



## Research Paper

# An Evaluation of Sysmex XS-1000i Five Part versus Orphee Mythic Three Part Differential Cell Counter in Hematological Disorders

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## Abstract

*Complete blood count (CBC) is the most commonly ordered investigation. It is most versatile yet most economical. CBC can be done by manual or automated method. This study evaluates the performance of two automated cell counters for the analysis of CBC. The main purpose of the study is to evaluate hematological parameters in various hematological disorders and to discuss the advantages, disadvantages of both instruments in relation with diagnosis of common hematological disorders. This prospective study was carried out at department of pathology in tertiary care hospital over the period of 2 years. Blood samples from 100 patients of age 13 years and above was collected into K3EDTA tube, and analyzed using both counters. The common hematological parameters between two counters were compared by using kappa test and then categorized into below normal, normal and above normal. The results were given in the form of strength of agreement (very good, good, fair and poor). Good to fair correlation were found for almost all parameters. However, MCV was underestimated by mythic 3part counter. The blood samples having too high and too low TLC were recognized only by sysmex. Thus this study concludes that, 5 part cell counter is technically more advanced with methodological superiority but 3part hematology analyzer is cost effective.*

**Keywords:** Automated cell counter, hematology analyzer, CBC.

## Introduction

The complete blood count (CBC) is often used as a broad screening test to determine an individual's general health status. It is the quantitative measurement of cellular blood elements including erythrocytes, leukocytes and platelets which is done by either manual or automated method.<sup>(1,2)</sup>

Automated methods are more precise, increases accuracy and speed of analysis. Also provide additional data describing cellular characteristics

such as cell volume and minimizing statistical error.<sup>(3)</sup>

The first automated cell counter have been introduced in the hematology laboratory some decades ago, the flowcytometry and aperture technology have steadily been further developed and refined. The first generation of analyzers counted only the number of red cells present in blood, while subsequent models were also able to quantify the white blood cells and platelets.

During the seventies and eighties the 'three-part WBC differential' was introduced, later followed by the 'five-part differential' which provides the absolute and relative number of leukocyte subsets.<sup>(4,5)</sup>

In 1953 Coulter has introduced the world's first streaming hematology analyzer-Coulter, Counter Model A.<sup>(6)</sup> The correct interpretation of results of automated analyzer requires extensive knowledge of the analytic performance of the instruments.<sup>(7)</sup>

Total 24 parameters are given by Sysmex XS-1000i with 5 part differential while 15 direct parameters by Orphee Mythic with 3 part differential.

The present study is undertaken to evaluate Sysmex XS-1000i 5part counter in comparison with Orphee Mythic 3part cell counter considering cost effectiveness and results in different hematological disorders. This is the first time study of its own type for benefit of pathologists as well as patients at a medical institutional level. The aim of this study was to evaluate hematological parameters in various hematological disorders and to discuss the advantages and disadvantages of both instruments in relation with diagnosis of common hematological disorders.

### Materials and Methods

This prospective study was carried out in department of pathology at tertiary care hospital over a period of 2 years. The sample size was 100. All clinically suspected or previously diagnosed patients of hematological disorders of age 13 yrs and above, both male and female admitted in various wards were selected randomly. The cases were evaluated as per record form.

Total 2.5 ml of blood was collected from each patient from ante-cubital vein in K3 EDTA tube using all aseptic precautions. The collected blood samples of these patients were analyzed using both counters. Peripheral blood smears were examined. The bone marrow aspirations were done in few cases whenever required.

There are total 14 common parameters in both counters i.e. total leukocyte count (TLC), red blood cell count(RBC), hemoglobin (HB), haematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin(MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), platelets (PLT), platelet distribution width (PDW), mean platelet volume(MPV), plateletcrit (PCT), Neutrophil percentage and Lymphocyte percentage. The results of common parameters were compared by using kappa test and categorized into below normal, normal and above normal. The kappa test gives results in the form of strength of agreement (very good, good, fair or poor).

### Results

In the present study distribution of total number of the cases were as follows. (Figure 1)

It was observed that maximum number of patients were of anemia 49 cases (49%) including pure anemia 25 cases (25%) and anemia with thrombocytopenia 14 cases (14%), pancytopenia 10 cases (10%). Anemia cases were followed by leukemia cases accounting for 33 cases (33%). Patients with pure thrombocytopenia were only 3 (3%). Eosinophilia cases were 10 (10%) and monocytosis accounts 5 cases (5%).

The maximum number of patients was in the age group of 13 – 20 years accounting for 27 cases (27%), followed by 31 – 40 years (25%), 21 – 30 years (19 %).

