Etiological study of bone marrow aspiration cytology in children in a tertiary care government hospital in India with a special focus on adolescent females

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ABSTRACT

Background: Bone marrow aspiration (BMA) cytology is a common and cheap technique which reveals the marrow cellularity, its structure, and stages of differentiation of different blood cells. **Objectives:** The objectives of the study were to study the etiology and the common presentation in patients undergoing BMA in pediatric age group with special focus on the adolescent females. **Materials and Methods:** This cross-sectional descriptive study was carried out in the Department of Pediatrics and Pathology of a Medical College Hospital of Bihar, India. The study was done from May 1, 2018, to April 31, 2019, on 259 cases. BMA was carried out and relevant clinical history, physical examination, and laboratory data were retrieved. **Results:** Out of 259 cases, 1 case was excluded from the final analysis due to inadequate marrow. Male-to-female ratio was 1.16:1. The most common indication was unexplained anemia (46.5%) and pancytopenia (26.7%). The most common etiological diagnosis was nutritional anemia (27.5%) followed by hypoplastic anemia (22%). Among adolescents (>11–18 years), male:female ratio decreased to 1:1 where nutritional anemia was the most common cause followed by hypoplastic anemia. **Conclusion:** The common hematological disorders prevailing in our community in pediatric age group are nutritional anemia, hypoplastic anemia, and acute leukemia.

Key words: *Adolescent females, Bone marrow aspiration cytology, Megaloblastic anemia, Nutritional anemia*

Hematological diseases in pediatric age group encompass a wide range of disorders ranging from benign disease such as iron deficiency anemia (IDA) and megaloblastic anemia to quite malignant conditions such as acute leukemia requiring urgent management. Bone marrow aspiration (BMA) cytology is a relatively safe, common, and cheap technique. BMA reveals the marrow cellularity and its structure and stages of differentiation of different blood cells [1] and even stages of various leukemias within short time frame.

The major indications for BMA include children with abnormal peripheral blood smears [2], to confirm hematological malignancies and hypoplastic anemia [2-5], follow-up after chemotherapy, or hematopoietic stem cell transplant [5]. The objective of this study was to delineate the etiology and the common presentation in patients undergoing BMA in pediatric age group with special focus on the adolescent females.

MATERIALS AND METHODS

This was a cross-sectional descriptive study done from May 1, 2018, to April 31, 2019, on all patients ≤18 years with anemia who reported to the department of pediatrics at a tertiary hospital of Bihar. All patients, >18 years of age or patients who had inadequate material or dry tap, were excluded from the study. The study was approved by the institutional ethical committee. Informed consent was taken from the parents/guardians.

BMA was done, smear was prepared, and reporting was done. The site of choice was posterior superior iliac crest. In case of repeat BMA or obese children, sternum was the preferred site. In patients <2 months of age, tibial tuberosity was preferred. BMA smears were prepared and stained with Leishman stain. Relevant history, physical examination, and laboratory tests were done for the patients. All the data were analyzed on SPSS software v23.

RESULTS

Out of 259 cases, 1 was excluded due to dry tap; therefore, 258 cases were included in the final analysis. The mean age was 8.2 years (range: 2 months–18 years). Out of them, 139 were male and 119 were female with a male:female ratio was 1.16:1, as shown in Table 1. The male: female ratio in the age group of 11–18 years was 1:1 which shows a remarkable increase in female patients in that age group. In contrast, <11 year age group had male:female ratio of 1.25:1.

Out of 258 smears examined, 83.9% showed pathology while normal bone marrow was seen in 25 (9.6%) and reactive bone marrow was seen in 17 (6.5%) cases. The most common etiological diagnosis among the pathological smear was nutritional

anemia (27.5%) followed by hypoplastic anemia (22%) and hematological malignancies (14.7%), as shown in Table 2. In patients >11–18 years, females relatively outnumbered males while undergoing BMA cytology.

The most common indications of BMA cytology in decreasing order of frequency were unexplained anemia (46.5%), pancytopenia (26.7%), and diagnosis and management of leukemia (12.4%), as shown in Table 3.

DISCUSSION

Hematological disorders include a wide range of diseases ranging from reactive hyperplasia to hematological malignancies. BMA plays a very important role not only in determining the cause of disease but also help in establishing a definitive diagnosis. In this study, nutritional anemia was the most common etiological diagnosis which was in accordance to a study by Hussain *et al.* [3]. It was found in 71 (27.5%) cases. After further evaluation, it was found that it occurred usually as a mixed disorder similar to a study by Egesie *et al.* [6]. This correlates with the fact that anemia due to lack of nutrients rarely occurs as a single nutrient deficiency [7,8]. In this study, megaloblastic anemia was the most common cause of nutritional anemia. This was in contrast to the earlier study done by Stoltzfus where IDA was the most common cause of nutritional anemia worldwide [9].

