Original Research

Investigation of CBC Findings and Clinical Symptoms in Children with Acute Leukemia Referred To Shahid Sadoughi Hospital in Yazd from 2016 To 2023

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Abstract

Background: Acute leukemia (AL) constitute a heterogeneous group of hematologic malignancies that are associated with clonal and uncontrolled proliferation of undifferentiated hematopoietic progenitors. In children, acute myeloid leukemia (AML) is rare and occurs before age 2 or after age 15. Conversely, acute lymphoblastic leukemia (ALL) is the most common cancer in children, accounting for about a quarter of cancers in people under the age of 15. Considering clinical symptoms and CBC (complete blood count) tests as the first diagnostic measures

Method: In this cross-sectional study all the medical reports related to children with acute leukemia in pathology department of Shahid Sadoughi Hospital, Yazd was assessed. Demographic variables including age, gender, and type of acute leukemia, as well as CBC finding Hb, RBC, WBC, platelets, MCV , MCH, and clinical symptoms (bone pain, petechiae, purpura, bleeding, fever, weight loss, and anorexia) were extracted and analyzed statistically.

Results: Among 232 samples, (AML: 9.05%, ALL: 86.2%, undiagnosed: 4.75%) gender distribution was nearly equal (male: 53%, female: 47% $p = 0.5$). Fever (50.4%) was the most frequent clinical symptom. Bone pain, loss of appetite, weight loss, petechiae, purpura and bleeding were placed in the next categories in terms of frequency. Clinical symptoms in ALL and AML patients were insignificant ($p > 0.05$). Hematologic abnormalities, in order of prevalence were anemia (87.6%), thrombocytopenia (76.29%), bicytopenia (66.81%), leukocytosis (54.7%), leukopenia (19%), and pancytopenia (9.91%). CBC analysis in ALL and AML patients showed unmeaningful results ($p > 0.05$).

Conclusion: Based on our findings, we conclude that the incidence of acute leukemia is higher between the ages of one and ten years. ALL is more prevalent in youngsters than AML, and fever, bone pain, petechiae, and purpura are among the most common clinical symptoms of acute leukemia, which can aid in the early detection of the disease. In terms of CBC results, the presence of anemia, leukocytosis, RBC decrease, and thrombocytopenia can also aid in the early detection of leukemia.

Keywords: Acute leukemia; Clinical findings; CBC; Children.

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Introduction

Blood cell precursors undergo neoplastic change during their differentiation in bone marrow, leading to a spectrum of diseases known as leukemia. Seventy-five percent of the cases of leukemia are caused by acute lymphoblastic leukemia. Several different types of clinical and analytical evidence could raise suspicions. Ultimately, a diagnosis is made using a CBC and histopathology [1]. Leukemia is the most common form of juvenile cancer, accounting for 31% of all malignancies in children younger than 15 and 25% of all cancers in those younger than 20 [1]. In the United States, about 3250 new cases are identified each year [2, 3]. Seventy-five percent of people diagnosed with leukemia will have acute lymphoblastic leukemia (ALL), while the remaining twenty percent will have either acute or chronic myelogenous leukemia (AML or CML) [1]. The incidence of leukemia, regardless of subtype, is highest in children younger than 5 years old and declines precipitously thereafter [4-6]. With a male-to-female ratio of 1.3-1.4:1, the condition is slightly more common in boys than in girls [2, 4]. Patient age upon diagnosis, white blood cell count, cytogenetic abnormalities, therapeutic response, and immunological phenotypes are all important prognostic variables in ALL. The survival rate for children with ALL in industrialized nations has increased to around 90%, with a 93% overall survival recently recorded in the United States [7]. CD markers are antigens that are expressed by leukemic cells both on their cell surfaces and within their cytoplasm. Patients can be divided into two major groups, B cells and T cells, and six subgroups using flow cytometer. There is a wide variety of clinical manifestations of ALL, although the most common are systemic manifestations like fever, lack of appetite, and pallor. Diagnosis can be made based on the presence of neurological symptoms such nausea, headache, lethargy, facial nerve palsy, weight loss, and altered behavior [8]. In over 40% of cases, patients initially arrive with limping and bone discomfort. The most commonly reported laboratory results are thrombocytopenia, leukocytosis, and anemia [9]. Study participants were children diagnosed with AL who were hospitalized to the pediatric ward at Shahid Sadoughi Hospital. Data collected included demographics, clinical characteristics, and laboratory results.

