ORIGINAL ARTICLE

An Evaluation Of The Beckman-Coulter AcT 3-Part Differential Haematology Analyzer In A Tertiary Hospital Laboratory

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ABSTRACT

Background: *The Beckman-Coulter AcT differential haematology analyzer was evaluated to compare its haemoglobin (HGB), haematocrit (HCT), platelet (PLT), total white cell count (WBC) values and differential leukocyte count (DLC) with the reference manual methods used in our laboratory.*

Methods: *Samples drawn into 5millilitres k3 EDTA bottles were selected on a random basis from our routine workload over a 4-week period. Fifty patient samples were analyzed on the AcT diff Coulter analyzer. The same patient samples were then reanalyzed using the reference manual method for comparison. Haemoglobin (cyanmethhaemoglobin method), haematocrit (micro-haematocrit method), total WBC (Turk's Method), platelet (Brecker-Cronkite method) were carried out and blood films were stained with leishman stain, and a 100-cell manual differential count was performed under oil immersion.*

Results: *The Beckman Coulter AcT 3diff haematology analyzer was shown to have excellent precision and accuracy for HGB and HCT with coefficient of correlation >0.974. WBC and PLT had low coefficient of correlation 0f 0.208 and 0.034 respectively. The DLC parameters was shown to have good correlation coefficients for neutrophils >0.876 and lymphocytes >0.84. Monocytes showed a low correlation of 0.082 without clinical significance.*

Conclusion: *The clinical sensitivity of the instrument in relation to the population evaluated was good. In all, the study results indicate that the AcT 3-part haematology analyzer could improve the overall laboratory productivity with flagged abnormal results being confirmed by the manual reference method.*

KEYWORDS: *AcT differential analyzer; Haematology analyzer; Beckman coulter; Evaluation.*

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INTRODUCTION

The Beckman Coulter AcT 3diff haematology analyzer is a highly compact automated haematology analyzer designed to provide 16 parameters of full blood count (FBC) and a 3 part differential leukocyte count (DLC) and to generate a panel of comprehensive flags in cases of abnormal results[1]. This instrument is useful in units with high sample turnover, for example, our current haematology workload is approximately 80 specimens per day. It is expected to give accurate and reproducible results for a wide variety of clinical conditions (and to provide these results without unnecessary delay), to reduce the number of manual WBC differentials required and to have the ability to measure large numbers of cells in a highly automated manner[2].

However, issues concerning accuracy have been raised. It has been shown that platelet results may be elevated and there may be difficulties in obtaining valid white blood cell count (WBC) due to incomplete lyses of erythrocytes and the presence of nucleated red blood cells (NRBCs) or other interferences[3]. There is paucity of data regarding the above issues in Nigeria, hence we decided to evaluate these in our practice in Port Harcourt, which is reputed to be the hub of the oil-rich Niger Delta of Nigeria with a population of over four million people. During 1 month we evaluated the Ac T 3-part diff analyzer's haemoglobin (HGB), haematocrit (HCT), total white count (WBC), platelet (PLT) and 3-part differential (neutrophils, lymphocytes, monocytes) values in comparison with the reference manual method currently used in our laboratory.

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MATERIAL AND METHODS

System description

The AcT 3diff analyzer (Beckman-Coulter company Miami, Florida, USA) is a small bench-top haematology system that can analyze up to 60 samples per hour and uses a 12 μl sample in FBC/DLC mode. The system uses a total of 3 packed reagents: AcT diff Diluents; to dilute the whole blood and stabilize cell membrane; AcT Lyses, lyses RBCs for leukocyte count and determine haemoglobin content; and AcT diff Rinse, a rinsing agent[4].

Samples and reagent are homogeneously mixed at specified times and delivered to appropriate temperature-controlled baths where the reactions occur. From there the reaction mixtures are transferred to the flow cells for analysis. It counts white blood cells (WBC), red blood cells (RBC) and platelets (PLT) by the impedance method. Haematocrit (HCT) is measured by the sum of RBC counted in a specified volume of diluted blood[5].

