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Incidence Rate of Various Types of Leukemia in Children at Bandar Abbas Children's Hospital: A Brief Report of Half a Decade

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ABSTRACT

Background and Objective: Leukemia is the most common type of cancer and the main cause of cancer-related mortality in individuals≤15 years. Leukemia is not only caused by an underlying genetic disease, but a number of environmental variables also contribute to its occurrence. The aim of the current study was to determine the incidence rate of various types of leukemia in children admitted to Bandar Abbas Hospital between 2011 and 2017.

Methods: All children referred to Bandar Abbas Children's Hospital between 2011 and 2017 who were diagnosed with leukemia were included in this retrospective cross-sectional study. The files in the archive department of the hospital and the information provided by the attending physician were the two sources of information needed for this study. Data such as age, gender, type of leukemia and place of residence were collected from the patient records. SPSS-22 was used to analyze the data.

Findings: Of 89 patients diagnosed with acute leukemia between 2011 and 2017, 83(93.3%) were diagnosed with acute lymphoblastic leukemia (ALL). B-cell ALL was the most common form of leukemia (69.7%). Boys developed leukemia more frequently than girls (61(68.5%) and 28(31.5%) cases respectively). Most patients with leukemia (70.8%) were aged 1-10 years.

Conclusion: According to the results, ALL was the most common type of leukemia in Hormozgan Province. In addition, the prevalence of leukemia was higher in boys than girls in this province. It is recommended that the risk factors affecting the different types of leukemia in this province be investigated in future studies.

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Introduction

Although there have been remarkable improvements in treatment and early detection, cancer remains the second leading cause of death in children in affluent countries. The incidence of childhood cancer varies between countries worldwide for children ≤15 years [1, 2]. Leukemia is classified into four categories: acute lymphoblastic leukemia (ALL), acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), and chronic myeloid leukemia (CML) [3]. Leukemia is the most common type of cancer in children worldwide, according to 2012 estimates. It is followed by cancers of the brain and nervous system, non-Hodgkin's lymphoma (NHL), kidney tumors and Hodgkin's lymphoma (HL) [3].

The etiology of childhood leukemia remains poorly understood [4, 5]. Nevertheless, certain risk factors are associated with the occurrence of cancer. Several studies have demonstrated a relationship between the development of this malignancy and a mixture of genetic risk factors and environmental variables [6].

Leukemia is associated with several risk factors, such as exposure to ionizing radiation, tobacco use (including cigarettes and hookahs), exposure to environmental chemicals (including pesticides and gasoline), changes in infectious behavior, family history, parental employment in the plastics and paint industries, living near chemical plants, and racial differences [7-9]. Genetic disorders such as Bloom syndrome, Down syndrome, Schwachman syndrome and Fanconi anemia are associated with an increased incidence of juvenile leukemia [10]. Currently, there is no a systematic plan to prevent the occurrence of juvenile leukemia. The prevention and control program cannot be implemented because the underlying risk factors for the disease occurring at the age of 11 years have not been identified [11]. The mortality rate of children from leukemia, especially ALL, has decreased in European countries, the United States of America, and Japan, thanks to continuous and significant advances in treatment [12].

The incidence of leukemia in the first year of life is higher in females, as different subtypes are observed in both boys and girls. However, T-cell ALL was more common in boys than in girls. There were hardly any differences between the sexes in the prevalence of AML. In addition, there are significant differences in the prevalence of leukemia between different racial groups. Caucasians, for example, have about twice the risk of ALL as African Americans, while Hispanics are significantly more likely to develop juvenile leukemia than non-Hispanics [13]. Between 2003 and 2008, the incidence of leukemia in Iranian boys and girls was found to be 18.7% and 19.9%, respectively [14]. Given the high mortality rate of leukemia and the high financial and social cost of this type of cancer, the researchers decided to study the incidence of leukemia in the children's hospital in half a decade as their research had not found any studies on it in Hormozgan province.

Methods

Design and participants

A retrospective cross-sectional analysis was conducted using the medical records of children admitted to Bandar Abbas Hospital between April 2011 and March 2017. Bandar Abbas Children's Hospital on Imam Khomeini Boulevard is considered the leading healthcare facility for children in the southern cities of Iran, particularly in Hormozgan Province. From 2011 to 2017, a total of 89 children diagnosed with different types of acute leukemia were referred to this medical facility and underwent chemotherapy. During the six-year period, there were no cases of CLL or CML at this center. The main conclusion of the study that was highlighted is that 20 cases of leukemia occur annually in Hormozgan province.

