RESEARCH PAPER

Bone Marrow Aspiratoin And Trephine Biopsy: A Clinicopathological Study Of Hematological And Non Hematological Disorders

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Abstract

Background: Hematological disorders are quite frequent in all age groups. Most of the hemtological disorders first present as anemia. Bone marrow aspiration plays major role in diagnosis of underlying cause.

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

Method This was retrospective study carried over a period of August 2024 to September 2025, in department of pathology P.D.U Medical College, Rajkot. Bone marrow examination was done on patients who referred with suspected haematological disorders and a total 44 cases of Bone Marrow Aspiration (BMA) and 26 cases of Bone Marrow Biopsy(BMB) were included in the study.

Results: In our study most common undergoing BMA were between 0-30 years and 41-50 years. In our study most common undergoing BMB were between 41-50 years. The male-to-female ratio in BMA and BMB were 4.2:3 and 3.6:2 respectively. The most common indications for BMA and BMB in this study were pancytopenia .Megaloblastic anemia was most common pathological finding in BMA and in BMB were Aplastic/Hypoplastic Anemia which is comparable to other studies. Most common malignancy in this study were Multiple Myeloma, Acute blastic leukemia and lymphoproliferative disorder.

Conclusion: Bone marrow examination in terms of both BMA and BMB are an important step to arrive at the confirmatory diagnosis of many haematological and non haematological disorders including hematologic malignancies within a short span of time.

Keywords: Anaemia, Bone Marrow Aspiration, Bone Marrow Biopsy, Leukaemia, Megaloblastic Anaemia

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Introduction

Haematological disorders usually presents with anaemia in any age group. Anaemia is common worldwide and particularly so in developing countries. The spectrum of haematological disorders is relatively different in the developing world than the developed countries.[2]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 neoplasms and storage disorders.

Aim and Objectives

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

Material and Method

The present study consists of 44 cases of Bone Marrow Aspiration and 26 cases of Bone Marrow Biopsy admitted to P.D.U. Medical College and Hospital, Rajkot, Gujarat as in-patients from August 2024 to September 2025 for the evaluation of various hematological disorders.

BMA and BMB were performed by trained pathologist, on those patients who were advised to do so by their consultants. Posterior Superior iliac spine was the site of choice for BMA and BMB in most of the patients, tibia for infants.. Records regarding the patient detailed information, clinical history, physical examination, clinical indication for the procedure, and all laboratory tests findings including peripheral smear reports were recorded.

Observations and Result

44 cases of Bone Marrow Aspiration and 26 cases of Bone Marrow Biopsy were diagnosed with various hematological disorders were studied during the period, August 2024 to September 2025, in the Department of Pathology, P.D.U Government Medical College and Hospital, Rajkot.

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Table 1: Shows age and sex of patient includes in the Bone marrow aspiration study

Age Group	Male	Female
0-10	3	6
11-20	3	0
21-30	4	5
31-40	3	2
41-50	5	4
51-60	3	1
>60	6	0
Total	26	18

Males were 26 (59.09 %) and, females were 18 (40.90%).
Male: Female ratio in this study is 4.2:3.
Ages of the patients ranged from 1 month to 70 years.

Table 2: Shows age and sex of patient includes in the Bone marrow biopsy study

Age Group	Male	Female
0-10	0	2
11-20	0	0
21-30	2	3
31-40	3	0
41-50	4	3
51-60	3	0
>60	3	2
Total	17	09

Males were 17 (65.38 %) and, females were 09 (34.62%).
Male: Female ratio in this study is 3.6:2
Ages of the patients ranged from 1 month to 70 years.

Site of Aspiration and Biopsy

Table 3: shows the site of bone marrow aspiration and Biopsy

Site of Aspiration	No. of Cases	Percentage
RT PSIS	23	52.27%
LT PSIS	20	45.45%
RT ASIS	00	00%
Tibial Tubrosity	01	2.27%

Most common site is right posterior superior iliac spine that comprise of 23 (52.27%) cases followed by left posterior superior iliac spine.

Indication of BM Examination

Table 4: Shows the indication of bone marrow examination.

Indication of Bone Marrow Aspiration	No. of Cases of bone marrow aspiration	No. of Cases of bone marrow biopsy	TOTAL
Pancytopenia	17	11	28
Anemia under investigation	14	05	19

Thrombocytopenia	06	06	12
PUO	02	02	04
Storage Disorder	00	00	00
Confirmation of Malignancy	04	02	06
Others	01	00	01
Total	44	26	70

Clinical triggers for BMA/BMB, led by pancytopenia (28/70 total, 40%) and anemia evaluation.

