



Research Article

Audit Of Hematological Malignancies on Bone Marrow Aspiration: A Retrospective Study of 3 Years at A Tertiary Care Centre

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ABSTRACT

Background: Hematological disorders encompass a wide spectrum of disorders ranging from nutritional anemia to various hematological malignancy. Bone marrow aspiration is a procedure that is often used to evaluate patients with hematological disorders including hematological malignancies which account for about 6.5% of all cancers worldwide.

Aims and Objectives: To study the pattern and type of different hematological malignancies on bone marrow examination.

Materials and Methods: This is a retrospective study conducted at P.D.U. Medical college and Hospital, Rajkot over a period of 3 years. It included the patients of hematological malignancies diagnosed on bone marrow examination. Patient's age, sex, clinical history, laboratory findings and bone marrow diagnosis were noted for every case.

Results: Bone marrow aspiration from 58 patients were analyzed. Acute lymphoblastic leukemia was the commonest malignant hematological disorder in the present study. Among the 58 cases, 31 cases were males and 27 were females with the highest number of cases in the age group of 0-20 years.

Conclusion: Bone marrow aspiration is a very potent investigation to confirm the diagnosis and management of suspected hematological malignancies. Although an invasive procedure, it is well tolerated by patients and also helps us in reaching a final diagnosis within a short span of time.

Keywords: Hematological malignancies, Bone marrow aspiration, Leukemia, Lymphoma.

INTRODUCTION

Haematologic malignancies are a heterogeneous group of cancers arising from malignant transformation of cells of the bone marrow and or the lymphatic organs. According to the most recent data. Haematologic malignancies are estimated to represent about 6.5 % of all cancers worldwide. They affect all ages and genders world over. The distribution of types may vary with age, sex, culture and the geographic region. Bone marrow aspiration examination is an important tool that aids in the diagnosis and management of various hematological malignancies. The aspirate smears are useful for studying the morphology of cells and for obtaining a differential cell count. Bone marrow aspiration specimens are useful in further diagnostic assays cytochemical and special staining, immune phenotyping cytogenetic analysis and molecular studies. It may be useful in establishing the diagnosis of storage diseases and metastatic non haemopoietic malignancies or when a leuco erythroblastic peripheral blood picture is present. Deviations from the normal may be qualitative with abnormal cell morphology or quantitative with aplasia, hypoplasia or hyperplasia. The aim of this study was to analyse the spectrum of malignant haematological disorders reported on BMA to formulate an effective and rapid method for diagnosing a wide spectrum of diseases. This study will highlight the diagnostic utility of BMA in various haematological disorders, as combined analyses are useful in achieving more accurate and informative data in some diagnostically challenging cases.

AIMS AND OBJECTIVES

To study the pattern and type of different hematological malignancies on bone marrow examination.

MATERIALS AND METHODS

This was a retrospective observational study aimed to document the prevalence and distribution of different haematologic malignancies at P.D.U. Medical college and Hospital, Rajkot over a 3 year period from January 2022 to January 2025 and included all the patients of haematological malignancies diagnosed on bone marrow examination. Patient's age, sex, residence, bone marrow indication, clinical history, relevant laboratory and radiological investigations along with bone marrow diagnosis were noted for every case. The bone marrow aspiration was primarily done from posterior superior iliac spine and the trephine biopsy was mostly performed in the same sitting wherever required. The smears were then stained with Leishman stain or May Grunwald geimsa stain and were examined carefully. Special cytochemical stains like Myeloperoxidase (MPO), Sudan black B (SBB) and Periodic acid-schiff (PAS) stain were also utilized for accurate staging and differentiating the type of leukemia. All the data were then statistically analysed and the results were presented as tables and figures.

