Research Article

Comparison of automated blood cell counting of breast cancer patients by Advia 120 and Sysmex XT 4000*i*

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Abstract

Breast cancer is one of the most common diseases found among women in Thailand. The disease is usually treated with surgery which may be followed by chemotherapy or radiation therapy, or both. During the treatment, complete blood counts (CBC) of the patients are important for follow-up and evaluation of the status of the patients. In this aspect, there might be certain CBC parameters which were affected by hematology analyzers. At present, Advia 120 and Sysmex XT 4000*i* routinely used in various hematology laboratories quantification of each parameter by these two analyzers is. Therefore, the aim of this study was to compare and to analyze the correlation between various parameters determined by Advia 120 and Sysmex XT 4000*i*. One hundred EDTA blood samples from breast cancer patients at Mahavajiralongkorn Cancer Center were tested by Sysmex XT 4000*i* and Advia 120. Among the 100 subjects in the study, eighty-nine patients had non-metastases and eleven patients had metastases. They were treated by radiation and/or chemotherapy. The Student's *t*-test and Pearson correlation coefficient were tested by using SPSS 17.0. The tested results were compared among the parameters determined by Advia 120 and Sysmex XT 4000*i* in the samples of the patients with breast cancer.

The correlation was found in thirteen parameters of Advia 120 and Sysmex XT 4000i in 100 patients with breast cancer with the means correlation coefficients (*r*) of 0.96. In conclusion, the thirteen parameters were acceptable, no significant bias, and good correlation. The accuracy and precision in most tested parameters Sysmex XT 4000*i* and Advia 120 were satisfactory in the patients with breast cancer

Keywords: Automated hematology analyzer; breast cancer; Sysmex XT 4000*i* and Advia 120

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1. Introduction

Hematology analyzers produce results that are accurate and precise enough for clinical use. In the case of automated cell counts, complete blood count (CBC), differential leucocyte count (DLC) and more recently the reticulocyte count or the extended differential count were included(1). These aspects concern the reliability of the numerical results, the productivity of automated methods, and the clinical sensitivity in terms of the ability to identify pathologic specimens (containing immature or atypical cells). Accordingly, Advia 120 and Sysmex XT 4000*i* are routinely used quantification of various parameters remain in question. Advia 120 hematology analyzer is a system which incorporates flow cytometric principles and cytochemistry (2) but the Sysmex XT-4000*i* automated hematology system utilizes the power of fluorescent flow cytometry and hydrodynamic focusing technologies(3).

Breast cancer (BC) is the most common cause of deaths in females in the ASEAN region(4). It is a heterogeneous disease that encompasses a variety of clinical patterns, biological behaviors, prognostic characteristics, and responses to different types of treatment. Ambitious efforts have been made to improve overall survival (OS) and morbidity early diagnosis and multiple therapies(5). Chemotherapy is a common cause of low white blood cell, red blood cell and platelet. These cells are manufactured in the bone marrow. During chemotherapy bone marrow activity may decrease resulting in lowered blood cell counts within the body. Complete blood count (CBC) has been used to screen the hematology status of the patients before chemotherapy or other treatments. In clinical laboratories, Advia 120 and Sysmex XT 4000*i* are routinely used quantifications remain challenging in the treatment of breast cancer. The aim of this study was to evaluate the complete blood count (CBC) testing by Advia 120 and Sysmex XT-4000*i*. It was found that the parameters CBC Sysmex XT 4000*i* and Advia 120 were satisfactory when tested with patients with breast cancer.

2. Materials and methods

2.1 Study design

The present study was approved by the Ethics Committee for Human Research, Mahavajiralongkorn Hospital in Thailand. A total of 100 EDTA blood samples were obtained from patients with pathologically confirmed breast cancer during May 2012 to November 2013. The inclusion criterion was a fresh sample with sufficient sample volume for the hematological analysis with both the Advia 120 and Sysmex XT-4000*i* analyzers.

2.2 Demographic data

The general characteristics of the breast cancer patients are shown in Table 1. The patients were treated with chemotherapy followed by radiation or both chemotherapy and radiation. The tumors were graded and staged according to the Staging Manual (7th edition) of the American Joint Committee on Cancer. The age range of the patients was from 41 to 55 years. Fifty patients had stage III tumors and forty-two patients had stage II tumors. There were 2 and 6 patients with stage I and IV, respectively.

