Original Research Article

Retrospective analysis of the bone marrow received at a tertiary care hospital- A study of 160 cases

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A R T I C L E   I N F O

A B S T R A C T

Introduction: Bone marrow examination becomes a crucial test in diagnosis of both hematological and non hematological malignancies, when the routine peripheral blood and other laboratory tests are not conclusive of a diagnosis.
Aim: The aim of this study was to find the indications of bone marrow and to assess the diagnostic value.
Materials and Methods: A total of 160 cases were analyzed retrospectively from January 2016 to December 2017. All the bone marrows received at the laboratory were included in the study.
Result: The youngest patient was 2 years old and the oldest 80 years. Amongst 160 cases 89 (55.62%) were male and 71 (44.37%) were female. M: F ratio is 1.25:1. Leucocytosis was the most common indication of bone marrow examination followed by bicytopenia and pancytopenia. Acute leukemia was the most frequented diagnosis (13.12%) followed by idiopathic thrombocytopenic purpura (11.25%), myeloproliferative diseases (8.12%) and myeloma (8.12%). Few of the rare diagnosis included hemophagocytic syndrome, hypersplenism and aplastic anemia.
Conclusion: The study concludes the bone marrow examination is crucial and important in reaching a diagnosis in most of the cryptic cases of cytopenias and unexplained leucocytosis.

1. Introduction

Bone marrow is the major site of hematopoesis giving rise to the three cellular elements namely red blood cells (erythrocytes), white blood cells (leucocytes) and platelets (thrombocytes). Various hematological disorders may arise from abnormality in one of the three lineages. It thus becomes necessary to examine the bone marrow to determine the actual cause. The history of in vivo bone marrow examination dates back to as early as 1876 when Mosler used a regular wood drill to aspirate bone marrow particles from a patient with leukaemia.[1] It is important in cases where diagnosis can't be reached after a routine CBC and other biochemical studies. Bone marrow aspirate is often done along with trephine biopsy to aid in the diagnosis. Its various indications include hematological and non hematological disorders like cytopenias, leucocytosis, staging of lymphomas and remission of hematological malignancies or a suspicion of metastasis.

2. Materials and Methods

This is a retrospective study carried out at Department of Pathology, Sterling hospital, Vadodara over a period of two years from January 2016 to December 2017. The relevant information was derived from the laboratory records to include the age, sex, indication of marrow and final diagnosis. All the 160 cases were included in the study. The peripheral blood smear and the aspirate were stained with Giemsa stain and the trephine biopsy with H&E and reticulin stain for marrow fibrosis.

3. Results

In our study the age group was from 2 years to 80 years (Table 1). The youngest being a 3 year male and the oldest

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80 year male.

Table 1: Youngest and oldest patient

	Male	**Female**
Youngest	3 years	2 years
Oldest	79 years	80 years

The M: F ratio is 1.25:1. Males undergoing BM examination were highest in the age of 51-60 years and females were in the range of 61-70 years (Table 2).

Table 2: Age and sex wise distribution of the cases

Age	Male	%	Female	%
<10	4	4.49	2	2.81
11-20	13	14.60	8	11.26
21-30	5	5.61	10	14.08
31-40	10	11.23	5	7.04
41-50	11	12.35	9	12.67
51-60	20	22.47	11	15.49
61-70	17	19.10	17	23.94
>70	9	10.11	9	12.67
Total	89		71	

Most of the marrows received were hyper cellular -70 cases, followed by normo cellular and hypo cellular for age. There were also a few cases of dry tap (Figure 1).

Cellularity
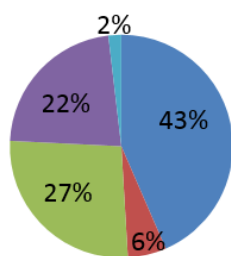
Fig. 1: Cellularity

The most common indication for marrow examination was leucocytosis, followed by bicytopenia and pancytopenia. Also the marrows were done for indications of hematological remissions, lymphoma staging, and suspicion of metastasis, myelomas, thrombocytopenia and anemia (Table 3).

