

# Measurement of Erythrocyte Sedimentation Rate and its Comparison by Microsed System and Westergren Method

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## ABSTRACT

**Aim:** To measure and compare Erythrocyte sedimentation rate by routinely used Westergren method and MicroSed system (Semi automated instrument).

**Study design:** Comparative study - Cross-sectional

**Place and duration of study:** It was conducted over a period of six months at Armed Forces Institute of Pathology (AFIP), Rawalpindi.

**Methodology:** Consecutive samples of 201 patients were collected and Erythrocyte sedimentation rate (ESR) was measured. Blood samples were collected in citrated vacutainer blood collection tube. Each sample was processed using both the methods. Significance of results was ascertained by applying Pearson coefficient of correlation.

**Results:** From a total of 201 patients, 100 (49.8%) were females, while 101 (50.2%) were males. Mean values were calculated. The mean of Semi-automated instrument (MicroSed system) was 20.2 mm /hr ( $\pm$  27.0) and for Westergren method was 21.8 mm /hr ( $\pm$  26.5). Between the two methods, Pearson coefficient of correlation was calculated and it was found to be 0.980 ( $P < 0.01$ ), having two-star positive correlation which signifies a 99% surety of correlation.

**Conclusion:** Measuring Erythrocyte sedimentation rate is comparable between the Semi automated instrument and the Westergren method.

**Keywords:** ESR, Semi automated instrument (MicroSed system), Westergren method.

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## INTRODUCTION

The sedimentation of red blood cells in diluted blood is measured by a method known as Erythrocyte sedimentation rate (ESR)<sup>1</sup>. This laboratory test is advised more commonly and frequently.<sup>2</sup> It is useful in detection of inflammation, acute or chronic infection and neoplasm<sup>3</sup>. It is an important investigation to reach the diagnosis of polymyalgia rheumatica and temporal arteritis. The activity of tuberculosis and rheumatoid arthritis is measured by ESR. It also helps in predicting the relapse of Hodgkin's disease<sup>4</sup>.

ESR may be affected by many clinical variables, including age, gender, anemia, fibrinogen levels and thyroid disease<sup>5,6</sup>. Additionally, laboratory variables may also substantially affect the ESR results, such as dilution of the blood, angle of the tube, duration of the test, and temperature<sup>1,7</sup>.

ESR is measured by two manual methods, Westergren method and Wintrobe method. The International Council for Standardization in Haematology (ICSH) in 1977 recommended the Westergren method for measuring ESR. The prognosis of patients with pulmonary tuberculosis was determined by this method introduced in 1921 by Westergren<sup>4,8</sup>.

The gold standard method for measuring ESR is the Westergren method. Some shortcomings of the test include testing time of one hour, the potential of being a biohazard risk, incorrect positioning of the tube and the variations in room temperature<sup>3,9</sup>.

To simplify the ESR analysis, automation of ESR measurement was developed. It provides the advantage to be safe, is easy to perform, reduces contact with potential biohazards, provides results quickly, requires minimal maintenance, technician time required to run the test is decreased and is operatively practice<sup>2,10</sup>.

MicroSed System is a semi automated ESR analyzer which is used for measuring ESR. Infra red beam measures the red cell sedimentation and it takes 15 minutes to display the result<sup>11</sup>.

Automation in the measurement of ESR has the advantage to be practical operatively. When compared to the Westergren method which is used in many laboratories, the measurement of ESR by the semi automated method is very easy to perform, provides quick results and is not affected by room temperature variations. Laboratories with increased work load and fast turnaround time will benefit from automation of ESR.

## METHODOLOGY

This cross-sectional comparative study was conducted at the Armed Forces Institute of Pathology, Rawalpindi. The study was conducted over a period of six months. The study included 201 patients visiting the outpatient reception at AFIP.

After taking consent from the patient, aseptic technique was used to draw 3.7 ml of venous blood from the antecubital vein. The two procedures were performed after separating the collected blood sample within 2 hours of collecting the blood sample.

For Westergren Method, Vacutainer blood collection tubes containing buffered sodium citrate were used to

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collect 2.4 ml of venous Venous blood sample was therefore diluted proportionately as 4 parts of blood to 1 part of citrate. Blood and anticoagulant were mixed by performing eight complete inversions of the tube. The blood was filled up till the zero mark on the Westergren glass tube. The Westergren tubes were placed in the appropriate rack in a vertical position at room temperature. At the end one hour, the markings on the tube were used to measure the distance which erythrocytes fell downwards. This was the result recorded in millimeters.

For the MicroSed System, Monosed ESR vacuum tubes containing buffered sodium citrate were used to collect 1.3 ml venous blood sample. This volume was collected so that the blood sample was diluted proportionately as 4 parts of blood to 1 part of citrate. Blood was appropriately blended with the anticoagulant in the tube by rolling it on the mixer for about 5 minutes. Then the Monosed ESR vacuum tube was placed in the instrument. After 15 minutes, the result appeared on the display in mm/hr.

Statistical program for social sciences (SPSS) version 15 was used to enter and analyze all the collected data.

Mean and standard deviation were calculated for the numerical data like age and ESR. Qualitative data like gender was analyzed by using percentages. The significance of the results was ascertained by applying Pearson coefficient of correlation.