Blood Samples

Samples drawn into 5-ml k3 EDTA bottles were selected on a random basis from our routine workload over a 4-week period. Fifty patient samples were analyzed on the AcT diff Coulter analyzer. The same patient samples were then reanalyzed using the reference manual method for comparison. Haemoglobin (cyanmethhaemoglobin method), haematocrit (micro-haematocrit method), total WBC (Turk's Method), platelet (Brecker-Cronkite method) [6] were carried out and blood films were stained with leishman stain, and a 100-cell manual differential count was performed under oil immersion.

The Coulter AcT instrument was calibrated before the beginning of evaluation. The performance of the instrument and the manual methods were established. The data were entered into a spreadsheet in Excel (Microsoft 2000) and regression analysis was performed using Vassar Stats plot software.

RESULTS

Method Comparison: FBC Parameters

The haemoglobin (HGB), haematocrit (HCT), total white cell count (WBC) and platelet (PLT) results were compared by regression analysis, the coefficients of correlation, slope, the mean difference between methods and intercept of the regression line were reported, as shown in Table I. The x, y regression plots are shown in Figures 1-4. The manual results are on the x-axis (reference), and the AcT 3diff Coulter on the y-axis (test).

HGB and HCT had coefficients of correlation of >0.974, WBC of 0.208 and PLT of 0.034.

Method Comparison: WBC Differential Parameters

The WBC differential parameters, neutrophils, lymphocytes monocytes and eosinophils were compared by regression analysis, the coefficients of correlation, slope of the mean difference between methods and intercept of the regression line were reported, the results as shown in Table I. The x, y regression plots are shown in Figures 2,4-6. The manual results are on the x-axis (reference), and the AcT 3diff Coulter on the y-axis (test).

Coefficient of correlation were >0.876 ($p < .0001$) for neutrophils, >0.84 ($p < .0001$) for lymphocytes, and 0.082 for monocytes showed no clinical significance. Eosinophils did not show any meaningful result for statistical analysis.

