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Haematological and Demographic Features of Acute Myeloid Leukemia among Patients attending the National Oncology Center, Sana'a City - Yemen.

Ikram Ayad Anwar Al-Adhami [1,2,*] , Ali Mohammed Al-Meeri [1]
Lutfi Abdulsalam Al-Maqtari [3] ,Omar Ahmed Ismael Al- dossary [4,5]

1- Department of Biochemistry and Molecular biology, Faculty of Medicine and Health Sciences, Sana'a University, Republic of Yemen.
2- Department of Diagnostic medicine and hematology, the National Oncology Center, Sana'a City – Yemen.
3- Department of hematology, Faculty of Medicine and Health Sciences, Sana'a University, Republic of Yemen.
4- Department of Basic Sciences, Faculty of Dentistry, Sana'a University, Republic of Yemen.
5- Department of Oral Microbiology and Clinical Immunology, Faculty of Medicine and Health Sciences, Sana'a University, Republic of Yemen.

***Corresponding author:** alobaidiikram@gmail.com

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ABSTRACT

Background: The distinctive feature of acute myeloid leukemia (AML) is the infiltration of abnormal myeloid precursors into the bone marrow and other tissues, frequently accompanied by the appearance of these abnormal cells in the peripheral blood. This study aimed to describe the hematological features and demographic characteristics of patients with AML who attended the National Oncology Center in Sana'a, Yemen.

Subjects and Methods: This descriptive study was carried out on 124 newly diagnosed AML patients of all ages and both genders who attended the National Oncology Center in Sana'a City, Yemen, during the period from November 2022 to November 2023. The complete blood count test was performed by drawing a few milliliters of blood sample, then was analyzed through a hematology analyzer, which performs quantitative analysis of blood elements including white blood cell count, WBC differential count, red blood cell count, hemoglobin, and platelet count.

Results: The median age of the patients was 35 years and a range (0.9-779 years); the majority of cases were older than 18 years (62.9%); and the frequency of AML was higher in males than in females (57.26% and 42.74%), respectively. Of 124 newly diagnosed AML patients, the median (range) of WBC and platelets were 50.47 (1.18-534.32 103/uL) and 45 (343 103/uL), respectively. The mean SD for RBC was 2.85 0.78 106/uL,, Hb was 8.40.94 g/dL, and Blast count was 75.26 16.04%). Leukocytosis was detected in (62.9%), Hyperleucotyosis in (25%), Erythropenia in (87.1%), and Thrombocytopenia in (86.3%). There was a significant positive correlation between age and platelets (r = 0.194, p-value = 0.03), WBC and Blast cells (r = 0.285, p-value = 0.001), and highly significant between RBC and Hb (r = 0.623, p-value = <0xC6><0xB0>0.001). For the WBC and platelet counts, there were variations between age groups and two genders; the variations were little in other hemological patterns, and there was no significance for all parameters. For WBC count, the median was 62 x 103 uL in the female group, higher than in the male group (46.5 x 103 uL), while there wasn't or little variation in the hematological features among male and female AML patients.

Conclusion: Hematological features of bone marrow/peripheral blood are essential diagnostic tools in AML patients. In the present study, approximately 87% of patients present with leucotyosis or hyperleucotyosis, erythropenia, and thrombocytopenia. And the blast cell count was > 20% for all AML patients, which is considered a diagnostic reference.

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1. Introduction:

Leukemia is a diverse cluster of hematological abnormalities, defined by an excess of malignant white blood cells that proliferate abnormally and accumulate in the peripheral blood and bone marrow (1). Globally, the prevalence of leukemia has increased and has the highest mortalities of any malignancy (2). In 2018, there were 437.0 thousand new cases and 309.0 thousand cancer deaths from leukemia worldwide (3). In Yemen, the prevalence of leukemia increased at the national oncology centers among hematological malignancies (HMs). ALL and AML constitute approximately a half and a quarter of leukemia (4).

Acute myeloid leukemia (AML) is characterized by infiltration of bone marrow and other tissues by abnormal myeloid precursors, often with the appearance of these abnormal cells in the peripheral blood. AML occurs at any age but is more common in adults (comprising about 80% of acute leukemias in adults), and about 20% of all leukemias in children (5, 6). It has the lowest survival rate of all leukemias and is characterized by a spectrum of clinical features (generally ascribed to marrow failure as well as infiltration by blast cells), morphological, immunophenotypic, chromosomal abnormalities, and hemopoietic insufficiency (with or without leukocytosis) (7).