Table 5: Findings on bone marrow aspiration.

Diagnosis	Male	Female	Total	%
Normal	2	4	6	13.66%
Erythroid Hyperplasia + Reactive	4	1	5	11.36%
Megaloblastic Anemia	3	2	5	11.36%
Trilineage hyperplasia	1	2	3	6.81%
Dimorphic Anemia	1	0	1	2.27%
ITP	0	2	2	4.54%
Aplastic/Hypoplastic Anemia	3	1	4	9.09%
Acute leukemia	2	0	2	4.54%
MDS	2	0	2	4.54%
Lymphoproliferative Disorder	0	1	1	2.27%
MM	2	0	2	4.54%
HLH	0	1	1	2.27%
Granulomatous Diseases	1	0	1	2.27%
Eosinophlia	1	0	1	2.27%
Diluted Marrow	4	4	8	18.18%
Total	26	18	44	100%

Diagnostic spectrum in BMA, topped by diluted marrow (18.18%) and normal/reactive changes (13.66% + 11.36%).

Table 6:Findings on bone marrow biopsy

Diagnosis	Male	Female	Total	%
Normal	1	1	2	7.69%
Erythroid Hyperplasia + Reactive	2	1	3	11.54%
Megaloblastic Anemia	2	0	2	7.69%
Trilineage hyperplasia	1	0	1	3.85%
Dimorphic Anemia	1	0	1	3.85%
ITP	1	1	2	7.69%
Aplastic/Hypoplastic Anemia	3	0	3	11.54%
Acute leukemia	0	0	0	0%
MDS	1	0	1	3.85%
Lymphoproliferative Disorder	0	1	1	3.85%
MM	2	0	2	7.69%
HLH	0	0	0	0%
Granulomatous Diseases	1	0	1	3.85%
Eosinophlia	0	0	0	0%
Inadequate	2	5	7	26.92%
Total	17	9	26	100%

BMB results, with inadequate samples highest (26.92%) and Aplastic/Hypoplastic anemia notable (11.54%)

Table 7: Age Wise Distribution of Various Disorders in Bone marrow Biopsy

Diagnosis	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Normal			1		1			2
Erythroid Hyperplasia + Reactive					2	1		3
Megaloblastic Anemia						2		2
Trilineage hyperplasia			1					1
Dimorphic Anemia				1				1
ITP			1		1			2
Aplastic/Hypoplastic Anemia					1		2	3
Acute leukemia								0
MDS							1	1
Lymphoproliferative Disorder	1							1
MM					1		1	2
HLH								0
Granulomatous Diseases				1				1
Eosinophlia								0
Diluted Marrow	1		2	2		1	1	7
Total	2	0	5	3	7	4	5	26

Age-stratified BMB disorders, showing diluted marrow spread (7/26) and middle-age peaks for anemias/malignancies.

Table 8: Age Wise Distribution of Various Disorders in Bone marrow Aspiration

Diagnosis	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Normal	2		3		1			6
Erythroid Hyperplasia + Reactive		1	1	2	1			5
Megaloblastic Anemia		1	1		1	2		5
Trilineage hyperplasia			1		1	1		3
Dimorphic Anemia							1	1
ITP	2							2
Aplastic/Hypoplastic Anemia			1		1	1	1	4
Acute leukemia	2							2
MDS		1					1	2
Lymphoproliferative Disorder					1			1
MM					1		1	2
HLH			1					1
Granulomatous Diseases				1				1
Eosinophlia	1							1
Diluted Marrow	2		1	2	2		1	8
Total	9	3	9	5	9	4	5	44

Comprehensive age distribution for BMA disorders, with diluted marrow prominent (8/44) across groups.

Table 9: Age Wise Distribution of Various Non Malignant Disorders in Bone marrow Aspiration

Diagnosis	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Normal	2		3		1			6
Erythroid Hyperplasia + Reactive		1	1	2	1			5
Megaloblastic Anemia		1	1		1	2		5
Trilineage hyperplasia			1		1	1		3
Dimorphic Anemia							1	1
ITP	2							2

Aplastic/Hypoplastic Anemia			1		1	1	1	4
HLH			1					1
Granulomatous Diseases				1				1
Eosinophlia	1							1
Diluted Marrow	2		1	2	2		1	8
Total	7	2	9	5	7	4	3	37

Non-malignant BMA cases by age (37/44), emphasizing younger onset for anemias like megaloblastic (5 cases)

Table 10: Age Wise Distribution of Various Malignant Disorders in Bone marrow Aspiration

Diagnosis	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Acute leukemia	2							2
MDS		1					1	2
Lymphoproliferative Disorder					1			1
MM					1		1	2
Total	2	1	0	0	2	0	2	7

Malignant BMA disorders by age (7/44), with acute leukemia in 0-10 years and MM in older groups.

