

## Spectrum of hematological diseases diagnosed by bone marrow examination in a tertiary care hospital

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### Abstract

**Introduction:** Hematological disorders are quite frequent in all age groups. Most of the hematological disorders first present as anemia. Bone Marrow Aspiration plays a major role in the diagnosis of its underlying cause.

**Aim:** The aim of this study was to know the spectrum of various hematological disorders diagnosed on bone marrow examination and to know the age and sex incidence

**Materials and Methods:** This was a retrospective study carried over a period of two years from January 2015- December 2016, in the department of Pathology, NRI Medical College, Chinakakani. Bone marrow examination was done on patients who were referred with suspected hematological disorders and a total of 375 cases were included in the study.

**Results:** The age range was from 13 months - 83 years with male: female ratio of 1.1:1. Most common diseases observed on bone marrow examination were erythroid hyperplasia (34.2%) and megaloblastic anemia (10.9%). In Hematological malignancies most common were chronic leukemia's (10.4%), followed by acute leukemia's (6.4%).

**Conclusion:** Bone marrow examination is an important step to arrive at the confirmatory diagnosis of many hematological disorders including hematologic malignancies within a short span of time.

**Keywords:** Anemia, Bone marrow aspiration, Leukemia, Megaloblastic anemia.

### Introduction

Hematological disorders usually presents with anemia in any age group. Anemia is common worldwide and particularly so in developing countries.<sup>1</sup> The spectrum of hematological disorders is relatively different in the developing world than the developed countries.<sup>2</sup> At most of the instances, the diagnosis can be made by complete clinical examination and by doing simple investigations. And sometimes the diagnosis can be confirmed only by bone marrow examination. Bone marrow picture along with peripheral blood smear and clinical findings can help in arriving at a conclusive diagnosis.

Bone marrow aspiration plays an important role to explain cytopenias and also aid to diagnose leukemias. Bone marrow examination is also done for the diagnosis as well as staging of neoplasm's and storage disorders.

### Aim and Objectives

This study was done to know the spectrum of various hematological disorders that can be diagnosed on bone marrow examination and to know the age and sex incidence.

### Materials and Methods

This was a retrospective study done in the department of Pathology, NRI Medical College, Chinakakani, over a period of two years from January 2015- December 2016. A total of 375 cases were included in this study.

The clinical details were taken from case sheets and BMA reports of the patients were collected from the bone marrow register of Pathology department. Then the data obtained was statistically analyzed.

The procedure of Bone marrow aspiration was done after giving 2% xylocaine as local anesthesia either from sternum or from posterior iliac spine. Leishman stained peripheral blood and bone marrow smears were studied. Bone marrow trephine biopsy was performed as an adjuvant when the bone marrow aspiration yields a bloody tap or dry tap. Bone marrow examination was done on Leishman stained bone marrow aspiration smears and on Hematoxylin and eosin stained bone marrow trephine biopsy sections. The diagnosis among various hematologic disorders was confirmed by using the standard criteria.

### Inclusion Criteria

All cases that were referred for bone marrow examination and also for staging of lymphomas and metastasis.

### Exclusion Criteria

Children below 1 year of age were excluded

### Results

A total of 375 patients who had undergone bone marrow examination were included in this study, of which 196 were males and 179 were females with M:F ratio of 1.1:1 and this gender ratio is shown in Table 1.

**Table 1: Sex distribution in the present study with M: F ratio of 1.1:1**

Sex	Number of patients	Percentage
Male	196	52.3%
Female	179	47.7%

In the present study, the age group of the patients was from 13 months to 83 years. The maximum number of cases (19%) were in the age group of 31-40 years, followed by 51-60 years and were shown in Table 2, shows the age distribution

**Table 2: Age wise distribution of the patients**

Age group	No. of cases
1-14	29 (7.7%)
15-19	31 (8.3%)
20-30	68 (18.1%)
31-40	71 (19%)
41-50	54 (14.4%)
51-60	69 (18.4%)
61-70	39 (10.4%)
71-80	13 (3.4%)
81-90	01 (0.3%)
Total no. of cases	375 (100%)

Erythroid hyperplasia was the most common finding in the present study (34%) followed by megaloblastic anemia noted in 11% of the cases, [Fig. 1] and then by chronic leukemia (10.4%). The spectrum of these various hematologic disorders on bone marrow examination in the present study were shown in Table 3.

