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Original Research Article

Study of bone marrow aspiration in various hematological disorders

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Abstract

Peripheral blood examination and other routine laboratory investigations do not always provide enough information for diagnosis of hematological disease. In such cases evaluation of the bone marrow is required for confirmation of a suspected clinical diagnosis or monitoring the course of therapy. Total numbers of 75 cases were evaluated for bone marrow examination. Clinical data was recorded including physical examination,complete hematological study along with other relevant investigations and proforma filled. Bone marrow aspiration slides were stained with leishman stain. Special stains were performed whenever required.A total of 75 patients were evaluated with a mean age of 38.8years. The most common presentingcomplaintandphysicalfindingswerefever(62.7%)andpallor (90.7%) respectively. The hemoglobin values ranged from 3-13 g/dl, total leukocyte count ranged from 1300-61700/mm3, platelet count ranged from 30000-700000/mm3. The commonest peripheral smear finding was Normocytic hypochromic and Microcytic hypochromic blood picture each in 13 cases (17.3%), followedbyDimorphicblood picture in 10 cases (13.3%). The most common bone marrow finding was Erythroid hyperplasia (29.3%).

Keywords: Pancytopenia, megaloblastic anemia, bone marrow aspiration

Introduction

Peripheral blood smear examination and other routine laboratory investigations do not always provide enough information for diagnosis of hematological disease[1].
In such cases evaluation of the bone marrow is required for confirmation of a suspected clinical diagnosis or monitoring the course of therapy.
Bone marrow evaluation is an important diagnostic tool for the diagnosis of various neoplastic and non-neoplastic haematological diseases[2].These disorders include anaemias, leukemias, lymphomas, myelodysplasticdisorder,myelofibrosis, osteoporosis, storage diseases, amyloidosis,mastocytosis,unexplained thrombocytopenia, neutropenia and pyrexia of unknownorigin.Bonemarrow aspiration is helpful for the cytological assessment of bone marrow cells. Patients who had undergone post-chemotherapy or bone marrow transplantation may also require a bone marrow evaluation if their peripheral blood

counts do not recover as expected. Some research treatment protocols may also require a bone marrow study at certain post-treatment intervals[3].
Bone marrow aspiration is an invasive test but have a crucial role in diagnosis of various haematological disorders. Most of these disorders present as anemia followed by pancytopenia or thrombocytopenia[4].Pancytopenia is the simultaneous presence of anemia, leucopenia and thrombocytopenia. The aetiologies causing pancytopenia varies depending upon factors e.g. age, sex, occupation, and geographical distribution.Themosteffectivewayofstudyingthecellularmorphologyofthe haematopoietic cells is by bone marrow aspiration. Bone Marrow Aspiration procedure is relatively easy and does not require sophisticated equipments. So, the examination of bone marrow is one of diagnostic cornerstones of hematological practice[5, 6].

Methodology

Source of collecting data

All cases who have been admitted for evaluation of various haematological conditions. Clinical data were recorded including physical examination, complete haematological study along with other relevant investigations and proforma filled.

Sample Size:75 cases.

Inclusion criteria

All the cases which are diagnosed with either anaemia, pancytopenia or as haematological malignancies on peripheral smear in the Central Laboratory, are included in the study.

Exclusion criteria

1. Severe coagulopathy.
2. Non-Co-operative patients.
3. Platelets counts < 20,000/mm^3.

Method of collection of data

Clinical details of the patient are obtained from the OP/IP casesheets.Informed consent is taken. Posterior superior iliac spine is the most suitable and safe site for both aspiration and biopsy, although anterior superior iliac spine andsternumare occasionally used. For children less than 2 years, anteromedial surface of tibia is preferred.
The patients are explained about the procedure and made to lie either in the left or right lateral decubitus position with the knees drawn up. The site is cleaned with an antiseptic (e.g., povidone-iodine or chlorhexidine gluconate), scrubbed and draped exposing only the site to be sampled.
Skin and periosteum were infiltrated with Inj. 2% Lignocaine. After waiting for5 minutes, Salah's needle was inserted along with the stylet. After reaching the periosteum needle is slowly advanced into bone. A slight give away would be noted when marrow was reached, then stylet was removed and 10 ml syringe was attached to the needle. 0.2-0.3 ml of marrow was aspirated and then transferred to a set of slides and smears were prepared by crushing the marrow particles. Then slides were fixed in methanol for 30 minutes. The needle was removed and the puncture site was sealed with tincture benzoin swab.