Table 1: Age and sex distribution among bone marrow aspiration cases

Age (years)	Male (n)	Female (n)	M: F ratio	Total, n (%)
≤2	25	17	1.47:1	42 (16.2)
>2–6	32	26	1.23:1	58 (22.5)
>6–11	44	38	1.15:1	82 (31.8)
>11–18	38	38	1:1	76 (29.5)
Total	139	119	1.16:1	258 (100)

The second most common etiological diagnosis was hypoplastic anemia (57, 22%) cases. Epidemiologically, hypoplastic anemia has a pattern of geographic occurrence opposite to that of leukemias, with higher frequency in the developing world than in the developed West [10]. The third common diagnosis was hematological malignancy found in 38 (14.7%) cases. Acute leukemia was found in 37 of the 38 cases diagnosed with malignancy. The incidence of acute lymphocytic leukemia was found to be lower as compared to the developed countries [11]. The fourth common diagnosis was immune thrombocytopenia (ITP) (18, 6.9%). In the previous studies, its frequency varies from 32% to 48% [12,13]. It is the most common cause of mucocutaneous bleeding among children. Fareed *et al.* found ITP as the most common cause of BMA [14].

There was 1 case (0.4%) of Gaucher's disease. Bone marrow involvement is common in storage disorders. They can present as hematological abnormalities, and BMA helps in confirming the diagnosis [15]. Infection in BMA was found in 1 case (0.4%) which came out to be microfilaria. Microfilaria in BM is a rare entity encountered [16,17]. The most common indication of BMA cytology was unexplained anemia (46.5%) followed by pancytopenia (26.7%) consistent with the findings of Dapus and Damen [18] and Tripathy and Dudani [19]. However, Bashawri [4] and Pudasaini *et al*. [20] reported pancytopenia and diagnosis and management of leukemia as the two common indications for the procedure.

Females outnumbered males relatively with male:female ratio of 1:1 in >11–18 years age group. The BMA cytology in that age group included nutritional anemia followed by hypoplastic anemia. These findings are in contrast with the findings of Janus and Moerschel, who found that among adolescent girls, IDA

Table 2: Etiology of hematological diseases diagnosed with bone marrow aspiration cytology

Diagnosis (%)	Total cases, n (%)	Female (11–18 years), (n=38)
Nutritional anemia	71 (27.5)	15 (39.5)
Megaloblastic	42 (16.2)	8
Iron deficiency anemia (micronormoblast)	19 (7.3)	4
Hemolytic	1 (0.4)	0
Dimorphic	9 (3.5)	3
Hypoplastic anemia	57 (22)	11 (28.9)
Hematological malignancy	(38) (14.7)	6 (15.7)
Acute lymphocytic leukemia	35 (13.5)	2 (5.2)
Acute myelocytic leukemia	2 (0.8)	
Myeloproliferative neoplasia	1 (0.4)	1 (2.6)
Immune thrombocytopenia (6.9%) Others	18 (6.9)	3 (7.89)
Congenital dyserythropoietic anemia	1 (0.4)	1 (2.6)
Thalassemia	3 (1.1)	0
Langerhans cell histiocytosis	1 (0.4)	0
Infection – Microfilariasis	1 (0.4)	0
Reactive bone marrow	17 (6.5)	5 (13.1)
Normal bone marrow	25 (9.6)	-

Table 3: Common indications of bone marrow aspiration

Indications	Number (%)
Unexplained anemia	120 (46.5)
Pancytopenia	69 (26.7)
Diagnosis and management of leukemia	32 (12.4)
Petechial rash	17 (6.5)
Hepatosplenomegaly	14 (5.4)
Lymphadenopathy	5 (1.9)
Anemia, recurrent infection, and hypertriglyceridemia	1 (0.4)

is the most common anemia due to menstrual blood loss and growth spurt [21]. The findings of this study are consistent with the findings of Patra *et al*. and Nalli *et al*., who found that IDA was the most common cause of anemia in pediatric patients; however, among adolescents, megaloblastic anemia was more significant [22,23]. Singh *et al*. found that megaloblastic anemia is an important cause among adolescents, especially with vegetarian diet pattern [24].

This study had few limitations. First, being a hospital-based study, actual data about the etiology and incidence of various anemia prevailing in our community might vary, which requires field survey. Second, there was a lack of follow-up of patients undergoing BMA.

CONCLUSION

BMA is a readily available tool to diagnose hematological disorders with minimal resources. It can be used to address the cause of the underlying disease.

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