Table 11: Age Wise Distribution of Various Non Malignant Disorders in Bone marrow biopsy

Diagnosis	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Normal			1		1			2
Erythroid Hyperplasia + Reactive					2	1		3
Megaloblastic Anemia						2		2
Trilineage hyperplasia			1					1
Dimorphic Anemia				1				1
ITP			1		1			2
Aplastic/Hypoplastic Anemia					1		2	3
HLH								0
Granulomatous Diseases				1				1
Eosinophlia								0
Diluted Marrow	1		2	2		1	1	7
Total	1	0	5	4	5	4	3	22

Non-malignant BMB by age (22/26), highlighting Aplastic anemia in 41+ years.

Table 12: Age Wise Distribution of Various Malignant Disorders in Bone marrow biopsy

Diagnosis	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Acute leukemia								0
MDS							1	1
Lymphoproliferative Disorder	1							1
MM					1		1	2
Total	1	0	0	0	1	0	2	4

Malignant BMB by age (4/26), featuring lymphoproliferative disorder in young and MM in elderly.

Table 13: Comparison of this study with other Bone Marrow Aspiration studies.

Finding	Current study (Out of 44 cases)	Niranjan Mainali et al (1) (Out of 88 cases)	Vidhisha Mahajan et al (2) (Out of 460 cases)	N.A Okinda et al (3) (Out of 356 cases)	Munir AH et al (4) (Out of 157 cases)
Normal	6 (13.66%)	4 (4.5%)	100 (21.7%)	74 (20.7%)	18 (11.4%)

Erythroid Hyperplasia + Reactive	5 (11.36%)	-	40 (8.7%)	51 (14.3%)	-
Megaloblastic Anemia	5 (11.36%)	12 (13.6%)	153 (33.2%)	29 (8.1%)	26 (16.5%)
Trilineage Hyperplasia	3(6.81%)	10(11.3%)	-	23 (6.4%)	9(5.7%)
Dimorphic Anemia	1(2.27%)	-	-	1(0.2%)	-
ITP	2(4.54%)	15(17.0%)	1(0.2%)	15(4.2%)	26(16.5%)
Aplastic/Hypoplastic Anemia	4(9.09%)	26(29.5%)	20(4.3%)	5(1.4%)	9(5.7%)
Leukemia	2(4.54%)	4(4.5%)	30(6.5%)	29(8.1%)	30(19.1%)
MDS	2(4.54%)	3(3.4%)	6(1.3%)	9(2.5%)	-
Leishmaniasis	-	3(3.4%)	4(0.8%)	-	2(1.2%)
Lymphoproliferative Disorder	1(2.27%)	1(1.1%)	54(11.7%)	24(6.7%)	-
MM	2(4.54%)	2(2.2%)	20(4.3%)	20(5.6%)	-
HLH	1(2.27%)	-	-	-	-
Granulomatos Reaction (TB)	1(2.27%)	-	8(1.7%)	-	-
Metastasis	-	2(2.2%)	1(0.2%)	9(2.5%)	2(1.2%)
Diluted Marrow	8(18.18%)	-	15(4.2%)	10(2.8%)	-
Drug Induced Bonemarrow Supression	-	-	5(1.4%)	4(1.1%)	-
Anemia Of Chronic Disease	-	-	29(8.1%)	-	8 (5.1%)

Table: 14: Comparison of this study with other Bone Marrow Biopsy studies.

Finding	**Current Study (n=26)**	**Kumar et al (India) (n=75)**	**Bashawri et al (Saudi Arabia) (n=142)**	**Niazi et al (Pakistan) (n=90)**	**Okinda et al (Kenya) (n=356)**
Normal marrow	2(7.69%)	8 (10.6%)	14 (9.8%)	11 (12.2%)	74 (20.7%)
Erythroid hyperplasia	3(11.54%)	10 (13.3%)	12 (8.4%)	8 (8.8%)	51 (14.3%)
Megaloblastic anemia	2(7.69%)	18 (24%)	20 (14.0%)	17 (18.8%)	29 (8.1%)
Aplastic/Hypoplastic marrow	3(11.54%)	7 (9.3%)	10 (7.0%)	9 (10%)	5 (1.4%)
Leukemia	-	9 (12%)	18 (12.6%)	14 (15.5%)	29 (8.1%)
MDS	1(3.85%)	3 (4%)	5 (3.5%)	2 (2.2%)	9 (2.5%)
Lymphoproliferative disorder	-	5 (6.6%)	11 (7.7%)	6 (6.6%)	24 (6.7%)
Multiple myeloma	2(7.69%)	4 (5.3%)	6 (4.2%)	5 (5.5%)	20 (5.6%)
Granulomatous lesion/TB	1(3.85%)	3 (4%)	2 (1.4%)	2 (2.2%)	-
Metastasis	-	2 (2.6%)	4 (2.8%)	2 (2.2%)	9 (2.5%)
Diluted/Inadequate marrow	7(26.92%)	6 (8%)	7 (4.9%)	5 (5.5%)	10 (2.8%)