## RESULTS

The study was performed on a total of 201 patients. Of all the patients, 100(49.8%) were females and 101(50.2%) were males. The patients age ranged between 7 and 80 years. 40±17 years was the median age. The Westergren method gave the mean ESR value of 21.8 mm/hr (± 26.5) and 20.2 mm/hr (± 27.0) by MicroSed system. Data was analysed between the two methods and P value was determined to be less than .01. The Pearson coefficient of correlation was observed to be 0.980, having two-star positive correlation implying 99% surety of connection among the factors. Data for different ranges of ESR by both the methods can be seen in table.

Table

Ranges of ESR mm/hr	Westergren ESR – mean (mm/hr)	Instrument ESR – mean (mm/hr)	Pearson Correlation (r)	P Value
0 – 10 (86 patients)	4.92 (± 2.88)	3.88 (± 3.11)	0.844	0.000
11 – 20 (46 patients)	15.63 (± 3.15)	13.36 (± 3.64)	0.714	0.000
21 – 40(47 patients)	28.86 (± 5.14)	26.32 (± 6.68)	0.731	0.000
41 – 60(07 patients)	48.28 (± 6.34)	46.71 (± 8.40)	0.774	0.041
61 – 80(06 patients)	72.00 (± 6.29)	70.33 (± 9.79)	0.321	0.535
> 80 (09 patients)	117.44 (± 27.39)	119.66 (± 25.04)	0.686	0.041

Data of different ESR ranges

## DISCUSION

Erythrocyte sedimentation rate is a universally performed laboratory test. It is stress-free to carry out and also low-cost, that is the reason it is used as a regular test for several clinical scenarios.<sup>12</sup> ESR being nonspecific parameter physicians use it as a clinical guide.<sup>13</sup> ESR can be helpful in diagnosis. Several clinical conditions are managed and diagnosed with findings of ESR. It is also helpful in follow up of diseases<sup>14</sup>.

The most acknowledged and standardized procedure for calculating ESR is Westergren.<sup>15</sup> It is a method having many biohazard threats as technicians in the laboratory are directly exposed to the blood sample. Additionally, it is a painstaking procedure requiring a testing time of sixty minutes<sup>16,17</sup>.

Numerous robotic frameworks are established to surpass the associated negatives. ESR measurement, after being automated has multiple advantages including ease of performance. It provides outcomes rapidly, requires nominal maintaining and least exposure to possible biological substances. It requires minimum amount of time and abridged unevenness in results between operators<sup>18,19</sup>.

Regardless of these advantages, it is essential to demonstrate that the results of the semi automated method are comparable to the manual procedure before its recommendation.

Both measurement methods (Westergren method and Microsed system) were used in this study and 402 tests

were done on blood from two hundred and one subjects. The results were analyzed using Pearson correlation. Results showed strong positive correlation. At the ESR range of 61 – 80 mm/hr Pearson coefficient of correlation is 0.321 (P=NS) in this study, it concludes no statistically significant relationship is found between these two methods whereas the mean values of both the methods are comparable with a slight difference of 1.7 mm/hr which is not clinically important. As the sample size is small, this is most likely reason for above mentioned discrepancy which can be easily corrected by increasing the sample size in this range of ESR values.

An additional important observation that can be drawn from these results is that by either method, the mean ESR values are similar in all the ranges. The only slight difference in the mean values is not clinically substantial. Internationally, only a few studies have been done on the topic. The results and procedure of this study match and are parallel to the one by Wiwanitkit V, in 2003. In the study 50 healthy males and 50 healthy females from Thai population were included. Their age in years' ranges from 18 to 51<sup>20</sup>.

In India, similar project on 75 patients gave a respectable correlation<sup>2</sup>.

To my knowledge, after literature search, no such studies are available so ours is the first one in Pakistan. When comparing to the manual procedure, MicroSed is easy to assemble requiring negligible training for being operated. It is very practical as minimum maintaining is

required. The technical staff for the purpose of sample collection needs to be trained periodically in Monosed Vacutainer tubes requiring extra 1.3 ml of patient's blood sample. Laboratory techs are trained at regular intervals to perform the test. Any problem regarding insufficient sampling can be overcome by taking it separately, occurring most commonly in the manual procedure.

MicroSed framework minimizes elements as not filling vacutainer to the optimum mark, tilting of the tube, improper dilution which are faced in manual procedure and practically gives the result of each sample in fifteen minutes whereas result by manual procedure is given in sixty minutes; consequently, being appropriate method in places with more volume of work<sup>20</sup>.

Concerning different charges of methods, the Monosed Vacutainers amount to be rupees 20, while disposable Westergren are for rupees 30. It doesn't include one time purchase charges of the machine required for the semi automated procedure. Numbers of bought machines depends on the volume of tests. However, the manual procedure can be used as a support when required.

In view of the points discussed, the MicroSed procedure is better substitute of Westergren procedure due to its ease of use and safety. It gives results quickly. The time required to perform the test is minimum and is highly cost effective.

## CONCLUSION

Measuring Erythrocyte sedimentation rate is equivalent between the MicroSed system (semi- computerized analyzer) and the Westergren technique. The MicroSed framework can be used in the routine diagnostic laboratories as it gives numerous benefits when contrasted with the Westergren technique.

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