Results

Table 1: Age Wise Distribution of BMA Diagnosis

BMA(Final Diagnosis)	< 20		21-30		31-40		41-50		51-60		> 60		Total
	No	%	No	%	No	%	No	%	No	%	No	%	
EH	2	16.7	5	31.3	4	25	3	30	6	40	1	16.7	21
Megaloblastic	4	33.3	2	12.5	3	18.8	0	0	2	13.3	2	33.3	13
Hypo-plastic marrow	2	16.7	0	0	0	0	1	10	1	6.7	1	16.7	5
Dual deficiency anemia	0	0	1	6.3	0	0	0	0	0	0	0	0	1
AL	1	8.3	0	0	1	6.3	0	0	2	13.3	1	16.7	5
MDS	0	0	0	0	0	0	0	0	2	13.3	0	0	2
MPN	0	0	0	0	0	0	2	20	0	0	0	0	2
ITP	0	0	1	6.3	0	0	1	10	1	6.7	0	0	3
MH	0	0	0	0	3	18.8	0	0	0	0	0	0	3
Inadequate	1	8.3	3	18.8	2	12.5	0	0	1	6.7	1	16.7	8
Normal	2	16.7	4	25	3	18.8	3	30	0	0	0	0	12
Total	12	100	16	100	16	100	10	100	15	100	6	100	75

Chi square-61.71, p-0.12, Not significant.
The age of the patient ranged from 3 to84 years with mean of38.8 years.
Among 75 cases, maximum number of cases (16 cases) each were clustered in the age group of 21-30 yrs and 31-40 yrs, which was followed by 15 cases, 12 cases, 10 cases and 6 cases clustered in the agegroup of 51-60yrs, <20 yrs, 41-50yrs and >60yrs respectively.
Erythroid hyperplasia (6 cases) is the most common finding observed in the age group 51-60yrs, which was followed by 5 cases and 4 cases in 21-30 and 31-40 age groups respectively.
Megaloblastic anemia (4 cases)is the most common condition notedin the age group of <20yrs.
All 3 cases of myeloid hyperplasia were observed in the age groups of 31-40yrs. Maximumnumber of Hypoplastic marrow cases (2 cases)were seen in the age group of <20yrs followed by one case each in the age groups of 41-50, 51-60 and > 60yrs.
2 cases of Acute leukemia were seen in the age group 51-60yrs followed by one case eachin the age groups of <20yrs, 31-40 yrs and >60yrs.
2caseseachofMyelodysplasticsyndromeand Myeloproliferativeneoplasmwere observed in the age groups of 51-60yrs and 41-50yrs.
One each case of Idiopathic thrombocytopenic purpura was noted in the age groups of 21-30yrs, 41-50yrs and 51-60yrs respectively.
The age wise distribution of cases showed no statistical significance with p value-0.12.

Table 2: Gender Wise Distribution of BMA Diagnosis

		Males		Females		Total
		No	%	No	%	No
BMA(Final Diagnosis)	EH	13	28.9	8	26.7	21
	Megaloblastic	7	15.6	6	20	13
	Hypoplastic marrow	4	8.9	1	3.3	5
	Dual deficiency anemia	1	2.2	0	0	1
	AL	3	6.7	2	6.7	5
	MDS	1	2.2	1	3.3	2
	MPN	1	2.2	1	3.3	2

	ITP	1	2.2	2	6.7	3
	MH	3	6.7	0	0	3
	Inadequate	2	4.4	6	20	8
	Normal	9	20	3	10	12
	Total	45	100	30	100	75

Both males and females were most commonly affected with Erythroid hyperplasia (13 and 8 cases) which was followed by Megaloblastic anemia (7 and 6 cases), Hypoplastic marrow (4 cases and 1case) and Acute leukemia (3 and 2 cases)respectively.
Males were most commonly affected with Myeloid hyperplasia and Dual deficiency anemia and females were most commonly affected with Idiopathic thrombocytopenic purpura.
BothmalesandfemaleswereequallyaffectedwithMyelodysplasticsyndromeand Myeloproliferative neoplasm.
The gender wise distribution of cases showed no statistical significance with p value 0.44.