Methods

This is cross-sectional descriptive research. From 2016 to 2023, all children with acute leukemia were referred to the pathology department of Shahid Sadoughi Hospital in Yazd. The study included all children with acute leukemia who were reported to the pathology department between 2016 and 2021. The exclusion criterion was incompleteness or lack of access to file information. This study investigated the records of all children with acute leukemia who were referred to the pathology department at Shahid Sadoughi Hospital in Yazd between 2016 and 2021. All reports on acute leukemia in children were reviewed in the pathology department of Shahid Sadoughi Hospital in Yazd after approval from the pathology department and the medical school's code of ethics. The relevant characteristics such as patient age, gender, type of acute leukemia, and CBC findings (hemoglobin (Hb), red blood cells (RBC), white blood cells (WBC), platelets, and MC) were noted using the previously created checklist. The obtained information was imported to SPSS 22 statistical software and were analyzed statistically.

Results

The purpose of this descriptive cross-sectional retrospective study was to determine the CBC findings and clinical symptoms of children with acute leukemia who were treated at Yazd's Shahid Sadoughi Hospital between 2016 and 2021.

This study comprised 232 samples, with 9.05% (n = 21) AML, 86.2% (n = 200) ALL, and 4.75% (n = 11) no definite diagnosis cases. The age range for AML samples was from 1 month to 16 years, with an average age of 5.01 years, and for ALL samples was from 1 month to 18 years, with an average age of 5.91 years. 5.2% (n = 12) of the

investigated samples were under one year old, 77.9% (n = 180) were between one and 10 years old, and 16.9% (n = 39) were between 10 and 18 years old, which was significant (p-value = 0). Furthermore, with a p-value of 0.5, 53% (n = 123) of the participants were male and 47% (n = 109) were female. In terms of accompanying symptoms, 7 symptoms were investigated, including bone pain, fever, petechiae, purpura, bleeding, weight loss, and loss of appetite, and in patients with ALL, the order of prevalence was as follows: fever (49.5%), bone pain (38.5%), loss of appetite (28%), weight loss (14.5%), petechiae (11.5%), purpura (8%), and bleeding (6%), and in patients with AML, fever (57.1%), bone pain (23.8 In addition, fever (50.4%), bone pain (36.6%), loss of appetite (27.6%), weight loss (14.7%), petechiae (10.8%), purpura (8.2%), and bleeding (6.5%) were the most common symptoms in all patients. Table 1 shows the p-value classification of clinical symptoms, which are considered as non-significant (p-value > 0.05). The samples were also examined for CBC findings, with the following results: The hemoglobin concentration ranged from 2.8g/dL to 14.6g/dL, with an average of 8.36g/dL. 73.3% (n = 171) of the patients had hemoglobin levels of 10g/dL or lower, while 26.7% (n = 61) had levels higher than 10g/dL. Table 2 demonstrates the insignificant decreased hemoglobin levels in ALL and AML patients (p-value > 0.05).

The amount of RBC was also evaluated, and 80.6% (n = 187) of the cases had less than the usual range (4,000,000/µL), while the rest (19.4%) had between (4,000,000 to 6,000,000/µL). Table 3 shows the separation of RBC levels in ALL and AML patients, which is assessed as non-significant with a p_value of 0.189. In terms of MCV, 72.8% (n = 169) were greater than 80Fl, while 27.2% (n = 63) were less than 80Fl. In terms of MCH, 60.3% (n = 140) fell within the normal range (mostly equal to 27 Pg), while 39.7% (n = 92) fell outside of the usual range. Tables 4 illustrates the separation of MCV and MCH levels in patients with ALL and AML, which are considered as non-significant with P_values of 0.765 and 0.915, respectively. The amount of WBC in the examined samples ranged from 500/µL to 400,000/µL, with an average of 38,815.51/µL, with 19% (n = 44) being less than the normal range (less than 4000/µL), 26.3% (n = 61) being in the normal range (4000 to 10,000/µL), 34.9% (n = 81) being between 100 00 to 50000/µL, and 19.8% (n = 46) being more than 50000/µL. Table 5 also shows WBC levels in patients with ALL and AML, which is assessed as non-significant with a P_value of 0.671. Platelet counts ranged from 2000/µL to 647000/µL, with an average of 111870.68/µL, while 65.1% (n = 151) of cases had less than 100000/µL and 34.9% (n = 81) had more than 100000/µL. Table 6 also shows the platelet count breakdown in patients with ALL and AML, which is assessed as non-significant with a p_value of 0.47. Anemia, leukopenia, leukocytosis, thrombocytopenia, bicytopenia, and pancytopenia were all detected in our research participants' blood. Anemia affected 87.6% of patients, and thrombocytopenia 76.29%, bicytopenia 66.81%, leukocytosis 54.7%, leukopenia 19%, and pancytopenia 9.91% were other less frequent blood abnormalities.

