

A new automated method for the determination of erythrocyte sedimentation rate (ESR)

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Abstract

The erythrocyte sedimentation rate (ESR) or sedimentation rate is a measure of the settling of red blood cells in a tube of blood during one hour. The rate is an indication of inflammation and increases in many diseases. A comparative study between the standard Westergren and a new automated method for the determination of erythrocyte sedimentation rate (ESR) was performed on 60 individual subjects. From this study, the comparison-of-methods plot automated method (Y) and VS Westergren method (X) gave the least square linear regression equation of $Y=1.0753 X+ 0.4594$ ($r=0.9761$) . Precision analysis gave a coefficient of variation below 3%. At present the new automated method seems to be an effective and safe technique for determination of the erythrocyte sedimentation rate.

Introduction

ESR is a nonspecific screening test for various inflammatory diseases; it is a simple and inexpensive laboratory test for assessing inflammatory or acute response (Saadeh,1998) .The test measures the rate of gravitation setting in one hour of anticoagulant red blood cells from a fixed point a calibrated tube of defined length and diameter held in an upright position(Malcolm etal,1999;Pizzorn & Murray,1992). A Suitable and effective techniques for erythrocyte sedimentation rate (ESR) determination are necessary for the success laboratory processes. There are Several methods for determination of the ESR, westergren method , wintrob's method ,landu method (Ahmed,2006), and there are new methods which are used by investigators(Imafuku etal,1998).The Westergren method is accepted as a standard technique and is recommended by the international committee for standardization in hematology(Ravel,1994;Thomas etal,1993) that has been widely used in world. Although the Westergren method has been popular for its many advantages, the risk to the practitioner regarding contact with blood specimens, which can lead to blood-borne infection, is still high. At present, many new methods to determine the ESR have been

developed to decrease the risk. (Wongsena et al,1997) Automated erythrocyte sedimentation determination is an example of newly developed equipment. The automated R tube is a specially designed erythrocyte sedimentation analyzer based on the principle of the electrical impedance of human blood. By using this new technology, the ESR can be easily performed. After application of the collected specimen tube onto the analyzer, determination can be carried out automatically.

Materials and methods

This study was a comparative study between the classical Westergren and automated methods for determination of the ESR. Sixty individual volunteer subjects were included. For each subject, two methods of ESR determination were performed. The first was the Westergren method, which was as standard method, Five ml of fresh venous blood from healthy volunteers were included , The whole blood sample was mixed with 0.5 Na₂ EDTA as an anticoagulant. 2ml of the antcoagulated blood sample added to the 0.5ml sodium citrate solution and immediately well mixed with it. We filled the westergren pipe exactly to (0) mark and place the pipe in the rack (fig.2), the depth of the interface separating the supernatant buffer from the sedimented erythrocyte was recorded every 10 min for 1 hr, at the end of the 1 hr recorded the number of millimeter, that the red blood cells have fallen this result is the ESR in mm / hr., And the second was the automated tube method fig.(2).The automated method was new and made use of the electrical impedance principle. The erythrocyte sedimentation rate for each sample was recorded after 1 hour. All data were collected, analyzed and interpreted. Linear regression was performed in order to assess the significant difference in the ESR obtained by the Westergren and automated methods.

