

# Spectrum of hematological disorders on bone marrow examination in a tertiary care Centre

Hina Bilal<sup>1</sup>, Sundas Ali<sup>2</sup>, Maha Tariq Kiani<sup>2</sup>

<sup>1</sup>Federal Medical College, Islamabad Pakistan

<sup>2</sup>Pakistan Institute of Medical Sciences, Islamabad Pakistan

## ABSTRACT

**Objective:** The aims of this study were to understand the range of different blood-related disorders diagnosed through bone marrow examination and to explore the connection between the age groups and genders of our patients with the subtypes of acute leukemia.

**Material and Methods:** This was a cross-sectional study carried over a period of one year from January 2022 to December 2022, in the department of Pathology, Pakistan Institute of Medical Sciences (PIMS), Islamabad. Analysis of bone marrow was conducted on patients referred with suspected blood-related disorders, and a total of 254 cases were incorporated into the study. We divided age into groups as 0-12 years (paediatric age group) and >12 years (adults) for comparison with subtypes of acute leukemias. Pearson chi-square test was applied. P value of <0.05 was considered statistically significant.

**Results:** The age range was from 05 months - 91 years with male: female ratio of 1.2:1. The prevalent non-malignant conditions identified during bone marrow examination were peripheral destruction/consumption of platelets (24.8%) followed by anemias (22%) and infection-related changes (9.4%). Among hematological malignancies, acute leukemias were the most frequent (22.8%), with chronic leukemias following at 7.1%. We also observed that Acute Lymphoblastic Leukemia was more common in Paediatric age group, while Acute Myeloid Leukemia was more frequent type of acute leukemia in adults (p <0.001).

**Conclusion:** The examination of bone marrow specimens is a key procedure for swiftly obtaining a confirmatory diagnosis for numerous hematological disorders, including hematologic malignancies.

**Keywords:** Anemia, Bone Marrow Trepchine Biopsy, Bone marrow aspiration, Leukemia, Megaloblastic anemia

This article can be cited as: Bilal H, Ali S, Kiani MT. Spectrum of hematological disorders on bone marrow examination in a tertiary care Centre. Pak J Pathol. 2024; 35(1): 44-48.

DOI: <https://doi.org/10.55629/pakjpathol.v35i1.791>

## INTRODUCTION

Blood disorders encompass a wide spectrum of conditions, spanning from common ailments like iron deficiency anemia to more complex and malignant diseases such as leukemias, myelomas, and lymphomas [1]. The prevalence of hematological malignancies varies globally, with higher rates in better resourced countries and lower rates in resource constraint

regions, often due to under-diagnosis and limited registration resources in developing nations. These malignancies account for approximately 6.5% of all cancers worldwide and stand as the fourth most commonly identified cancer in economically advanced nations for both men and women.

Hematological malignancies can be generally categorized into two groups based on their cell lineage: myeloid and lymphoid. Common subgroups within lymphoid neoplasms include Acute Lymphoblastic Leukemia, Chronic Lymphocytic Leukemia, Hodgkin and Non-Hodgkin's lymphoma, Multiple Myeloma, Waldenstrom macroglobulinemia. Myeloid neoplasms predominantly comprise Myeloproliferative Neoplasm, Myelodysplastic Syndrome, and Acute Myeloid Leukemia [2].

Correspondence: Dr. Sundas Ali, Medical Officer/ Haematologist, Pakistan Institute of Medical Sciences, Islamabad Pakistan

Email: [sundasali243@gmail.com](mailto:sundasali243@gmail.com)

Receiving Date: 14 Oct 2023

Revision Date: 10 Nov 2023

Acceptance Date: 04 Jan 2024

Copyright © 2024. Hina Bilal, et al. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License, which permits unrestricted use, distribution & reproduction in any medium provided that original work is cited properly.



A fundamental diagnostic tool for both blood-related (hematological) and non-blood-related (non-hematological) disorders is examination of bone marrow biopsies. [3]. Although it involves some invasion, patients typically handle this procedure well and provides rapid insights into many cases, aiding in timely diagnosis. This procedure proves cost-effective and invaluable in the field of hematology, facilitating the identification of both malignant and non-malignant hematological disorders [4].

