



Diagnostic Outcome of Bone Marrow Aspiration in a Paediatric Centre in Hyderabad, India

Authors

Dr Ather Fatima¹, Dr Mohd Irshad Ahmed²

¹Department of Pathology, GMC, Nizamabad

²Department of Pathology

Corresponding Author

Dr Ather Fatima

Department of Pathology, Government Medical College, Khaleelwadi, Nizamabad

Email: atherfatima12345@gmail.com

Abstract

Introduction: Haematological diseases are common among paediatric age group. They range from common disorders like nutritional deficiency anaemia to very serious and rare conditions like leukemia and syndromic disorders that affecting stem cell differentiation of the bone marrow like Diamond-Blackfan syndrome, etc. Bone marrow examination is an important diagnostic tool in haematology. Bone marrow aspiration (BMA) provides reliable information regarding bone marrow cellularity, its architecture and the stage of maturation of different blood cells. It also provides detailed information regarding the presence of haemoparasites within the bone marrow, the presence of infiltrates and storage diseases. It helps in the diagnosis and staging of haematological malignancies.

Objectives

1. To determine the age and sex distribution of paediatric population.
2. To identify the common indications for BMA studies in the paediatric population.
3. To study the pattern of childhood haematological disorders on bone marrow examination.

Materials and Methods: The study was conducted at LOTUS HOSPITALS FOR WOMEN AND CHILDREN, Hyderabad, a specialist referral centre for the children. It is a facility based retrospective cross section study. The data was collected from the hospital records from the Department of Pathology from January 2011 to December 2015.

The data collected include detailed case history with physical examination with all necessary lab investigations. The data was entered into Microsoft excel 2007 version and analysed using Epi info 7.2.1.0

Results: BMA from 220 patients were analyzed. Reactive marrow and Nutritional anemia contributed highest number of cases among the non neoplastic group. Acute lymphoblastic leukemia was the commonest malignant hematological disorder in the present study.

Conclusion: Common haematologic disorders in our setting are reactive marrow, nutritional anaemias and leukaemias. There is need to expand the scope of laboratory investigations beyond morphology.

Keywords: Bone marrow aspiration, indications, outcome.

Introduction

Haematological diseases are common among paediatric age group. They range from common disorders like nutritional deficiency anaemia to very serious and rare conditions like leukemia and syndromic disorders that affecting stem cell differentiation of the bone marrow like Diamond-Blackfan syndrome, etc.

Bone marrow examination is an important diagnostic tool in haematology. It is a simple and relatively safe procedure carried out routinely in hospitals for the diagnosis and management of haematological disorders primarily and to some extent non haematological disorders.

Bone marrow aspiration (BMA) provides reliable information regarding bone marrow cellularity, its architecture and the stage of maturation of different blood cells. It also provides detailed information regarding the presence of haemoparasites within the bone marrow, the presence of infiltrates and storage diseases.^[3] It helps in the diagnosis and staging of haematological malignancies.^[4] Therefore Bone marrow examination is quite a valuable test, which has become very important these days for the diagnosis of haematological disorders.^[1,2] Though an invasive, procedure, it can be easily performed even in the presence of severe thrombocytopenia with little or no risk of bleeding.^[4]

Various studies have identified different indications for bone marrow examination. A study by Bashawri, identified pancytopenia, leukemia, staging of lymphoma among others as the major indications for BMA.^[5] In a similar study in Nigeria, Egesie et al. identified anemia as a major indication for BMA.^[6]

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Materials and Methods

The study was conducted at LOTUS HOSPITALS FOR WOMEN AND CHILDREN, Hyderabad, a specialist referral centre for the children. It is a facility based retrospective cross section study. The data was collected from the hospital records from the Department of Pathology from January 2011 to December 2015. Only BMA cytology records were included in the study. BMA that resulted in dry tap, inconclusive results and bone marrow biopsies were excluded from the study.

The data collected include detailed case history with physical examination with all necessary lab investigations. The data was entered into Microsoft excel 2007 version and analysed using Epi info 7.2.1.0

Complete blood count including hemoglobin, total and differential leukocyte count, total platelet count, and blood indices were performed using automated hematology analyzer (Sysmex K21). Peripheral blood smear examination was done after Leishman stain and retic stain.

Ethical Consideration

Ethical approval was obtained from the Ethics and Research Committee of hospital before the commencement of the study.

