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Stability and Reliability of Complete Blood Count Parameters with Extended Storage toward Pathological Applications with Defined Specifications: A Mini Review

Sajid Hussain*

*Multan Institute of Nuclear Medicine and Radiotherapy (MINAR), Nishtar Hospital, Multan, Pakistan.

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ABSTRACT

Complete blood count is a primary and important basic test for analysis of medical abnormalities. Measurements were performed by using Celltac G MEK-9100 CBC analyzer at regular intervals up to 246 h (10 days). Analysis of red blood count, white blood count, and hemoglobin level was clinically stable and qualitatively reliable upto186 h (7.75 days), 126 h (5 days) and 90 h (3.75 days) respectively extended storage at 4 ± 1°C. While the most parameters of complete blood counts were clinically and significantly unaffected up to 48 h (2 days) except for the platelet with its indices plateletcrit and mean platelet volume which was significant qualitatively reliable up to 6 h. It is concluded that there is no guarantee for the quality and reliability of CBC parameters for the refrigerated blood samples during extended periods of storage at 4°C after 2 days except that of red blood cell count, hemoglobin level and white blood cell counts.

Keywords: CBC, Stability, Reliability, Extended storage and temperature

Abbreviations: CBC: Complete Blood Count; RBC: Red Blood Cells; HGB: Hemoglobin; WBC: White Blood Cells; NE: Neutrophills; LY: Lymphocytes; MO: Monocytes; EO: Eosinophills; BA: Basinophil; HCT: Hematocrit; MCV: Mean Corpuscular Volume; MCV: Mean Corpuscular Volume; MCH: Mean Corpuscular Hemoglobin; MCHC: Mean Corpuscular Hemoglobin Concentration; PLT: Platelet; MPV: Mean Platelet Volume; PCT: Plateletcrit

INTRODUCTION

Stability and reliability are compulsory for the preservation of the excellence for final results of the analyzer, storage temperature, and extended duration. Especially where the blood samples are held in reserve for a long period of time before analysis, there is a risk of the quality for reliability and stability of measurements when they are run for analyzing. There are three process phases of analytical diagnostics, pre-analytical phase, analytical and the post-analytical phase. Primarily, accurate blood collection, proper handling and shifting in the laboratory are the essential process to get the superior quality and reliability of the test results in hematology, which have been published by the ICSH, WADA and WHO [1-3].

Di-potassium (K2) and Tri-Potassium (K3) salts of EDTA are the standard anticoagulants used for the maintenance of cellular parts of blood for hematology investigations. Enhanced stability has been detected in the blood specimen stored at refrigeration (4°C) with K2-EDTA-anticoagulant [4,5]. K2-EDTA is now contemplated as the anticoagulants choice for modern automatic CBC analyzers [1,6]. K2-EDTA has a lesser diluents outcome and minor influence on mean corpuscular volume, hematocrit and effects on red blood cell size to improve the concentrations over K3-EDTA [7,8]. According to the guidelines of WADA, ideal storage for blood samples is 4°C [7,9]. Blood samples stored at <2°C can cause freezing destructions to RBCs leading to hemolysis whereas storage at >6°C can create an overgrowth of indefinite bacteria during sampling [5,6,10-13].

RESULTS AND DISCUSSION

Recently different authors have established that the measurements of HGB concentration and RBC counts are stable up to 72 h after blood collection if blood is stored at

Corresponding author: Sajid Hussain, Multan Institute of Nuclear Medicine and Radiotherapy (MINAR), Nishtar Hospital, P.O. Box.377, Multan, Pakistan, Tel: +92-3006861199; E-mail: sajid9596@gmail.com

