

Comparison between manual procedure and automated for determinant of WBCs and PCV in maternity and labor hospital in Karbala city

Karem Kdaer Karem,^a Aseel Najah Sabour,^b Bara Majed Kulaifa^a

^aDepartment of Environmental Health, College of Applied Medical sciences, University of Karbala, Karbala, Iraq.

^bDepartment of Biology, College of Education, University of Al-Qadisiyah, Al-Diwaniyah, Iraq.

Correspondence to Aseel Najah Sabour (Email: dr_phy@yahoo.com).

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Objectives This study was designed to determine white blood cells (WBCs) and hematocrit (packed cell volume PCV) by manual procedure and comprised with an automated method in the maternity and labor hospital in Karbala city.

Methods During the period of comparative cross sectional study, 52 cases of blood sample were collected into tri-potassium ethylenediamine tetra-acetic acid (K3EDTA) from pregnant women admitted to hospital during February to April 2016 for the analysis of PCV and WBCs by Sysmex XP-300™ in the hematological department laboratory performance manual method in the same time. All data analyzed by Pearson correlation coefficient as well as using 2 Mean & Standard deviation for both methods.

Results For two hematologic parameter test, the correlation coefficient was ($R = 0.75$) for hematocrit thus improved strong correlation between two procedure manual and automated to evaluate WBCs ($R = 0.94$), which was significantly different ($P < 0.001$) for two parameter methods.

Conclusion From the results of our research, it can be concluded that the automated analyzer (WBCs) and (Hb) were well correlated with manual standard method for two hematologic parameter. So health care workers in the laboratory can save performance time for hematologic parameter in automated analyzer.

Keywords manual procedure, automated method, WBC, PVC

Introduction

Automated method for the estimation of complete blood count (white blood cells, hematocrit and hemoglobin etc.) is commonly used in routine practice laboratory but many other labs still work on manual procedure for the abnormal automated results as well as health care workers in laboratory can be optimized by doing test on manual microscopic procedure as validation technique for automated method.¹ In the recent past, huge progress in automated analysis for hematology examination.² No automated cell counter can equal the performance of manual differentiation for the presence of old results for leukocyte.³ White blood cells (WBCs), also called leukocytes or leucocytes, are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders.⁴ Automated systems for white blood cell recognition are currently available in the market. The importance of traceability in the medical diagnostics market is increasing. A technique that can make a determination from a microscope slide (or from a set of images) has the advantage that the data from which a diagnosis is made can be kept on file for future quality assurance needs.⁵

Hematocrit is a test that measures the percentage of blood that is comprised of red blood cell. This is often referred to as packed cell volume (PCV) or erythrocyte volume fraction. It is considered as an integral part of a person's complete blood count, along with hemoglobin concentration, white blood cell count and platelet counts.^{6,7} In Ethiopia, hematocrit is one of the most common parameters from complete blood count used as a routine examination by physicians in any parts of the country where automated method are unavailable, microhematocrit procedure is used to evaluate HCT value of patients.⁸

Materials and Methods

A comparative cross sectional study was conducted from 28 December 2015 to 28 January 2016 to assess the analytical performance between manual procedure and automated methods for

hematocrit and white blood cells determination for EDTA blood sample by Sysmex XP-300™ Automated Hematology Analyzer for a clinic sample laboratory or research testing. It provides 17 reportable parameters and three part differential, which include an absolute neutrophil count (ANC), the results in histograms for WBC, RBC, and Platelet (PLT). Venous blood was obtained from the patients admitted to maternity and labor hospital in Karbala city during study period. The study sample size was 52. About 2–3 ml of blood from the vein of selected patients was collected in a tube containing EDTA anticoagulant. The percentage of packed cell volume was measured manually by filling a capillary tube (plain) and sealing with modeling clay and centrifuging at 3000 g for 5 minutes, then the result was read using hematocrit reader. Also WBC counting was done manually using chamber counter after adding blood (20 μ l) to tube containing glacial acetic acid (0.4 ml), and then calculated WBC by equation summation of two parts of chamber and multiplied by 100. The result was obtained from Sysmex XP-300™ analyzer. The WBC and PCV values for both method registered were analysed by SPSS version 23 as a Pearson correlation co-efficient. Precision was determined using coefficient of variation and the significance of value was decided based on the P -value [0.05] at 95% confidence.