RESULTS

Out of total 210 bone marrow aspirations conducted over the duration of 3 years; hematological malignancies accounted for 58 cases of all hematological disorders. Out of those 58 cases; males constituted 31 cases (53.45%) and females constituted 28 cases(46.55%). Male to female ratio was 1.14:1. (Fig 1)

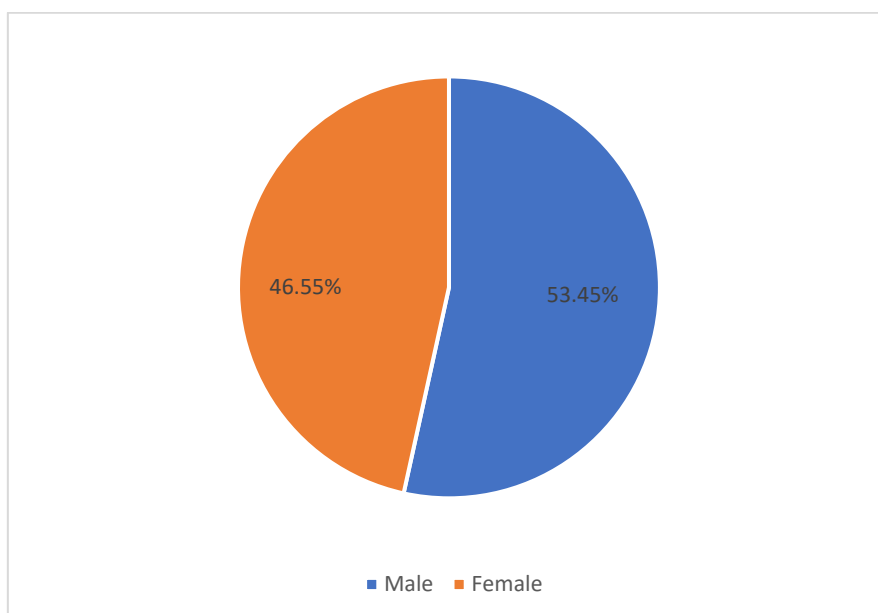


Fig 1: Sex wise distribution of hematological malignancies

In the present study, the age ranged from 9 months to 80 years. The maximum no. of cases were belonging from 0-20 years (39.65%) of age group followed by 41-60 years (24.14%), 21-40 years (22.41%) and 61-80 years (13.80%) respectively (Fig 2).

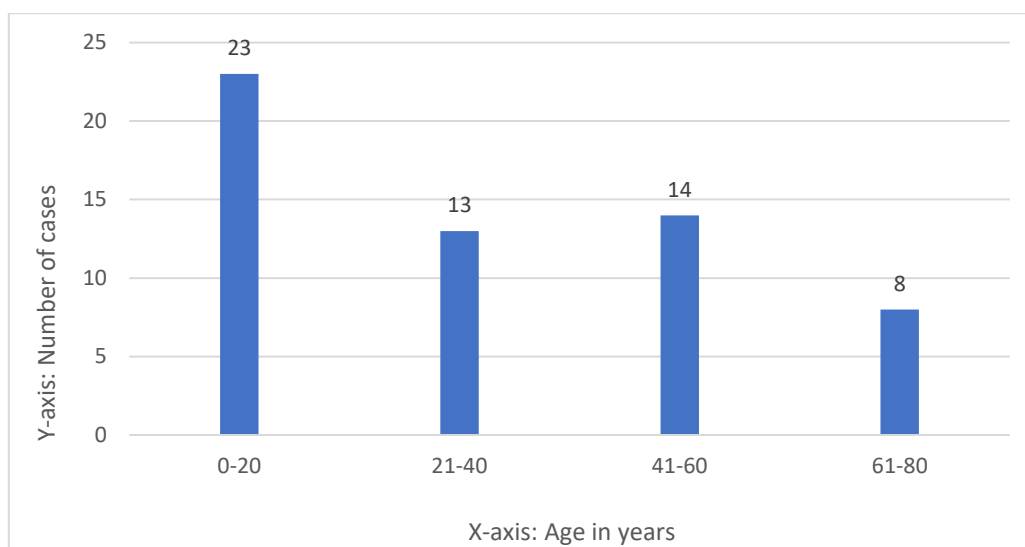


Fig 2: Age wise distribution of hematological malignancies

In the present study, the most common presenting symptom was fatigue, which was seen in 85.2% of patients followed by fever in 75% of cases. Other symptoms were loss of appetite (45%), loss of weight (38.5%), bone pain (28.4%), cough and cold (30.3%), petechiae (22%), and CNS symptoms (8 %). While most common presenting signs were splenomegaly and pallor, which were seen in 83% and 80%, respectively, other common signs found were hepatomegaly (62%) and lymphadenopathy (35%).

