Original Article

The bone marrow biopsy: Its crucial role in evaluating various hematological disorders

Shashidhar M R[1*], Shariff M H[2]

[1]Assistant Professor, [2]Associate Professor, Department of Pathology, Yenepoya Medical College, Mangalore, Karnataka, INDIA.
Email: shash.mr@gmail.com

Abstract

Introduction: Bone marrow aspiration and biopsy are procedures used to evaluate the blood cells within the bone marrow, as well as its structure. These are not routine tests, however they are useful in helping to detect, diagnose, monitor and/or stage a number of diseases and conditions that can affect the bone marrow and blood cell production. **Aims and Objectives:** To the evaluate bone marrow aspiration and bone marrow biopsy findings in detection of haematological disorders and to compare and correlate the bone marrow aspiration and bone marrow biopsy findings. **Materials and methods:** The present study was done in the Department of Pathology, Yenepoya Medical College, Mangalore for evaluation of various haematological conditions from June 2012 to June 2016 are included. Sample size: 100. **Results:** In present study out of 100 cases, majority of the patients were male (61%) and females were 39%. The mean age of the patients is 44.39 with standard deviation(SD) ±18.09. In our study bone marrow biopsy of most of the patients show reactive marrow. followed by megaloblastic anemia(12%) and chronic myeloid leukemia(11%). **Conclusions:** Bone marrow aspirations and bone marrow biopsies are complementary modalities. Bone marrow aspiration smears provides good morphological details/cytologic diagnosis.

Keywords: Bone marrow, biopsy, necrosis, fibrosis.

[*]**Address for Correspondence:**
Dr. Shashidhar M R, Assistant Professor, Department of Pathology, Yenepoya Medical College, Mangalore, Karnataka, INDIA.
Email: shash.mr@gmail.com
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INTRODUCTION

Bone marrow aspiration and biopsy are procedures used to evaluate the blood cells within the bone marrow, as well as its structure. They are performed in conjunction with a complete blood count (CBC) and blood smear to provide information about the health of the bone marrow and capability for blood cell production, including red blood cells (RBCs), white blood cells (WBCs), and platelets. These are not routine tests, however they are useful in helping to detect, diagnose, monitor and/or stage a number of diseases and conditions that can affect the bone marrow and blood cell production. Bone marrow evaluation is an important diagnostic tool for the diagnosis of various neoplastic and non neoplastic haematological diseases.[1] Indications have included diagnosis, staging, and therapeutic monitoring for lymphoproliferative disorders such as chronic lymphocytic leukemia (CLL), Hodgkin and non-Hodgkin lymphoma, hairy cell leukemia, myeloproliferative disorders, myelodysplatic syndrome and multiple myeloma. Furthermore, evaluation of cytopenia, thrombocytosis, leukocytosis, anemia, and iron status can be performed.[2] The application of bone marrow analysis has grown to incorporate other, nonhematologic, conditions. For example, in the investigation for fever of unknown origin (FUO), specifically in those patients with acquired immuno deficiency syndrome(AIDS),[3] the marrow may reveal the presence of microorganisms, such as tuberculosis, Mycobacterium avium intracellulare (MAI) infections, histoplasmosis, leishmaniasis, and other disseminated fungal infections. Furthermore, the diagnosis of storage diseases (eg. Niemann-Pick disease and Gaucher disease) as well as the assessment for metastatic carcinoma and granulomatous diseases (eg, sarcoidosis) can be performed[4]. Bone marrow analysis may reveal toxic

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effects of certain offending medications or substances, such as alcohol, or nutritional deficiencies, such as copper/zinc or vitamin B12/folate. Bone marrow analysis can also be performed in patients with idiopathic thrombocytopenia purpura (ITP), incidental elevated serum paraprotein levels, iron deficiency anemia, polycythemia vera, essential thrombocytosis, or infectious mononucleosis; but these conditions are often more appropriately diagnosed by routine laboratory evaluation.[5]

MATERIALS AND METHODS

The present study was done in the Department of Pathology, Yenepoya Medical College, Mangalore for evaluation of various haematological conditions from June 2012 to June 2016 are included. In each case detailed Clinical data were recorded including physical examination, complete haematological study along with other relevant investigations and proforma filled. Patients were explained and written consent was taken regarding the procedure, usefulness and complications of the same. Bone marrow aspiration slides were stained with Leishman stain and special stains like PAS, perl and sudan whenever needed. Bone marrow biopsy specimen after fixation and decalcification are subsequently processed as per the standard technique. Paraffin sections were then cut and stained by Haematoxylin and Eosin, special stain like reticulin, PAS done wherever necessary.

