Diesse CUBE 30 Touch – Excellent Correlation to Modified Westergren

The Diesse CUBE 30 Touch reduces the potential biohazard, shortens the turn-around time, and provides excellent correlation to the Modified Westergren benchmark method.

Abstract

This study was conducted to verify correlation of the automated Diesse CUBE 30 Touch system to the Modified Westergren benchmark method and the Diesse MINI-CUBE and Streck ESR-Auto Plus® automated methods. Three CUBE 30 Touch systems were evaluated against the manual Fisherbrand Dispette 2, the Diesse MINI-CUBE and the Streck ESR-Auto Plus. In summary, the data collected indicates the CUBE 30 Touch system meets or exceeds a 94% correlation to the Modified Westergren method for 4.0 mL CUBE 30 Touch samples.

Introduction

The erythrocyte sedimentation rate (ESR) continues to be one of the most widely performed laboratory tests. The Westergren method, first introduced in 1921, and recommended as the ESR method of choice in 1973 by the International Council for Standardization in Haematology (ICSH), remains the benchmark against which other ESR methods are evaluated.[1] As described in Clinical and Laboratory Standards Institute (CLSI) document H02, *Procedures for the Erythrocyte Sedimentation Rate Test*, a modification of the Westergren method employs blood anticoagulated with EDTA and then diluted with saline to reproduce results identical to those obtained by the classical Westergren method.[2]

While the Westergren method is considered the benchmark for ESR analysis, it is not without significant limitations. Samples must be set up and analyzed within four hours of blood collection when samples are stored at room temperature, and within 24 hours when samples are stored at 4 °C. Sedimentation data must be visually evaluated by a technologist at precisely 60 +/- 1 minute and manually recorded. In addition, a number of variables including temperature control, vibration, tube verticality, and operator technique will affect the sedimentation rate. A number of automated systems are available for ESR testing, but most pose some inconveniences for the clinical laboratory. A separate ESR tube is often needed, which does not eliminate the risk of exposure of lab personnel to potentially infectious material.

The CUBE 30 Touch system simplifies the testing procedure while maintaining excellent correlation to the Modified Westergren method. The CUBE 30 Touch performs a direct measurement of samples collected in standard 13 x 75 mm K_2 or K_3 EDTA tubes, thereby eliminating the need for a separate ESR collection tube and potentially biased results due to improper sodium chloride dilutions, as well as reducing exposure to biological hazards. The instrument offers an internal mixing function for batch sample preparation, a data archive for patient and QC results, LIS compatibility, an internal barcode scanner for positive patient identification and an internal printer.[3]

To accommodate variability in patient sample volumes, the CUBE 30 Touch system is compatible with standard 13 x 75 mm K_2 or K_3EDTA blood collection tubes with a sample volume of 1.5 mL to 4.0 mL. Correlation data is outlined in the Results section.

Methods

Sample Collection

Blood from 50 donors was collected into three standard 13 x 75 mm, 4.0 mL K_2EDTA tubes. Samples collected in EDTA tubes were mixed immediately after collection by completely inverting the tubes six to eight times. All samples were tested within 4 hours of collection.

Sample Preparation for Modified Westergren

Blood samples collected in standard 4.0 mL K_2EDTA tubes were inverted six to eight times allowing the air bubble to reach the end of the tube with each inversion. Using a transfer pipette, aliquots of 1.0 mL of blood were added to the fill line of a Dispette 2 reservoir, capped and mixed by manual inversion eight times allowing the air bubble to reach the end of the tube with each inversion. Following manufacturer instructions carefully, the Dispette 2 tubes were grasped at the 180 mm region and inserted through the cap membrane of the filling reservoir. After penetrating the reservoir, the pipette was gently pushed to the bottom of the reservoir and tubes were gently transferred and placed on a level stand at room temperature. ESR levels were recorded in mm/hr at exactly 60 minutes.

Sample Preparation for Diesse CUBE 30 Touch

4.0 mL sample volume: Blood samples collected in standard 13 x 75 mm, 4.0 mL draw volume K_2EDTA tubes were inverted six to eight times allowing the air bubble to reach the end of the tube with each inversion.

Identification numbers assigned to each donor were entered into the CUBE 30 Touch systems. When prompted, the tubes were inserted into a free position in the CUBE 30 Touch to initiate testing. Results in mm/hr automatically printed at the conclusion of the 20-minute measurement.

Sample Preparation for Diesse MINI-CUBE

4.0 mL sample volume: Blood samples collected in standard 13 x 75 mm, 4.0 mL draw volume K_2EDTA tubes were inverted six to eight times allowing the air bubble to reach the end of the tube with each inversion.

Care was taken during sample mixing to avoid the formation of bubbles, which could interfere with sample results. Identification numbers assigned to each donor were entered into the MINI-CUBE systems. When prompted, the tubes were inserted into a free position in the MINI-CUBE to initiate testing. Results in mm/hr automatically printed at the conclusion of the 20-minute measurement.