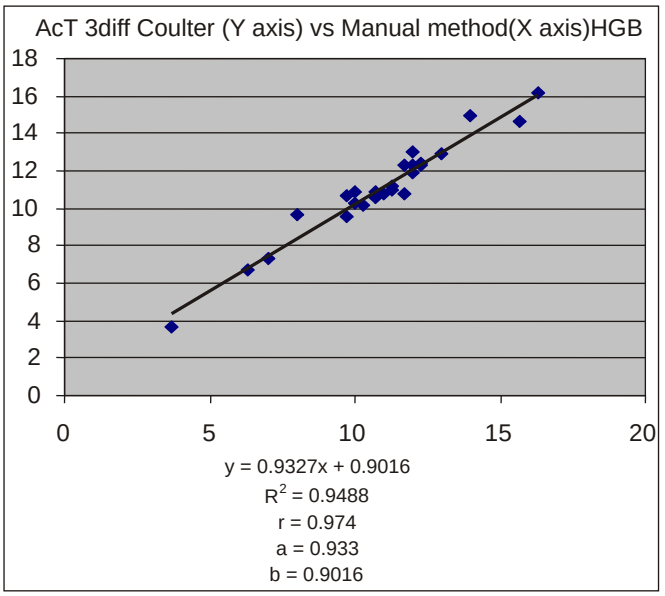

Fig. 1. Regression Analysis for Haemoglobin

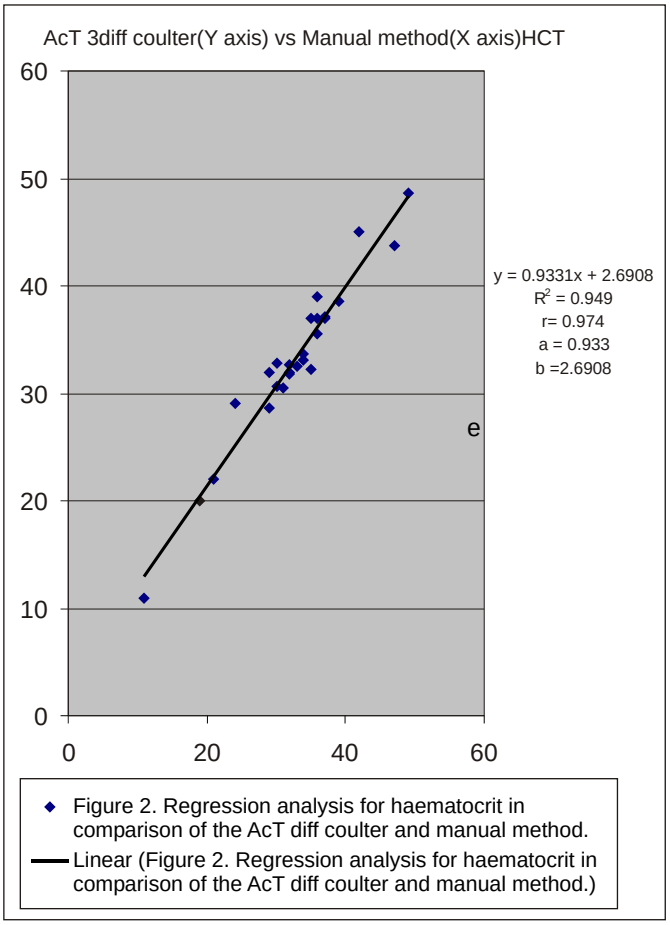

Fig.2.Regression Analysis for Haematocrit

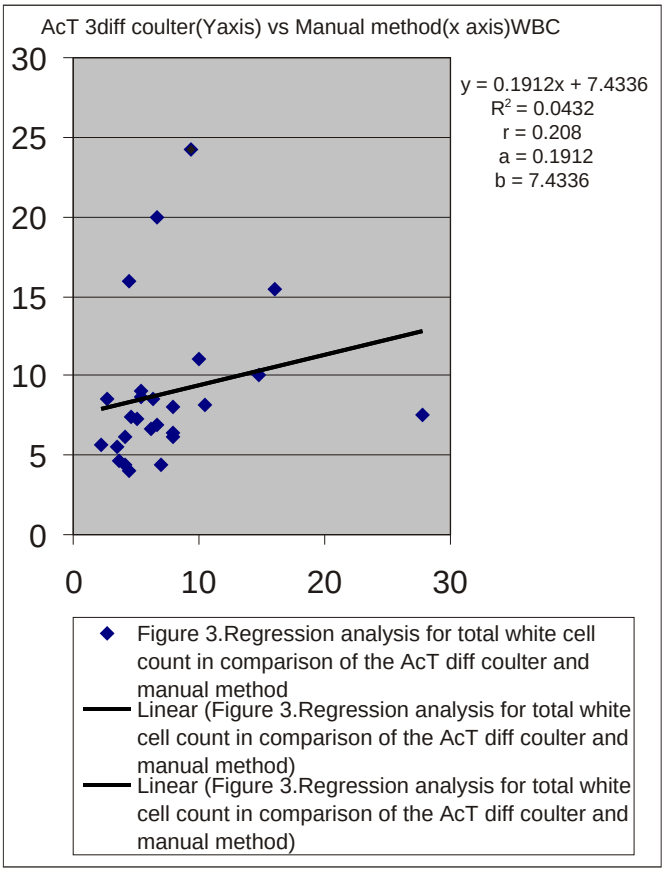

Fig.3.Regression Analysis for Total WBC

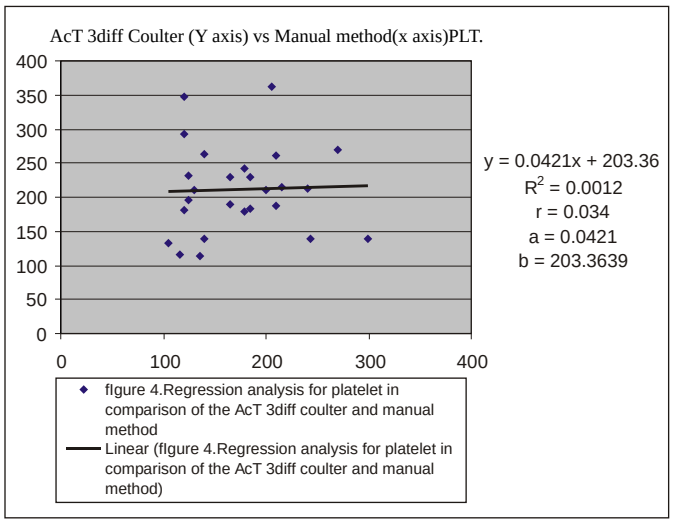

Fig.4.Regression Analysis for Platelet

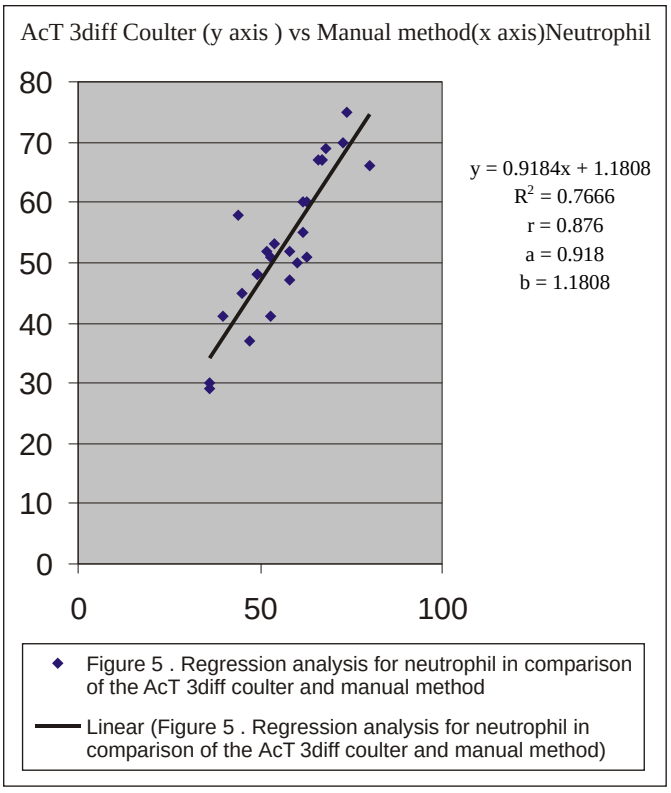

Fig.5.Regression Analysis for Neutrophil

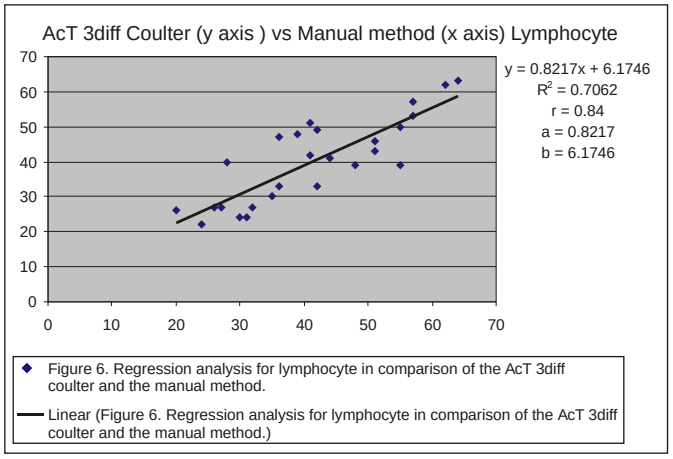

Fig.6.Regression Analysis for Lymphocyte

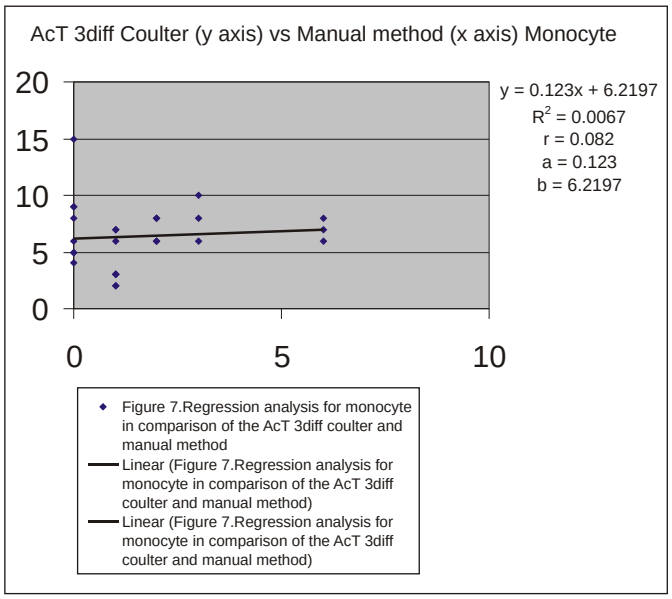

Fig.7.Regression Analysis for Monocyte

Table I. Correlation Data: AcT 3diff (y) vs. Manual Method (x)

		Mean		Mean Difference			
Parameters	Slope	X	Y	Y - X	Intercept	R	P
Haemoglobin g/dl	0.933	10.9	11.1	0.2	0.9016	0.974	< .0 001
Haematocrit %	0.933	32.7	33.2	0.5	2.6908	0.974	< .0001
WBC x 10 ^{9}/L	0.191	7.49	8.87	1.35	7.4336	0.208	< .1541
Platelets x 10/mm ^{3}	0.042	174	211	37	203.3639	0.034	< .4341
Neutrophils %	0.918	56.9	53.4	-7.9	1.1808	0.876	< .0001
Lymphocytes %	0.822	41. 3	40.1	-1.2	6.1746	0.84	< .0001
Monocytes %	0.123	1.65	6.42	4.77	6.2197	0.082	< .3455

DISCUSSION