Bone marrow aspiration and bone marrow biopsy complement each other and are often performed simultaneously for diagnostic purposes [5]. Bone marrow aspirate smears offer cytological insights into hemopoietic cells, while bone marrow biopsy assesses cellularity, infiltration patterns and fibrosis [4]. It plays a pivotal role in diagnosing conditions like Granulomatous diseases, myelodysplastic syndromes, myeloproliferative disorders, non-Hodgkin's lymphomas, aplastic Anemia, and metastatic tumours eliciting a fibrotic response [5]. This study aimed to explore the diverse spectrum of hematological disorders through bone marrow analysis and observe the association of age group and gender of patients with subtypes of acute leukemia. There is huge patient turn over in our setup and patients from different parts of Punjab and North visit our facility. The range of hematological disorders differs across regions. Therefore, the purpose of this study is to diagnose and offer valuable information about various blood-related disorders to clinicians for improved management of these cases.

## MATERIAL AND METHODS

It was a cross-sectional study done in the Pathology department of Pakistan Institute of Medical Sciences (P.I.M.S) for a period of one year. The record of patients who were sent to Pathology department of PIMS for bone marrow examination, from January 2022 to December 2022 was scrutinized. Bone marrow examination of 600 patients was done in the pathology department in the year 2022. Follow up cases of hematological and non-hematological malignancies and cases for staging of other

malignancies were excluded from the study. A total of 254 remaining cases were included in the study. All data was entered and analyzed by using SPSS version 16. The categorical variables like gender and diagnosis were measured as frequency and percentages. The quantitative numerical variables like age were measured as mean and standard deviations. Association of age-groups and gender with subtypes of acute leukemias was analysed. We divided age into groups as 0-12 years (paediatric age group) and >12 years (adults) for comparison with subtypes of acute leukemias. Pearson chi-square test was applied. P value of <0.05 was considered statistically significant.

## RESULTS

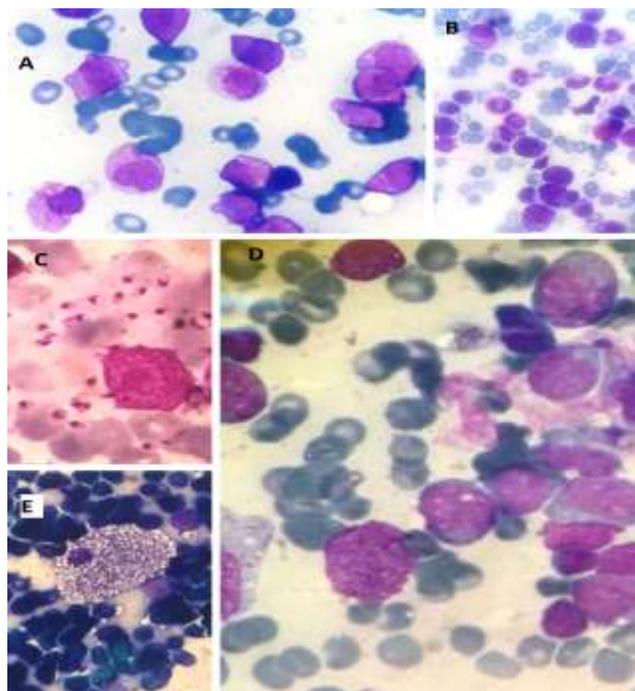
Mean age of patients in this study was  $23 \pm 22.9$  years. Most of the patients were of age group 0-10 years (46.9%), 13% patients were of age group 11-20 years while 9.4% of patients were of age group 41-50 years. When the cases were analysed, 63 (24.8%) patients had diagnosis of excessive peripheral platelet destruction/consumption and 56 (22%) of patients presented with Anemias. Out of total, 58 (22.8%) patients presented with acute leukemia while 18 (7.1%) presented with chronic leukemia (Table-I). Of 56 cases of Anemias, 21(37.5%) cases presented with megaloblastic Anemia, 13(23.2%) presented with mixed deficiency Anemia, 10 (17.8%) presented with iron deficiency Anemia, 8 (14.2%) presented with aplastic Anemia and 4 (7.1%) presented with haemolytic Anemia. Of the 58 cases of acute leukemias, 37(63.8%) patients had Acute lymphoblastic leukemia and 21 (36.2%) had Acute myeloid leukemia. So, over all non-malignant haematological disorders were observed more frequently in current study. Figure-I shows the Giemsa-stained bone marrow microscopic images of the most common cases in our study. We analysed association of age-groups and gender with acute leukemia subtypes. There was statistically significant association between age-groups and subtypes of acute leukemia (p value <0.001). (Table-III).