Results

A total of 220 BMA cytology examinations were carried during the study period. Ages of the patients ranged from 2 months to 12 years. The mean ages of the patients were 3 ± 2.5 years. Among these, 120 (60%) were males and 100 (40%) were females. The male to female ratio was 1.2:1 [Table 1]. The two most common indications for BMA cytology examination were persistent fever (36.3%) and anaemia for evaluation (22.7) and for diagnosis and management of leukemia (15.9). The most common clinical presentation acute leukemia is

pallor and fever with anaemia with a higher frequency occurring in male.

Other indications for BMA cytology occurred in various proportions [Table 2]. 93.19% (205) of the marrow aspirate had pathological features while 5% (11) were normal marrow aspirate and 1.81%

(04) smears showed reactive marrow hyperplasia [Table 3].

Non malignant hematological disorders were seen in 163 (74.09%) patients [Table 4] and malignant hematological disorders were seen in 46 (20.9%) patients [Table 5].

Table 1: Age and sex distribution of patients

AGE	GENDER (%)		TOTAL (%)
	MALE	FEMALE	
2m – 2y	45	33	78
>2y – 6y	35	27	62
>6y -12y	49	29	80
TOTAL	120	100	220

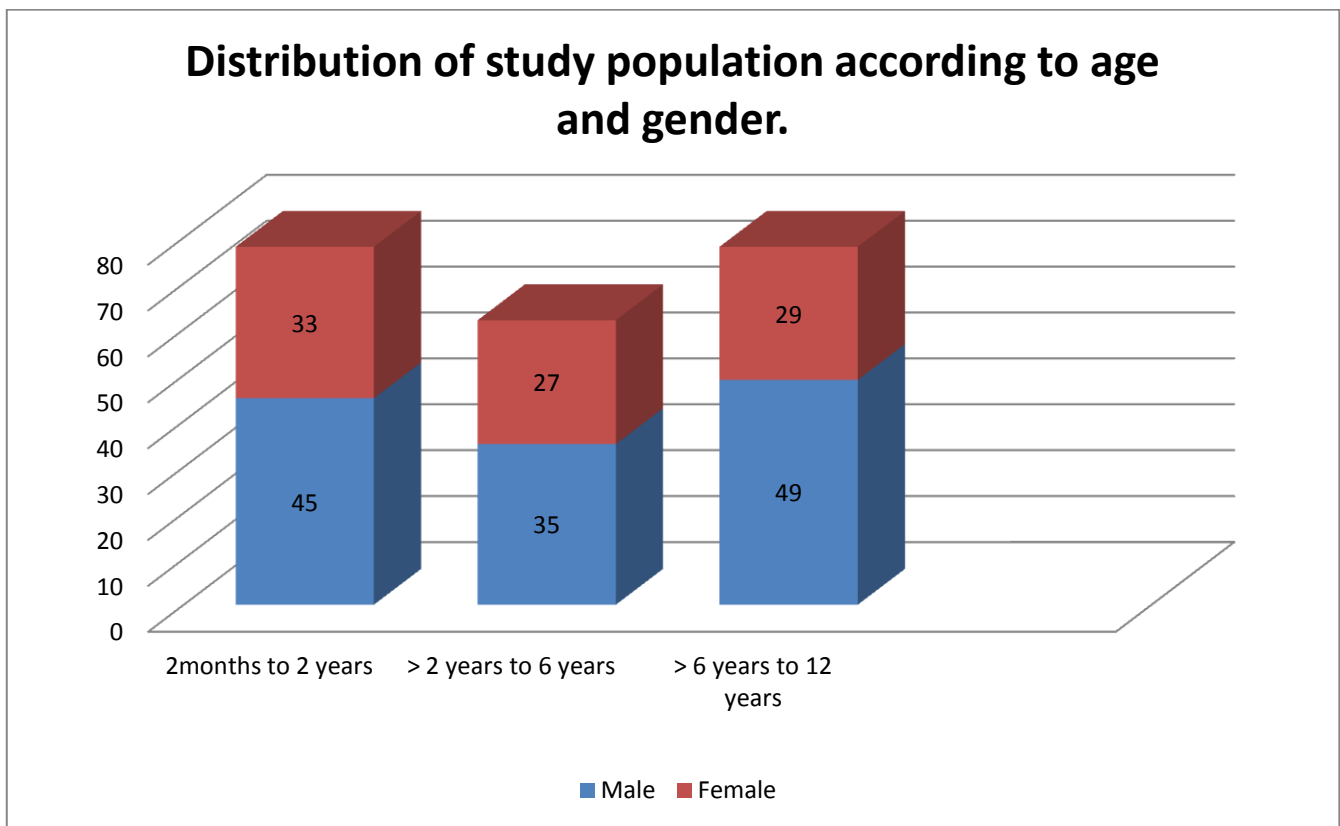


Table 2: Indications for BMA among patients

Indications	2 month-2 year	>2 years-6 years	>6 years-12 years	Male	Female	Total
Persistent fever for evaluation	31	23	26	52	28	80
Anemia under evaluation	18	9	23	22	28	50
Leukemia	13	11	11	19	16	35
Thrombocytopenia for evaluation	5	7	9	7	14	21
Pancytopenia	4	7	7	10	8	18
Hepatosplenomegaly	6	3	4	8	5	13
Storage disorder	1	1	0	1	1	2
Metastasis	0	1	0	1	0	1

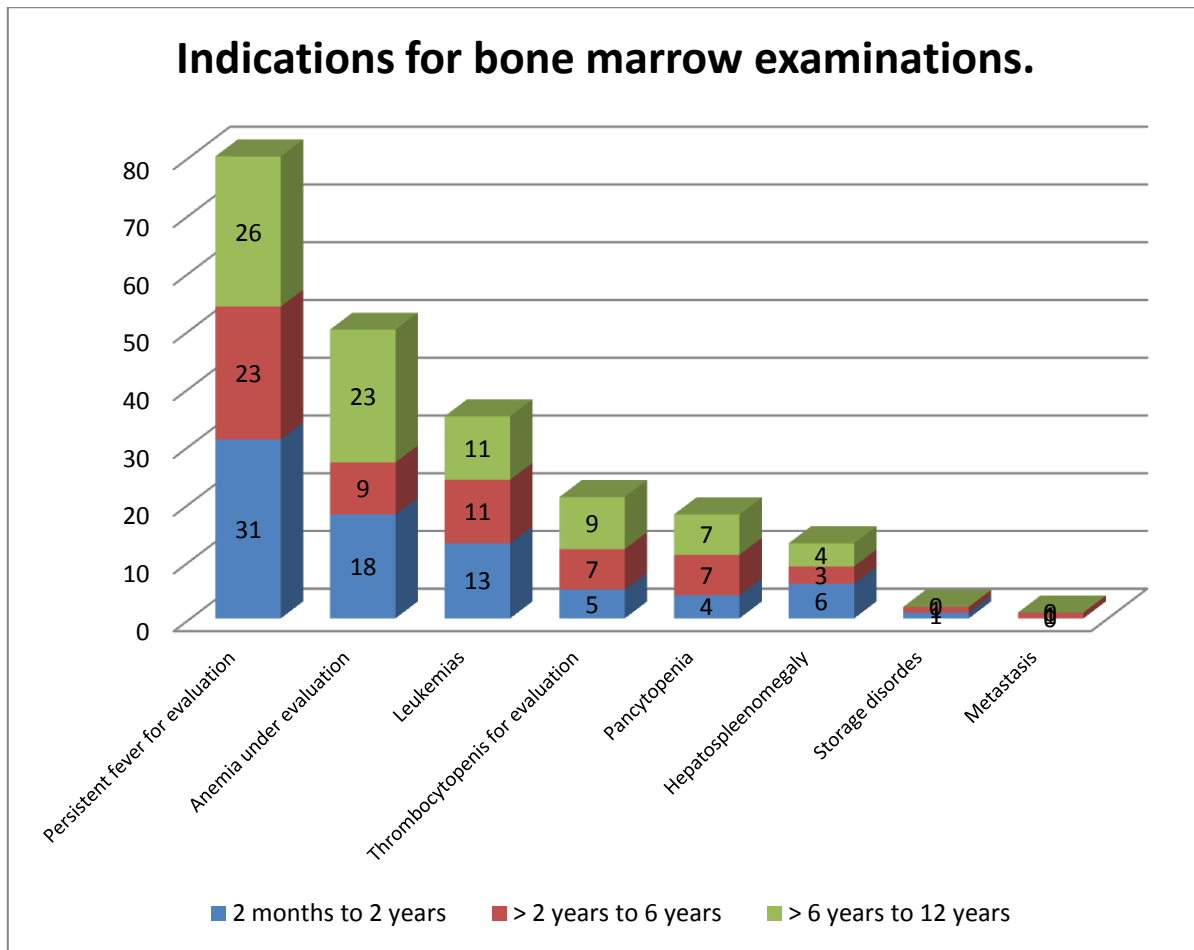


Table 3: Proportions of BMA findings in patients

Bone marrow feature	2 month-2 year	>2 years-6 years	>6 years-12 years	Male	Female	Total
Normal	4	5	2	7	4	11
Reactive marrow	2	1	1	3	1	4
Pathological marrow	72	56	77	110	95	205

