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Research Article

Spectrum of bone marrow aspirations and their clinico-hematological profile in children

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ABSTRACT

Background: Objective of current study was to study the spectrum of bone marrow aspiration results and their clinico-hematological profile in children.
Methods: Design: Cross sectional descriptive study, conducted from 1st April 2011 to 31st March 2012. Setting: Referral care centre in Northern India. Participants: All hospitalized patients in the age group of 0-18 years requiring a bone marrow examination for various hematological disorders. Procedure: A total of 140 children underwent bone marrow examination during the study period. An aspirate smear was prepared and stained with Romanowsky's stain, Prussian blue stain was used for staining iron. Demography, history, examination and the investigations of patients who underwent bone marrow aspiration were noted in a preset proforma.
Results: The most common hematological disorder encountered was Iron deficiency anemia accounting for 41.43% of all cases. Idiopathic thrombocytopenic purpura was the most common platelet disorder (12.85%). Acute lymphoblastic leukemia was the commonest hematological malignancy diagnosed (6.42%), followed by acute myeloblastic leukemia (4.28%), visceral leishmaniasis (1.43%), malaria (0.71%), lymphohistiocytosis (0.71%) and anemia of chronic disorder (0.71%).
Conclusions: The most common condition encountered on bone marrow examination during our study was iron deficiency anemia. In absence of relevant etiological investigations in resource poor settings bone marrow aspiration is done in severe anemia to confirm nutritional deficiency anemia or to rule out hematological malignancies. The threshold of doing bone marrow was also low in patients of ITP as one contemplated putting a patient on steroids.

Keywords: Bone marrow, IDA, ALL, AML, ITP

INTRODUCTION

The basic indication for performing a bone marrow aspiration is to answer questions that a routine hematology examination of a blood sample does not answer. It allows excellent morphologic evaluation of cells, differential count and myeloid to erythroid ratio. It gives an assessment of hematopoietic activity. Deviations from the normal may be qualitative with abnormal cellular morphology or quantitative with presence or absence of iron stores as evaluated by Prussian blue staining. Details about parasites or cell inclusions are also delineated on bone marrow aspiration.

METHODS

This study was conducted in the post graduate department of pediatrics, GB Pant Cantonment general hospital, an associated hospital of the government medical college Srinagar. It was a cross sectional descriptive study, conducted from 1st April 2011 to 31st March 2012.

All hospitalized patients in the age group of 0-18 years requiring bone marrow examination for various hematological disorders were included in the study. The bone marrow examination was carried in following group of patients:

A) Investigation for unexplained anemia or abnormality in the peripheral blood involving the white cells or platelets.

B) Investigation for suspected cases of hematological neoplasms including leukemias or lymphomas.

C) For the diagnosis of many diverse hematological conditions such as hepatosplenomegaly, suspected leishmaniasis and Pyrexia of Unknown Origin (PUO), especially where infections such as typhoid or disseminated TB were suspected and cultures from conventional sites were negative.

D) Suspected storage diseases such as Gaucher's and Niemann-pick.

A detailed history, examination and all the relevant investigations were noted in a proforma prepared for this purpose. Peripheral blood smears, complete blood counts and hematological parameters like Bleeding Time (BT), Clotting Time (CT), Prothrombin Time (PT) and platelet count were performed prior to bone marrow aspiration. A written informed consent was taken in all cases.

Bone marrow was collected by bone marrow aspiration needle under all aseptic conditions after giving local anaesthesia by 2% lidocaine hydrochloride in a dose not exceeding 1.5 mg/kg. Bone marrow was taken from the upper end of tibia in children less than 2 years, iliac crest was used in older children. An aspirate smear was prepared and stained with Romanowsky's stain, Prussian blue stain was used for staining iron. The slide was observed under the microscope and findings noted.

Patients with metastasis from non-hematological organs and follow up patients of acute leukemia were not part of study as they were evaluated in other departments.