Table 1: Presenting symptoms and signs

Symptoms	Percentage (%)
Fatigue	85.2%
Fever	75%
Loss of appetite	45%
Weight loss	38.5%
Bone pain	28.4%
Petechiae	22%
CNS symptoms	8%
Signs	
Splenomegaly	83%
Hepatomegaly	62%
Lymphadenopathy	35%
Palor	80%

In present study; Anemia was seen in majority of patients and among them 56.90% patients have severe anemia (<7 g%). These findings are correlating with clinical examination, which shows pallor in 82.7% of cases. Most of the patients (58.62%) had white blood cell (WBC) count >10,000/mm³ with 27.60% had >50,000/mm³. Two patients had WBC count <5000/mm³ (Table 2).

Table 2: Laboratory findings of all patients

Laboratory findings	Value	Number of cases (%)
Hemoglobin	<7	33 (56.90%)
	7-11	24 (41.38%)
	>11	01 (1.72%)
Total		58 (100%)
Wbc	<5000	02 (3.44%)
	5000-9999	06 (10.34%)
	10,000-49,999	34 (58.62%)
	>50,000	16 (27.60%)
Total		58 (100%)
Platelet count	<20,000	07 (12.06%)
	20,000-99,999	30 (51.74%)
	>1,00,000	21 (36.20%)
Total		58 (100%)

The various hematological malignancies were majorly divided according to the cell lineages into Lymphoid disorders which constituted 29 cases (50%) and Myeloid disorders that constituted 21 cases (36.2%) and 8 (13.8%) cases were inconclusive (dry tap/ diluted).

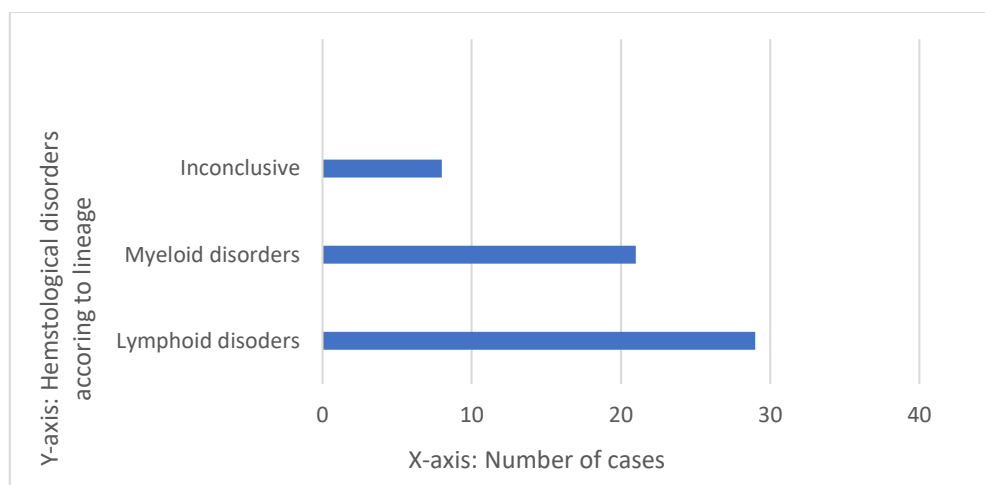


Fig 3: Distribution of hematological malignancies according to cell lineage

The Lymphoid disorders were then classified into Lymphoma which constituted 6.89% (2 cases) , Chronic lymphocytic leukemia 10.34% (3 cases), Plasma cell myeloma(Multiple myeloma) 31.05% (9 cases) and Acute lymphoblastic leukemia 51.72% (15 cases) respectively.

