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The comparison of erythrocyte sedimentation rate (ESR) modify Westergren Caretium Xc-A30 and Westergren Manual in Clinical Pathology Laboratory, Sanglah General Hospital, Denpasar, Bali

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ABSTRACT

Background: The erythrocyte sedimentation rate (ESR) test is one of the most widely performed laboratory test to assess acute phase of inflammation, infection, autoimmune or malignancy. The reference method for ESR measurement was introduced by Westergren. This method is generally easy, un-expensive, yet, time consuming. Automatic instrument has been introduced to decrease the measurement time. Caretium XC-A30 is automatic instrument to measure ESR; it is used in Sanglah General Hospital Denpasar without previous research. Aim of this study was to assess comparison, correlation and agreement of Caretium XC- A30 to the reference method.

Methods: A total of 35 samples in consecutive sampling were taken during August 2018 at Sanglah General Hospital, Denpasar. The samples were examined for ESR with Caretium XC-A30 and manual Westergren. Comparison, correlation and agreement were tested for both methods used.

Results: The Westergren method was the reference method and Caretium XC-A30 was the tested method. Wilcoxon signed rank test showed no difference between two methods (p= 0.439). There was a very strong correlation and excellent agreement showed by Spearman coefficient correlation r= 0.989 and kappa coefficient 0.942.

Conclusion: This study showed no difference between Caretium XC-A30 and Westergren as the reference method for ESR measurement, with very strong correlation and excellent agreement. Thus, Caretium XC-A30 has a potential use in performing ESR measurement with high throughput and lesser time than manual Westergren method.

Keywords: Caretium XC-A30, erythrocyte sedimentation rate, Westergren

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INTRODUCTION

The erythrocyte sedimentation rate (ESR) or *blood bezinking-snelheid der erythrocyten* (BBS) is the speed of deposition of erythrocyte cells in a blood-filled tube that has been given anticoagulation within one hour.[1] ESR is still widely used as an examination of acute phase response screening and monitoring test for infection, autoimmune and malignant diseases.[1,2]

According to the International Council for Standardization in Hematology (ICSH) and the National Committee for Clinical Laboratory Standards (NCCLS) the reference method for ESR measurement is the Westergren method.[3-5] Manual ESR examination using the Westergren method is an easy, relatively in-expensive method, yet, it uses a large number of samples, requires a long inspection time and requires trained personnel.[6] Sanglah General Hospital Laboratory uses Caretium XC-A30 due to the reason that too many requests per day for the ESR test. This automatic tool can shorten Turn Around Time (TAT), increase throughput and requires fewer samples.

There have been many studies conducted to compare several automated tools in ESR measurement with the reference method, but no previous studies on Caretium XC-A30.[4] Based on the aforementioned above, this study aim to assess the comparison, correlation and agreement of the Caretium XC-A30 and the Westergren manual as a reference method. Thus, the results of this study might be used a reference for scientist, laboratories and community in using automatic tools for ESR measurement.

MATERIAL AND METHODS

An observational analytical method with cross sectional setting was conducted at Sanglah General Hospital Laboratory in August 2018. The examination material was taken by consecutive sampling. A total of 35 EDTA blood samples that had met the inclusion and exclusion criteria were examined for ESR values using the automatic Caretium XC-A30 and Westergren manuals.

Examination of ESR manually used the Westergren reference method. Blood samples collected in tubes containing Ethylene-diamine-tetra-acetic-acid (EDTA) anticoagulant were taken 1.6 mL, diluted with a solution of 0.9% sodium chloride (NaCl) 0.4 m (ratio 4: 1). It mixed homogeneously, drew into the tube until a scale of 0 mm Westergren then placed upright on a shelf Westergren. The examiner read the length of the meniscus part plasma (zero scale) with the upper limit of the erythrocyte sedimentation after one hour, reported as the erythrocyte sedimentation rate in mm/h.[7-9]

Caretium XC-A30 was an automatic tool to analyze red cell sediment. Westergren's-modifed method on this tool used an infrared barrier to measure the red cell sedimentation. Blood samples collected in tubes containing EDTA anticoagulant, 1.28 ml were taken into the ESR tube containing 0.32 ml sodium citrate anticoagulant. The recommended blood height is 55 mm (according to the volume of 1.6 ml à 0.32 ml of anticoagulants + 1.28 ml of sample). The solution is mixed either by flipping the tube vertically 5 (five) times, then put it into the holder. Infrared rays start measuring automatically every cycle 3 minutes from the start when the tube is inserted, by measuring the initial height of the blood (L1) then detecting the deposition that occurs. The blood on the 30th minute termed L2. The measurement time for 30 minutes refers to Westergren (yield) 1 hour. Calculation of the percentage of sedimentation that occured for 30 minutes follows the formula% S30 '= 100 (L1-L2) / (L1 + K).[10]

The research data was processed using IBM SPSS version 16 software. Before conducting a different test, the correlation and agreement the data were carried out by Saphiro-Wilk test to determine the differences in the two devices, followed by Wilcoxon test if needed. The spearman and Kappa coefficient analysis were done to evaluate correlation and agreement between these tools.

RESULTS

The study revealed that 35 study participants had ranging ages from 18 to 79 years with characteristics of 34% adult age (18-45 years), 49% middle age (46-59 years), 14% old age (60-74 years) and 3% in over 74 years group. All blood samples were measured for blood sedimentation values using the Westergren manual method and Westergren modify method with the Caretium XC-A30 automatic tool. All blood samples examined had mean, median, minimum-maximum and SD values of 45.34, 28, 2-137 and 41.55 in the Westergren manual method, respectively. In Caretium XC-A30 the mean, median, minimum-maximum and SD values are 45.05, 26, 2.5- 141, and 41.65 (Table 1).