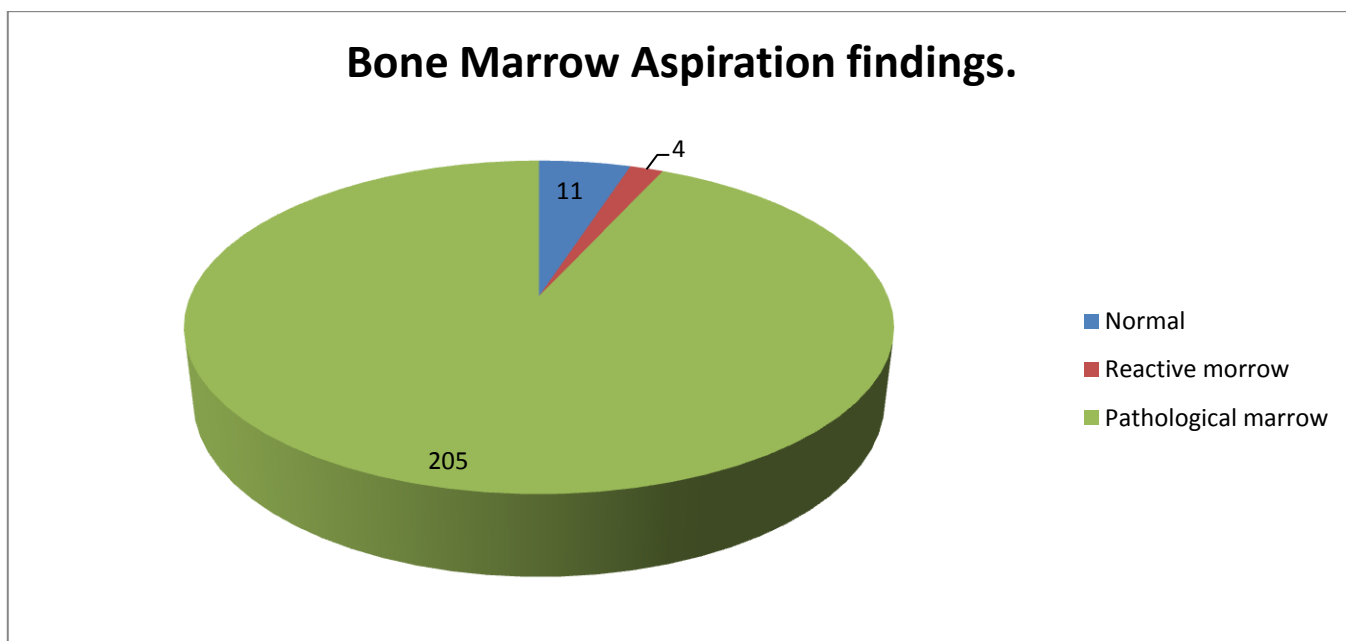
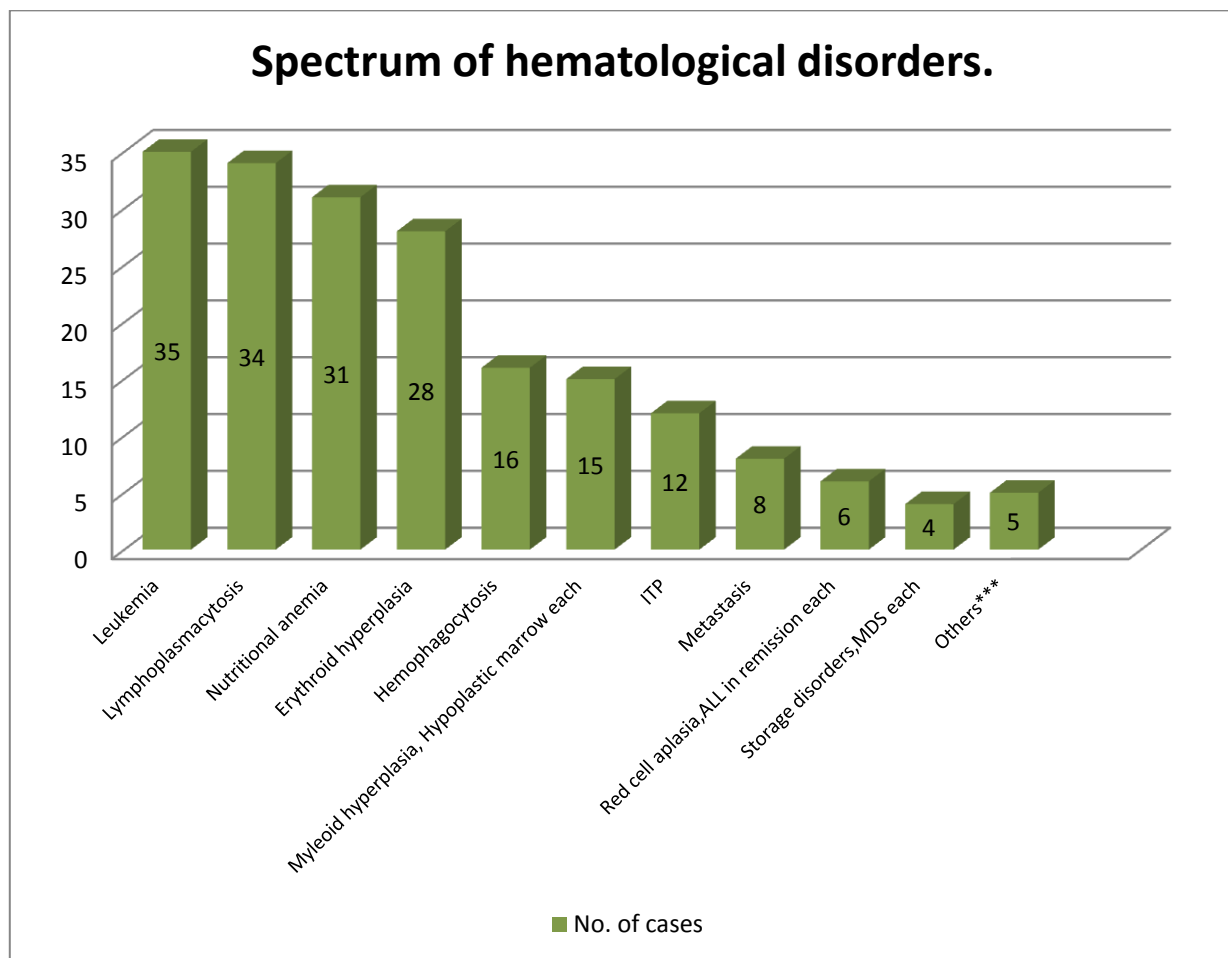