Table1. Characteristics of patients with breast cancer

Characteristics	n = 100
Age (range)	41-55 years
Tumor grade	**n**
Grade 1	2
Grade 2	42
Grade 3	50
Grade 4	6
Main sites of metastasis	
No metastasis	89
Bone	4
Liver	2
Lung	2

Lymphatic grand	2
Lung and Lymphatic grand	1
Treatment	
Chemotherapy	40
Radiation	2
Both	58

3. Statistical analysis

Statistical analysis was performed with SPSS 17. Correlation coefficients of the parameters patients with breast cancer were determined by using a 2-tailed Pearson test. The normal parameters and patients with breast cancer were compared Student's *t* test.

4. Results

In this study, CBC results of breast cancer patients by Advia and Sysmex XT 4000i were analyzed for their correlations. All thirteen hematologic parameters were calculated. The correlation coefficients (*r*) of CBC parameters WBC, RBC, HGB, Hct, MCV, MCH, PLT were 0.986, 0.966, 0.973, 0.905, 0.969, 0.976, and 0.955, respectively as shown in Figure 1. The correlation coefficients of the parameters of WBC, absolute neutrophil count, neutrophils, absolute lymphocyte count, lymphocytes, monocytes and eosinophil's were 0.985, 0.986, 0.956, 0.982, 0.933 and 0.95, respectively (Figure 2). There were no abnormal parameters of CBC and parameters of white blood cells in breast cancer patients among the subjects during chemotherapy and radiation as presented in Tables 2 and 3. It was found that the two analyzers exhibited very good correlation.

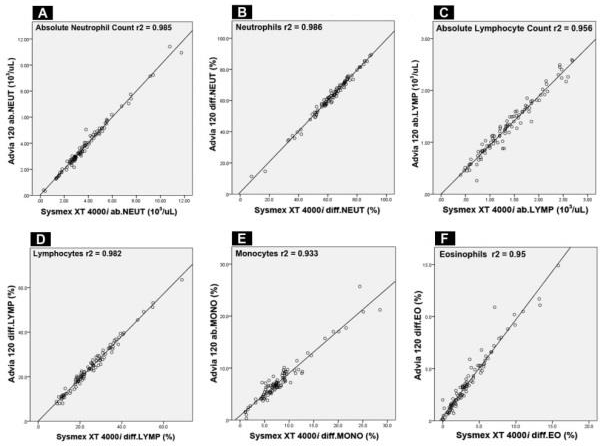

Fig.1. Regression results for complete blood counts. A, WBC, r = 0.986; B, RBCr, = 0.966; C, HGB r = 0.973; D, Hct, r = 0.905; E, MCV r = 0.969; F, MCH, r = 0.976; G, PLT, r = 0.955.

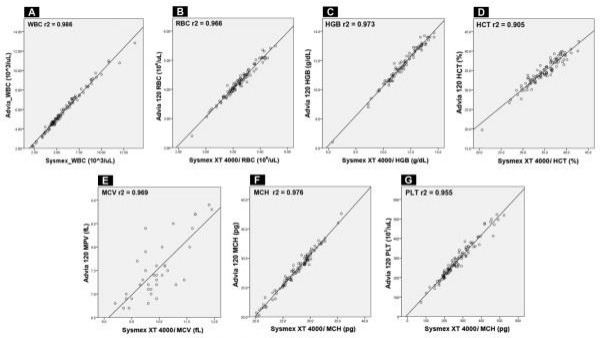

Fig.2. Regression results for parameters of white blood cells. A, absolute neutrophil count, r = 0.985; B, neutrophils, r = 0.986; C, absolute lymphocyte count, r = 0.956; D, lymphocytes, r = 0.982; E, monocytes, r = 0.933; F, eosinophils, r = 0.95.

Table2. Mean parameters of CBC of patients with breast cancer.

Parameters	**Advia 120**	**Sysmex XT 4000i**	**Normal Values**
WBC ($x10^9$)	5.7	5.7	5.1-10
RBC ($x10^9$)	4.2	4.2	4.5-5.9
HGB (g/dl)	11.8	11.7	12-16
Hct (%)	34.4	34.9	37-47
MCV (fl)	82.4	83.1	82-96
MCH (pg)	27.9	27.5	26-32
PLT ($x10^3$/µl)	284.6	269.1	150-450

WBC, white blood cell; RBC, red blood cell; HGB, hemoglobin; Hct, hematocrit; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; PLT, platelet count

Table3. Mean parameters of white blood cells of patients with breast cancer.