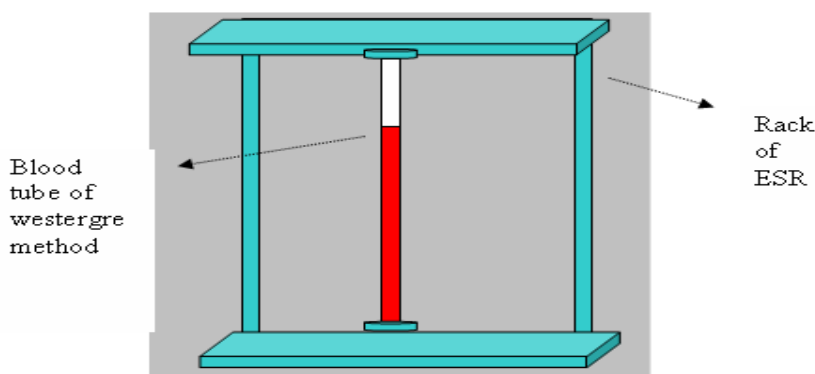


Fig. (1): Schematic representation of the westergren method

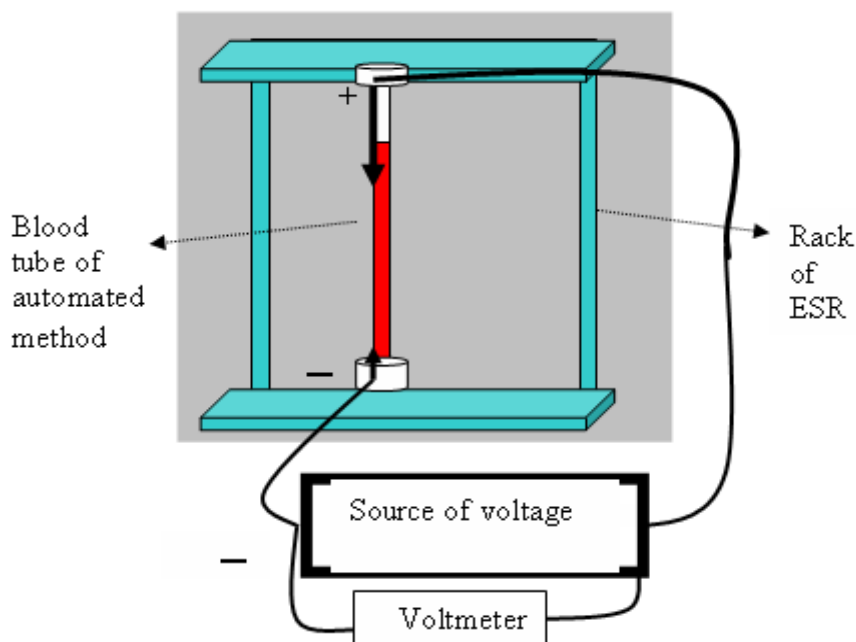


Fig.(2): Schematic representation of the automated method

Results

All 60 samples were analyzed for ESR by the Westergren and automated methods. The data from this study are summarized in Table 1 ,the average difference in value between both methods was (1.5 ,0.5mm/hr) $p=0.072$. The comparison-of-methods plot automated method (Y) VS Westergren method (X) fig.(3) gave the least square linear regression equation of $Y=1.0753 X+ 0.4594$ ($r=0.9761$) (Figure 1). Assays Values (mm/hr) Westergren method Automated method (25.5,7.0) and (24.0,6.5) ($p>0.05$) for higher and lower values. Precision analysis gave a variation coefficient of below 3%.

Table (1): Higher and lower values

Method	Higher value (mm\hr)	Lower value(mm\hr)
Westergren method	25.5	7.0
Automated method	24	6.5

Discussion

The ESR is an important laboratory investigation in medicine. Although it is a non-specific parameter, it can help physicians to diagnose and follow-up many diseases(Ravel ,1994).Therefore, a number of methods for ESR determination have been performed.The Westergren method

(Saadeh ,1998;Thomas etal,1993) is accepted currently as standard, but there are some limitations to this technique. Firstly, it is an open method, therefore, practitioners have to make direct with contact blood specimens.

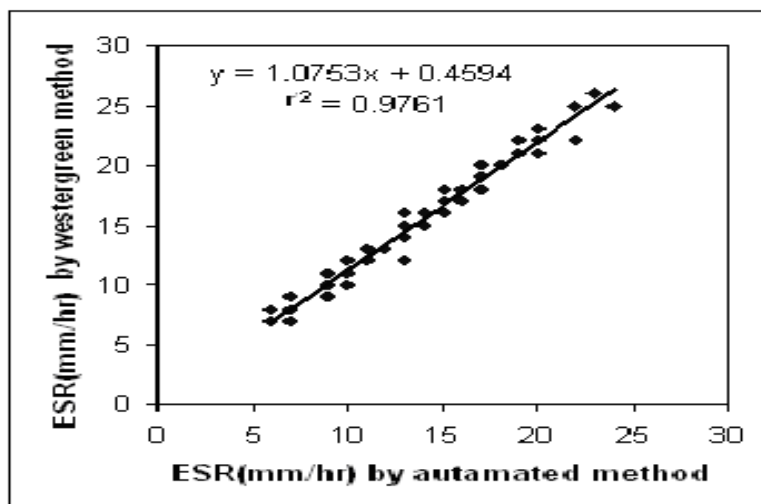


Fig.(3) compare between the westergren method values and the automated method values

At present, there are a number of blood-borne pathogens, the cause diseases, Furthermore, the classical Westergren erythrocyte sedimentation tube is made of glass and must be washed each time before use. Hazards are not only possible from damaged glassware, but contaminated blood can also be expected. Therefore, the Westergren method seems inappropriate as blood borne infection carries a rather high risk and this technique does not match the concept of laboratory safety. In view of this a number of methods have been developed to overcome these problems. Red cells carry a negative surface charge that impedes red cell aggregation , in the presence of a symmetric high molecular weight proteins especially those with a positive charge the tendency for red cells to repel each other is reduced and red cell aggregation is promoted (Tarik&David,2002;Slvarani &Hunder,2001). The automated method is new and based on the measurement of change in blood impedance after the red cell aggregation - sedimentation phenomenon occurs. From the response to determine the ESR of the piezoelectric crystal impedance (PCI) sensor, the erythrocyte aggregation time and sedimentation rate could be obtained during erythrocyte aggregation and sedimentation. From this study, it was revealed that the usage of this new technique could provide a very good correlation $r = 0.9761$.

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طريقة جديدة لحساب معدل ترسيب كريات الدم الحمر

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الخلاصة

إن نسبة ترسيب كريات الدم الحمراء أو نسبة الترسيب هو قياس لترسيب خلايا الدم الحمراء في أنبوبة الاختبار خلال ساعة واحدة . هذه النسبة هي مؤشر للالتهاب والزيادة في أمراض عدة ، الدراسة مقارنة بين طريقته وستيركزين القياسية والطريقة الآلية الجديدة في إيجاد نسبة ترسيب خلايا الدم الحمراء ، انجرت على ٦٠ عينة وتمت المقارنة بين الطريقتين برسم الطريقة الآلية على محور Y وطريقة وستيركزين على محور X حيث استنتجت العلاقة التالية ($r=0.9761$) $Y=1.0753X+0.4594$. إن التحليل الدقيق قد أعطى معامل تغير 3% ،حالياً فإن الطريقة الآلية الحديثة تبدو أكثر تأثيراً وأماناً كتقنيته لإيجاد نسبة ترسيب الخلايا الحمراء .