Of all the cases of leucocytosis the most common diagnosis was that of chronic myeloid leukemia, followed by Acute Leukemia, CLL /SLL and three marrows were

Table 3: Indication of bone marrow

Indication	No of cases	% of cases
Leucocytosis	30	18.75
Bicytopenia	29	18.12
Pancytopenia	24	15
?Metastasis	6	3.75
Hematological remission	21	13.12
Myeloma	11	6.87
Lymphoma staging	15	9.37
Thrombocytopenia	15	9.37
Anemia	6	3.75
Others	3	1.87
Total	**160**	**100**

normal.

The most common diagnosis on B one Marrow was that of Acute leukemia (Figure 2) accounting to 13.12%, followed by Idiopathic thrombocytopenic purpura (ITP) - 11.25% (Figure 3)

Of the 16 cases received for lymphoma staging, 2 cases showed marrow involvement by lymphoma (1.25%). Cases of myeloproliferative neoplasm(8.12%), myeloma (8.12%), metastatic diseases (2.5%) and myleodysplastic syndrome (1.25%) were also diagnosed. Other rare diagnosis included a single cases of hemophagocytic syndrome, Amegakary-ocytic thrombocytopenia, hypersplenism, monocytosis and two cases of aplastic anemia (Table 4)

**Table 4:** Bone marrow examination findings

Diagnosis		No of cases	% of cases
Acute leukemia (AML/ALL)		21	13.12
Lymphoproliferative / CLL		09	5.62
Metastasis		04	2.5
Myeloma / Plasma cell dyscrasia		13	8.12
ITP		18	11.25
Hematological remission	Complete remission	15	9.37
	Non remission	5	3.12
Normal marrow		17	10.62
Lymphoma staging	Un -involved	14	8.75
	Involved	2	1.25
Myeloproliferative diseases		13	8.12
MDS		2	1.25
Megaloblastic anemia		12	7.50
Inconclusive		8	5.00
Others		5	3.12
Aplastic anemia		2	1.25
Total		**160**	**100**

4. Discussion

Hematological disorders, both benign and malignant comprise a major health problem. They have a high mortality and morbidity. Both men and women get
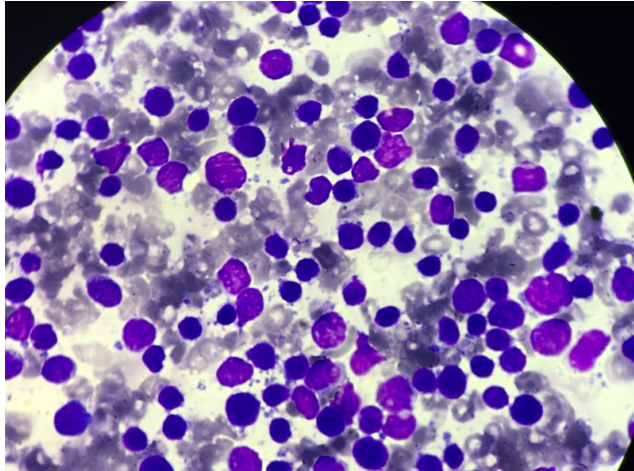
Fig. 2: Hyper cellular marrow showing lymphoblasts in a case of ALL
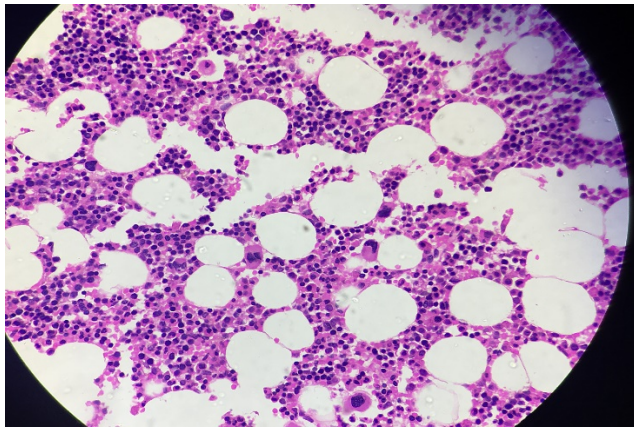
Fig. 3: Hypercellular marrow showing increased megakaryocytes in a case of ITP

affected at any age. Early diagnosis and prompt treatment can save the patient if managed timely. Bone marrow examination consists of bone marrow aspirate cytology and bone marrow trephine biopsy. While the aspirate helps in evaluating individual cell population, the trephine biopsy is important to know the overall cellularity, architecture, fibrosis and metastatic deposits. Hence, Bone marrow examination remains a crucial test in diagnosis of both hematological and non hematological malignancies, when the routine peripheral blood and other laboratory tests are not conclusive of a diagnosis. A wide spectrum of diagnosis ranging from anemia to leukemia can be made on the bone marrow and help in management of the patient.