Table3: Distribution of Lymphoid neoplasms: (n=29)

Lymphoid neoplasms	Number of cases (%)
Lymphoma:	
Hodgkins lymphoma	02 (6.89%)
Non hodgkins lymphoma	
Chronic lymphocytic leukemia	03 (10.34%)
Plasma cell myeloma(Multiple myeloma)	09 (31.05%)
Acute lymphoblastic leukemia	15 (51.72%)
Total	29 (100%)

The myeloid disorders were divided into Acute myeloid leukemia which constituted 33.33% , Chronic myeloid leukemia (19.04%), myelodysplastic syndrome (33.33%) and myeloproliferative neoplasm (14.30%)

Table 4: Distribution of Myeloid neoplasms: (n=21)

Myeloid neoplasms	Number of cases (%)
Acute myeloid leukemia	07 (33.33%)
Chronic myeloid leukemia	04 (19.04%)
Myelodysplastic syndrome	07 (33.33%)
Myeloproliferative neoplasm	03 (14.30%)
Total	21 (100%)

Out of all hematological malignancies (50 cases); majority cases were leukemic disorders (58%) whereas 42% were non leukemic disorders (Fig 4) and further the distribution of all leukemic disorders is given as below in Fig 5.

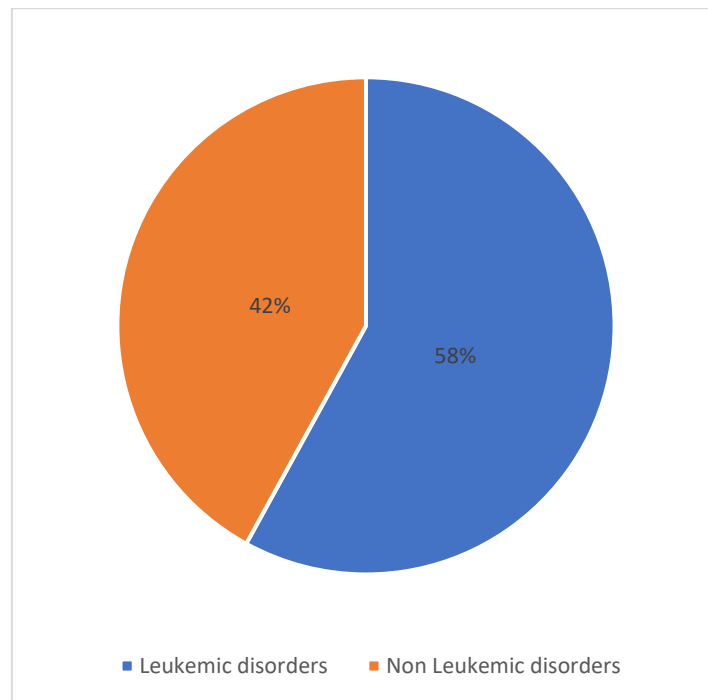