The result of all common 14 parameters was compared using kappa test. The comparison of total leukocyte count is shown in Table 1. The Kappa value for TLC was 0.787. It denotes good strength of agreement for TLC between two counters.

Mythic 3part did not give total leukocyte count and differential leukocyte count of 6 patients. Out of which 4 samples showed very high TLC ( $>250 \times 10^3/\mu\text{l}$ ) and rest 2 showed very low TLC ( $<1.3 \times 10^3/\mu\text{l}$ ). On peripheral blood smear (PBC) and bone marrow (BM) those with very high TLC

were diagnosed as chronic myeloid leukemia (3 cases) and acute myeloid leukemia (1case). While rest 2 cases were diagnosed as acute myeloid leukemia (1case) and acute lymphoblastic leukemia (1case)

The red blood cell count was similarly compared. (Table 2) For RBC number of observed agreements was 64 (64.65% of the observations). The Kappa= 0.278. So, the strength of agreement for RBC in both counters was considered to be 'fair'. The strength of agreement for Hemoglobin between two counters was good.

The comparison of analysis of result of MCV is shown in Table 3. The Kappa value for MCV was 0.131 Thus the strength of agreement for MCV between two counters was poor. It indicates both counters gave different results for MCV.

Due to discrepancy between 9 cases of MCV values of both counters, values were correlated

with peripheral blood smear and bone marrow aspiration findings. All 9 cases showed above normal limit of MCV by Sysmex while normal value in mythic. PBS and BM findings of these all 9 cases were suggestive of erythroid hyperplasia with megaloblastic maturation. MCV by Sysmex were correlated with manual PBS and B.M. findings.

The strength of agreement was fair for MCH, MCHC, PCT and RDW; good for PLT and HCT; moderate for neutrophil% and lymphocyte% while poor for PWD and MPV.

Eosinophilia (10 cases) and monocytosis (5 cases) were diagnosed only by sysmex. Sysmex showed 4 cases with high basophil count which were confirmed as Chronic Myeloid Leukemia with basophilia on PBS.

**Table 1:** Analysis of comparison of TLC between two counters

		TLC by Sysmex 5part counter			Total
		Below Normal	Normal	Above Normal	
TLC by Mythic 3part Counter	Below Normal	18	3	0	21
	Normal	5	26	0	31
	Above Normal	0	5	37	42
Total		23	34	37	94

**Table 2:** Analysis of result of red blood cell count

		RBC by Sysmex 5part			Total
		Below Normal	Normal	Above Normal	
RBC by mythic 3part	Below Normal	53	2	0	55
	Normal	24	11	0	35
	Above Normal	0	9	0	9
	Total	77	22	0	99

**Table 3:** Comparison of Mean Corpuscular Volume

		MCV by Sysmex 5part			Total
		Below normal	Normal	Above normal	
MCV By Mythic 3part	Below Normal	33	38	5	76
	Normal	1	12	7	20
	Above Normal	0	0	0	0
Total		34	50	12	96

