement of erythrocyte sedimentation rate. *Indian J Pathol Microbiol.* 2011;54(1):70-4.
5. Westergren A. The technique of the red cell sedimentation reaction. *Am Rev Tuberc.* 1926;14:94-101.
6. Sox HC Jr, Liang MH. The erythrocyte sedimentation rate: guidelines for rational use. *Ann Intern Med.* 1986;104:515-23.
7. Saadeh C. The erythrocyte sedimentation rate: old and new clinical applications. *South Med J.* 1998;91:220-5.
8. International Council for Standardization in Haematology Expert Panel on Blood Rheology. ICSH recommendations for measurement of erythrocyte sedimentation rate. *J Clin Pathol.* 1993;46:198-203.
9. National Committee for Clinical Laboratory Standards 2000. Reference and Selected Procedures for the Erythrocyte Sedimentation Rate (ESR) Test (H2-A4). Wayne, PA:NCCLS;2000.
10. Zhao TX, Lockner D. Electrical impedance and erythrocyte sedimentation rate (ESR) of blood. *Biochim Biophys Acta.* 1993;1153(2):243-8.
11. Dobashi T, Idonuma A, Toyama, Sakanishi A. Effect of concentration on enhanced sedimentation rate of erythrocytes in an inclined vessel. *Biorheology.* 1994;31:383-93.
12. Manley RW. The effect of room temperature on erythrocyte sedimentation rate and its correction. *J Clin Pathol.* 1957;10(4):354-6.
13. Wongsena W, Kunakorn M, Tanprasert S, Petchclai B. Detection of HIV-1 window period infection in blood donors using borderline anti-HIV results, HIV-1 proviral DNA PCR, and HIV-1 antigen test. *J Med Assoc Thai.* 1997;80Suppl1:S112-5.
14. Stuart J, Barrett BA, Prangnell DR. Capillary blood collection in haematology. *J Clin Pathol.* 1974;27:869-74.
15. Shah Y, Kumar A. Erythrocyte sedimentation rate: evaluation of a micro technique. *J Natl Med Assoc.* 1982;74(9):887-9.
16. Napitupulu A, Sembiring R, Lubis CP, Manoeroeng SM, Siregar H. The micro erythrocyte sedimentation rate (ESR) among children of the tobacco plantation laborers in North Sumatra. *Paediatr Indones.* 1979;19(11-12):302-7.

17. Barrett BA, Hill PI. A micromethod for the erythrocyte sedimentation rate suitable for use on venous or capillary blood. *J Clin Pathol.* 1980;33(11):1118-20.

**Cite this article as:** Preet K, Anchinmane VT, Sankhe S. Evaluation of micro-ESR method with Westergren method for determination of erythrocyte sedimentation rate. *Int J Res Med Sci* 2018;6:628-31.