**Table 3: Spectrum of various hematological disorders diagnosed on bone marrow examination**

Disease pattern	No. of cases	Percentage
Erythroid hyperplasia	128	34%
Megaloblastic anemia	41	11%
Dimorphic anemia	9	2.4%
Anemia of chronic disease	1	0.3
Hypoplastic marrow	12	3.2%
Acute leukemias	23	6%
Chronic leukemias	39	10.4%
Multiple myeloma	19	5.2%
Myelofibrosis	10	2.7%
ITP	17	4.4%
Metastasis	03	0.8%
Staging	19	5.2%
Normal study	39	10.4%
Remission	10	2.7%
Inadequate	03	0.8%
Infective pathology	02	0.5%
Total no. of cases	375	100%

**Table 4: Distribution of non- malignant hematological disorders according to the age and sex**

S. No	Disease	1-14 yrs	15-20 yrs	21-30 years	31-40 years	41-50 years	51-60 years	61-70 years	71-83 years	M:F	Total cases
1	Erythroid hyperplasia	17	11	25	23	16	19	12	05	1.1:1	128
2	Megaloblastic anemia		7	10	9	5	6	3	1	1.2:1	41
3	Dimorphic Anemia			2	6	1				1:8	09
4	Anemia of Chronic Disease	1								M	1
5	Hypoplastic marrow		1	4	-	1	2	3	1	2:1	12
6	ITP	1	2	8	3	1	-	2	-	1:4.7	17
7	Infective pathology						1	1		M	2
Total no. of cases											210

In the present study, non-malignant hematological disorders constituted to 210 cases. Among them, the commonest disorder was erythroid hyperplasia with M:F ratio of 1.1:1, followed by megaloblastic anemia M:F ratio of 1.2:1. There were 17 cases of ITP showing female preponderance with M: F ratio of 1:4.7. This distribution of non malignant hematologic disorders is shown in Table 4

Out of 375 cases studied, hematologic malignancy was found in 100 (26.66%) cases. Chronic myeloid leukemia (CML) was the commonest malignant hematological disorder in the present study constituting to 8% of overall cases and 30% of malignancies. The next common malignancies in this study were acute leukemias followed by multiple myeloma [Fig. 2]. Others were 10 cases (2.66% overall; 10% of malignancies) of myelofibrosis [Fig. 3], 8 cases (2.13% overall; 8% of malignancies) of Chronic Lymphocytic leukemia, and 7 cases (1.86% overall and 7% of malignancies) of lymphomatous involvement of the marrow. The present study also showed 2 cases (0.53% overall; 2% of malignancies) of metastatic secondary deposits of which one was from the mucin secreting adenocarcinoma of stomach [Fig. 4]. The study also included a single case of polymphocytic leukemia.

The distribution of hematologic malignancies according to age and sex was shown in table 5.

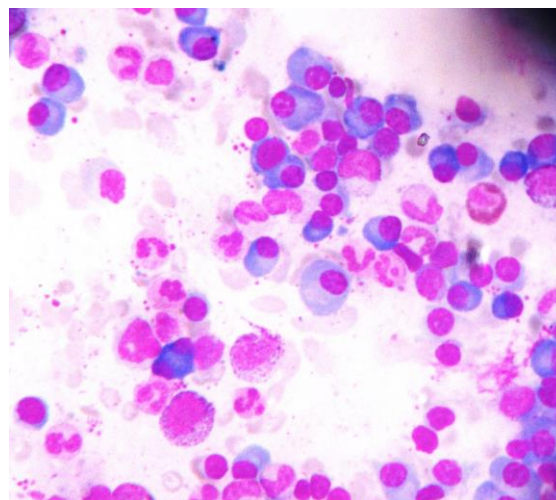
**Table 5: Distribution of hematological malignancies according to the age and sex**

