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Original Article

Bone Marrow Aspiration Cytology Study in a Tertiary Care Center, Gujarat, India

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Abstract

Background: Hematological disorders are quite frequent in all age groups. Bone marrow aspiration (BMA) is crucial in evaluation, diagnosis, and management of anemia and other hematological disorders, especially in situation where diagnosis remains cryptic after detailed clinical history, physical examination, and peripheral blood analysis. This relatively safe and simple procedure is important particularly in resource-poor center since assess to adjuvant diagnostic techniques is often lacking. The present study aims to analyze the causes of hematological disorders, its spectrum, and indication of BMA findings.

Materials and Methods: This was a retrospective as well as prospective study carried out in the Department of Pathology, Government Medical College and Sir Takhtasinhji Hospital, Bhavnagar, Gujarat, India, over 3 years 6 months. BMA of 141 cases was carried out and examined by the expert. Patient details regarding clinical history, physical examination, and laboratory reports were retrieved.

Results: Of 141 patients, total of 28 cases were excluded from the study due to inadequate material or dry tap. Majority of the patient were of pediatric age group (<15 years). Male-to-female ratio was 1.17:1. The most frequent indication for BMA was unexplained anemia (44.24%) and thrombocytopenia (19.46%), followed by pancytopenia (16.18%) and suspected leukemia (9.73%). 7.96% BMA was absolutely normal without any pathology. Nutritional anemia (52.21%) was the most common pathological finding, followed by immune thrombocytopenia (11.5%), leukemia (8.84%), and aplastic anemia (6.19%).

Conclusion: BMA cytology is a relatively simple, safe, and cheap yet a highly informative and important diagnostic test of wide range of hematological disorders in developing country like India.

Key words: Anemia, Bone marrow aspiration, Leukemia, Pancytopenia

INTRODUCTION

Bone marrow aspiration (BMA) is an invasive but relatively simple and safe procedure, whereby representative specimen of spongy bone marrow is obtained through a needle aspiration for diagnostic evaluations in hematology and stem cell harvest.[1,2] Often times, patients with suspected marrow diseases whose diagnosis remains inconclusive after examination of the peripheral blood with complete blood count, peripheral smear examination, and ancillary tests require BMA. It gives a more complete picture of the reaction of the hemopoietic tissue to anemia than can be gained from peripheral blood smear alone. The procedure may be necessary for the diagnosis and management of hematological and to some extent non-hematological disorder, for staging, prognostication, and evaluation of therapeutic response in some disorders.[3]

Despite being a highly informative test procedure in diagnostic evaluation, there is sparse local literature on its indications and diagnostic utility/findings of BMA. This study therefore evaluated and reports on age and sex distribution, the spectrum of common indications and diagnosis of bone-marrow aspiration among patients seen at Government Medical College and Sir Takhtasinhji Hospital, Bhavnagar, Gujarat, India. This would also serve for possible comparison with findings from other parts of India and beyond.

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MATERIALS AND METHODS

This was a retrospective and prospective study carried out over 3 years and 6 months (January 2014 to October 2017), at the Department of Pathology, Government Medical College and Sir T. Hospital, Bhavnagar, Gujarat, India.

BMA was performed by trained pathologist, on those patients who were advised to do so by their consultants. Posterior superior iliac crest was the site of choice for BMA in most of the patients, tibia for infants, and sternum in case of obese. 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.

The BMA material was collected, and smears were prepared by wedge-spread method and stained with Leishman stain. Wherever needed, special stains such as Myeloperoxidase stain, periodic acid–Schiff stain, and Perl stain were used. Aspirates of inadequate material or dry tap were excluded from the study. All slides were examined by the expert pathologist, and the data were manually collected and subsequently analyzed.

RESULTS

Of 141 patients, who were performed BMA, the material acquired was inadequate for interpretation or diluted with blood in 26 cases, and in 2 cases, there was dry tap which is excluded. Hence, a sample size of the study is 113.

Of 113 cases, the majority of patients 34.52% were of pediatric age group (<15 years). The smallest patient was just 2-day-old baby. 53.98% were males and 46.02% were females having male-to-female ratio 1.17: 1. Table 1 presents age and sex distribution of cases.

