

Indications and Spectrum of Haematological Disorders from Bone Marrow Aspiration Examination: A Three Year Review Study

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Abstract: *Background:* Haematological disorders have diverse modes of presentation that often requires bone marrow examination for both diagnosis and management. This simple and relatively safe procedure is important particularly in resource poor centres since access to adjuvant diagnostic techniques are often lacking or absent. This study was conducted to determine the indications and the spectrum of Haematological diseases diagnosed using this procedure.

Methodology: This was a retrospective study conducted in the Department of Haematology University of Uyo Teaching Hospital from January 2011 to December 2013. Bone marrow aspiration cytology records of 62 suspected cases of haematological diseases were reviewed and analyzed using STATA software version 10.

Results: Majority of the patients who had bone marrow aspiration were adults aged 19 years and above. The male to female ratio was 1.2:1. Most (93.5%) of the marrow aspirate examined had definitive pathologic features while 4 (6.5%) were normal marrow elements. The main indications for BMA examination in order of decreasing frequency include; anaemia (37.1%), diagnosis of Leukaemia (30.7%) and pancytopenia (5.1%). Acute leukaemia was the most common haematological disease diagnosed using this procedure. Acute myeloid leukaemia was twice as common as acute lymphoblastic leukaemia. Also, mixed nutritional deficiencies occurred more commonly than single nutrient deficiency.

Conclusion: The indications for BMA examination in this study are similar to those reported in other studies. This procedure remains a veritable tool in the diagnosis and management of a wide range of haematological diseases especially in a resource poor centre like ours.

Keywords: Anaemia, Bone marrow aspiration cytology, Biopsy, Leukaemia.

INTRODUCTION

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 and to some extent non-haematological disorders. In addition, the procedure may be necessary in staging, prognostication and evaluation of therapeutic response in some disorders [1].

A normal bone marrow consists of stem cells which are largely primitive undifferentiated cells that are supported by fibrous tissues called stroma. Bone marrow can be one of two types, red or yellow marrow depending on whether it consists mainly of haemopoietic tissues or fatty tissues respectively. Progressive differentiation and maturation of the primitive stem cells results in specific marrow cell type *i.e.* Leucocytes, Erythrocytes and Platelets [2].

Diseases affecting the bone marrow may be primary or a secondary spread to the marrow. In both cases the

normal marrow cellular architecture is distorted. Anaemia is a common presentation in most of these diseases whether haematological or otherwise. Hence, a detailed description of the morphology of the marrow elements may provide sufficient explanation for unexplained cytopaenias, leukaemia, and other haematological disorders including metastases to the bone marrow [1].

Various studies have identified different indications for bone marrow examination. A study by Bashawri LA, identified pancytopenia, leukaemia, staging of lymphoma among others as the major indications for bone marrow aspiration [3]. In a similar study in Nigeria, Egesie *et al*, identified anaemia as a major indication for BMA [4].

Therefore, the aims of this current study are to identify the common indications for BMA cytology and the spectrum of Haematological disorders commonly diagnosed using this procedure.

METHODOLOGY

Study Site

The study was conducted at University of Uyo Teaching Hospital (UUTH), a specialist referral

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institution in south-south Nigeria. The hospital renders specialized medical services to the indigenes of Uyo and its environs.

Study Design

The bone marrow records from the Department of Haematology of UUTH from January 2011 to December 2013 were reviewed in retrospect. Only BMA cytology records were reviewed. BMA that resulted in dry tap, inconclusive results and bone marrow biopsies were excluded from the study.

Data Collection & Analysis

A specially designed and well-structured proforma was used in data collection. Information extracted from the records include; age, sex, indications for BMA, and the final diagnosis from BMA cytology over the stated period.

The data obtained was analyzed using STATA software version 10. Data was presented in simple tables and descriptive statistics using Chi Square were used as appropriate. The level of significance was set at 5% ($p < 0.05$)

Ethical Consideration

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

RESULTS

A total of 62 BMA cytology examinations were carried during the study period. Majority (79%) of the patients were 19 years and above while 21% (13) were 18 years and below. The mean ages of the patients were 36.98 ± 2.46 years. The male to female ratio was 1.2: 1 with mean ages of 39.5 ± 3.60 years and 33.7 ± 3.12 years respectively (Table 1).