S. No	Hematologic malignancy	1-14	15-19	20-30	31-40	41-50	51-60	61-70	71-83	M:F	Total cases
1	CML	1	1	4	8	5	6	4	1	1:1.5	30
2	AML		2	4	2	3	6	1	1	1.1:1	19
3	MM				1	5	6	5	2	1:1.4	19
4	MF			2	4	1	2	1		1.5:1	10
5	CLL					3	2	2	1	1.7:1	8
6	NHL			1	2	1	3			1:1.3	7
7	ALL	3	1							M	4
8	Mets				2					M	2
9	PLL						1			M	1
Total No. of cases											100

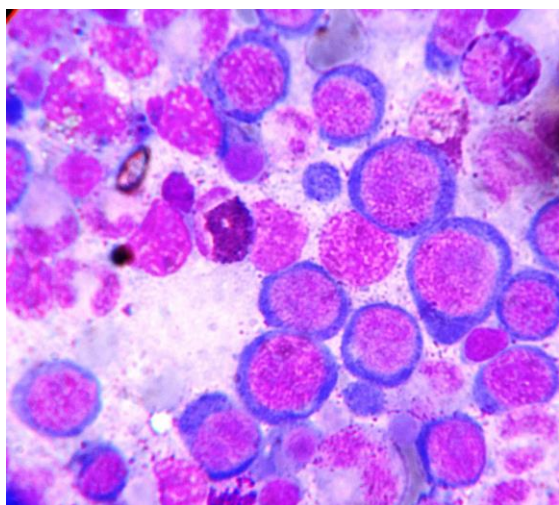
The present study also encountered 39 cases of normal marrow study, 10 cases of acute leukemias under remission and 3 cases with inadequate yield and has underwent bone marrow biopsy with inconclusive report and are shown in table 6.

**Table 6: Distribution of other hematological conditions**

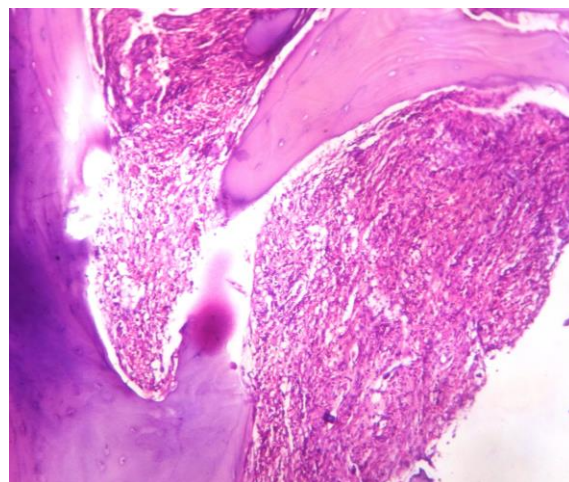
Other conditions	No. of cases	M:F
Normal marrow study	39	22:17
Inadequate samples	03	All are females only
Hematological malignancies under remission	10	6:4
Un involved by lymphomatous process	12	10:2
No metastatic deposit seen	01	M
Total cases	65	



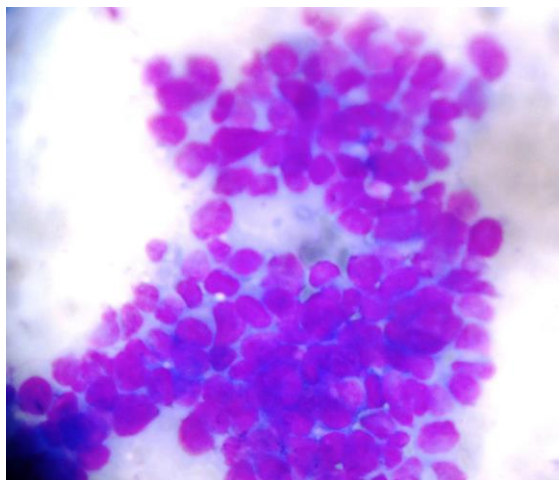
**Fig. 2: Multiple myeloma (Leishman stained, high power)**