**Table-I: Depiction of hematological disorders diagnosed on bone marrow examination (n=254)**

Hematological Disorders	Frequency	Percent
Excessive peripheral destruction /consumption of platelets	63	24.8
Acute leukemia	58	22.8
Anemias	56	22
Infection related changes	24	9.4
Chronic leukemias	18	7.1
Multiple myeloma	14	5.5
Storage diseases	8	3.1
Visceral Leishmaniasis	5	2
Pure red cell aplasia	3	1.2
Burkitts lymphoma	3	1.2
Chediak-Higashi Syndrome	1	0.4
Chronic granulomatous disease	1	0.4
<b>Total</b>	<b>254</b>	<b>100</b>

**Table-II: Association of age-groups and gender with subtypes of Acute leukemia (n= 58).**

		ALL	AML	P-value
<b>Age range</b>	<b>0-12 years</b>	25	1	.000
	<b>&gt;12 years</b>	12	20	
<b>Total</b>		37	21	
<b>Gender</b>	<b>Male</b>	22	10	.384
	<b>Female</b>	15	11	
<b>Total</b>		37	21	

**Figure 1: Photomicrographs showing bone marrow aspirate smears A) Acute Promyelocytic Leukemia B) Megaloblastic anemia C) Visceral Leishmaniasis D) Acute Myeloid Leukemia E) Niemann Pick Disease (Giemsa 1000X).**

## DISCUSSION

Over the past several years, the analysis of samples from bone marrow has gained widespread significance in the accurate diagnosis and staging of different blood diseases. Extracting bone marrow samples and their subsequent analysis can be instrumental in confirming presumed blood related disorders. In grown-ups, a complete bone marrow examination, incorporating both aspiration and trephine biopsy, is necessary for a detailed evaluation of the marrow's structure. It's worth noting that the arrangement of blood related and non-blood related diseases varies between developing and developed regions [6].

The analysis of both Bone Marrow Aspiration and Bone Marrow Trephine Biopsy has become a routine procedure for assessing a range of conditions, including low blood counts, hematologic malignancies, non-malignant conditions, and spread of distant cancers. Biopsy of the bone marrow plays a fundamental role in the investigation of disorders related to blood and might be the sole approach through which a precise diagnosis can be achieved. Notably, both aspiration and trephine biopsies are straightforward and secure methods that could be easily conducted on an outpatient basis [7]. This diagnostic approach can either confirm a clinically suspected disease or unveil previously unrecognized diagnoses [8]. Furthermore, Immunohistochemistry can be applied on trephine biopsy sections for reaching a definitive diagnosis especially in cases of bone marrow infiltration.

The mean age of participants in our investigation was 23 years with a standard deviation of  $\pm 22.9$ . A substantial proportion of patients fell into the 0-10 years age group (46.9%). On the flip side, a different study conducted by M. Atchyuta and colleagues documented the highest percentage of instances (19%) in the 31-40 age bracket, with the next highest in the 51-60 age range.[9]. This discrepancy may be attributed to a higher rate of paediatric patient referrals to the Pathology Department for bone marrow examinations. Out of 254 patients, 141 (55.5%) were males and 113 (44.5%) were females, resulting in a male-

to-female ratio of 1.2:1, consistent with the previously mentioned study, which reported a similar ratio of 1.1:1 [9].