RESULTS

A total of 140 children underwent bone marrow examination during the study period. 102 patients were diagnosed with nutritional anemia, out of which 58 patients had Iron Deficiency Anemia (IDA), 29 had Dual Deficiency Anemia (DDA) and 15 Megaloblastic Anemia (MA). We diagnosed a total of 15 childhood leukemias, out of which 9 had Acute Lymphoblastic Leukemia (ALL) and 6 had Acute Myeloid Leukemia (AML). 18 patients had Immune Thrombocytopenic Purpura (ITP), two had Visceral Leishmaniasis (VL) and one each malaria, Anemia of Chronic Disease (ACD) and lymphohistiocytosis (LH). Sex distribution of children with hematological disorders was given in Table 1.

Table 1: Gender distribution of hematological disorders.

Disorder	Male	Female
Iron deficiency anemia	35	23
Dual deficiency anemia	17	12
Megaloblastic anemia	06	09
ITP	11	07
Acute lymphoblastic leukemia	04	05
Acute myeloblastic leukemia	04	02
Visceral leishmaniasis	02	00
Malaria	00	01
Lymphohistiocytosis	00	01
Anemia of chronic disease	01	00

The age distribution of children was given in Table 2. The frequency of clinical features present in each hematological disorder is shown in Table 3. Table 4 shows the blood counts of these patients.

Table 2: Age distribution of hematological disorders.

Disorder	<1 Y	1-<3 Y	3-<6 Y	6-<11 Y	≥11 Y
Iron deficiency anemia	8	19	14	11	6
Dual deficiency anemia	3	5	6	8	7
Megaloblastic anemia	0	0	3	4	8
ITP	1	4	6	6	1
ALL	0	2	0	5	2
AML	1	2	0	2	1
Anemia of chronic disease	0	0	1	0	0
Malaria	0	1	0	0	0
Visceral leishmaniasis	0	1	1	0	0
Lymphohistiocytosis	0	0	0	0	1

Table 3: Clinical presentation of patients.

Clinical features	No. of patients									
	Iron deficiency anemia (n=58)	Dual deficiency anemia (n=29)	Megalo-blastic anemia (n=15)	Acute lympho-blastic leuk (n=9)	Acute myelo-blastic leuk (n=6)	ITP (n=18)	Malaria (n=1)	Lymphohi-stiocytosis (n=1)	Anemia of chronic disease (n=1)	VL
Fever	07	8	06	05	03	02	01	01	01	01
Pallor	58	29	15	08	06	04	01	01	01	01
Icterus	0	03	01	01	0					
Petechiae	0	01	02	02	02	18				
Hepatomegaly	08	08	03	04	02		01	01		01
Splenomegaly	18	13	03	05	02		01	01		01
Lymphadenopathy	01	0	0	01	02					

Table 4: Blood counts.

	IDA	Dual DEF	Megaloblast	ITP	ALL	AML	Malaria	Lymphohist	VL	ACD
Range Hb (g/dl)	2-6.4	1-6.6	2.7-5.7	8-13.7	2.7-8.5	3-6.2				
Mean	4.67	4.89	3.98	10.88	4.87	4.933	3.5	5	4.9	5.5
Range TLC (Cells/mm^3)	1800-19400	2200-18000	1600-7600	4200-11300	1000-55200	3500-142000				
Mean	9181	7958	3973	8405	14077	54150	5500	3400	3400	8600
Range PLT (Cells/mm^3)	11500-600000	13000-670000	22000-250000	8000-92000	10000-47000	24000-80000				
Mean	225889	232896	81600	41944	26777	47250	180000	76000	55000	434000

DISCUSSION

Bone marrow aspiration is a useful adjunct and a diagnostic study for evaluation of various hematological disorders. The most common condition encountered on bone marrow examination during our study was micronutrient deficiency anemia (72.34%). Majority of these patients are usually diagnosed on basis of complete blood count, red cell indices, red cell distribution width, peripheral blood smear examination, serum ferritin/ iron levels, serum homocysteine/methyl malonic acid levels, serum and red cell folate levels. These patients needed bone marrow for diagnosis because many of them had atypical presentations like concomitant fever, organomegaly and petechiae. Splenomegaly, hepatomegaly and fever were present in 31%, 14% and 12% of patients with Iron deficiency anemia respectively. In patients of dual deficiency anemia splenomegaly, hepatomegaly, fever and icterus was noted in 45%, 27.5%, 27.5%, 10.3% respectively. Megaloblastic anemia presented with fever in 40%, splenomegaly in 20%, hepatomegaly in 20% and petechiae in 13.3%. We also believe that in absence of relevant etiological investigations in resource poor settings like ours bone marrow aspiration is overdone in severe anemia to confirm nutritional deficiency anemia or rule out hematological malignancies. The mean Hb of patients with IDA, DDA, MA was 4.6g/dl, 4.8 g/dl and 3.9 g/dl respectively. These are representative of only severely symptomatic cases requiring hospital care, the tip of the iceberg of actual disease burden in the community.