Table 4: Spectrum of haematological disorders

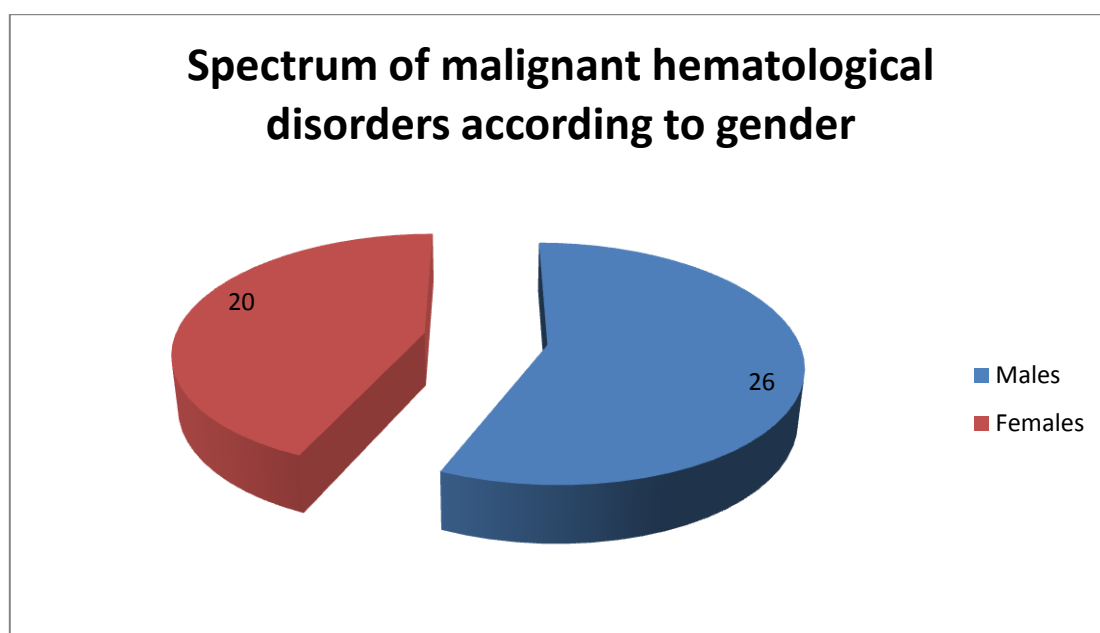
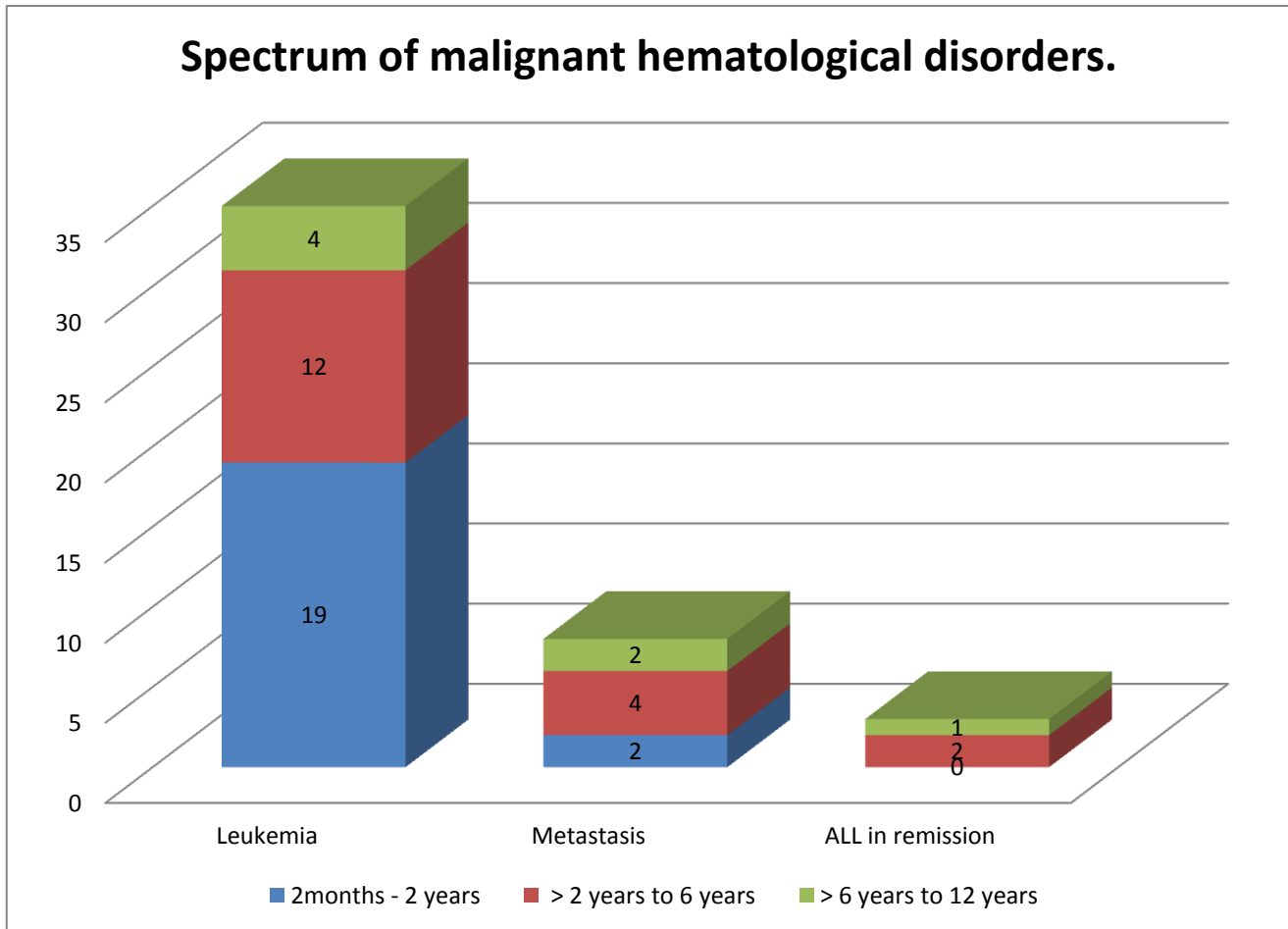
Diseases	2 month-2 year	>2 years-6 years	>6 years-12 years	Male	Female	TOTAL
Leukemia	19	12	4	19	16	35
Lymphoplasmacytosis	17	5	12	16	18	34
Nutritional anemia	9	6	16	17	14	31
Erythroid hyperplasia	8	6	14	15	13	28
Hemophagocytosis	3	7	6	7	9	16
Myeloid hyperplasia	5	4	6	8	7	15
Hypoplastic marrow	6	3	6	8	7	15
ITP	4	3	5	8	4	12
Normal	4	5	2	7	4	11
Metastasis	2	4	2	5	3	08
Red cell aplasia	0	2	1	2	1	03
ALL in remission	0	2	1	2	1	03
Storage disorder	0	1	1	1	1	02
MDS	0	1	1	1	1	02
Dyserythropoiesis	0	1	0	0	1	01
Pearson marrow pancreatic syndrome	0	0	1	1	0	01
LD bodies	0	1	0	1	0	01
Myelofibrosis	0	0	1	1	0	01
Angiogenic myeloid metaplasia	0	0	1	1	0	01
TOTAL	78	62	80	120	100	220