Ninety-three point five percent (58) of the marrow aspirate had pathological features while 6.5% (4) were normal marrow aspirate (Table 2).

Table 2: Proportion of Normal and Abnormal Bone Marrow Features

Bone marrow feature	Frequency (%)
Pathological Marrow	58 (93.5)
Normal Marrow	4 (6.5%)

The two most common indications for BMA cytology examination were anaemia (37.1%) and diagnosis and management of leukaemia (30.7%), with a higher frequency occurring in males in both conditions. The indications for BMA cytology varied significantly in both sexes. Other indications for BMA cytology occurred in various proportions (Table 3)

Table 3: Indications for BMA Among Patients in UUTH

Indications	Frequency (%)
Anaemia	23 (37.1)
Bicytopenia	3 (4.8)
Hepatosplenomegaly	1 (1.6)
Diagnosis & Mgt of Leukaemia	19 (30.7)
Lymphadenopathy	2 (3.2)
Pancytopenia	5 (8.1)
Persistent fever	3 (4.8)
Staging of Lymphoma	2 (3.2)
Thrombocytopenia	2 (3.2)

The spectrums of haematological disorders commonly diagnosed with BMA cytology are summarized in (Table 3). Acute leukemia was the most common disease diagnosed with this procedure. Acute myeloid leukaemia occurred more commonly than acute lymphoblastic leukaemia (Table 4).

Table 1: Age and Sex Distribution of Patients' Undergoing BMA in UUTH

Variable	Sex		Total	Statistical Indices
	Male	Female		
Age group (years)				
Under 5	3	1	4	Chi2=0.599 Df= 2 P value=0.894 ⁺
5 to 18	5	4	9	
19 and above	27	22	49	
Mean (SD)	39.5(3.6)	33.7 (3.12)	36.98 (2.46)	

Table 4: Spectrum of Haematological Disorders Diagnosed by BMA in UUTH

DIAGNOSIS	FREQUENCY (%)
Chronic Leukaemia	9 (14.5)
Myelodysplastic Syndrome (MDS)	6 (9.7)
Acute leukaemia	10 (16.1)
Aplastic anaemia	4 (6.5)
Megaloblastic anaemia	4 (6.5)
Lymphoma	7 (11.3)
Mixed Nutritional deficiency	7 (11.3)
Multiple myeloma	5 (8.1)
Iron deficiency	3 (4.8)
Eosinophilia	1 (1.6)
Idiopathic thrombocytopenic Purpura (ITP)	2 (3.2)
Normal Marrow	4 (6.5)

DISCUSSION

The present study sought to determine the common indications and diagnostic value of BMA cytology examination in a resource poor center.

This study like other studies have shown that BMA cytology can be carried out in all age group. The age range (2 to 71 years) as well as the sex ratio of subjects undergoing BMA evaluation is similar to that reported in other studies [5-7].

The diagnostic efficacy of BMA cytology in making or arriving at a definitive diagnosis in this study is quite high (93.5%) and comparable to those of similar studies [4]. Egesie *et al.* using this procedure were able to identify the causes of anaemia in majority (96.8%) of the cases reviewed [4]. Thus, this suggests that BMA is an important diagnostic tool especially in resource poor centers.

However, in 4 (6.5%) cases of suspected haematological diseases, no pathology was found on examination of the bone marrow aspirate. Higher values of 14.4% and 38% respectively have been reported by Damulak *et al.* and Bashawri *et al.* [8, 3]. These higher values may be due to the larger number of cases reviewed in both studies. This observation shows that some non-haematological conditions may present with haematological manifestations, thus suggesting some limitations of this procedure.

The most common indications for BMA cytology identified in this study in descending order of frequency

are anaemia, diagnosis and management of leukaemia and pancytopenia. Similar to our study, Damulak *et al.* [8], and Tripathy *et al.* [9] also reported anaemia as the commonest indication for BMA cytology in their studies, but contrast studies by Pudasaini *et al.* [5] and Bashawri *et al.* [3], both reported pancytopenia, diagnosis and management of leukemia as the two most common indications for this procedure. These similarities and differences may be due to the wide spectrum of haematological disorders in most climates.

Isolated thrombocytopenia was not a common indication for BMA cytology in this study. Only one case of isolated thrombocytopenia of which the diagnosis was Idiopathic thrombocytopenic Purpura (ITP) was recorded during the period under review. This contrast the observation by Pudasaini *et al.* [5], in which isolated thrombocytopenia as an indication for BMA cytology was reported in 14% of cases reviewed.