The results of the examination of these tools were processed by the Kolmogorov-Smirnov and Shapiro-Wilk normality tests, obtained p values <0.05 which indicated that the data were not normally distributed. A different tests were conducted with the Wilcoxon Signed Ranks Test (p = 0.439) indicates there is no difference between the second tool (Table 2).

To determine the correlation between two instruments Spearman correlation test had done. The results between Caretium XC-A30 (X axis) compared to manual methods Westergren (Y axis) showed a very strong correlation with the value coefficient of r = 0.989 (Table 3, Figure 1).

The results of the study of 35 samples found a very good match between the Caretium tool XC-A30 and the Westergren manual with the coefficient Kappa was 0.942 (Table 4).

DISCUSSION

Erythrocyte sedimentation rate is a fairly simple test and is often done in the laboratory. Although ESR is not a specific marker for inflammation, nowadays, it frequently used by clinicians to help make a diagnosis and to help in evaluating or monitoring patients with chronic diseases.[11,12] The reference method of ESR measurement is the Westergren method according to the International Committee for Standardization in Hematology (ICSH). This method is an easy method, and not expensive. But there are some shortcomings, such as the time measurement issue (± 1 hour) and the influence of several other factors leading to unsuitable measurement results, such as room temperature and the position of the tube that is not perpendicular. Laboratory technicians also have a high risk of exposure to any disease because they take direct contact with blood samples.[13-15]

With some limitations of the Westergren method, various variations of ESR measurement methods

Table 1 The results of ESR measurement by the Westergren and Caretium XC-A30 manuals

Method	N	Mean	Median	Range	SD
Westergren Manual	35	45.34	28	2-137 mm / hour	41.55
Caretium Xc-A30	35	45.05	26	2.5-141 mm/ hour	41.65

Table 2 Test different test of Caretium XC-A30 ESR with Westergren Manual

Total	Caretium XC-A30	Westergren Manual	p
n	35	35	0.439

Table 3 Analysis of the Spearman correlation test on ESR measurement method

Reference Method	Tested tool	Correlation (r)
Westergren Method	Caretium XC-A30	0.989

Table 4 Compliance as the results of inspection of the Caretium XC-A30 and Westergren device

Parameters (ESR)	<20 mm / hour	≥ 20 mm / hour	N	Kappa
Caretium XC-A30	15	20	35	0.942
Westergren Manual	16	19	35	

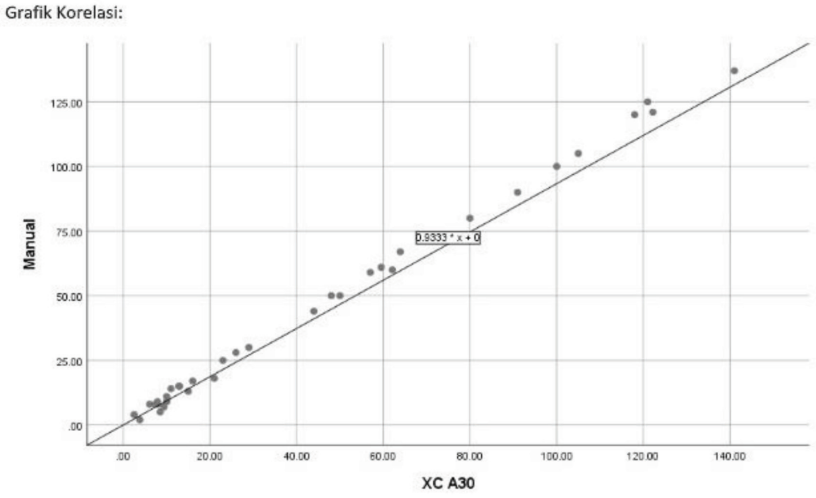

Figure 1 Spearman correlation graph on ESR measurements

using automated tools began to be developed such as Starrsed (R & R Mechatronic), SEDIsystem (Becton Dickinson), Caretium XC-A30 and many other tools. The method developed provides several advantages, such as shortening the measurement time, using fewer samples and reducing risk of exposure or direct contact with the blood sample being examined.[11,12] Nonetheless, validation of automatic tools is very important to do by testing the tool with the Westergren standard method. This study is useful to find out whether this automatic tool can be used as a Westergren-method replacement to measure ESR values. In this study, the automatic tool with the Westergren Caretium XC-A30 modify method has no difference with the standard method, which is seen from the p value = 0.439 (p> 0.05). The Spearman correlation test revealed that the correlation of the two tools was very strong as indicated by the value r = 0.989. The kappa coefficient is a tool for analyzing agreement/compatibility of binary results between two tools.[16] The coefficient kappa with 0.942 values in this study showed very good agreement between the automated tools and the reference method. This phenomenon might be caused by the measurement method used in the tested tool is a modified from the Westergren reference method, hence mimicking the result. Some weaknesses in this study such as automatic ESR measurements were only performed on each blood sample so that reproducibility of results cannot be determined with certainty. In the other hand, the sample size cannot reflect the results of all patients examined by this automatic tool, hence, the needs of subsequent studies with larger number of samples should be conducted in order to reveal better validation.

CONCLUSION

In this research we found no difference between Caretium XC-A30 automatic tool and the Westergren method. Both methods showed a very strong level of correlation and a very good level of agreement. This tool can be used to measure ESR to shorten TAT.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ETHICAL CONSIDERATION

This article was approved by Udayana University Ethics Committee.

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