**Fig. 1: Megaloblastic anemia (Leishman stained, Oil immersion)**



**Fig. 3: Bone marrow biopsy showing myelofibrosis (H&E)**



**Fig. 4: Bone marrow aspiration showing metastatic mucin secreting adenocarcinomatous deposits (Leishman stained, Oil immersion)**

## Discussion

Bone marrow examination is the safe invasive procedure that can be done to arrive at a final diagnosis in certain hematological disorders.

In the present study, out of 375 cases studied, there were 196 males (52.3%) and 179 females (47.7%). The male to female ratio was 1:1.1. The age of the patients who underwent bone marrow examination ranged from 13 months to 83 years. The mean age was 39.1 years and the most common age group was 31-40 years. This finding was similar to the study done by Pudasani S et al,<sup>3</sup> in which the majority of the patients were from 30-45 years. According to the study done by Gayathri et al,<sup>4</sup> the age range in their study was from 2 years to 80 years and M:F ratio of 1.2:1, which was similar to the present study findings.

The most common finding in the present study on bone marrow examination was erythroid hyperplasia which was seen in 128 cases (34%) with the common age group being 21-30 years and M:F ratio of 1.1:1. Similar findings of 21% and 19.6% cases of erythroid hyperplasia was seen in a studies done by Pudasani S et al<sup>3</sup> and by Jha et al.<sup>5</sup>

The 2nd common diagnosis in the present study was Megaloblastic anemia in the age group between 21-30 years and M:F ratio was 1.4:1 and was similar to the studies done by Pudasani S et al,<sup>3</sup> Niazi et al<sup>6</sup> and Jha et al.<sup>5</sup>

In the present study, ITP was seen in 17 cases (4.4%) with maximum number of cases in the age group of 21-30 years and M:F ratio of 1:4.7, showing high female preponderance. In the study done by Pudasani et al<sup>3</sup> ITP was seen in 6 cases (10.5%) and was also reported as 6.21%, 14.5%, 6.8% and 5% of cases in other studies.<sup>2,7,8</sup>

Hypoplastic marrow was seen in 12 cases (3.2%) and has been diagnosed based on both BMA findings as well as on bone marrow biopsy, mostly in the age group of 21-30 years with M:F ratio of 2:1. Compared to our study hypoplastic anemia was reported as 5.3%, 19%, 29% and 14% of cases in other studies.<sup>3-5,8</sup>

There were 9 cases (2.4%) of dimorphic anemia mostly in the age group of 31-40 years and with M:F ratio of 1:8. In the study done by Rajendra Kumar Nigam et al,<sup>9</sup> dimorphic anemia was noted in 16.72% and 4.7% in Fazlur Raheem et al<sup>10</sup> and 2.87% in AL-Ghazaly. J et al<sup>11</sup> while dimorphic anemia was not reported by Pudasani S et al<sup>3</sup> and Anita et al.<sup>12</sup>

The present study also encountered 2 cases of infective pathology and 1 case of anemia of chronic disease.

Hematologic malignancy was found in 100 cases out of 350 cases and constituted to 26.66% of overall hematologic disorders. According to the studies done by Rajendra Kumar Nigam et al,<sup>9</sup> Fazlur Rahman et al,<sup>10</sup> Al -Ghazaly J<sup>11</sup> and Anita Tahlan et al,<sup>12</sup> the hematologic malignancies constituted to 20.28%, 27.12%, 47.48% and 18% respectively.

Chronic leukemia's were the commonest malignant hematological disorder in the present study constituting to 10.13% of overall cases and 38% of malignancies. Among the chronic leukemia's, chronic myeloid leukemia (CML) was most common comprising to 30 cases (8% of over all malignancies and 30% of malignancies). The common age group among CML was 31-40 years with M:F ratio of 1:1.5 and most of the cases were diagnosed in chronic phase.