Fig 4: Types of hematological malignancies

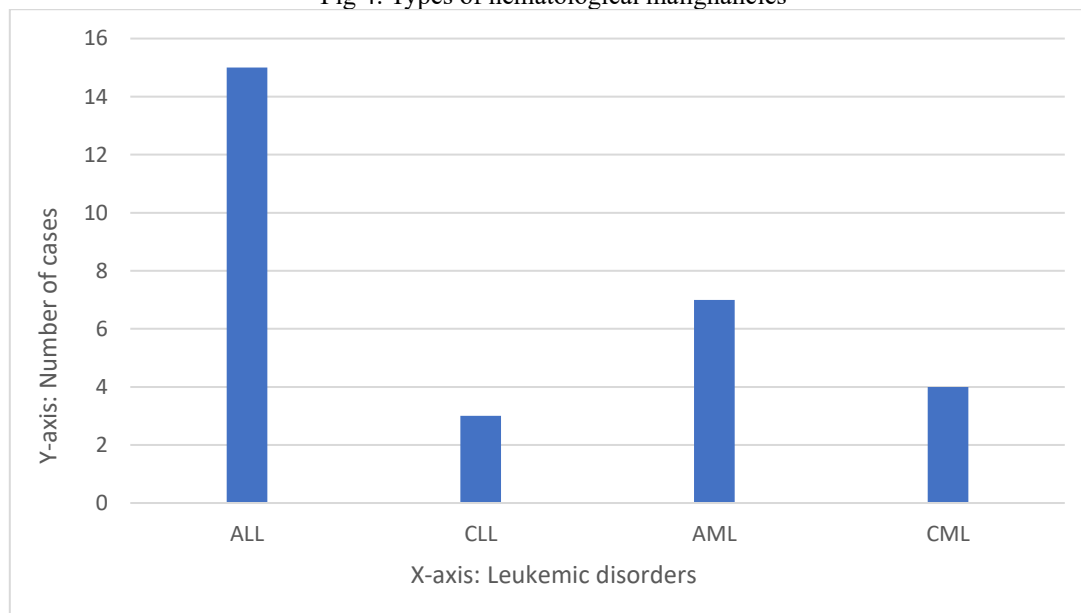


Fig 5: Distribution of various leukemic disorders

In present study, out of all cases of ALL; L1 type of lymphoblast was seen in 80% case, L2 type in 13.33% cases, and L3 type in 6.67% of cases. Hence, L1 is predominant type of lymphoblast in ALL, comprising three-fourth of the cases. In AML, 14.28% of cases had blasts of M1 type, 71.44% had M2 type, and 14.28% had M3 type of myeloblast.

Table 5: Blast typing in bone marrow examination:

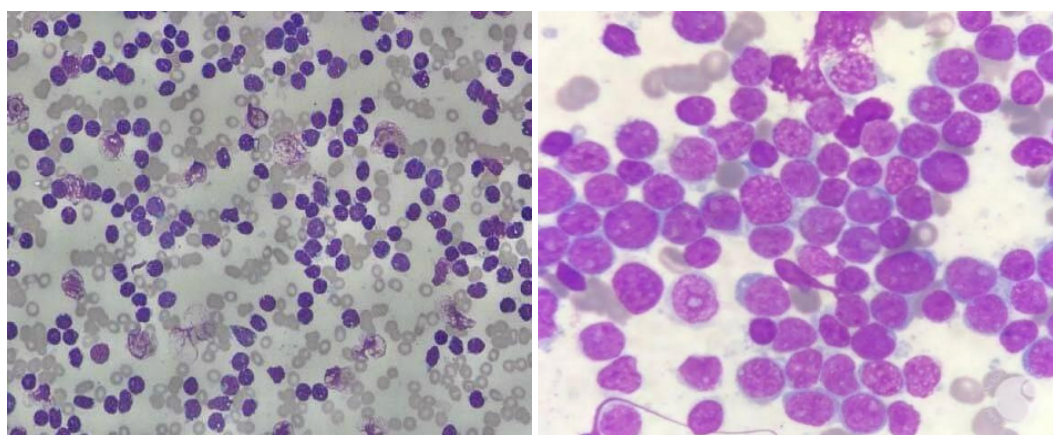
Blast type	Number of cases (%)
Lymphoblasts (Among total cases of ALL)	
L1	12 (80%)
L2	02 (13.33%)
L3	01 (6.67%)
Myeloblasts (Among total cases of AML)	
M1	01 (14.28%)
M2	05 (71.44%)
M3	01 (14.28%)

Special cytochemical staining was done in cases of Acute leukemias (AML & ALL). Out of all cases of Acute myeloid leukemia; 85.71% cases were positive for MPO stain, 100% positive for SBB stain and PAS stain was positive in 28.57% cases.