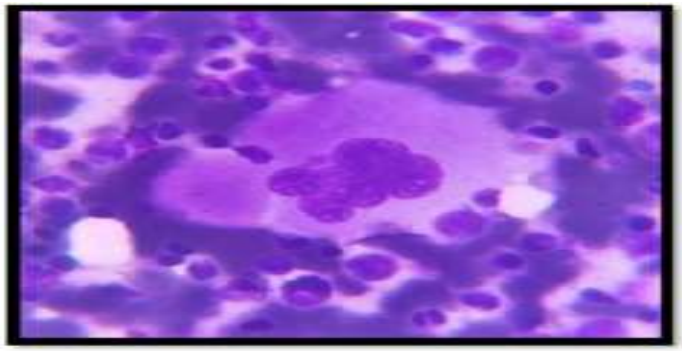

Figure 1: Bone marrow aspiration showing Hypolobated Megakaryocyte cytoplasmic border and reduced granularity ITP. Field stain 100x

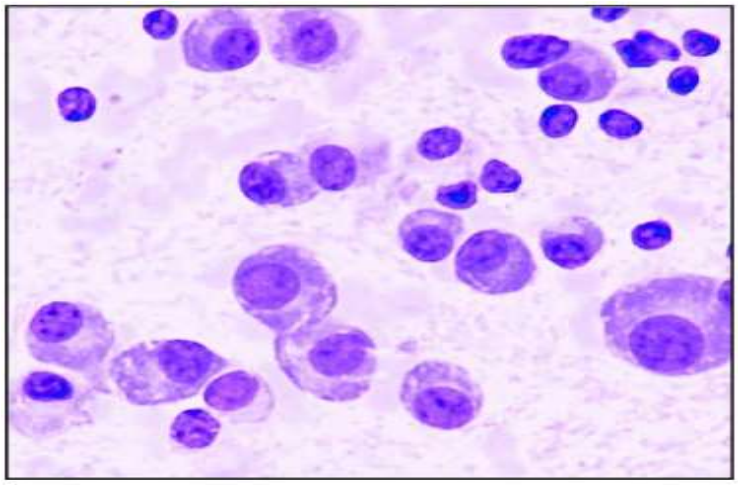

Figure 2: Bone Marrow aspiration showing mainly many abnormal plasma cells. Cells having eccentric nucleus in Multiple Myeloma. Field stain 100x

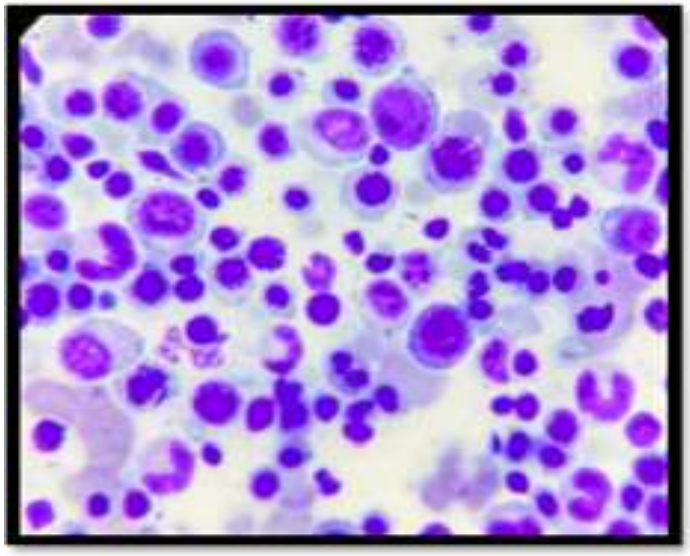

Figure 3: Bone marrow aspiration showing Giant metamyelocyte in Megaloblastic anemia. Field stain 100x.