In our study, the patients undergoing bone marrow examination ranged from 2 years to 80 years of age. The M: F ratio was 1.25: 1 which is comparable to most of the studies which show a slight male predominance which is compared in Table 5.

Table 5: Comparison of age and sex with various studies

Study name	Age range	M: F ratio
Kumar K et al[2]	9 days to 75 years	1.02 : 1
Pudasaini S et al[3]	9 months to 75 years	1.1 : 1
Gilotra M et al[4]	1.5 years to 88 years	1.2 :1
Thiyagarajan P[5]	8 years to 90 years	1.3 :1
Present study	2 years to 80 years	1.25 : 1

In our study the most frequent indication of bone marrow examination was of leucocytosis (18.75%), followed by bicytopenia (18.12%) and pancytopenia (15%). Other indications included bone marrow for hematological remission (13.12%), thrombocytopenia, staging for lymphoma, myeloma and anemia. Similar studies like Kumar et al[2] reported anemia (34.4%) to be the most common indication, Aljadeyeh et al[6] reported anemia (22.4%) and hematological remssion (23.2%) as the most common indication of marrow examination.

In our study the most common diagnosis was that of acute leukemia (13.12%), it was comparable with studies by Al-Gwaiz (27.3%), Ridha (28.16%), Bashwari (17.76%).

This was in contrast with studies from authors of Indian subcontinent like Katiyar, Khatik and Atla BL who reported megaloblastic anemia to be the most common diagnosis with 28.1%, 21.33% and 49.5 % respectively (Table 6). This contrast in our study when compared to the Indian studies may be due to the fact that ours being a tertiary care center, more patients of leukemia and lymphomas are referred while the ones with anemia are treated at primary and secondary centers.

Table 6: Comparison of most frequent diagnosis

Study name	Most frequent diagnosis	% of cases	% of Acute leukemia
Katiyar et al[7]	Megaloblastic anemia	28.1	3.59
Khatik et al[8]	Combined def anemia	21.33	12.67
Atla BL et al[9]	Anemia	49.5	16.2
Bashawri[10]	Acute leukemia	17.76	17.76
Parajuli[11]	Erythroid hyperplasia	13.33	12
Ridha[12]	Acute leukemia	28.16	28.16
Al-gwaiz[13]	Acute leukemia	27.3	27.3
Present study	Acute leukemia	13.12	13.12

We also encountered some rare interesting cases of hemophagocytic syndrome (Figure 4), aplastic anemia and hyperspleenism.
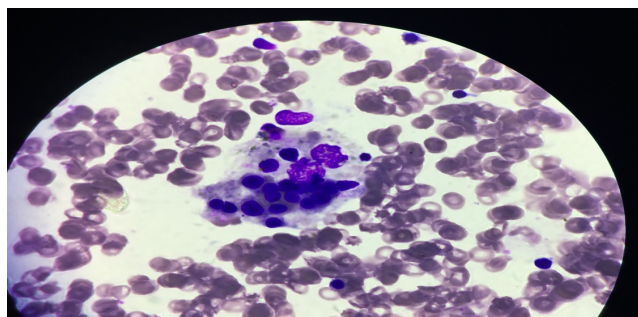
Fig. 4: Macrophage showing hemophagocytosis in a case of Hemophagocytic syndrome.

Most of the cases who underwent BM examination for leucocytosis had CML as diagnosis, followed by acute leukemia and chronic lymphocytic leukemia.

In case of dry tap which were followed with a trephine biopsy, diagnosis of acute myeloid leukemia and metastasis were made. This shows how important trephine biopsy is in case of a dry tap and it should not be ignored as a faulty aspiration technique.

5. Conclusion

The study concludes that bone marrow aspirate along with trephine biopsy are very crucial in reaching a final diagnosis in cases of various cytopenias, leucocytosis and suspected metastasis. It also aids in the hematological staging and a therapeutic response.

6. Source of funding

None.

7. Conflict of interes

None.

8. Author statement

All authors have read, reviewed, agree and approved the final manuscript.

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