RESULTS

In present study out of 100 cases, majority of the patients were male (61%) and females were 39%. The mean age of the patients is 44.39 with standard deviation(SD) ±18.09. Age of the patients were ranging between 8-85 years and the highest number of cases were recorded in the 4th decade (25%) followed by 19 cases in the 6th decade and only one cases each in 1st and 9th decade. In our study bone marrow biopsy of most of the patients show reactive marrow. followed by megaloblastic anemia (12%) and chronic myeloid leukemia (11%). acute myeloid leukemia (9%), chronic lymphocytic leukemia, remission, acute lymphoblastic leukemia, myeloproliferative disease, dry tap, myelodysplastic syndrome, metastasis, splenic sequestration, reactive marrow, mixed nutritional deficiency anemia, non hodgkins lymphoma, secondary polycythemia, bone marrow necrosis, iron deficiency anemia, anemia of chronic disease, idiopathic thrombocytopenic purpura, eosinophilia, normal study.(TABLE 2) There was a positive correlation of 85.8% between bone marrow aspiration and biopsy diagnosis in our study

Table 1: Age distribution pattern of breast lesions

	n	Minimum	Maximum	Mean (±SD)
Age	100	8	85	44.39 (±18.09)

Table 2: Aspiration and biopsy correlation of various haematological disorders

Sr. No	BMB	no	BMA	
1	AML	9	AML	8
			US	1
2	CML	11	CML	10
			US	1
3	CLL	2	CLL	2
4	ALL	3	AML	1
			R	2
5	MYP	2	DT	1
			MYP	1
6	MDS	2	MDS	2
7	MET	4	MET	4
8	SPS	3	SPS	3
9	RM	19	RM	18
			MIX	1
10	NHL	1	LYMPHOCYTOSIS	1
11	MM	4	MM	3
			RM	1
12	POLY-2	1	POLY-2	1
13	BN	1	DT	1
14	MF	4	DT	2
			RM	1
			MYP	1
15	MB	12	MB	12
16	ID	6	ID	5
			ACD	1
17	AA	1	RM	1
18	MIX	4	MIX	4
19	ITP	1	ITP	1
20	HPS	1	HPS	1
21	EO	1	EO	1
22	NS	6	NS	6
23	US	2	ID	1
			R	1

(Bmb-bone marrow biopsy, BMA – bone marrow aspirartion, AML- acute myeloid leukemia,US-unsatisfactory,CML-chronic myeloid leukemia, CLL-chronic lymphocytic leukemia, R- remission, ALL- acute lymphoblastic leukemia, MYP- myeloproliferative disease, DT- dry tap, MDS- myelodysplastic syndrome, MET- metastasis, SPS- splenic sequestration, RM-reactive marrow, MIX- mixed nutritional deficiency anemia, NHL- non hodgkins lymphoma, POLY2-secondary polycythemia, BN- bone marrow necrosis, MB- megaloblastic anemia, ID- iron deficiency anemia, ACD- anemia of chronic disease, ITP- idiopathic thrombocytopenic purpura, EO- eosinophilia, NS- normal study).

DISCUSSIONS

Bone marrow aspiration is one of the well established, cost effective diagnostic test for evaluation of haematological disorders. It also helps in early diagnosis compared to bone marrow biopsy. A total of 100 cases were included in the present study. Both bone marrow aspiration and biopsy were complementary to each other in few cases of haematological malignancies. Bone marrow aspiration was most effective in studying the morphology of the individual cells and biopsy to know the cellularity and pattern of involvement. Age of the patients ranged from 8-85 years with the mean age of 50.05 years. Upper limit of the age range of the present study was comparable to the studies conducted by, Gayatri *et al* and Pudasini *et al* and netra *et al* with slight variation in lower limit of age range. (TABLE 3).