There were 8 cases of Chronic Lymphocytic leukemia, (2.13% overall; 8% of malignancies) the common age group being 41-50 years with M:F ratio of 1.7:1

The next common malignancy in this study was acute leukemia comprising to 23 cases (6.12% of overall cases and 23% of hematologic malignancies) of which there were 19 cases of AML and 4 cases of ALL. The common age group in AML was 51-60 years with M:F ratio of 1.1:1. Among ALL the age ranged from 1-14 years and all were males. In the study done by Pudasani et al,<sup>3</sup> Acute leukemia was seen in 7 cases (12.3%). Out of this, 6 cases (10.5%) were AML and 1 case (1.8%) was ALL. Out of 6 cases of AML, the commonest type was AML M3 (3 cases). Other series also showed that acute leukemia is the commonest hematological malignancy and AML is more common than ALL.<sup>1,2</sup>

We encountered 19 cases of multiple myeloma (5.06% overall; 19% of malignancies) and the common age group was 51-60 years with M:F ratio of 1:1.4. In the study done by Pudasani et al,<sup>3</sup> there were 5.06% cases of multiple myeloma compared to Kibria et al,<sup>2</sup> Laishram et al<sup>13</sup> and Jha et al<sup>5</sup> who reported an incidence of 9.04%, 20.5% and 0.94% in their studies respectively.

Other hematologic malignancies that were encountered in the present study were 10 cases (2.66% overall; 10% of malignancies) of myelofibrosis, 7 cases (1.86% overall and 7% of malignancies) of lymphomatous involvement of the marrow and 2 cases (0.53% overall; 2% of malignancies) of metastatic secondary deposits of which one was from the mucin secreting adenocarcinoma of stomach [Fig. 4]. The study also included a single case of prolymphocytic leukemia.

In our study, we observed 10.4% of chronic leukemias, 6% of acute leukemia, 2.7% cases of myelofibrosis and

5.2% of Multiple Myeloma The spectrum of hematology malignancies among various studies was as follows: Rajendra Kumar Nigam et al<sup>9</sup> reported 58.27% cases of acute leukemia (34.28% AML, 24.28% ALL), 8.57% cases of Myeloproliferative disorders and 8.57% of multiple myeloma cases and 1.42% cases of Non Hodgkin Lymphoma while Pudasaini S et al<sup>3</sup> reported Acute leukemia in 12.3% cases, 3.5% cases of Myelo Dysplastic Syndrome and 3.5% of Multiple Myeloma cases. In the study done by Fazlur Rahim et al<sup>10</sup> Acute leukemia was seen in 24.28% cases (AML 6.36% & ALL 17.92%), 1.17% cases of Lymphoma and 0.47% each of CML & Neuroblastoma. According to the study done by Anita et al<sup>12</sup> there were 41% cases of Acute Leukemia, 30% of CMPD, 14.2% of Lymphoma cases, 7.5% cases of CLL & 7% cases of Multiple Myeloma. There were 37.31% cases of acute leukemia (AML 25.35%, ALL 11.96%), 5.74% cases of CLL & 1.27% cases of multiple myeloma in the study done by Al-Ghazaly J et al.<sup>11</sup>

And this variation is due to differences in the studied age groups & population in different areas.

### Conclusion

Bone marrow examination plays an important role in diagnosing wide varieties of hematologic disorders. In our study, the spectrum among these hematologic diseases showed that nonmalignant diseases were common than hematologic malignancies. And among these nonmalignant hematologic diseases, the most common disorder was erythroid hyperplasia followed by megaloblastic anemia, ITP, Hypoplastic marrow, dimorphic anemia, Infective pathology and Anemia of chronic disorder. Chronic leukemias were common followed by acute leukemias and multiple myeloma among hematological malignancies.

**Conflict of Interest:** None.

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