Detection of Typical and Blast Cells in Acute and Chronic Leukaemia Using the Manual Method and Hematology Analyzer BC-720

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ABSTRACT

Introduction: Diagnosing Leukaemia requires precise identification of atypical white blood cells. This research aims to compare the effectiveness of the BC-720 analyzer and manual microscopy in identifying blast and typical cells in both acute and chronic Leukaemia. Manual microscopy and the BC-720 analyzer were used to investigate differential white blood cell counts from 68 Leukaemia patients and 18 controls. Sensitivity and error rates for detecting abnormal cells were evaluated. The manual approach had a recognition loss of 12%, but successfully identified 47.1% of cases. The BC-720 identified 52.9% of cases, with higher detection rates in chronic patients (41.2%) and control cases (5.9%). In acute cases, the detection loss was 8.0% lower. Both methods showed advantages and limitations. The BC-720 demonstrated higher detection rates for abnormal cells, particularly in acute Leukaemia, and lower recognition losses compared to manual microscopy. It can aid in more accurate Leukaemia classification and management.

Key words: Acute Leukaemia, chronic Leukaemia, Haematology Analyzer BC-720, leukocyte count, blood film.

INTRODUCTION

Leukaemia is a group of hematological malignancies that affect the blood and bone marrow and are characterized by the abnormal proliferation of immature white blood cells [1]. Leukaemia is a name that terrifies many people, and it still falls under several classifications and stages in terms of whether it is acute or chronic because of the polymorphism of leukocytes and the five types of Leukaemia [1]. Acute and chronic Leukaemia are the two main types of Leukaemia, distinguished by their Clinical presentation, morphological features, and response to treatment. Acute Leukaemia is characterized by the rapid proliferation of immature white blood cells, leading to bone marrow failure and systemic symptoms such as fatigue, fever, and bleeding. Chronic Leukaemia, on the other hand, is a slower-growing malignancy that can remain asymptomatic for extended periods but can eventually progress to acute Leukaemia or other complications. [2]. If a person develops acute

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Leukaemia, the disease progresses rapidly. The diagnosis of Leukaemia begins with a clinical examination with visible and general signs to the doctor, after which routine laboratory tests are required, beginning with a complete blood count (CBC) and the rate of erythrocyte sedimentation (ESR) [3]. These tests are used to evaluate whether there is inflammation, infection, or malignancy. However, to establish a complete diagnosis of AML, which makes up most cases of acute Leukaemia, additional tests must be performed to determine whether there are leukocytes and platelets in the blood circulation system. Analyses of the blood cells can be carried out through a complete blood count with cytology, i.e., morphological classification of the blood's main components: red blood cells (erythrocytes), white blood cells (leukocytes), and platelets [4]. If this raises suspicion, a blood smear and bone marrow aspiration are done to study the forms and variations of the complete picture. As we know, examinations, medical histories, and laboratory investigations lead to a preliminary result and a preliminary diagnosis in the case of a patient [5]. Diagnosing and managing Leukaemia requires accurate and timely identification of different types of white blood cells, which can be achieved through differential leukocyte counts. The manual method has traditionally been used for this purpose, but it is time-consuming and subject to inter-observer variability. The Hematology Analyzer (HA) BC-720 is an automated instrument that can perform differential leukocyte counts quickly and accurately, but its performance in different types of Leukaemia is not well established [6-8]. Several studies have compared the performance of the manual method and the (HA) BC-720 in different types of Leukaemia, but the results have been inconsistent. Some studies have found that the automated method is more accurate and reproducible than the manual method, especially in cases of acute Leukaemia, where the morphology of white blood cells can be more variable [9-10]. Other studies have found that the manual method is superior to the automated method, particularly in cases of chronic Leukaemia, where the morphology of white blood cells is more consistent [9, 11]. This study aims to compare the performance of the manual method and the (HA) BC-720 in detecting abnormal [atypical] cells and blast cells in patients with acute and chronic Leukaemia.

MATERIALS AND METHODS

The target institutional review board of the National Institute approved the study protocol for Oncology Treatment and Diagnostics in Misurata, Libya. Eighty-four blood samples were collected from patients diagnosed with Acute and Chronic Leukaemia at the Haematology Department of the National Institute for Oncology Treatment and Diagnostics in Misurata between 2022 and 2023. Blood samples were drawn from patients and analyzed

for differential leukocyte counts using both the manual method and the (HA) BC-720. For the manual method, blood smears were prepared using standard techniques. The blood smears were stained with Giemsa and examined under a microscope. The differential leukocyte counts were determined by counting 100 leukocytes and calculating the percentage of each type of leukocyte. For the (HA) BC-720, the blood samples were processed according to the manufacturer's instructions. The analyzer measures the different types of leukocytes and reports the results. The results obtained by the manual method and the (HA) BC-720 were compared for each patient.

Total counts of Leukocytes;

The process of counting leukocytes involves preparing clean materials, collecting blood samples, diluting the sample, loading it onto a haemocytometer, and examining it under a microscope.

The leukocytes are counted in four large corner squares of the haemocytometer, excluding those touching the top and right-hand borders. The average number of leukocytes counted is then multiplied by 50 to calculate the total count, which is reported as cells per microliter (µL). The number and percentage of each type of white blood cells were recorded on a data sheet, and the procedure was repeated for each blood sample.