Hyperleukocytosis (HL) is presented in 5% to 20% of patients with AML (8). HL is a laboratory abnormality, commonly defined by a white blood cell count of 100 $\times 10^9$/L (9). Two main pathogenetic factors were reported to be responsible for the development of HL: first, a rapid blast proliferation leading to a high leukemic tumor burden; second, disruption in normal hematopoietic cell adhesion leading to a reduced affinity to the bone marrow (8, 10). Thus, HL may result in 3 main complications: leukostasis, tumor lysis syndrome, and disseminated intravascular coagulation. Pulmonary and central nervous system injuries are the major issues associated with HL patients (11, 12).

The aim of this study was to describe the hematological features and demographic characteristics of patients with AML who attended the National Oncology Center, Sana'a City, Yemen.

2. Subjects and Methods:

This descriptive study included 124 newly diagnosed AML patients of all ages and both genders who attended the National Oncology Center in Sana'a City, Yemen, during the period from November 2022 to November 2023.

Only AML patients were included. Chronic myeloid leukemia (CML), acute lymphoid leukemia (ALL), chronic lymphoid leukemia (CLL), and myeloproliferative disorders or patients who have received chemotherapy or are

on treatment for acute leukemia were excluded from the study.

The current study was approved by the committee of the Faculty of Medicine and Health Science, Sana'a University, Yemen. All participants were informed orally about the nature of the study and sample collection, and they submitted an informed consent form. 2 ml of peripheral blood samples were collected and dispensed in a K3-EDTA tube for the following tests: complete blood count (CBC) and peripheral blood smear.

Complete blood count (CBC) assessment:

The complete blood count test was performed by drawing a few milliliters of blood sample, which was then analyzed through a hematology analyzer (ADVIA® 2120i System, Siemens Healthineers), which is the blood testing machine used to perform a CBC or hemogram. It performs quantitative analysis of blood elements, including: white blood cell count (WBC or leukocyte count), WBC differential count, red blood cell count (RBC or erythrocyte count), hemocrit (Hct), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), platelet count, and mean platelet volume (MPV).

In automated cell counters, the cells were suspended in a conductive medium, and when the cell passes through a small aperture, the impedance changes. The change in impedance is proportional to cell volume, resulting in a cell count and measure of volume. The blood testing machine automatically counts the blood cells from the given sample of blood and displays the count as results.

3. Data analysis:

Descriptive analyses and the data analysis were carried out using Statistical Package for the Social Sciences (SPSS Inc., Chicago, USA) version 26.0 software. Data were presented as mean <0x7E> SD for normally distributed data and median with range for not normally distributed variables. Qualitative and categorical variables were expressed as frequencies and percentages. Categorical data (nominal) between the groups were compared using chi-squared, one-way ANOVA, and Kruskal-Wallis analysis tests. CI was set at 95%, and a P-value <0.05 was considered significant.

4. Results:

In this descriptive study, 124 patients with newly diagnosed AML participated. The median age of the patients was 35 years and a range (0.9–79 years); the majority of cases were older than 18 years (62.9%) (Table 1). The frequency of AML was higher in males than in females (57.26% and 42.74%), respectively, and the male/female ratio was 1.33. Other details of the patients are shown in Table 1.

TABLE 1: Distribution of age and sex in AML patients:

Parameters	Statistics				
Age	**Median**	**Min.**	**Max.**		**Range**
	35 Years	0.9 Years	79 Years		78.1 Years
	Age group	**No.**	**%**		
	< 2	9	7.25		
	2 – 18	37	29.84		
	> 18	78	62.91		
Sex	**No.**	**%**	**Total**		**Male/Female Ratio**
			No.	**%**	
Male	71	57.26	124	100	1.33

Female	53	42.74			

The hematological features in AML patients (n = 124) included white blood cells (WBC), red blood cells (RBC), hemoglobin (Hb), platelets, and blast cells. They presented in mean (SD) for RBC, Hb, and blast cells or median (range) for WBC and platelets according to data distribution (normal/non-normal), minimum, and maximum (Table 2).