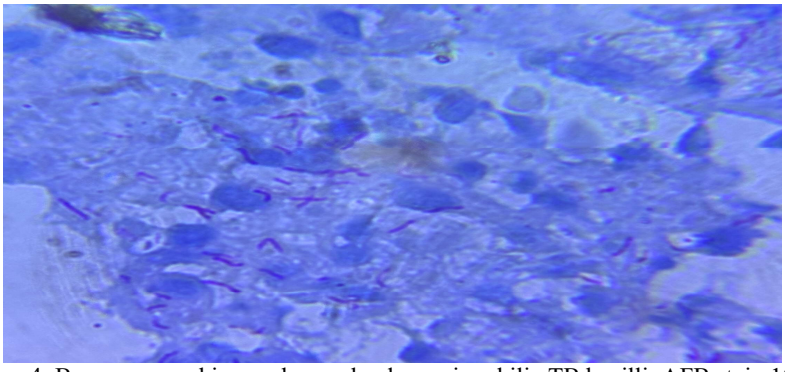

Figure 4: Bone marrow biopsy shows slender eosinophilic TB bacilli. AFB stain 100x.

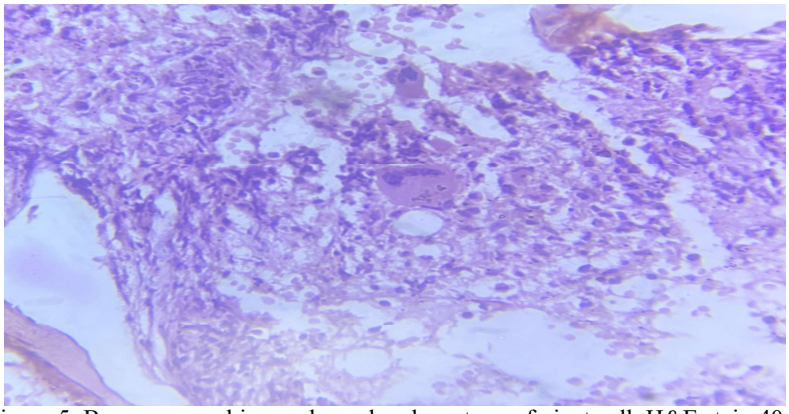

Figure 5: Bone marrow biopsy shows langhans type of giant cell. H&E stain 40x**.**

Discussion

Bone marrow examination remains an essential diagnostic modality for evaluation of hematological and selected non-hematological disorders. In the present retrospective study conducted at P.D.U. Medical College, Rajkot, 44 bone marrow aspirations and 26 bone marrow biopsies were analyzed over the study period. The procedures were performed across a wide age range, demonstrating utility in pediatric, adult, and elderly patients. In our series, male predominance was observed in both aspiration and biopsy groups. The commonest clinical indication for marrow examination was pancytopenia, followed by anemia under evaluation and thrombocytopenia. This finding supports the role of marrow assessment in unexplained cytopenias where peripheral investigations are inconclusive. Among aspiration cases, megaloblastic anemia was one of the most frequent pathological diagnoses, reflecting the continued burden of nutritional deficiency states in developing regions. Erythroid hyperplasia/reactive marrow and aplastic-hypoplastic marrow were also common findings. In biopsy specimens, aplastic/hypoplastic anemia and erythroid hyperplasia/reactive changes were frequent diagnoses. Hematological malignancies identified in the present study included acute leukemia, myelodysplastic syndrome, lymphoproliferative disorder, and multiple myeloma. Multiple myeloma and acute leukemia constituted important malignant diagnoses, highlighting the value of marrow morphology in rapid confirmation and treatment planning. A proportion of diluted/inadequate marrow samples was noted, emphasizing the importance of proper technique, adequate sampling, and clinico pathological correlation. Use of biopsy alongside aspiration improves diagnostic yield, particularly in hypocellular marrow, focal infiltrative lesions, fibrosis, and staging work-up.

Conclusion:

Bone marrow aspiration and biopsy are safe, cost-effective, and highly informative investigations that significantly aid diagnosis of hematological disorders. In the present study, pancytopenia was the leading indication for marrow examination. Megaloblastic anemia was a common diagnosis on aspiration, while aplastic/hypoplastic anemia was frequent on biopsy. Malignant disorders such as acute leukemia, multiple myeloma, myelodysplastic syndrome, and lymphoproliferative disorders were also identified. Combined interpretation of clinical findings, peripheral smear, aspiration, and biopsy provides the highest diagnostic accuracy. Bone marrow examination therefore remains indispensable, especially in resource-limited settings.

Type Of Publication: Original Research article
Conflicts of Interest: Nil

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Author Contributions
All authors contributed to the conception, clinical evaluation, hematological analysis, drafting, and final approval of the manuscript. All authors agree to be accountable for all aspects of the work.

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