Results

The results in **Figure 1** show a strong correlation between WBC value in automated Sysmex XP-300™ and manual results. At the same time, the relationship between the two methods is extrusive, the value of correlation is +0.95.

In the scatter plot chart in **Figure 2** shows the correlation of result Packed cell volume in both methods manual and automated procedure. This value is +0.95.

A comparison of automated and manual method to determine the hematocrit for 52 patients is shown by mean \pm SD in **Table 1**.

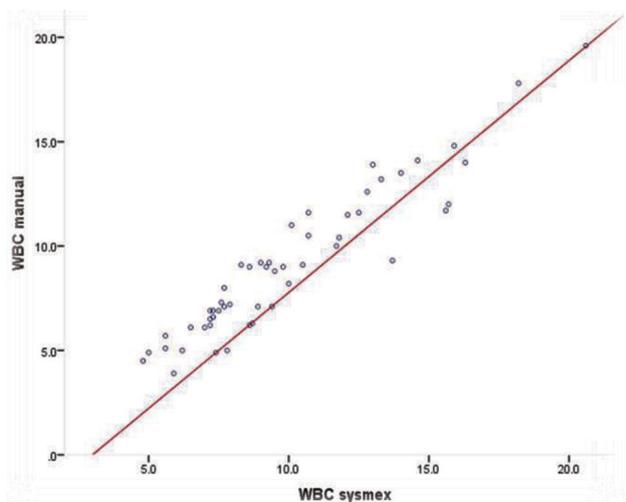


Fig. 1 Scatter plot showing the correlation of WBC automated and manual method ($R = 0.95$).

Table 1. Mean \pm standard deviation (SD) of hematocrit result by automated and manual methods

Parameter	Manual	Automated	P value
Hematocrit	41.6 \pm 5.1	34.5 \pm 4.9	0.001

Correlation is significant at the 0.01 level (2-tailed).

Table 2. Mean \pm SD of WBC result by automated and manual methods

Parameter	Manual	Automated	P value
White Blood Cell	9.0 \pm 3.4	9.9 \pm 3.5	0.001

Correlation is significant at the 0.01 level (2-tailed).

In Table 2, a comparison of automated and manual method to determine the white blood cells for 52 patients is shown by mean \pm SD. The correlation coefficients for relationships between the manual and automated (Sysmex XP-300™) was calculated using Pearson's correlation coefficient formula, which was $R = 0.95$. The correlation coefficient ($R = 0.95$) indicated the strong positive correlation between manual and automated methods to determine the hematocrit and White Blood Cell. The mean \pm SD of HCT result by the manual method is 41.6 \pm 5.1, whereas the automated method is 34.5 \pm 4.9. The mean \pm SD of WBC result by manual method is 9.0 \pm 3.4, whereas in automated method is 9.9 \pm 3.5. This implicated that the manual and automated for both tests WBC and PCV were significantly different ($P < 0.001$) which is less than 0.05 at 95% of confidence interval.

Discussion

Automated peripheral blood, leukocyte counts are widely accepted in routine practice. However, many laboratories still reflexively perform manual CBC solely based on abnormal automated results or instruments “flags”, before any manual triage step, to established manual procedure for quality control.⁹ This study indicated that manual HCT is higher than the automated HCT. It shows that the hematocrit values determined by the autohematological analyzer (Sysmex XP-300™) cannot replace the manual (microhematocrit) results

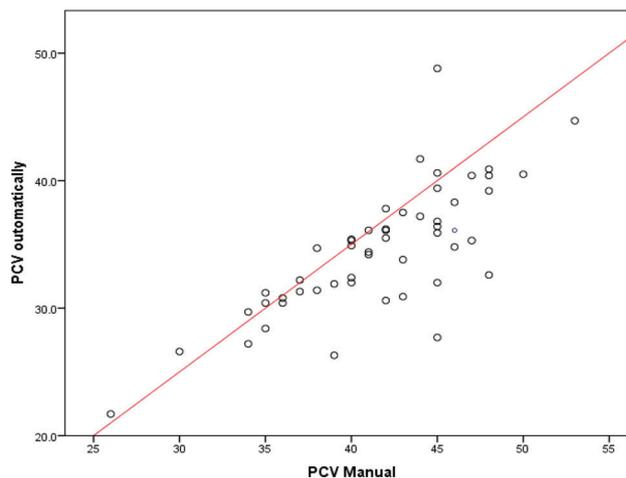


Fig. 2 Scatter plot of PCV manual and automated method ($R + 0.95$).