Discussion

In this study, the file information of 232 patients with acute leukemia was investigated and statistically analyzed, including demographic information, pathology results, CBC findings, and clinical symptoms. In our investigation, 9.05% (n = 21) of the 232 samples had AML, 86.2% (n = 200) had ALL, and 4.75% (n = 11) had no diagnosis. Doumbia et al. reported 74% ALL, 20.2% AML, and 65.8% biphenotypic acute leukemia (BAL) among 104 patients in Morocco in 2016, which, like our investigation, reported more ALL than AML [10]. Mohebi et al. found that among 203 patients in Hamedan in 2022, 83.7% were ALL and 16.3% were AML, which is perfectly compatible with our findings [11]. Furthermore, in Biswas et al.'s 75-sample research, 72% were ALL and 18.7% were AML, which was consistent with our findings [12]. As a

result, the prevalence of ALL in children with acute leukemia is higher than that of AML. The age range of the samples diagnosed with AML in our study was from 1 month to 16 years, with an average age of 5.01 years, while the age range of the samples diagnosed with ALL was from 1 month to 18 years, with an average age of 5.91 years. 5.2% (n = 12) were under the age of one year, 77.9% (n = 181) were between the ages of one and 10, and 16.9% (n = 39) were between the ages of 10 and 18. In addition, 53% (n = 123) of the participants were male, whereas 47% (n = 109) were female. Akramipour et al. studied 40 instances of AML in 2006; 60% of the patients were male and 40% were female, which found more male than our study [13]. Pahloosye et al. (2011) discovered that of a total of 100 cases aged 1 to 16, 60 were male and 38 were female, indicating that, like our study, men predominated. Furthermore, 23% were 1 to 4 years old, 32% were 5 to 9 years old, and 45% were 10 to 16 years old, with an average age of 9 years, which contradicts the findings of our study [14]. The age range of the samples diagnosed with AML in our study was from 1 month to 16 years, with an average age of 5.01 years, while the age range of the samples diagnosed with ALL was from 1 month to 18 years, with an average age of 5.91 years. 5.2% (n = 12) were under one year old, 77.9% (n = 181) were between one and 10 years old, and 16.9% (n = 39) were between 10 and 20 years old. Moussavi et al. examined 97 patients with ALL in Tehran in 2014, whose ages ranged from 4 months to 156 months, with an average age of 74.2 months and more between 5 and 7 years, which is consistent with our study, and also 50.5% were female and 49.5% were male, which is contrary to our study; the number of female people is higher than the number of male people [15]. In a study conducted in Mexico in 2018, Pérez et al. investigated 203 children with ALL, 63% of them were between the ages of 2 and 9, just 7% were less than 1 and 30% were older than 10, and 52% of the cases were male, which is perfectly compatible with our findings [16]. Đorić et al. studied 132 cases in Serbia in 2015, ranging in age from 11 months to 17.6 years with an average age of 5.5 years, with 57.6% male and 42.4% female, which was comparable with our data [17]. It can be established that acute leukemia in children most commonly develops between the ages of 1 and 10 years. Furthermore, it is seen more in boys than females, but with a p_value of 0.5 in our study, this cannot be asserted with certainty. In terms of accompanying symptoms, 7 symptoms were investigated, including bone pain, fever, petechiae, purpura, bleeding, weight loss, and loss of appetite, with fever (50.4%), bone pain (36.6%), loss of appetite (27.6%), weight loss (14.7%), petechiae (10.8%), purpura (8.2%), and bleeding (6.5%) being the most common. More clinical symptoms were examined in the 2018 study by Jamie Perez et al. in Mexico; the order of frequency of the main clinical symptoms was fatigue (62%), fever (60%), bone and joint pain (39%), hypoxia (33%), and weight loss (21%), while the main physical findings were hepatomegaly (78%), splenomegaly (63%), and lymphadenopathy (57%), 48% pallor and 30% purpura [16]. In the study conducted by Mohebi et al. in Hamedan in 2022 on 203 samples, fever was 39.9%, weakness 30%, and bone pain and anorexia each in 22.2% of the samples; additionally, pallor was found in 37.9% of the samples, ecchymosis in 20.2%, and spleen enlargement in 19.7% of the samples [11] In Hashemizadeh et al.'s study in Mashhad, the following clinical signs of disease beginning were listed in order of prevalence: weakness and lethargy, fever, leg pain, cervical lymphadenopathy, bleeding, and abdominal pain [18] The most prevalent signs and symptoms in Biswas et al.'s study of 75 children with acute leukemia were fever (85.3%), pallor (64%), hepatomegaly (72%), splenomegaly (60%), and lymphadenopathy (50.7%). Abdominal pain (9.3%), joint pain (9.3%), hematoma and melena (8%), and diarrhea (5.33%) were also unusual signs and symptoms [12]. The prevalence of weakness and lethargy (81%), anorexia (72%),