Parameters	**Advia 120**	**Sysmex XT 4000i**	**Normal Values**
Abs. neutrophil ($x10^3$/µl)	3.75	3.75	1.9-8
Diff. neutrophil (%)	62.5	62.7	40-74
Abs. lymphocyte ($x10^3$/µl)	1.3	1.4	0.9-5.2
Diff. lymphocyte (%)	23.8	25.0	19-48
Diff. monocyte (%)	7.4	8.0	3.4-9
Diff. eosinophil (%)	3.6	3.6	0-7

Abs. neutrophil, absolute.neutrophil; Diff.neutrophil, differential.neutrophil; Abs.lymphocyte, absolute.lymphocyte; Abs. lymphocyte, absolute. Lymphocyte; Diff.lymphocyte, differential.lymphocyte; Diff. monocyte, differential. Monocyte; Diff. eosinophil, differential.eosinophil

5. **Discussion**

The CBC determination in patients with breast cancer showed that all 13 parameters displayed acceptable performance for routine screening of blood by Advia 120 and Sysmex XT 4000*i*. Although of the Advia 120 results were excellent, it was found that all 13 parameters of the Sysmex XT 4000*i* results were always relatively greater than 0.9. The hematology analyzer Advia 120 uses light scattering and cytochemistry(2) but Sysmex XT 4000*i* uses light scattering, impedance, and conductivity. They all use the principle of flow cytometry, but they differ in that they use their own reagents in red cell analysis and leukocyte differential counts and in that they use different analytic techniques. In patients with breast cancer RBC also showed very good correlation (r = 0.96) and the overall agreement were very good (r = 0.969 and r = 0.976, respectively). Measurements of the hemoglobin and Hct were good (r = 0.9736 and 0.905, respectively). The platelet counts of breast cancer patients also showed good correlations (r = 0.955). These results showed using the Advia 120 analyzer, red cell and platelets analysis is done by flow cytometry and laser. The Advia 120 analyzer has option to measure total Hb with a cyanide-free colorimetric method. In addition, the Hb concentration is internally controlled the MCHC. The MCHC is calculated based on Hb, MCV, and RBC results. However, using the Sysmex XT 4000*i* analyzer, Hb is measured with a cyanide-free, spectrophotometric method. The RBC and PLT impedance (PLT-I) are measured using

direct-current detection with hydrodynamic focusing. Hct value is simultaneously determined applying the RBC pulse-height detection method as. Mean corpuscular volume, MCH, and MCHC are calculated automatically from the impedance count. The 13 parameters from Advia 120 and Sysmex XT 4000*i* have similarly in breast cancer patients and benefits for routine use. The most common type of blood testing for patients with breast cancer has been the complete blood count test, which determines the amount of red blood cells, white blood cells and platelets during and after treatment. Red cell parameters of patients with breast cancer showed that they are slightly anemic.(Table 1). Anemia the cancer cells in the body, a result of biologically active products of the cancer cells or even as a consequence of the treatment of cancer. For WBC count, we also found a good correlation 2 analyzers ($r = > 0.986$) for patients with breast cancer. For the 5-part LDC, absolute neutrophil count and neutrophils of with breast cancer showed very good overall correlation with the analyzer means ($r2$ = 0.985 and 0.986). WBC parameters were normal as shown in Table 2.

The present automated blood analyzer determines the basic hematology parameters for monitoring patients. Complete blood count was analyzed accurately resulting in rapid diagnosis. The principle of automated complete blood cell counting should be understood by the medical technologists. However, analysis using automated machines still has certain limitations such as the identification of certain abnormal samples. Therefore, a combination of testing by the automated blood analyzer with a blood smear will lead to a more accurate result. Additionally, the quality control and calibration of the machine as well as its accessories will produce accurate and reliable analysis. It was concluded from the study that both Advia 120 and Sysmex XT 4000*i* provide the correlated CBC results in patients with breast cancer and can be used alternatively.

6. Acknowledge

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