Among micronutrient deficiency anemia, iron deficiency was the commonest cause of anemia (41.42%). An estimated 60 to 80% of the world's population has this nutritional deficiency.[1] In our study majority of patients with IDA were in the age group of 1-6 years (56.8%). The prevalence of IDA in preschool age children in South East Asia, according to the WHO database on anemia, is 65.5%.[2] Most of the patients with IDA in our study were from areas considered to have higher prevalence of poverty, limited access to health services & illiteracy. The demographic pattern of DDA and MA followed a pattern similar to IDA, as expected. We could not figure out the cause of megaloblastic anemia due lack of availability of relevant biochemical tests. Idiopathic thrombocytopenic purpura was the third most common hematological disorder in our study (12.85%). Most of the patients of ITP were in the age group of 1-6 years (55.5%), consistent with other studies.[3] Bone marrow examination is hardly ever needed to make a diagnosis of ITP. It was done for presence of atypical features (like fever in 2 and anemia in 4) in patients with petechiae. Perhaps the threshold of doing bone marrow was also low whenever one contemplated putting a patient on steroids. In our study ALL was the commonest hematological

malignancy diagnosed (6.42%). Githanga JN et al.[4] in a study found ALL to be the commonest hematological malignancy of childhood. Similar results were shown by Rahim F et al.[5] Most of our patients were in the age group of 6 -11 years (55%). In developed countries, the age distribution of ALL shows a major peak at pre-school age (between 1 and 5 years of age) with a slow decline toward adolescence.[6] This contrasts to the typical age distribution in less developed countries with no pre-school peak.[7,8] In a study by Yasmeen N and Ashraf S[9] on ALL, fever and pallor were the commonest presenting features. Anaemia (86%), hepatomegaly (67%) and splenomegly (58%) were common findings on physical examination. The most common presentation in our study was pallor (88%), followed by fever (55.5%), splenomegaly (55.5%), hepatomegaly (44%), petechea (22%), lymphadenopathy (11%) and bone tenderness (11%). In our study, AML was the 2nd commonest hematological malignancy. Biswas S et al.[10] noted the following features in patients of AML, fever 92.9%, pallor 57.1%, gum bleeding 42.9%, bleeding from skin 42.9 %, lymph-adenopathy 35.7%, hepatomegaly 78.6%, splenomegaly 66.6%, sternal tenderness 7.14%. Our results were pallor (100%), fever (50%), petechiae (33.33%), hepatomegaly (33.33%), splenomegaly (33.33%) lymphadenopathy (33.33%) and proptosis (16.67).Visceral Leishmaniasis (VL) has been endemic in India since ancient times.[11,12] At present, it is a serious public health problem in Indian subcontinent, especially in Bihar state. However, cold and harsh winter conditions of the Kashmir valley do not favour the survival of the leishmania parasite or its vector, the sand fly, and the disease is practically unheard of in the valley. Rarely patients are reported from the Uri belt in South-west Kashmir. Both our patients belonged to this region. Diagnosis of cutaneous leishmaniasis in native Kashmiris of the Uri belt in South-west Kashmir has been done previously.[13] Documented cases of visceral leishmaniasis in this area have emerged in the past couple of years.[14] Indigenous malaria does not occur in kashmir except Baramulla, Uri, and Domel.[15] Our patient with malaria had a history of travel outside the state.

In conclusion, the most common condition encountered on bone marrow examination during our study was micronutrient deficiency anemia, particularly the iron deficiency anemia. Further, in resource poor settings like ours bone marrow aspiration is being used as the investigation of choice in severe anemia to confirm nutritional deficiency anemia or rule out hematological malignancies. And use of bone marrow in ITP is more frequent than is necessary because of apprehension of putting a patient of leukemia on steroids.

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