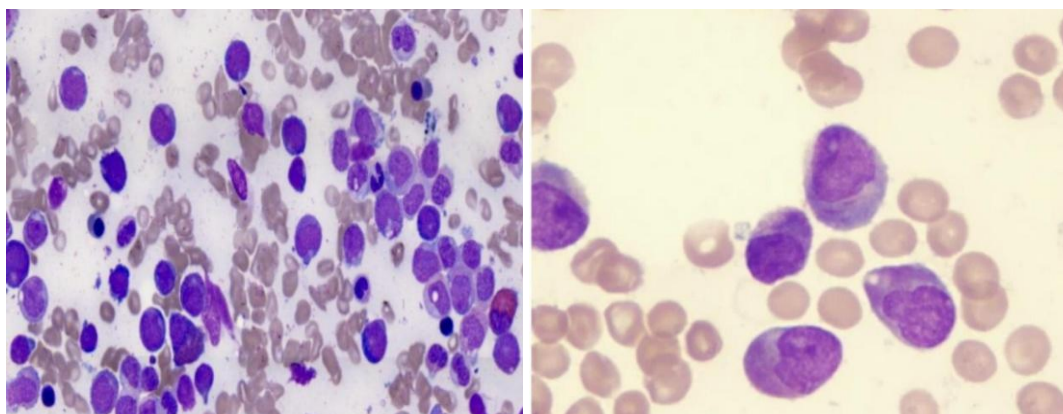
Out of all cases of ALL, 93.33% cases showed PAS positivity whereas MPO and SBB stains were negative in 100% of cases. (Table 6)

Table 6: Cytochemical staining in acute leukemias

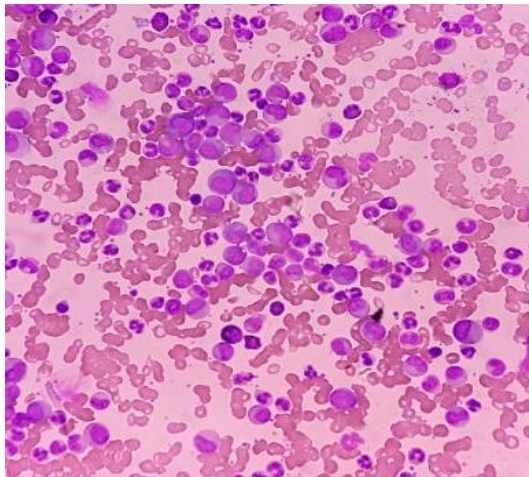
Cytochemical stains	Diagnosis		
		ALL	AML
MPO stain	Positive	0%	85.71%
	Negative	100%	14.29%
SBB stain	Positive	0%	100%
	Negative	100%	0%
PAS stain	Positive	93.33%	28.57%
	Negative	6.67%	71.43%



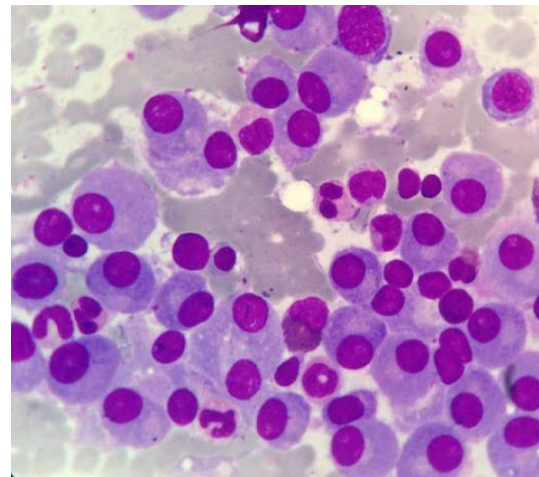
ALL: 40x image of bone marrow aspirate showing multiple lymphoblasts and 100x image of bone marrow smear showing large number of lymphoblasts having high N:C ratio, scant cytoplasm and coarse nuclear chromatin (some blasts show hand mirror appearance)