Others*** include dyserythropoises, Pearson marrow, LD bodies, Myleofibrosis and Angiogenic myeloid metaplasia.

Table 5: Spectrum of malignant haematological disorders

Diseases	2 month-2 year	>2 years-6 years	>6 years-12 years	Male	Female	TOTAL
Leukemia	19	12	4	19	16	35
Metastasis	2	4	2	5	3	8
ALL in remission	0	2	1	2	1	3
TOTAL	21	18	07	26	20	46



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. It's a relatively safe procedure. This study was conducted to determine the common indications and diagnostic value of BMA cytology examination in children in a resource-poor center.

In this study, nutritional anaemia is the second most common disorders, identified similar to a study by Rahim et al.^[4] In other similar studies, its frequency ranges from as low as 24% to as high as 68%.^[7,8] Furthermore, evaluation of nutritional anaemia showed that mixed nutritional deficiencies occurred more commonly than isolated or single nutrient deficiency. This finding is similar to that reported by Egesie et al.^[9] and thus corroborates the observations from previous studies that anaemia resulting from nutritional deficiency rarely occur as a single nutrient deficiency.^[10,11] In addition, the single nutrient deficiency i.e. megaloblastic and iron deficiency anaemia (IDA) occurred in almost equal proportion. This contrasts the findings from other studies in which IDA has been reported to be the most common cause of nutritional anaemia globally.^[12] Thus, bone marrow examination could be used effectively in most cases to determine the cause of anaemia.

In this study, Leukemia is first most common disorder. In other similar studies frequency of leukemia range from as low as 24% to as high as 68%^{7,8}.

Reactive Lymphoplasmacytosis is third most common haematological disorder found on bone marrow examination in our patients.

There was one case of Gauchers disease This is similar to study by majumdar et al bone marrow involvement is common in storage disorders they may present as haematological abnormalities or as splenomegaly bone marrow studies helps in confirming the diagnosis.

There was one case each of Dyserythropoiesis, Pearson marrow pancreatic syndrome and LD bodies. Other cases were of haemophagocytosis, reactive myeloid hyperplasia ITP. ITP is the most common cause of muco-cutaneous bleeding in children. Its frequency on bone marrow examination varies between 32% to 48%^[13,14]. Fareed et al. found among non-malignant disorder ITP as the most common in their patients.^[15] Hypoplastic marrow was found in 15 cases. Epidemiologically, aplastic anaemia has a pattern of geographic variation opposite to that of leukemias, with higher frequency in the developing world than in the industrialized West.^[16]

There was one cases of visceral leishmaniasis. Although their incidence is low, but hemoparasites can be a cause of hematological disorders and they should be specifically looked for while examining the bone marrow aspirate.^[17]

In our study 46 cases of neoplastic disorders were found. Of these cases acute leukemia is the most common haematological malignancy. In the study conducted by Majumdar et al., 62 cases were of haematological malignancies out of which,50 were acute leukemias.

The most common indications for BMA studies, identified in this study in descending order of frequency are persistent fever, anemia and leukemia. In the study by Majumdar et al, most common indications in descending order of frequency are pancytopenia, diagnosis and management of leukemia and ITP. Studies done by Pudasaini *et al.*^[20] and Bashawri^[21] reported that pancytopenia, diagnosis and management of leukemia as the two most common indications for this procedure. But studies done by Damulak and Damen^[22] and Tripathy *et al.*^[23] showed anemia was the most common indication for BMA cytology. These similarities and differences may be due to the wide spectrum of hematological disorders.

Conclusion

The indications for BMA examination in this study are similar to those reported in other studies.

Although BMA is an uncomfortable procedure for the patient, it should be performed only when there is a clear clinical indication. It is a useful technique in the diagnosis and management of a wide range of hematological and some non hematological diseases especially in a resource poor centre like ours. However, it should be combined with biopsy as a complete study and should be supplemented with the use of special stains and immune histochemistry, immune phenotyping and cytogenetics to complete the study in some cases.