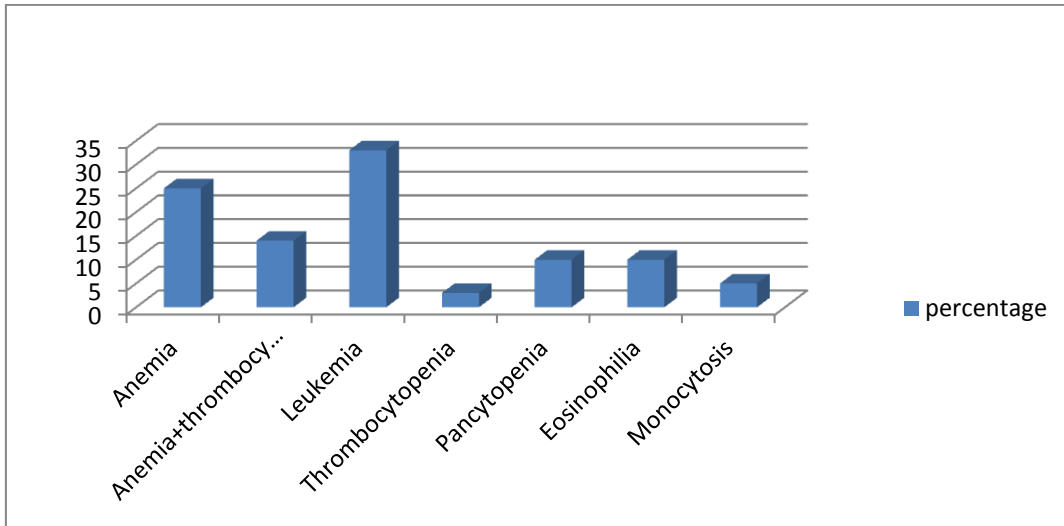


Figure 1: Distribution of cases



Figure No.2 – Sysmex XS 1000i 5part counter



Figure No.3 – Sampler Mode of Sysmex XS 1000i 5part counter



**Figure No.4** – Mythic 3part Cell Counter



**Figure No.5** – K3 EDTA tube

### Discussion

In this study, we compared 2 hematology analyzers—Orphee mythic and Sysmex XS-1000i regarding sensitivity and specificity for different CBC parameters. For the evaluation of CBC parameters both machines were compared using kappa test and strength of agreement were determined. No large differences were detected for most of the CBC parameters like HB, RBC, WBC, PLT, MCH, MCHC, RDW, PCT, neutrophil %, lymphocyte % and HCT. While MCV and PDW showed poor strength of agreement.

Orphee mythic 3 part counter was unable to give TLC and DLC in 6 samples (4 samples having very high and 2 having low TLC) and this might be related to its different WBC counting technology.

Mythic 3part counter uses impedancemetry technique for counting of the cellular elements in a blood sample<sup>(8)</sup> and Sysmex 5part counter uses fluorescence flow cytometry technique in which, the RNA and DNA components in the cell are stained with special fluorescence dyes without destroying the cell.<sup>(9)</sup> The technology is very specific and sensitive for detection of immature and malignant blood cells e.g. immature granulocyte and offer a reliable warning messages. At the same time, it is also suitable method for excluding negative effects on DLC due to otherwise troubling particles e.g. lysis-resistant red blood cells, lipids. As these particles have no nucleic acid thus does not provide any detectable fluorescence signal so recognized as 'ghost area' on the scatter gram and do not influence DLC. Thus Sysmex 5part is able to give correct WBC, DLC and flags<sup>(9,10)</sup>.

We observed clinically significant difference in MCV. We found lower values of MCV on Orphee mythic so 9 cases of megaloblastic anemia were missed by 3part counter. While MCV values by Sysmex 5part counter were correlated with PBS and BM findings. It might be due to different technology.

In Mythic 3part, hemoglobin measurement is done in WBC chamber by spectrophotometry at 555nm.<sup>(8)</sup> Sysmex 5part counter uses sodium lauryl sulphate which lyses RBC as well as WBC. So there is no dilution of samples due to leukocytosis. It also eliminates disturbing effects of the lipaemic samples.<sup>(9)</sup>

It is difficult to compare our findings with previous published work, because different analyzers were used in each study. Bruegel M et al studied five different hematology analyzers.<sup>(11)</sup> Meintker L et al state that flagging for blasts and immature granulocytes showed moderate sensitivity and specificity.<sup>(12)</sup> Buoro S et al

compared analytical performance between two hematological analyzers according to them difference exist between the two analyzers, especially in the generation of morphology flags.<sup>(13)</sup>

RDW-SD is more sensitive indicator of anisocytosis, not affected by MCV is given only by Sysmex 5part counter. Blast flagging as one of the clinically most relevant warning message, a significant improvement of sensitivity was found only for sysmex 5part.P-LCR which help in diagnosis of thrombocytopenia, is additional parameter given by Sysmex 5part.

There is huge difference between cost of 3-part and 5-part hematology analyzer. For Mythic 3part counter cost per sample is very less when compared with Sysmex 5part counter. However in some cases Sysmex 5part counter is far more superior and specific. So Sysmex 5part counter should preferentially be used in tertiary care centers. Small laboratory cannot afford 5part counter due to its high operational cost which ultimately cost the patient higher than the 3part cell counter.

Budding pathologist has a problem of budget distribution among instruments so according to utility of instrument he has to choose instrument with better results but lower cost and he can use his manual skills at the diagnosis of hematological disorders.

We suggest the use of three part differential counter in the early phase and later on five part differential counters if required according to its own judgment because results of both are varying in only few parameters and in few hematological disorders.

Five part differential cell counter and next generation cell counters like 7 part and so on can be useful for specialty hospitals and institutes where sample size will be higher and which are referral centers.

### Conclusion

Side by side testing of two hematology analyzers, revealed a good concordance for most of CBC

parameters except for MCV & PDW. With respect to MCV and too high or too low TLC mythic 3part revealed main limitations compared to microscopic analysis. Regarding flagging quality between two instruments, the highest sensitivity for presence of blasts, atypical lymphocytes and immature granulocytes was found for sysmex5part.Sysmex 5part hematology analyzer offers more parameters and is technically advanced with methodological superiority when compared with Mythic 3part counter. But mythic 3part counter's operational cost is lower without much compromising most of hematological parameters, is better suitable for small laboratories however Sysmex 5part counter is better for referral centers.

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