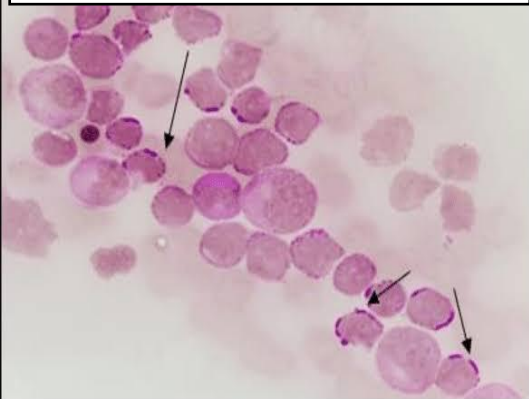
AML: Bone marrow smear showing a significant number of myeloblasts with fine nuclear chromatin and prominent nucleoli and magnified image of myeloblast showing auer rods in cytoplasm



CML: Image showing increased number of immature granulocytes like myelocytes, metamyelocytes and band cells.



Multiple myeloma: Bone marrow smear showing multiple plasma cells having large round/oval eccentric nucleus with prominent nucleoli and basophilic cytoplasm



ALL showing PAS positive lymphoblasts (black arrow)

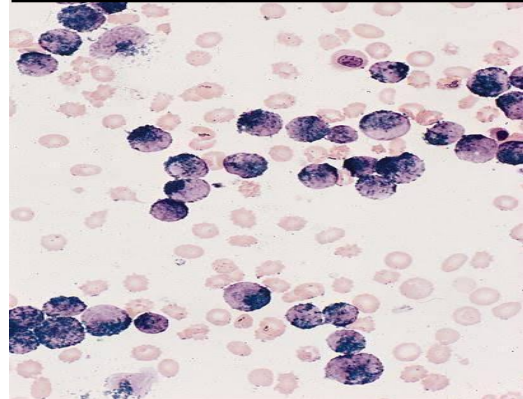


Image showing MPO positivity in AML

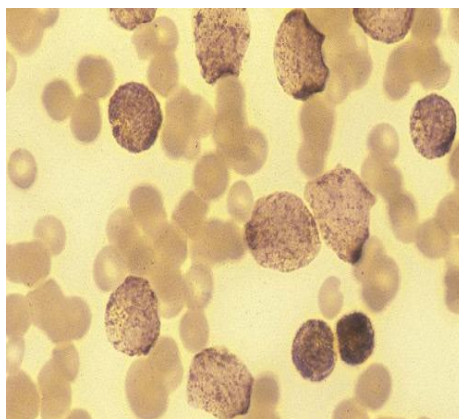


Image showing SBB positivity in case of AML.

DISCUSSION

Bone marrow aspiration(BMA) is a cytologic preparation of bone marrow cells obtained by aspiration of marrow and a smear of the cells. BMA plays a very important role both in determining the cause of a disease as well as reaching a definitive final diagnosis. It is used to diagnose, confirm, and/or stage hematologic malignancies. The present study was carried out at the Department of Pathology at P.D.U. Medical college and Hospital, Rajkot over a period of 3 years . Total

of 58 cases of BMA smears were studied. The observations of the present study were compared and correlated with various other studies.

In the present study, the participating patient's ages ranged from 9m to 80 years, which were in concordance with the findings of N Sangeetha et al (2020), where age ranged from 11m-70 years, Nirali V et al (2020) where cases age ranging from 11m-67 years, and Pudasaini et al (2012) with age group belonging to 9m-75 years. The present study found that the maximum number of cases belonged to the 0-20 years age group. This was in concordance with the findings of Satyasri K et al (2018) where the maximum number of cases belonged to the 0-10 years age group. However, in the study conducted by Renuka Verma et al (2024), Fatima Arshad et al (2021) and N Sangeetha et al (2020) the maximum number of cases belonged to the age group 21-30 years.

Table 7 : Comparison of peak age of presentation in various studies.