Sample Preparation for Streck ESR-Auto Plus

Blood samples collected in standard 4.0 mL K_2EDTA tubes were inverted six to eight times allowing the air bubble to reach the end of the tube with each inversion. Using a transfer pipette, the sample was added to the fill line of a Streck ESR-Vacuum Tube, capped and mixed by manual inversion eight to 10 times allowing the air bubble to reach the end of the tube with each inversion.[4] Identification numbers assigned to each donor were entered into the ESR-Auto Plus instrument. When prompted, the tubes were inserted into a free position in the ESR-Auto Plus to initiate testing. Results in mm/hr automatically printed at the conclusion of the 30-minute measurement.

Results

Table 1 summarizes the correlation data obtained from samples collected in 13 x 75 mm K_2EDTA tubes (4.0 mL) and analyzed on the Diesse CUBE 30 Touch and Diesse MINI-CUBE; Dispette tubes for analysis on the Dispette 2 method; and Streck ESR-Vacuum Tubes for analysis on the ESR-Auto Plus.

Table 1

Diesse CUBE 30 Touch Whole Blood Correlation

Method	Correlation	Sample Size
Diesse CUBE 30 Touch (4.0 mL*) vs. Dispette 2	94.39%	n = 50
Diesse CUBE 30 Touch (4.0 mL*) vs. MINI-CUBE (4.0 mL*)	96.66%	n = 50
Diesse CUBE 30 Touch (4.0 mL*) vs. ESR-Auto Plus	89.30%	n = 50

**CUBE 30 Touch and MINI-CUBE samples prepared in standard 13 x 75 mm K_2EDTA tubes.*

Discussion

ESR results obtained from specimens collected by direct patient draw or transferred from a K_2EDTA tube are equivalent on the automated methods in this study. The ESR test is susceptible to a variety of errors. It is important to stress that proper specimen mixing and handling are critical for reproducing the results from this study. Care was taken during sample mixing to avoid the formation of bubbles, which could interfere with the sample results. Both manual and automated ESR methods are subject to a high degree of variability in samples that lack a clear erythrocyte to plasma interface. Testing should commence within four hours of collection if specimen was held at ambient temperature. Results can be affected by a variety of pathological factors including anemia and red blood cell size, and environmental factors such as temperature and vibration.

When samples are added to a cycle by the random access feature, the Diesse Cube 30 Touch employs a carousel that introduces slight lateral movement to the samples in order to scan the sample barcodes. While ESR testing traditionally requires samples to remain undisturbed, the ESR results obtained in this study indicate no appreciable difference or adverse effects as a result of the slight carousel movement.

The clinical utility of the ESR test has long been debated. The use of the ESR as a screening test to identify patients who have serious disease is not supported by the literature. There has been some use of the ESR as a diagnostic parameter for rheumatoid arthritis but the test is a means of staging the disease, not a key diagnostic finding as the American College of Rheumatology's criteria states an elevated ESR is one of four bloodwork findings that may be present.[5] Although there is an enormous body of literature concerning the ESR, an elevated value remains a non-specific finding. The FDA continues to classify all automated ESR systems, such as the CUBE 30 Touch, as class 1, 510(k) exempt medical devices.[6]

Statistical tools such as total error, commonly used in more sophisticated chemistry and immunoassay testing, are most practical when applied to control material given the rapid degradation of biological material and the compound variability and total error of the manual, comparative method. The value of total analytical error for clinicians is that it provides a measure of the quality of the assay that can be directly tied to improving medical errors. The challenge lies in defining how good a test needs to be for its intended clinical use.

A note about statistical quality control

Statistical quality control (SQC), while outside the scope of this bulletin but worth a brief mention, is an essential tool for managing analytical quality, but the rules and criteria should be optimized for value and efficiency. Experts in laboratory statistical analysis are moving towards a merger of the traditional Westgard QC "multi-rules" and the Six Sigma principles, a process improvement methodology focused on eliminating defects in a product or service utilizing the following formula:

Sigma scale = (TEa – Bias) / CV

- TEa, allowable Total Error (using Proficiency survey limits or CLIA limits)
- Bias, inaccuracy of the method (Lab Mean – Peer Mean)
- CV, imprecision of the method (using daily quality control data or from a replication experiment)

These calculations lead to the application of the Westgard Sigma Rules, a quicker approach to helping laboratories select the appropriate statistical quality control for their applications.[7]

Conclusion

CLSI recommends that all new ESR methodologies be verified to give results in accordance with the traditional Westergren reference method and the H02 guideline suggests a traditional regression analysis for this whole blood comparison. This regression analysis serves as part of the laboratory's documentation for risk assessment to meet CLIA's IQCP regulation.[8] Automated instruments such as the CUBE 30 Touch improve the practicality of the original Westergren method. The Diesse CUBE 30 Touch further reduces the potential biohazard, shortens the turn-around time, and provides excellent correlation to the Modified Westergren benchmark method.

References

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