In most of the cases, BMA was hypercellular (60.17%). Cellularity of BMA is summarized in Table 2.

The most frequent indication for BMA was unexplained anemia (44.24%), followed by unexplained thrombocytopenia (19.46%), unexplained pancytopenia (16.18%), and suspected leukemia (09.73%) [Table 3].

The most common marrow diagnoses were dimorphic anemia (18.58%) and megaloblastic anemia (18.58%). Overall, 52.21% of cases were having nutritional anemia, 8.84% having hematological malignancy, and 5.30% having infectious etiology like malaria or leishmaniasis. The BMA of youngest 2-day-old baby was diagnosed to have congenital dyserythropoietic anemia. Among all cases, 7.96% BMA was absolutely normal. The spectrum of hematological disorders diagnosed with BMA cytology is shown in Table 4.

Table 1: Age and sex distribution of BMA cases

Age (years)	Number of cases	Male (total 61)	Female (total 52)	Percentage
<15	39	19	20	34.52
15–30	22	10	12	19.46
31–45	25	14	11	22.13
>45	27	18	9	23.89

BMA: Bone marrow aspirate

Table 2: Cellularity of bone marrow in aspirated smears

Marrow cellularity	Number of cases (%)
Hypercellular	68 (60.17)
Normocellular	30 (26.54)
Hypocellular	18 (15.93)

Table 3: Indications of BMA

Indication	Number of cases (%)
Unexplained anemia	50 (44.24)
Unexplained thrombocytopenia	22 (19.46)
Unexplained pancytopenia	19 (16.81)
Suspected leukemia	11 (9.73)
Unexplained spleenomegaly	4 (3.53)
Unexplained fever	5 (4.42)
Others	2 (1.76)

BMA: Bone marrow aspirate

Table 4: Spectrum of hematological disorders diagnosed with BMA cytology

Broad category (%)	Diagnosis	Number of cases (%)
Nutritional anemia (52.21)	Micronormoblastic	17 (15.4)
	Megaloblastic	21 (18.58)
	Dimorphic	21 (18.58)
Aplastic anemia (6.19)	Aplastic anemia	7 (6.19)
Hematological malignancy (8.84)	ALL	5 (4.42)
	AML	1 (0.88)
	CML	3 (2.65)
	CLL	1 (0.88)
ITPs (11.5)	ITP	13 (11.5)
Others (7.96)	MDS	4 (3.53)
	Myelofibrosis	1 (0.88)
	CDA	1 (0.88)
	Hypersplenism	1 (0.88)
	Hemophagocytic syndrome	1 (0.88)
	Essential thrombocythemia	1 (0.88)
Infection (5.3)	Infection	6 (5.3)
Normal BM (7.96)	Normal BM	9 (7.96)

BMA: Bone marrow aspirate, ALL: Acute lymphoblastic leukemia, AML: Acute myeloid leukemia, CML: Chronic myeloid leukemia, CLL: Chronic lymphoblastic leukemia, ITP: Immune thrombocytopenia, MDS: Myelodysplastic syndrome, CDA: Congenital dysplastic anemia, BM: Bone marrow

DISCUSSION

The bone marrow is one of the body's largest organs, constituting 4.5% of the total body weight and weighs 3375 g in an average 75 kg individual.[4] It is the principal site of hematopoiesis. The hematopoietic bone marrow is organized around the vasculature of the bone cavity. Its main function is to supply mature hematopoietic cells for circulating blood in a steady state as well as to respond to increased physiological or pathological demands. BMA is a cytologic preparation of bone marrow cells obtained by aspiration of marrow and a smear of the cells. It is used to diagnose, confirm, and/or stage hematologic malignancies. It helps to evaluate cytopenias, thrombocytosis, leukocytosis, anemias, and iron status. It is also a diagnostic tool in non-hematological disorders such as storage disorders and systemic infections. The spectrum of hematological disorders is very wide. It is an ambulatory procedure performed under local anesthesia with minimal morbidity. It is a safe and useful test in reaching the final diagnosis. The present study determines the indications and spectrum of disorders diagnosed by BMA cytology examination.