Inclusion and Exclusion criteria

Inclusion criteria were children clearly diagnosed with leukemia, children with a comprehensive medical record on file at the hospital, regardless of whether they are currently alive, have died, or relapsed between 2011 and 2017. Additionally, at least 3 years must have passed since completion of treatment. The study excluded incomplete files and other non-malignant patients, with the exception of those with leukemia.

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Sample Size

We reviewed records of children diagnosed with leukemia who met the specified inclusion criteria. Hence, the sample size in this study was determined using the census method.

Data collection

Pediatric assistants saw the children when they first arrived at the emergency department, and initial hospital admissions were made after notification of the hematology and oncology specialist. The hematology and oncology specialists managed the patients' subsequent referrals and actions. Initial tests included peripheral blood smears, CBC diff/ESR/CRP/ldh/uric acid, and bone marrow aspiration in case the patient was still suspected of having leukemia. Initial tests were performed at Bandar Abbas. Bone marrow analysis and flow cytometry were forwarded to Shahid Mohammadi Hospital or a private laboratory in the city. A blood and pediatric cancer specialist took a bone marrow sample and chemotherapy initiated when the flow cytometry result confirmed the leukemia diagnosis. A hematologist-oncologist completed the patient data collected from the hospital records interns and specialized assistants in the blood department. Children with leukemia often have ALL, CLL, AML, and CML. The percentage of positive CD markers in the bone marrow aspirate sample was determined using flow cytometry. The exact onset time of the disease (determined using flow cytometry results from the first bone marrow aspiration sample) was considered the primary event, while the time of the patient's death or treatment discontinuation was regarded as the final event. Cases where treatment was discontinued for reasons unrelated to leukemia were classified as incomplete data. Recovery, relapse, and disease-related mortality were considered as treatment outcomes.

Statistical analysis

The data (age, gender, place of residence and type of leukemia) from patient records were statistically analyzed at a significance level of 0.05 using SPSS 22. Descriptive statistics with mean and standard deviation were used for quantitative data such as age. For qualitative data including gender, place of residence and type of leukemia, frequency and percentage were used.

Results

The study included 89 patients with a mean age of 5.52±3.67 years. The mean age of boys was 5.69±3.55 years, while the mean age of girls was 5.13±3.96 years. Of the 89 patients, 61 cases (68.5%) studied were boys, and 28 cases (31.5%) were girls. The age range of most patients (63 cases) was between 1 and 10 years. Nineteen patients were >10 years, while seven of the remaining patients were younger than one year. Compared to girls, boys were more frequently affected by leukemia and were older on average. Moreover, 53.9% of urban residents and 46.1% of suburban residents were patients.

Sixty-two of them (69.7%) were diagnosed with B-cell ALL leukemia. Twenty-one cases (23.6%) of ALL (T-cell leukemia) and six cases (6.7%) of AML were found. The most common type of leukemia (69.7%) was B-cell ALL, the least common type was AML (6.7%). The mean age of patients with T-cell ALL was 8.00±3.77 years, while the mean ages of patients with B-cell ALL and AML were 4.76±3.33 years and 4.67±3.44 years, respectively. No CML patients were diagnosed or recorded during the six-year study.

Table 1 illustrates the patients' demographic data.

Table 1: Demographic data of the study participants

Variable		Frequency	Percent
Gender	Boy	61	68.5
	Girl	28	31.5
Age	Under 1 year	7	7.9
	1 - 10 years	63	70.8
	Above 10 years	19	21.3
Address	Bandar Abbas city	48	53.9
	Other cities in Hormozgan province	41	46.1
type of leukemia	B-cell ALL	62	69.7
	T-cell ALL	21	23.6
	AML	6	6.7

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Discussion

The aim of the present study was to determine the incidence rate of various forms of leukemia in Hormozgan province and to determine the age and gender distribution of leukemia in this population. Of the 89 individuals diagnosed with acute leukemia between 2011 and 2017, 83 patients had ALL. B-cell ALL had the highest prevalence rate at 69.7% of all leukemia cases. The likelihood of developing leukemia was higher in men than in women, with 61 cases observed in boys and 28 cases in girls.

In the current study, 69.7% of patients were found to have B-cell ALL, while 23.6% had T-cell ALL. Furthermore, 6.7% of patients were diagnosed with acute myeloid leukemia (AML). In a cross-sectional study conducted in Sanandaj between 2006 and 2012, 84 cases of ALL were detected in children. Of these cases, 15.5% (13 cases) were diagnosed with T-cell leukemia, while the remaining 85% had B-cell ALL [15]. In our study, the incidence rate of T-cell ALL leukemia was higher than in the study conducted in Sanandaj. Both studies analyzed an identical number of patients over a six-year period.