TABLE 2: Haematological Parameters in AML patients:

Parameter (n = 124)		Minimum	Maximum
WBC 10^3/uL (Median-Range)	**50.47** (1.18-534.32)	1.18	534.32
RBC 10^6/uL (Mean±SD)	**2.85** ± 0.78	1.20	5.90
Hb g/dL (Mean±SD)	**8.40** ± 1.94	0.90	14.20
Platelet 10^3/uL (Median-Range)	**45** (3 - 343)	3.00	343.00
Blast % (Mean±SD)	**75.26** ± 16.04	28%	98%

The pattern of hematological parameters in AML patients (n = 124). Leukocytosis was detected in 78 patients (62.9%), and hyperleukocytosis was in 25% of patients. Erythropenia was detected in 108 patients (87.1%). Anemia was detected in 120 patients (96.8%), and thrombocytopenia was detected in 107 patients (86.3%). The blast cell count was > 20% for all AML patients, which is considered a diagnostic reference, and most patients were > 60% (Table 3).

TABLE 3: Hematological parameters pattern in AML patients (n = 124):

Haematological parameters		Frequency	Percentage
WBC (10^3/uL)	**Leucopenia** (< 3.5)	**1**	**0.8**
	Normal (3.5-9.5)	**14**	**11.3**
	Leucotyosis (> 10 - < 100)	**78**	**62.9**
	Hyperleucotyosis (≥100)	**31**	**25**
RBC (10^6/uL)	**Erythropenia**	**108**	**87.1**
	Normal (3.8-5.8)	**16**	**12.9**
Hb (g/dL)	**Low**	**120**	**96.8**
	Normal (11.5-17.5)	**4**	**3.2**
Platelet (10^3/uL)	**Thrombocytopenia**	**107**	**86.3**
	Adequate (125-350)	**17**	**13.7**
Blast range (%)	**20 – 40**	**4**	**3.2**
	41 – 60	**18**	**14.5**
	61 – 80	**50**	**40.4**
	> 80	**52**	**41.9**

Table 4 shows there was a significant positive correlation between age and platelets (r = 0.194, p-value = 0.03), WBC and Blast cells (r = 0.285, p-value = 0.001), and highly significant between RBC and Hb (r = 0.623, p-value = <0.001), while there was a non-significant correlation between other variables.

TABLE 4: Correlations between variables among AML patients (n = 124):

variables		Sex	Age	WBC	RBC	Hb	Platelet	Blast
Sex	**R**	1	0.135	0.133	- 0.086	- 0.161	- 0.125	0.014
	***P*-v**	-	0.13	0.14	0.34	0.74	0.16	0.88
Age	**R**	0.135	1	0.126	0.063	- 0.070	**0.194**	0.098

	***P*-v**	0.13	-	0.16	0.49	0.44	**0.03***	0.28
WBC	**R**	0.133	0.126	1	- 0.171	- 0.057	0.083	**0.285**
	***P*-v**	0.14	0.16	-	0.06	0.53	0.38	**0.001***
RBC	**R**	- 0.086	0.063	- 0.171	1	**0.623**	0.022	- 0.011
	***P*-v**	0.34	0.49	0.06	-	**<0.001***	0.81	0.9
Hb	**R**	- 0.161	- 0.070	- 0.057	**0.623**	1	0.067	- 0.094
	***P*-v**	0.74	0.44	0.53	**<0.001***	-	0.33	0.3
Platelet	**R**	- 0.125	**0.194**	0.083	0.022	0.067	1	0.081
	***P*-v**	0.16	**0.03***	0.38	0.81	0.33	-	0.37
Blast	**R**	0.014	0.098	**0.285**	- 0.011	- 0.094	0.081	1
	***P*-v**	0.88	0.28	**0.001***	0.9	0.3	0.37	-

* Correlation is significant at the 0.05 level or less (2-tailed).

For WBC count the median was 62×10^3uL in the female group higher than in the male group 46.5×10^3uL, while there wasn't or little variation in the hematological features among male and female AML patients (Table 5).