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stable up to 72 h after blood collection if blood is stored at 4°C, while MCV and HCT values display to increase after 6-12 h in an expected measure [14-16]. Evaluation of RBC and HGB were qualitatively reliable up to 186 h and 90 h, respectively and other most parameters of complete blood counts were stable up to 48 h except platelet, PCT and MPV that was significantly stable up 6 h in the study conducted by Sajid [7]. Many other studies conducted in past conflicting results regarding findings of white blood count, red blood count, hemoglobin level, platelet counts with their indices at room temperature [11,17,18]. However, some studies that were conducted using refrigerated (4°C) temperature show that white blood count, red blood cell count, and hemoglobin level were constant up to 72 h [19,20]. Only Ashenden et al. [21] recently confirmed that hemoglobin was stable for at least 168 h using the Sysmex XT-2000i analyzer when maintained temperature between 4°C and 6°C [21]. The differences of stability observed between WBC, RBC and HGB level and those observed by some others may be due to different experimental conditions and analyzers type.

White blood cell counts with automated differentials were stable at 4°C for at least 24 h or still to 72 h in different studies. Particularly in MO tends to rise, whereas EO and LY counts tend to reduce over time, NE count was stable up to 72 h with a latest advanced generation analyzer [20,22]. The study conducted by Sajid [7] showed stability and reliability 126 h (5 days) for white blood cell count; 42 h (1.75 days) up to 66 h (2.75 days) for WBC differentials (NE, LY, MO and EO) and basophils were comparatively much less stable up to 6 h. Studies were done by of Baca [19], Muller [23] and Joshi [24] are showing stability time of 48 h to 72 h in these parameters which is not much varied to results conducted by Sajid [7] at refrigerated storage.

Stability of HCT and MCV were stood secure up to 54 h and 42 h, respectively that are identical to other many studies conducted at 4°C [8,24-27] while studies made by Turhan [18] and Lippi [28] demonstrate increment was monitored after 48 h due to reflect the swelling of RBC at room temperature. Described by Wood [29] increment is prevented by refrigerated temperature which favors to the conducted study by Sajid [7]. The stability of MCH up to 18 h, MCHC and RDW-SD up to 30 h, as well as RDW-CV up to 42 h, were noted in the study made by Sajid [7]. The MCV, HCT, RDW-CV and RDW-SD increased while the MCHC decreased over the time at 4°C. The conclusion of these parameters is identically investigated by Baca et al. [14], at room temperature using Sysmex X-2100 and Sven Christen Voss et al. [19] at 4°C.

Main significant finding in my study was the statistically significant decline in PLT, PCT and MPV from 6 h to onwards. The platelet counts in specimens stored at 4°C is considered stable for up to 24 h or even 72 h in some studies that disagree with the results of Sajid [6,21], although some studies have also demonstrated gradually decrease over time [5,22]. Murphy and Richard proved lifespan of the platelet is less at 4°C than room temperature. Storage at 4°C issued in a noticeable reduction of the lifespan i.e. the lifespan (t1/2) of refrigerated and stored at room temperature of platelets are 1.3 and 3.9 days, respectively [28,30,31]. Concluded by Massimo et al., platelet counts using (impedance and fluorescent) techniques was stable at 4°C up to 6 h and Dammika et al., also concluded PLT and MPV were stable up to 6 h which support the results of Sajid et al. [25,32]. Time and concentration associated alterations in platelet from curled to round and an abnormal enlargements do cause in a specimen collected in EDTA and stored at 4°C; as a result of these alterations, the mean platelet volume is not fully reliable. The increment in MPV over time disclose by many studies [18,19,26,27,33]. The above discussion shows, PLT, PCT and MPV may be done for examination within 6 h after blood collection. According to the discussion and results of Sajid et al., CBC blood samples can be stored at 4°C when the delay is anticipated up to two days except for PLT, PCT and MPV.

CONCLUSION

The conclusion from the study conducted by Sajid et al., the broad and recently compiled knowledge regarding the performance of CBC parameters over time under various situations allow the detection of definite requirements and time threshold for pathological applications in hematology laboratory, according to specific demands.

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