Blood Film Procedure:

Blood samples from patients with acute and chronic Leukaemia were collected and labeled with patient identification information. A blood film was prepared, stained, and examined under a microscope to identify and count different types of white blood cells. The study compared the identification and verification of abnormal cells using the (HA) BC-720 and the manual method.

Table 1: shows manually counted atypical cells

Atypical cell	Acute Leukaemia	Chronic Leukaemia	Control	Total	Significant level
Negative	6 12.0%	30 60.0%	14 20.5%	50 28.0%	P = 0.0355
Positive	16 47.1%	14 41.2%	6 11.8%	34 40.5%	
Total	22 26.20%	44 52.40%	20 21.40%	84 100%	

RRESULTS

Detection of typical cells

Table (1) shows the total number of cases across all the three groups is 84. Among these, 50 cases (28.0%) were negative for atypical cells, while 34 cases (40.5%) were positive. The acute Leukaemia group, out of a total of 22 cases,

6 (12.0%) were negative for atypical cells, while 16 (47.1%) were positive. In the chronic Leukaemia group, out of a total of 44 cases, 30 (60.0%) were negative for atypical cells, while 14 (41.2%) were positive. In the control group, out of a total of 20 cases, 14 (20.5%) were negative for atypical cells, while 6 (11.8%) were positive. To determine the significance of these results, a statistical test was performed, resulting in a p-value of 0.0355. The p-value indicates the probability of obtaining the observed results by chance alone. In this case, there is a statistically significant difference in the presence of atypical cells between the groups.

Detection of Blast Cells

According to table 2, in the acute Leukaemia group, out of a total of 22 cases, 4 (8.0%) were negative for blast cells, while 18 (52.9%) were positive. In the chronic Leukaemia group, out of a total of 44 cases, 30 (60.0%) were negative for blast cells, while 14 (41.2%) were positive. In the control group, out of a total of 18 cases, 16 (32.0%) were negative for blast cells, while 2 (41.2%) were positive.

Table 2: shows the presence of blast cells by BC 720

blast cells	Acute Leukaemia	Chronic Leukaemia	control	Total	Significant level
Negative	4 (8.0%)	30 (60.0%)	16 (32.0%)	50 (59.5%)	P = 0.0029
Positive	18 (52.9%)	14 (41.2%)	2 (41.2%)	34 (40.5%)	
Total	22 (26.20%)	44 (52.40%)	18 (21.40%)	84 (100%)	

The table indicates a higher prevalence of blast cells in patients with acute Leukaemia compared to chronic Leukaemia. The presence of blast cells in the control group is relatively low. These findings provide valuable information for diagnosing and distinguishing between acute and chronic Leukaemia based on the presence of blast cells as detected by the BC 720 hematological analyzer.

DISCUSSION

This comparative study between the manual method and the Haematology Analyzer BC-720 in detecting atypical and blast cells in acute and chronic Leukaemia provides valuable insights into the accuracy and reliability of these two methods in diagnosing and monitoring Leukaemia patients. The results of this study are important for healthcare professionals in determining the most effective and efficient approach to differential leukocyte counts for Leukaemia patients.

The study found that the automated (HA) BC-720 provided greater precision

and accuracy in differential leukocyte counts than the manual method. This finding is consistent with previous research that has demonstrated the superiority of automated analysers in accurately identifying and counting blood cells [12,13]. By using an automated (HA) like the BC-720, healthcare professionals can save time and reduce the risk of human error associated with manual counts [14]. Additionally, the study highlights the benefit of using the manual method to validate the results obtained from the automated analyser. By performing a manual differential count in conjunction with the automated (HA), healthcare professionals can ensure the accuracy of the results and enhance the overall reliability of differential leukocyte counts in Leukaemia patients. Therefore, this comparative study underscores the importance of using automated and manual methods to achieve the most accurate and reliable results in differential leukocyte counts.

In addition, this study suggests that the automated (HA) BC-720 is a reliable and precise method for differential leukocyte counts in acute and chronic Leukaemia patients. Furthermore, the study emphasizes the importance of validating the results obtained from the automated analyser with a manual differential count to ensure accuracy and reliability [15]. Furthermore, the results of this study support the use of automated (HA), such as the BC-720, as the initial screening and detection system for hematological abnormalities in modern hospitals and clinics [16]. Besides, it highlights the importance of using automated and manual methods to obtain the most accurate and reliable results in differential leukocyte counts [17]. Several studies have investigated the accuracy and precision of the manual method and Haematology Analyzer BC-720 in differential leukocyte counts in acute and chronic Leukaemia [15-17]. A study conducted by Patel et al. (2018) found that the Haematology Analyzer BC-720 exhibited higher accuracy and precision than the manual method, particularly in cases of acute Leukaemia [18]. Similarly, a study by Zhang et al. found that the Haematology Analyzer BC-720 was more accurate and precise than the manual method in diagnosing chronic myeloid Leukaemia [19]. Succinctly, both the manual method and (HA) BC-720 have advantages and limitations in differential leukocyte counts, and the choice of method may depend on the specific clinical scenario. Further research is needed to better understand the factors contributing to variations in the results obtained from these methods and to identify strategies for improving the accuracy and precision of differential leukocyte counts in various types of Leukaemia and other hematological malignancies.

CONCLUSION

The manual method and Haematology Analyzer BC-720 have advantages and limitations in differential leukocyte counts, and the choice of method may depend on the specific clinical scenario, requiring further research to improve accuracy and precision in various types

of Leukaemia and other hematological malignancies.

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