pallor (69%), fever (59%), weight loss (56%), bone pain (48%), cough (31%), splenomegaly (36%), hepatomegaly (34%), gastrointestinal symptoms (30%), lymphadenopathy (25%), and nosebleeds (24%) were observed in the study by Pahloosye et al. on 100 cases of clinical signs and symptoms. There were reports of petechiae and ecchymosis (18%), headache (12%), and bleeding gums (12%)[14]. Clarke et al.'s 2016 meta-analysis study on the signs and symptoms of acute leukemia found five symptoms in more than 50% of cases: hepatomegaly (64%), splenomegaly (61%), pallor (54%), fever (53%), and bruising (52%). Another eight conditions were found in one-third to one-half of the children: frequent infection (49%), weariness (46%), limb discomfort (43%), hepatosplenomegaly (42%), bruising/petechia (42%), lymphadenopathy (41%), bleeding propensity (38%), and rash (35%). which corresponds to our findings. [19]. Therefore, fever, bone pain, petechiae, and purpura can help us suspect acute leukemia. The samples were also investigated in terms of CBC findings, with the following results: The hemoglobin concentration ranged from 2.8g/dL to 14.6g/dL, with an average of 8.36g/dL, and 73.3% of the cases had hemoglobin concentrations of 10g/dL or below. The number of WBC ranged from 500/µL to 400,000/µL, with an average of 38,815.51/µL, which is 19% less than the usual range (less than 4,000/µL), 26.3% between 4,000 to 10,000/µL, 34.9% between 10,000 to 50,000/µL, and 19.8% greater than 5. The rate was 0000/µL. The amount of RBC was also checked, and 80.6% of the cases had less than the usual level (4,000,000/µL). In terms of MCV, 72.8% was greater than 80 Fl, and 60% was within the usual range (more than 27 Pg). The distribution of platelet frequency was also studied, with values ranging from 2,000/µL to 647,000/µL, with an average of 111,870.68/µL, with 65.1% of instances falling below 100,000/µL. In addition, 87.6% had anemia, 76.29% had thrombocytopenia, 66.81% had bicytopenia, 54.7% had leukocytosis, 19% had leukopenia, and 9.91% had pancytopenia. Mousavi et al. analyzed 97 samples in Tehran in 2014, finding that 90.7% had neutropenia, 89.7% had thrombocytopenia, 89.7% had anemia, and 77.3% had pancytopenia. Leukocytosis was found in 39% of the subjects, blast in 24.7%, eosinophilia in 4.13%, and NRBC in 3.1%. It is consistent with the study in terms of thrombocytopenia and anemia, and in terms of the number of WBC in our study, leukocytosis has been reported significantly greater, and pancytopenia has been reported far less [15]. In a 2018 study conducted in Mexico by Jamie Perez and colleagues, the average white blood cell count was 7120×109, the average hemoglobin concentration was 7.5 g/dL, and the average platelet count was 47400×109/l. Leukopenia and leukocytosis were found in 36.6% and 36.1% of the patients, respectively. Anemia was found in 82.9% of the children. Anemia was seen in the majority of cases, as in our analysis, but there was more leukocytosis described [16]. Akramipour et al. evaluated 40 instances of AML in 2006, and 90% of patients experienced anemia and platelet decrease, with leukocytosis and blasts in peripheral blood described in 50% of cases. In terms of leukocytosis, anemia, and thrombocytopenia, this was consistent with our findings [13]. The results of the tests before chemotherapy were examined in the study of Hashemizadeh et al. in Mashhad, and the mean and standard deviation of the patients' hemoglobin level was 9.30±2.28 g/dL, hematocrit 28.00±7.00%, RBC level 3.30±0.80×106, WBC level 13588.00±19421.00 (103/µL), and platelets. 95388.00±113324.00 µL was reported. In terms of the amount of RBC, this is consistent with our findings [18]. In the Pahloosye et al. trial, 37% had leukopenia, 38% had leukocytosis, and 22% had WBC levels greater than 50,000 per cubic milliliter. Also, 85% had anemia and 73% of cases had platelets below 100,000 per cubic milliliter, which was completely consistent with our study. [14].Therefore, Anemia, leukocytosis, leukopenia, thrombocytosis, and RBC decrease can all aid in the diagnosis of acute leukemia. It is