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References

1. Dacie JV, Lewis SM, editors. Dacie and Lewis Practical Hematology. 8th ed. Edinburgh: Churchill Livingstone; 1994.
2. Sitalakshmi S, Srikrishna A, Devi S, Damodar P, Alexander B. The diagnostic utility of bone marrow trephine biopsies. *Indian J Pathol Microbiol* 2005;48:173-6.
3. Bain BJ. Bone marrow biopsy morbidity: Review of 2003. *J Clin Pathol* 2005;58:406-8.
4. Rahim F, Ahmad I, Islam S, Hussain M, Khattak TA, Bano Q. Spectrum of hematological disorders in children observed in 424 consecutive bone marrow aspirations/biopsies. *Pak J Med Sci* 2005;21:433-6.
5. Bashawri LA. Bone marrow examination. Indications and diagnostic value. *Saudi Med J* 2002;23:191-6.
6. Egesie OJ, Joseph DE, Egesie UG, Ewuga JO. Epidemiology of anaemia necessitating bone marrow aspiration cytology in Jos. *Niger Med J* 2009;50:61-3.
7. Mussarat N, Raziq F. The incidence of underlying pathology in pan cytopenia. An experience of 89 cases. *J Postgrad Med Inst* 2004;18:76-9.
8. Ng SC, Kuperan P, Chan KS, Bosco J, Chan GL. Megaloblastic anaemia – A review from University Hospital, Kuala Lumpur. *Ann Acad Med Singapore* 1988;17:261-6.
9. Egesie OJ, Joseph DE, Egesie UG, Ewuga JO. Epidemiology of anaemia necessitating bone marrow aspiration cytology in Jos. *Niger Med J* 2009;50:61-3.
10. Carvalho NF, Kenney RD, Carrington PH, Hall DE. Severe nutritional deficiencies in toddlers resulting from health food milk alternatives. *Pediatrics* 2001; 107:E46.
11. Kumar R, Sangwan L, Peter R, Bansal S, Malik T. Prevalence and a etiology of nutritional anaemia in children aged 6 month to 60 month in Fatehabad district of Haryana. *J Basic Appl Sci* 2014; 4:317-21.
12. Stoltzfus RJ. Iron deficiency: Global prevalence and consequences. *Food Nutr Bull* 2003; 244 Suppl: S99-103.
13. Ng SC, Kuperan P, Chan KS, Bosco J, Chan GL. Megaloblastic anemia – A review from university hospital, Kuala Lumpur. *Ann Acad Med Singapore* 1988; 17:261.
14. Mohammad AJ. Thrombocytopenia in children. *J Postgrad Med Inst* 2004; 18:353-8.
15. Fareed TH, Haddad, Wraikat A, Khasawneh R. Analysis of pediatrics bone marrow aspiration results done in King Hussein medical center (K.H.M.C). *Int J Biol Med Res* 2012; 3:1479-81.
16. Issaragrisil S, Leaverton PE, Chansung K, Thamprasit T, Porapakham Y, Young NS. The aplastic anemia study group: The incidence of aplastic anaemia in Thailand. *Am J Hematol* 1999; 61:164-8.
17. Dhingra KK, Gupta P, Saroha V, Setia N, Khurana N, Singh T. Morphological findings in bone marrow biopsy and aspirate smears of visceral Kala Azar: A review. *Indian J Pathol Microbiol* 2010; 53:96-100.

18. Thomas AS, Mehta A, Hughes DA. Gaucher disease: Haematological presentations and complications. *Br J Haematol* 2014; 165:427-40.
19. Rajajee S, Desikulu MV, Pushpa V. Survival of childhood acute lymphoblastic leukemia: Experience in Chennai. *J Trop Pediatr* 1999; 45:367-70.
20. Pudasaini S, Prasad KB, Rauniyar SK, Shrestha R, Gautam K, Pathak R, *et al.* Interpretation of bone marrow aspiration in haematological disorders. *J Pathol Nepal* 2012; 2:3099-312.
21. Bashawri LA. Bone marrow examination. Indications and diagnostic value. *Saudi Med J* 2002; 23:191-6.
22. Damulak OD, Damen JG. Diagnostic outcome of bone marrow aspiration in a new centre in Nigeria. *Glob Adv Res J Med Sci* 2012; 1:166-71.
23. Tripathy S, Dudani S. Comparative evaluation of simultaneous bone marrow aspiration and trephine biopsy.