Authors	No. of cases	Age range years	Peak age incidence
Pudasaini S et al, Kathmandu (2012)	57	9months-75years	31-45year
Satyasri K et al, Vishakhapatnam (2018)	120	1months-85 years	0-10 year
M. Atchyuta et al, Chinakakani (2019)	375	13months-83years	31-40 year
N Sangeetha et al, Ghanpur (2020)	176	11months-70years	21-30 year
NiraliV et al, Baroda (2020)	63	11months-67years	41-50 year
Fatima Arshad et al, Karachi (2021)	756	7months-85years	21-30 year
Piplani G et al., Manglore (2022)	100	9months-85years	50-59 year
Ali Dogan et al., Turkey (2022)	500	18months-87years	35-67 year
Gupta C et al. (2023)	323	5months-85years	11-20 year
Sanjana et al (2024)	48	4months-80years	60-80year
RenukaVerma et al., Rohtak (2024)	518	3months-86years	21-30 year
Our study, Rajkot (2025)	58	9months- 80 years	0-20 year

In the present study, a total of 58 cases were included out of which 31 were male and 27 were female. Male preponderance was observed in the present study and the male: female ratio was 1.14:1 which was in concordance with the study conducted by Renuka Verma et al (2024), Gupta C et al (2023), Pudasaini S et al (2012) and Satyasri K et al (2018) where male: female ratio was 1.3:1, 1.6:1, 1.1:1 and 1.4:1 consecutively. However, in studies conducted by Fatima Arshad et al (2021) female preponderance was observed, and the male: female ratio was 1:1.25 which was discordant with the present study. (Table No. 8)

Table 8: Sex-wise distribution of study population in various studies

Authors	No. of cases	Male:Female ratio
Pudasaini S et al, Kathmandu (2012)	57	1.1:1
Satyasri K et al, Vishakhapatnam (2018)	120	1.1:1
M. Atchyuta et al, Chinakakani (2019)	375	1.4:1
N Sangeetha et al, Ghanpur (2020)	176	1.1:1
NiraliV et al, Baroda (2020)	63	1:1.25
Fatima Arshad et al, Karachi (2021)	756	1.8:1
Piplani G et al., Manglore (2022)	100	1.7:1
Ali Dogan et al., Turkey (2022)	500	1.2:1
Gupta C et al. (2023)	323	1.06:1
Sanjana et al (2024)	48	1.08:1
RenukaVerma et al., Rohtak (2024)	518	1.3:1
Our study, Rajkot (2025)	58	1.14:1

In the present study; the most common malignancy was Acute lymphoblastic leukemia which was similar to Satyasri K et al and Renuka Verma et al. However, M. Atchyuta et al and Fatima Arshad et al showed the most common malignant haematological disorder was Chronic leukemia which was discordant with current study. (Table 9)

Table 9: Comparison of the spectrum of BMA among various studies

Authors	Hematological malignancies
Pudasaini S et al, Kathmandu (2012)	Acute leukemia
Satyasri K et al, Vishakhapatnam (2018)	Acute lymphoblastic leukemia
M. Atchyuta et al, Chinakakani (2019)	Chronic myeloid leukemia
N Sangeetha et al, Ghanpur (2020)	Acute myeloid leukemia
Nirali V et al, Baroda (2020)	Acute leukemia
Fatima Arshad et al, Karachi (2021)	Chronic leukemias
Piplani G et al., Manglore (2022)	Myeloproliferative neoplasm
Ali Dogan et al., Turkey (2022)	Acute leukemia
Gupta C et al. (2023)	Acute leukemia
Sanjana et al (2024)	Acute myeloid leukemia
Renuka Verma et al., Rohtak (2024)	Acute lymphoblastic leukemia
Our study, Rajkot (2025)	Acute lymphoblastic leukemia

CONCLUSION

The Bone marrow aspiration study remains an important diagnostic tool for many hematological disorders. A complete clinical examination, patient history, and investigations like peripheral blood examination along with bone marrow examination complete the diagnostic workup for many hematological conditions. In present study, leukaemias were the most prevalent haematologic malignancies and ALL was the predominant leukaemia as well as the most prevalent haematological malignancy in our centre.

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