Table 3: Distribution Based on Cellularity and BMA Diagnosis

BMA(Final Diagnosis)		Diluted blood		Hypercellular		Hypocellular		Normocellular		Total
		No	%	No	%	No	%	No	%	
	EH	0	0.0	19	42.2	0	0.0	2	11.1	21
	Megaloblastic	0	0.0	12	26.7	0	0.0	1	5.6	13
	Hypoplastic marrow	0	0.0	0	0.0	5	55.6	0	0.0	5
	Dual deficiency anemia	0	0.0	1	2.2	0	0.0	0	0.0	1
	AL	0	0.0	5	11.1	0	0.0	0	0.0	5
	MDS	0	0.0	2	4.4	0	0.0	0	0.0	2
	MPN	0	0.0	2	4.4	0	0.0	0	0.0	2
	ITP	0	0.0	0	0.0	0	0.0	3	16.7	3
	MH	0	0.0	3	6.7	0	0.0	0	0.0	3
	Inadequate	3	100.0	0	0.0	4	44.4	1	5.6	8
	Normal	0	0.0	1	2.2	0	0.0	11	61.1	12
Total	Total	3	100.0	45	100.0	9	100.0	18	100.0	75

Chi square -136.52, p-0.0001, Highly significant.
In the present study of 75 cases, 45 cases showed hypercellular marrow and among these 45 hypercellular cases,19 cases of Erythroid hyperplasia, 12 cases of Megaloblastic anemia, 5 cases of Acute leukemia, 3 cases of Myeloid hyperplasia, 2 cases each of Myelodysplastic syndrome and Myeloproliferative neoplasm and 1 case of Dual deficiency anemia were associated with hypercellularity.
All 5 cases of Hypoplastic marrow and 3 cases of Idiopathic thrombocytopenic purpura were not associated with hypercellularity ofthe marrow.
But all 5 cases of Hypoplastic marrow showed hypocellular marrow and all 3 cases of Idiopathic thrombocytopenic purpurashowed normocellular marrow.

Discussion

Table 4: Comparison of Cellularity of Bone Marrow

Sl. No.	Cellularity	Pudasini*et al.*[7] 2012	Ambrish*et al.* [77] 2012	Present study (2019)
1.	Hypercellular	61.4%	27.4%	60%
2.	Normocellular	26.3%	29.6%	24%
3.	Hypocellular	12.3%	22.2%	12%
4.	Dry tap + blood mixed aspirate	-	29.6%	4%

The cellularity of bone marrow was comparable to the studies conducted by Pudasini*et al*.

(2012).

In the present study, Anemia was the most common haematological disorder seen in 45% of cases. This includes Erythoid hyperplasia (28%) and Megaloblastic marrow (17%).

Similar finding was seen in a study conducted by Pudasini*et al*. (2012) where 40.3% of the patients presented with anemia. In a study conducted by Shastry S *et al*. (2012), 64.5% of the cases presented with anemia.

Megaloblastic anemia comprised of 17% of the cases. According to Tilak N *et al*.9 Megaloblastic anemia was the mostcommon causeof pancytopenia. Inthepresent study, 10 out of 13 cases (76.9%) showed pancytopenia on peripheral smear, which was also the most common cause.

Table 5: Comparison of Distribution of Cases

Sl. No.	Conditions	Kibria *et al*. [10]	Pudasini*et al*. [11]	Pandya *et al*.[12]	Shastry*et al*. [13]	Parujali*et al*. [14]	Present study
1.	Anaemia	24.87	40.3	14.8	64.54	37.48%	34
2.	Infective pathology (Myeloid hyperplasia)	-	12.3	-	1.81	6.81%	03
3.	Acute leukemia	36.6	12.3	14.8	3.63	13.63%	5
4.	Chronic myeloid leukemia	7.34	-	14.8	0.9	5.68%	1
5.	Chronic lymphoblastic leukemia	-	-	11.2	-	2.27%	-
6.	Immune thrombocytopenic purpura	6.2	10.5	-	-	13.6%	3
7.	Myeloma	-	3.5	3.7	0.9	2.27%	-
8.	Myelofibrosis	1.69	-	3.7	-	-	-
9.	Myelodysplastic syndrome	7.91	3.5	-	0.9	2.27%	2
10.	Aplastic anaemia	10.7	5.3	-	11.81	-	-
11.	Normal	1.69	10.5	25.9	9	9%	12
12.	Others	1.69	10.5	25.9	2.7	5%	15

Conclusion

- Bone marrow evaluation is an important diagnostic tool for the diagnosis of various neoplastic and non-neoplastic haematological diseases. These disorders include anaemias, leukemias, lymphomas, myelodysplastic disorder, myelofibrosis, osteoporosis, storage diseases, amyloidosis, mastocytosis, unexplained thrombocytopenia, neutropenia and pyrexia of unknown origin.
- Bone marrow aspiration is an invasive test but have a crucial role in diagnosis of various haematological disorders.

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