Most of the aspirate specimens were taken from the posterior iliac crest. The tibia is the preferred site in children aged <18–24 months.[2,5,6] The sternum was the last choice due to the possible fatal risk of damage to the great vessels during sternal puncture.[6,7]

This study like other studies has shown that BMA cytology can be carried out in all age groups. The age range (2 days to 78 years) as well as the sex ratio of subjects undergoing BMA evaluation is similar to that reported in other studies.[8-10] In our study, the most common age group undergoing BMA was pediatric population (<15 years). The male-to-female ratio was 1.07:1. In a study done by Niazi and Raziq,[11] the majority of the patients were from the age group 1 to 30 years.[11]

In our study, we found that most of the BMA were hypercellular (60.17%) which is comparable to Marwah *et al*.[12] It is due to compensatory erythroid hyperplasia seen in BMA due to peripheral anemias. Though, 7.96% bone-marrow aspiration were absolutely normal without any pathology.

Cytopenias generally result from accelerated peripheral destruction of blood cells as in autoimmune disease, underproduction, or maturation defects.[13] Most times, if the cause is not found peripherally, there is a need for examination of the bone marrow, the site of hematopoiesis. It is therefore not surprising that unexplained cytopenia was the most frequent indication for bone marrow examination in the study. The most common indications for BMA in this study were unexplained anemia and thrombocytopenia, followed by diagnosis and management of pancytopenia and leukemia. Similarly, Damulak and Damen[14] and Tripathy and Dudani[15] also reported anemia as the most common indication for BMA cytology in their studies, but contrast studies by Pudasaini *et al*.[8] and Bashawri[16] showed pancytopenia, diagnosis, and management of leukemia as the two most common indications for this procedure. Mahabir *et al*.[17] reported that the role of BMA in thrombocytopenic patients is to exclude other hematological diseases like leukemia in children and myelodysplastic syndrome in adults. This was corroborated in a survey in which 74% of pediatric hematologists were of the view that bone marrow examination is necessary in acute childhood immune thrombocytopenia, and the main reason cited was the need to exclude other hematological disorders such as leukemia, dysmyelopoietic syndrome, and aplastic anemia.

Both dimorphic anemia and pure megaloblastic anemia were most common pathological findings, which is comparable to other studies. In a study done by Gayathri and Rao,[10] megaloblastic anemia was the most common cause of pancytopenia and was the most common finding in BMA. The increasing incidence of megaloblastic anemia and dimorphic anemia reflects the higher prevalence of nutritional deficiency in developing countries like the US. Microcytic anemia was observed in 15.4% of cases. However, in a study done by Ahmed *et al*.,[9] 23.8% of cases were diagnosed as iron deficiency anemia. Although the most common anemia in our country is due to iron deficiency, there is no need of BMA for diagnosis and management. Hence, the prevalence of dimorphic and pure megaloblastic anemia is a higher side in the study. Thus, bone marrow examination could be used effectively in most cases to determine the cause of anemia.

We found hematological malignancies in 8.84% of cases, of which acute lymphoblastic leukemia (ALL) was the most common diagnosis. In contrast, Egesie *et al*.,[18] Kibria *et al*.,[19] and Gayathri and Rao[10] had reported acute myeloid leukemia more common than ALL.

Aplastic anemia was seen in 7 cases (6.19%). Compared to our study, 19%, 29%, and 14% cases of hypoplastic anemia were seen in other studies.[10,20,21] Infective pathology was seen in 6 cases (5.3%) consisting of leishmaniasis, malaria, and tuberculosis. Similar finding was seen in a study done by Santra and Das.[22] Other studies showed 2.82%, 1.2%, and 0.67% of leishmaniasis,[11,19,20] but the maximum number of cases (14%) were seen in a study done by Khodke *et al*.[21] Recent advances in the treatment of hematologic malignancies have been paralleled by renewed

interest on the part of pathologists and hematologists in methods of obtaining and preparing bone marrow for diagnostic studies.

CONCLUSION

Bone marrow examination is an important investigation to arrive at the confirmatory diagnosis of hematological disorders in resource-poor country like India. The study provides a valuable insight into the causes of anemia or pancytopenia in our country. The procedure remains a veritable tool in the diagnoses and management of a wide range of hematological and some non-hematological diseases.

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