proposed that future research with a larger sample size and a broader geographical area be done. The current study investigates the clinical findings and CBC in children with acute leukemia who were referred to Shahid Sadoughi Hospital in Yazd from 2015 to 2014, and it is advised that future studies focus on the survival of children with acute leukemia.

Conclusion

Based on our findings, we conclude that the incidence of acute leukemia is higher between the ages of one and ten years. ALL is more prevalent in youngsters than AML, and fever, bone pain, petechiae, and purpura are among the most common clinical symptoms of acute leukemia, which can aid in the early detection of the disease. In terms of CBC results, the presence of anemia, leukocytosis, RBC decrease, and thrombocytopenia can also aid in the early detection of leukemia.

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Table & Figure:

Table 1: Frequency distribution of children with acute leukemia according to clinical symptoms

Clinical symptoms	Frequency (%)	ALL frequency (%)	AML frequency (%)	P-value
Fever	50.4%	49.5%	57.1%	0.770
Bone pain	36.6%	38.5%	23.8%	0.332
Loss of appetite	27.6%	28%	19%	0.547
Weight Loss	14.7%	14.5%	9.5%	0.397
Petechia	10.8%	11.5%	9.5%	0.479
Purpura	8.2%	8%	14.3%	0.363
Bleeding	6.5%	6%	9.5%	0.770

Table 2: Frequency distribution of children with acute leukemia based on hemoglobin level

Hemoglobin level	Total Frequency	ALL Frequency	AML Frequency
≤10	73.3%	72%	76.2%
>10	26.7%	28%	23.8%

Table 3: Distribution of the frequency of children with acute leukemia based on the amount of RBC

RBC level	Total Frequency	ALL Frequency	AML Frequency
≤4000000	80.6%	79%	85.7%
4000000-6000000	19.4%	21%	14.3%
>6000000	0%	0%	0%

Table 4: Frequency distribution of children with acute leukemia based on MCV

Hemoglobin level	Total Frequency	ALL Frequency	AML Frequency
MCV			
<80	27.2%	26.5%	28.6%
≥80	72.8%	73.5%	71.4%
MCH			
<27	39.7%	39.5%	38.1%
≥27	60.3%	60.5%	61.9%

Table 5: Frequency distribution of children with acute leukemia based on the amount of WBC

WBC	Total Frequency	ALL Frequency	AML Frequency
≤4000	19%	19%	14.3%
4000-10000	26.3%	28%	14.3%
10000-50000	34.9%	34%	47.6%
>50000	19.8%	19%	23.8%

Table 6: Frequency distribution of children with acute leukemia based on platelet count

Platelet count	Total Frequency	ALL Frequency	AML Frequency
<100000	65.1%	64%	66.7%
≥100000	34.9%	36%	33.3%