In our research, the prevailing non-cancerous disorder detected was peripheral destruction/consumption of platelets (ITP). The diagnosis of ITP depends on clinical suspicion and a standard peripheral smear, except for low platelet count. Bone marrow examination is conducted to rule out conditions such as leukemia, myelodysplastic syndrome, or aplastic anemia [10]. Anemias ranked as the second most common non-malignant disorders identified through bone marrow biopsy, with 56 (22%) patients presenting with various forms of anemia. Of 56 cases of Anemias, 21 cases presented with megaloblastic Anemia, 13 presented with mixed deficiency Anemia, 10 presented with iron deficiency Anemia, 8 presented with aplastic Anemia and 4 presented with haemolytic Anemia. Serum B12 and folate levels were not done in patients diagnosed as megaloblastic or mixed deficiency anemia either due to recent transfusions or financial constraints of patients. This pattern of anemia subtypes aligns with other studies [1,3], which also reported megaloblastic anemia as the most prevalent form, with mixed deficiency anemia and aplastic anemia coming next. In another research study, nutritional anemias, including megaloblastic, mixed deficiency (comprising both microcytic and macrocytic types), and iron deficiency, collectively constituted 32.5% of cases within the non-hematological category. Among these nutritional anemias, megaloblastic anemia emerged as the most prevalent non-malignant hematological disorder, accounting for 24.92% of cases, followed by mixed deficiency anemia at 4.71%. Iron deficiency anemia was the least frequently encountered, representing only 3.53% of cases [11]. The reason for iron deficiency anemia being the least common type of nutritional anemia detected on bone marrow biopsy is that the serum markers such as Iron, Ferritin, TIBC are available for its diagnosis easily. Ideally bone marrow biopsy should only be done if patient is not responding to iron therapy.

Regarding malignant disorders, our study found that acute leukemias were the most common, constituting 58 (22.8%) cases. Among these, acute lymphoblastic leukemia accounted for 63.8%, while acute myeloid leukemia constituted 36.2%. The diagnosis of acute leukemias on bone marrow biopsy in our study was supplemented by Flow Cytometry either on peripheral blood sample or bone marrow aspirate sample. In contrast to our findings, a study by Iqbal *et al.* reported a different distribution, with acute myelogenous leukemia diagnosed in 23.08% of patients and acute lymphoblastic leukemia in 23.08% [12]. This difference could be attributed to variations in age distribution, with ALL being more prevalent in children and AML in adults. Our study included a higher number of paediatric patients. In another study, the most prevalent malignant diagnoses, listed in descending order of frequency, were as follows: leukemia (20%), multiple myeloma (13%), and lymphoma (11%). Notably, acute leukemia constituted a significant portion, accounting for 46% (11 out of 24 cases) of all diagnosed leukemia cases when compared to chronic leukemia [13]. Our own findings echoed this trend, revealing a higher prevalence of acute leukemia cases in contrast to chronic leukemias and lymphomas. Our research indicated a higher occurrence of ALL in the pediatric age group, consistent with Ahmad *et al.*'s study, which found that ALL is more frequent and prevalent among those under 10 years old (31.25%, n=125). ALL stands out as the most prevalent malignancy in children, constituting 25% of all childhood cancers and about 75% of all childhood leukemia cases [14]. Conversely, conditions such as storage diseases, Visceral Leishmaniasis, Pure red cell aplasia, Chediak-Higashi syndrome, and Chronic granulomatous disease were less frequently observed.

Recognizing the constraints of our study is crucial, especially given the relatively modest sample size. To obtain more definitive findings, larger multi-centric studies conducted in local settings are recommended.

## CONCLUSION

Conducting bone marrow aspiration and trephine biopsy is a crucial procedure appropriate for diagnosing various blood-related diseases in an outpatient setting. This research highlighted the significance of bone marrow examination in the diagnosis of hematological diseases. Bone marrow examination in our setup is used more frequently for diagnosis in pediatric population. We noted a diverse range of conditions, ranging from non-malignant to malignant blood-related disorders. The prevalent non-hematological issues identified in this study included excessive peripheral platelet destruction/consumption (ITP) and various types of anemias. The most frequent malignant disorders observed were acute leukemias.

## CONFLICT OF INTEREST

Authors declare no conflict of interest.