In our evaluation of the AcT 3-diff Coulter system, the haemoglobin (HGB) and haematocrit (HCT) parameters demonstrated good correlation while platelet (PLT) and total white blood cell count (WBC) showed low correlation. The coefficients of correlation for these parameters (HCT and WBC) were >0.974.These results were consistent with that reported by other workers[2], except PLT and WBC which had low correlation coefficient of 0.208 and 0.034 respectively.

This finding can be attributed to several factors, which include differences in technology. The technology of the AcT 3 diff Coulter focuses light on cells in a stream of diluents and aligns them to pass through the flow cell singly. Cell volumes are determined by the Coulter principle (impedance) and light absorbance are measured. This means that the automated instruments are scanning thousands of cells compared to the fewer cells being counted in a manual method[7].

Secondly, there was interference from cellular fragments or microcytes (shape effect). The difficulties in total white cell counts may be attributed to incomplete lyses of erythrocytes. However, presence of nucleated red blood cells (NRBCs) can also affect results from the AcT 3diff Coulter[2].

Thirdly, aberrant impulses that include coincidence, edge effect, and recirculation occurring more frequently on aperture in coulters result in measurement variances[8].

All leucocytes differential (DLC) parameters of the AcT 3diff Coulter showed good correlation coefficients for neutrophils >0.876 and lymphocytes >0.84 while monocytes showed a lower correlation coefficient of 0.082 without clinical significance. Other investigators have reported such differences between monocyte count on automated instruments versus manual counts[9]. The low number of sample as well as low number of cells counted for eosinophils prohibited meaningful regression statistics, which was excluded in this study.

In conclusion, we consider the performance of the AcT 3 diff Coulter system to be acceptable in our laboratory with the necessity of flagged abnormal results to be confirmed by the appropriate manual reference method. It is envisaged that automation in laboratory

practice would become more commonplace as funding of medical practice improves in Nigeria. We therefore recommend regular quality control assessments and measures to ensure optimum performance and service from this equipment, which invariably requires huge capital outlay for their procurement and regular maintenance.

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