TABLE 5: Hematological features among male and female AML (Hematological features for AML patients in relation to gender):

Parameter (n = 124)	Male (n=71)	Female (n=53)	F	P-value
WBC 10^3/uL (Median-Range)	**46.5** (4.25 – 423.8)	**62** (1.18 - 534.32)	1.327	0.2
RBC 10^6/uL (Mean±SD)	**2.87** ± 0.71	**2.81** ± 0.89	0.223	0.6
Hb g/dL (Mean±SD)	**8.62** ± 2.0	**8.09** ± 1.82	2.341	0.1
Platelet 10^3/uL (Median-Range)	**48** (8 - 343)	**42** (3 - 240)	2.235	0.1
Blast % (Mean±SD)	**75.42** ± 15.51	**75.05** ± 16.87	0.016	0.9

5. Discussion:

Acute leukemias are highly malignant neoplasms and are responsible for a large number of cancer-related deaths (13). Although the survival rates have improved remarkably in the younger age group, the prognosis in older patients is still poor (14). In acute myeloid leukemia (AML), malignant transformation and uncontrolled proliferation of an abnormally differentiated, long-lived myeloid progenitor cell result in high circulating numbers of immature blood cells and replacement of normal marrow by malignant cells (15).

In the present study, there was an increased prevalence of AML in males (57.26%) more than in females (42.74%), similar to a study by Al-Nuzaili et al., 2022 (16). And the majority of cases were older than 18 years (62.9%); it was compatible with many studies (15, 17, 18). The median (range) count of WBC was 50.47 (1.18-534.32 103/uL), and for the platelets, it was 45 (3 - 343 × 103/uL), and the mean count ± SD for Hb was 8.40 ± 1.94 g/dL. These agree with a study by Al-Nuzaili et al., 2022 (4), and Zhang, Aoli et al., 2023 (19), and others. There was a significant positive correlation between age and platelets (p-value = 0.03), WBC and blast cells (p-value = 0.001); this is similar to the studies by (5, 20, 21), while different from a study by Al-Nuzaili et al. (4), where they reported that there was a significant positive correlation between Hb and WBC (p = 0.001) and between age and Hb (p = 0.009) and WBC (p = 0.002) only.

Among adult patients with acute leukemias, 5 to 30% present with hyperleukocytosis (2, 18, 20) and symptoms of leukostasis, and this is similar to the present study (25% of AML patients had hyperleukocytosis). Hyperleukocytosis is defined as a total peripheral WBC above

100×10^9/L. Hyperleukocytosis increases the blood viscosity and is associated with the aggregation of leukemic cells in the microcirculation, Many adult studies showed that HL predicted poor prognosis (22-26). In one of the studies on the clinical course of patients with AML looking for the impact of WBC count on the initial course and overall outcome of these patients, it was observed that a white cell count > 100 109/L had led to significantly more deaths during the first week of therapy than did patients with a count <0x3C> 50 109/L (22).

Thrombocytopenia is a well-known manifestation of acute leukemias. In this study, 86.3% of patients developed thrombocytopenia, and a low platelet count was observed consistently in AML patients in most studies (4, 18, 20, 21). Gaydos et al. were the first to document this finding in patients with acute leukemia in 1962. They demonstrated that there was a linear relationship between bleeding and platelet count (27). It is generally noted that clinically significant bleeding occurs in approximately 20% to 32% of thrombocytopenic patients with AML (excluding patients with promyelocytic leukemia) (23).

Anemia is a constant feature in all acute leukemias, and in the majority of cases it is due to bone marrow infiltration leading to decreased production and rarely due to decreased red cell life span and autoimmune destruction. The results of the present study showed that mean hemoglobin was quite low (8.40 g/dL); they are comparable with other studies (18, 20-22).

6. Conclusion:

Pancytopenia is not a common finding in AML, as the majority of patients have a high leukocyte count, though platelets, RBC counts, and hemoglobin are decreased in a majority of patients. Pancytopenia is associated with complications of susceptibility to life-threatening infections and bleeding tendency. It is not a disease entity itself but a hematological manifestation of several different disease processes. These disorders may affect bone marrow either primarily or secondary, resulting in the manifestation of pancytopenia. Blast cells are infiltrated in BM/peripheral blood, and clinical features are generally ascribed to this infiltration. Also, the presence of blast cells—more than 20%—is considered a diagnostic reference for AML patients.

It is recommended to conduct additional research in a variety of regions in Yemen to give information that helps in an appropriate diagnosis and treatment plans for AML patients.

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