## GRANT SUPPORT & FINANCIAL DISCLOSURE

Declared none

## AUTHORS CONTRIBUTION

**Hina Bilal:** Concept, literature search, data collection, data analysis, data interpretation, drafting

**Sundas Ali:** Literature search, data collection, drafting, review

**Maha Tariq Kiani:** Data collection, drafting, review

## REFERENCES

1. Qureshi H, Farooq N, Amjad M, Arif S, Ullahhsan. Pattern of hematological disorders on bone marrow aspirate examination. *J Med Sci.* 2019; 27 (2): 130-4.
2. Khan S, Mir A, Khattak BR, Khan SN, Hameed M, *et al.* Pattern of adulthood hematological malignancies in Khyber Pakhtunkhwa. *J Blood Disord Transfus.* 2019; 10: 1000424.  
DOI: <https://doi.org/10.4172/2155-9864.1000424>
3. Khan SP, Geelani S, Akhter S, Bhat S, Hussain S, Manzoor F, *et al.* Bone marrow aspiration in haematological disorders: Study at a tertiary care centre. *Int J Res Med Sci.* 2018; 6: 2361-4.  
DOI: <https://doi.org/10.18203/2320-6012.ijrms20182817>
4. Bansal M, Kumar N, Sharma HB, Sharma R. Pattern of hematological diseases diagnosed by bone marrow examination in a tertiary care hospital. *Int J Acad Med Pharm.* 2022; 4 (3); 240-3.  
DOI: <https://doi.org/10.47009/ijamp.2022.4.3.55>
5. Bashir N, Musharaf B, Reshi R, Jeelani T, Rafiq D, Angmo D. Bone marrow profile in hematological disorders: An experience from a tertiary care centre. *Int J Adv Med.* 2018; 5:608-13.  
DOI: <https://doi.org/10.18203/2349-3933.ijam20182111>
6. Fareed N, Mehmood T, Quraishy MS, Fatima G. Pattern of hematological disorders on bone marrow examination: A tertiary care hospital experience. *Hematol Transfus Int J.* 2021; 9(6):117-20.  
DOI: <https://doi.org/10.15406/htij.2021.09.00267>
7. Mohammad NH, Hussein F, Ahmad I. The role of bone marrow aspiration and bone marrow biopsy in diagnosis of bone marrow metastases. *IJBC* 2017; 9(3): 80-83.
8. Piplani G, Teerthanath S. Study of spectrum of lesions in bone marrow aspiration and trephine biopsy from a tertiary care centre in South India. *Int J Pediatr Res.* 2022; 8: 138.  
DOI: <https://doi.org/doi.org/10.23937/2469-5807/1510138>
9. Atchyuta M, Premalatha P, Renuka IV, Krishnamashary PAV, Tejeswini V. Spectrum of hematological diseases diagnosed by bone marrow examination in a tertiary care hospital. *Indian J Pathol Oncol.* 2019; 6(2): 185-9.  
DOI: <https://doi.org/10.18231/j.ijpo.2019.036>
10. Purohit A, Aggarwal M, Singh PK, Mahapatra M, Seth T, Tyagi S, *et al.* Re-evaluation of need for bone marrow examination in patients with isolated thrombocytopenia contributors. *Indian J Hematol Blood Transfus.* 2016; 32(2): 193-6.  
DOI: <https://doi.org/10.1007/s12288-015-0533-2>
11. Rahim F, Ahmad I, Islam S, Hussain M, Khattak TAK, Bano Q. Spectrum of hematological disorders in children observed in 424 consecutive bone marrow aspirations/ biopsies. *Pak J Med Sci.* 2005; 21(4): 433-6
12. Iqbal K, Hussain Z, Malik SN, Rahman AK, Riaz M, Qureshi H, *et al.* Frequency of hematological malignancies based on bone-marrow aspiration and trephine biopsy in patients presenting to tertiary care hospital. *Pak J Med Health Sci.* 2022; 16(12): 403-5.
13. Tshabalala WS, Pillay S, Wilson DPK. Diagnostic outcomes of bone marrow aspirate and trephine biopsies performed at a hospital in KwaZulu-Natal, South Africa. *Afr J Lab Med.* 2020; 9(1):1028.  
DOI: <https://doi.org/10.4102/ajlm.v9i1.1028>
14. Ahmad S, Shah KA, Hussain H, Haq AU, Ullah A, Khan A, *et al.* Prevalence of acute and chronic forms of leukemia in various regions of Khyber Pakhtunkhwa, Pakistan: needs much more to be done!. *Bangladesh J Med Sci.* 2019; 18(2): 222.  
DOI: <https://doi.org/10.3329/BJMS.V18I2.40689>