Table 2: Comparison of age range in different studies

Sr. No	Study	Age in Years
1	Pudasini *et al* [6]	1-75
2	Netra *et al* [1]	4-78
3	Gayathri *et al* [7]	2-80
4	Present study	8-85

The most common age group undergoing bone marrow examination in our study was 31-40 years comprising of 25 % of the cases. In a study conducted by and Egesie *et al*, the majority(35%) of the patients were from the age group of 21-30 years and Netra *et al* showed 5th decade**.**

Table 3: Comparision of age distribution of patients

Sr. No.	AGE GROUP	Netra *et al*	Egesie *et al* [8]	PRESENT STUDY
1	0-10	2	16	2
2	11-20	3	28	7
3	21-30	9	35	15
4	31-40	10	34	25
5	41-50	29	15	15
6	51-60	17	17	19
7	61-70	21	19	8
8	71-80	9	20	7
9	81-90	-	1	2

The male to female sex ratio in the present study was 1.5:1 with male predominance Male predominance was also seen in the studies conducted by Egesie at al, Gayatri *et al*, Kibria *et al*[9], Pudasini *et al* and Jha *et al*[10] In our study megaloblastic anemia(12%) was the most common cause of pancytopenia, According to Tilak N *et al*[11], Megaloblastic anaemia was the most common cause of pancytopenia. In our study, 6 out of 10 cases(66.7%) showed pancytopenia on peripheral smear.4 cases in whom bone marrow aspiration yielded dry tap, were diagnosed as myelofibrosis, 1 case each of myeloproliferative disorder and bone marrow necrosis. in our study biopsy was crucial in diagnosing above lesions because of dry tap/ diluted marrow due to either marrow fibrosis or tightly packed marrow by leukemic cells.similar observation is seen in study done by Shefali verma *et al* [12].

Table 4: Comparision of dry taps with the others studies

Sr. No	Various Studies	%
1	Pandya *et al* [13]	18
2	Netra *et al*	9
3	Humphries *et al* [14]	4
4	Present study	4

One case of lymphocytosis was diagnosed in bone marrow aspiration, but it turned out to be NHL in bone marrow biopsy examination. this may be due to tophographical arrangement of lymphoma cells are best seen on biopsy sections. This is in agreement with the study done by Smitha Chandra *et al*[15]. We reported one of the rare case in which 28 years male patient presented with fever, chronic otomastoiditis and moderate spleenomegay. On investigation it showed pancytopenia on peripheral smear,reticulocyte count 0.7%, workup for autoimmune diseases were not significant. There was markedly increased erythrocyte sedimentation rate and culture revealed E.Coli. unfortunately aspirartion was dry tap but biopsy showed thinned out trabaculae, majority of marrow contains degenerated hematopoietic cells along with few viable cells in a background eosinophilic amorphous granular background. The final diagnosis of bone marrow necrosis seconadary to sepsis was given. On follow up patient recovered on appropriate antibiotics. Bone marrow necrosis may be due to Interference with blood supply or failure to meet increased metabolic demands Or both. High concentration of tumor necrosis factor in blood also can contribute for necrosis of the marrow. Usually bone marrow necrosis accompanied by bone pain and fever, Presents with leukoerythroblatic blood picture and pancytopenia. Recovery is by repopulation with hematopoietic tissue with small / large fibrotic scar and new bone is laid down on spicules of dead bone. So whenever patients presents with pancytopenia (along with common causes like megaloblastic anemia, MDS, acute leukemia, myefibrosis etc,) bone marrow should be evaluated[16,17,18.]

CONCLUSION.

Bone marrow aspirations and bone marrow biopsies are complementary modalities. Bone marrow aspiration smears provides good morphological details/cytologic diagnosis. But biopsy sections are helpful in cases where aspiration yielded dry tap or diluted marrow and in identifying architectural pattern, cellularity and fibrosis.

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