Between 2011 and 2019, approximately 176 patients were diagnosed with pediatric ALL in the study conducted in Urmia by Noroozi et al. Only 18 patients (10.3%) were T-cell ALL 16, while 100 patients (56.8%) were pre-B-cell ALL and 6 patients (3.4%) were mature B-cell ALL [16]. B-cell ALL was the most common type of leukemia in Noroozi's study, which is in line with our results. Comparing the current study with the Noroozi's study, which included twice as many patients and approximately the same time period, the incidence rate of T-cell ALL leukemia was higher.

According to the study conducted by Lialestani et al., in Qom in 2019, only 6 cases (6.2%) of leukemia in hospitalized adolescents were T-cell ALL. In children aged 17 years, B-cell ALL was the predominant type of leukemia malignancy with a total of 91 cases [17]. The present study included 83 children diagnosed with ALL over a six-year period. Of these cases, 69.7% were classified as B-cell ALL and 23.6% as T-cell ALL. Although the current study had a shorter duration compared to the Lilestani study, the prevalence of T-cell leukemia was higher in Bandar Abbas than in Qom. The ongoing study suggested that B-cell ALL was the most common type of leukemia, which is consistent with the findings of the Lialestani's study.

A study conducted by Al-Hashimi found that ALL is the most commonly diagnosed type of leukemia, accounting for approximately 33.56% of cases [18]. Leukemia is more common in individuals younger than 19 years, with children aged 1-4 years having an incidence of ALL more than 9 times higher than individuals aged 20-24 years [19]. Conversely, AML is less common in children and has an incidence rate of 4 to 9 cases per million people per year in Europe [20].

In the present study, the incidence of acute leukemia was 2.17 times higher in boys than in girls. The results of the current study demonstrate that boys are more likely to develop leukemia than girls. This result is similar to the results of the previous studies [21, 22].

According to a review study by Owaidhah et al. in Ascension, Arabia, leukemia is the most common malignancy in children and is more common in males, in which is consistent with the finding of the current study [23]. In a study by Moradavisi et al., of 84 children with ALL, 65.5% were boys and 34.5% were girls (the incidence rate for boys was 1.9 times higher than that for girls) [15]. According to a study conducted in Iraq, which included 8570 cases of childhood leukemia diagnosed between 2000 and 2019, the ratio of males to girls was 1.32 to 1. This means that leukemia was more common in boys than in girls, which is with the same as the ongoing study [18]. In the studies by Noroozi et al. and Lialestani et al., the incidence of leukemia was 1.17 and 1.26 times higher in males than in females, respectively, which agrees with the finding of the present study [16, 17]. Boys are more likely to develop cancer than girls, which may be due to gender-specific factors (e.g. sex hormones).

According to Namayandeh's research, Singapore, Malaysia and the Republic of Moldova had the highest incidence rates for leukemia in both males and females in 2018. To be precise, the rates per 100,000 people in Singapore, Malaysia and Moldova were 2.8, 8 and 7.2, respectively [2]. In 2017, Steliarova-Foucher et al. published several leukemia incidence rates in adolescents. Furthermore, they demonstrated that lower diagnosis rates were

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probably the reason for the low incidence in countries with low human development index [24]. Inequalities in the detection and availability of health services in various parts of the world could be a major cause of the different incidence rates. Leukemia diagnosis methods, including morphologic, immunohistochemical, and cytogenetic tests performed on patients both in person and in laboratories, may affect the incidence rate of leukemia. The different incidence rates in various countries can be explained by the heterogeneity of epidemiologic patterns resulting from the interaction of genetic and environmental factors. However, it should not be forgotten that the differences in accessibility and quality of healthcare systems are not exclusively due to geographical differences [25].

One of the limitations of the present study is that it was not possible to access children with leukemia in Hormozgani who were admitted to hospitals in other provinces. In addition, this study was conducted retrospectively using patient records and it was not possible to measure many variables.

Conclusion

According to the results, ALL was the most common type of leukemia in Hormozgan province. Moreover, the prevalence of leukemia was higher in boys than in girls in this province. It is recommended that the risk factors influencing the different types of leukemia in this province be investigated in further studies.

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Ethical approval

This study obtained ethics committee approval (Ehical code: IR.HUMS.REC.1399.361)

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Conflicts of interest

There is no conflict of interest.

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