obtained, as the mean difference between both methods is significant ($P < 0.001$), as observed in other studies. A study undertaken in Nigeria, using Sysmex KX-21N, revealed statistically significant difference ($P < 0.0001$) when the mean and SE values of the two methods (automation and manual) were compared. In another study conducted on canine and feline, there were significant differences between manual and automated HCT ($P < 0.05$). The results of these studies also indicated that the HCT values from the automated method could not be used to substitute for those of the manual method, though the values of the two methods were accurate and precise.^{10,11} Unlike to this study which reported higher value of HCT in manual method, another study reported a higher PCV value from Coulter automated analyzer, even though there was no significant association observed.¹² Also there was a correlation coefficient in result of hematocrit with both methods Fig. 2.

In this study, there was highly correlation by using Pearson between the WBC result in manual and automated procedure which was done by Sysmex XP-300™ (0.94) with highly significant P value (0.001) among (52) cases in our study. Similar to revealed result of highly significant and correlation (0.96), P value (0.0001),¹³ this indicates that the automated hematology analyzer (Sysmex KX-21N) readings correlated well with the manual methods. In my opinion, the standard manual procedure is still an optimal method comparing to the automated assessment procedure although progressing.

Conclusion

The results of the present study confirm that the automated hematology analyzer readings are as reliable as the standard manual method. Generally, the study showed the hematocrit value obtained from hematology analyzer (Sysmex XP 300™) is different from that of manual, but it is directly proportional in most cases. The automated method cannot replace the manual for hematocrit determination though the result of both methods are close to each other.

Recommendation

All health workers in laboratories should take manual method together automated method to reach accurate result. ■

References

1. Siekmeier R, Bierlich A, Jaross W. The white blood cell differential: three methods compared. *Clin Chem Lab Med*. 2001;39:432–445.
2. Verso ML. The evolution of blood counting techniques. *Med Hist*. 1962;8:149–58.
3. Pohland D. Evaluation of the automated haematology analyser Sysmex M-2000. *J Clin Chem Clin Biochem*. 1989;27:41–47.
4. La Fleur-Brooks M. *Exploring Medical Language: A Student-Directed Approach* (7th ed.). St. Louis, Missouri, US: Mosby Elsevier. (2008, p. 398).
5. Alfred RJ. Katz, (Image Analysis and Supervised Learning in the Automated Differentiation of White Blood Cells from Microscopic Images) thesis, 2009.
6. Kathleen K. The Clinical Laboratory Improvement Act (CLIA) and the Physician's Office Laboratory. *Continuing Medical Education*. 2007.
7. CLSI Procedure for Determining Packed Cell Volume by the Microhematocrit Method; Approved Standard (3rd edn) CLSI document H7-A3 [ISBN 1-56238-413-9]. CLSI, 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087–1898, 2000, USA.
8. Birhaneselassie M, Birhanu A, Gebremedhin A, Tsegaye A. How useful are complete blood count and reticulocyte reports to clinicians in Addis Ababa hospitals, Ethiopia? *BMC Hematol*. 2013;13:11.
9. Lantis KL, Harris RJ, Davis G, Renner N, Finn WG. Elimination of instrument-driven reflex manual differential leucocyte counts. Optimization of manual blood smear review criteria in a high-volume automated hematology laboratory. *Am J Clin Pathol*. 2003;119(5):656–662.
10. Ike SO, Nubila T, Ukaejiofo EO, Nubila IN, Shu EN, et al. Comparison of haematological parameters determined by the Sysmex KX-2IN automated haematology analyzer and the manual counts. *BMC Clin Pathol*. 2010;10:3.
11. Prihirunkit K, Lekcharoensuk C, Pisetspaisan K. Comparison between Manual and automated methods for determination of canine and feline hematocrit and hemoglobin concentration. *Kasetsart J Nat Sci*. 2008;42: 655–659.
12. Kakel SJ. The evaluation of traditional and automatic Coulter method in estimation of haematological parameters in adult rats. *Beni-Suef Univ J Basic and Appl Sci*. 2013;2:31–35.
13. Ike SO, Nubila T, Ukaejiofo EO, Nubila IN, Shu EN, Ezema I. comparison of haematological parameters determined by the Sysmex KX-2IN automated haematology analyzer and the manual counts. *BMC Clin Pathol*. 2010;10:3.