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RESEARCH ARTICLE

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

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ABSTRACT

Background: Bone marrow aspiration is useful in evaluation, diagnosis, and management of anemia and other hematolymphoid disorders, where diagnosis remains disguised even after detailed clinical history, physical examination, and peripheral blood smear examination. This present study is done to look after the causes of various hematological disorders, indication and spectrum of Bone marrow aspiration findings.

Materials and Methods: This was a retrospective as well as prospective study carried out in the Department of Pathology, New Medical College hospital (NMCH) Kota and associated Maharao Bhim Singh Hospital (MBSH)l, Kota, Rajasthan, India, over 2 years. Bone marrow aspiration of 397 cases was carried out (270 cases MBSH, 127 NMCH). Patient details regarding clinical history, physical examination, and laboratory test reports were recouped.

Results: Of 397 patients, total of 75 cases were excluded from the study due to inadequate material. Majority of the patient were of pediatric age group (<15 years). Male-to-female ratio was 1.09:1. The most frequent indication for BMA was unexplained anemia ((51.55%) and pancytopenia (23.6%), followed by suspected leukemia (16.45%) and thrombocytopenia (7.45%). 3.76% Bone marrow aspiration was absolutely normal without any pathology. In anaemia, Nutritional anemia (60.05%) was the most common pathological finding, followed by Hemolytic anaemia (4.66%) and aplastic anemia (2.79%).

Conclusion: Bone marrow aspiration cytology is a simple, safe, cost effective and a highly important and informative diagnostic and prognostic test useful in wide range of hematological disorders.

Keywords: Bone Marrow Aspiration; Pancytopenia; Thrombocytopenia

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 the Department of Pathology, New Government Medical College and associated Maharao bhim singh Hospital, Kota, Rajasthan, India. This would also serve for possible comparison with findings from other parts of India.

Materials and Methods

This is a retrospective and prospective study carried out over 2 years and 4 months (January 2019 to April 2021), at the Department of Pathology, Government New Medical College, and associated MBS Hospital kota, Rajasthan, India.

BMA was performed by trained residents, sternum was the site of choice for BMA in most of the patients followed by PSIS & Tibia for infants. Documents regarding the patient detailed family & clinical information, physical examination, clinical indication, and all the laboratory tests findings were recorded.

The BMA material was collected, and smears were prepared by wedge-spread method and stained with Leishman stain and giemsa stains. Slides were examined by the expert pathologist, and the data were manually collected and analyzed.

Results

Out of 397 patients, the material acquired was inadequate for interpretation or diluted with blood in 75 cases. Therefore, sample size left for study is 322 cases.

Of 322 cases, the majority of patients 43.16% were of pediatric age group (<15 years). The smallest patient was just a 20-day-old baby & oldest was a 80 year female. 52.39% were males and 47.82% were females having male-to-female ratio 1.09: 1. Table 1 presents age and sex distribution of cases.

In most of the cases, BMA was hypercellular (77.01%). Cellularity of BMA is summarized in Table 2.

The most frequent indication for BMA was unexplained anemia (51.55%), followed by unexplained pancytopenia (23.6%),and suspected leukemia(16.45%), unexplained thrombocytopenia (7.45%) [Table 3].

The most common marrow diagnoses were dimorphic anemia (22.36%) and iron deficiency anaemia (21.7%). Overall, 60.05% of cases were having nutritional anemia, 16.45% having hematological malignancy, and 2.79% having infectious etiology like malaria etc. The BMA of youngest 20-day-old baby remained undiagnosed due to diluted tap.

The spectrum of hematological disorders diagnosed with BMA cytology is shown in Table 4.

Age (years)	Number of cases (322)	Male (total 168)	Female (total 154)	Percentage
0-1	**39**	**28**	**11**	**12.11**
2-14	100	58	42	31.05
15–29	71	39	32	22.04
31–45	45	14	31	13.90
>45	67	29	38	20.08

Table 1: Age and sex distribution of BMA cases

Marrow cellularity	Number of cases (%)
Hypercellular	248(77.01)
Normocellular	65 (20.18)
Hypocellular	9 (2.79)

Table 2: Cellularity of BMA

Indication	Number of cases (%)
Unexplained anemia	166 (51.55)
Unexplained pancytopenia	58 (18.01)
Suspected leukemia	53(16.45)
Unexplained thrombocytopenia	24 (7.45)
Unexplained spleenomegaly	9 (3.41)
Unexplained fever	7(3.72)
Others	5(4.34)

Table 3: Indications of BMA

Broad category (%)	Diagnosis	Number of cases (%)
Nutritional anemia (60.55)	Dimorphic	72 (22.36)
	Micronormoblastic	70 (21.7)
	Megaloblastic	53 (16.4)
Hematological malignancy (16.45)	ALL	13 (4.02)
	AML	10 (3.10)
	CML	24 (7.45)
	CLL	6 (1.80)
ITPs (7.45)	ITP	24 (7.45)
Hemolytic anaemia(4.66)	Hemolytic anaemia	15 (4.66)
Normal BM (3.76)	Normal BM	12 (3.76)
Infections(2.79)	Infection	9 (2.79)
Aplastic anemia (2.79)	Aplastic anemia	9 (2.79)
Others (1.5)	Multiple myeloma	2 (0.62)
	Hemophagocytic syndrome	2 (0.62)
	Hypereosinophilia	1 (0.31)

BMA: Bone marrow aspirate, ALL: Acute lymphoblastic leukemia, AML: Acute myeloid leukemia, CML: Chronic myeloid leukemia, CLL: Chronic lymphoblastic leukemia, ITP: Immune thrombocytopenia,

Table 4: Spectrum of hematological disorders diagnosed with BMA

Discussion

The bone marrow is the principal site of hematopoiesis and weighs 3375 g in an average 75 kg individual.[4]. 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 helps to evaluate cytopenias, thrombocytosis, leukocytosis, anemias, and iron status. It is used to diagnose, confirm, and/or stage hematologic malignancie.It is also a diagnostic tool in non-hematological disorders such as storage disorders and systemic infections. It is a safe and useful test in reaching the final diagnosis. It is an ambulatory procedure performed under local anesthesia with minimal morbidity The present study determines the indications and spectrum of disorders diagnosed by BMA cytology examination.

Most of the aspirate specimens were taken from the sternum. The tibia is the preferred site in children aged <18–24 months [2,5-7].

This study like other studies has shown that BMA cytology can be carried out in all age groups. The age range (20 days to 80 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 (77.07%) which is comparable to Marwah et al. [12]. It is due to compensatory erythroid hyperplasia seen in BMA due to peripheral anemias. Though, 3.76% 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, followed by leukemia and pancytopenia. 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 iron deficiency anemia were most common pathological findings, which is comparable to other studies, in a study done by Ahmed et al. [9], 23.8% of cases were diagnosed as iron deficiency anemia. Microcytic anemia was observed in 21.74% of cases in our study. The increasing incidence of megaloblastic anemia and dimorphic anemia reflects the higher prevalence of nutritional deficiency in developing countries like the US Although the most common anemia in our country is due to iron deficiency. Thus, bone marrow examination could be used effectively in most cases to determine the cause of anemia.

We found hematological malignancies in 16.45% of cases, of which in acute leukemias 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 9 cases (2.79%). 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 9cases (2.79%) consisting of 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

The study provides a valuable insight into the causes of anemia or pancytopenia in our country. Bone marrow examination is an important investigation to arrive at the confirmatory diagnosis of hematological disorders.

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