Studies have shown that bone marrow examinations are less informative in patients with isolated thrombocytopenia. In a study by Jubelirer *et al.* [10], no underlying or occult malignancy was reported in 86 patients with isolated thrombocytopenia reviewed. Also, in a related study, no underlying haematological disease was found in 61 patients aged 65 years and below presenting with isolated thrombocytopenia [11].

Furthermore, some studies have shown that bone marrow examinations are unreliable and frequently non-diagnostic in ITP [12, 13]. Perhaps, the inconsistencies in bone marrow findings in ITP and the reasons documented in the studies above may have accounted for the low request for BMA cytology in cases of isolated thrombocytopenia by physicians in our center. Mahabir *et al.* [12] reported that the role of bone marrow examination in thrombocytopenic patients is to exclude other haematological diseases such as leukaemia in children and myelodysplastic syndrome in adults. This assertion was corroborated in a survey in which 74% of Paediatric haematologists were of the view that bone marrow examination is necessary in acute Childhood ITP, and the main reasons cited was the need to exclude other haematological disorders such as leukaemia, dysmyelopoietic syndrome and aplastic anaemia [14].

This study has also shown that the acute leukaemias (16.1%) were the most frequently diagnosed Haematological malignancy from BMA examination in our centre. Out of this, 6 cases (9.6%)

were Acute Myeloid Leukaemia (AML) and 4 cases (6.5%) were Acute Lymphoblastic leukaemia (ALL). Of the AML subtypes, AML-M2 was the most common (3 cases) followed by AML-M3 (2 cases) and AML-M4 (1 case). Other studies have reported similar findings with AML being more common than ALL [4, 6, 15].

Other malignancies reported in this study, in descending order of occurrence include; lymphomas, MDS, multiple myeloma.

All the cases of suspected lymphoma (7 cases) were diagnosed with BMA examination; however bone marrow examination appears not to be a routine practice in staging of lymphoma in our centre as only two cases were staged using this procedure. This finding is at variance with the observation from a similar study in which bone marrow examination especially bone marrow biopsy was a frequent practice in the staging of lymphomas [3]. Bone marrow biopsy (BMB) provides a more reliable index of marrow cellularity, infiltration, fibrosis and granulomas.

The incidence of multiple myeloma in this study (8.1%), closely approximate (9.04%) that reported by Kibria *et al.* [16], but lower than that reported by Laishram *et al.* [17]. However, the incidence of MDS (9.7%) was relatively higher than those reported in other studies [6, 15, 16].

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.* [4], and thus corroborates the observations from previous studies that anaemia resulting from nutritional lack rarely occur as single nutrient deficiency [18, 19]. 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 [20, 21]. Thus, bone marrow examination could be used effectively in most cases to determine the cause of anaemia.

CONCLUSION

The indications for BMA examination in this study are similar to those reported in other studies. The procedure remains a veritable tool in the diagnoses and management of a wide range of haematological and some non-haematological diseases especially in a resource poor center like ours.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- [1] Rock WA Jr, Stass SA, eds. Handbook of Hematologic Pathology. New York, NY: Marcel Dekker, Inc.; 2000: 1-26.
- [2] Kaushansky K. Haematopoietic Stem cells, progenitors and cytokines. In: Lictman MA, Beutler E, Seligsohn U, Kaushansky k, Kipps TO eds. Williams Haematol. McGraw-Hill. New York; 2006: 29-58.
- [3] Bashawri LA. Bone marrow examination. Indication and diagnostic value. Saudi Med J. 2002; 23(2): 191-196.
- [4] Egesie OJ, Joseph DE, Egesie UG, Ewuga JO. Epidemiology of anaemia necessitating bone marrow aspiration cytology in Jos. Niger. Med. J. 2009; 50: 61-63.
- [5] Pudasaini S, Prasad KBR, Rauniyar SK, Shrestha R, Gautam K, Pathak R *et al.* Interpretation of bone marrow aspiration in haematological disorders. Journal of pathology of Nepal 2012; vol 2: 3099-312.
- [6] Gayathri BN, Rao KS. Pancytopenia: a clinic haematological study. J Lab Physician 2011; 315-320.
- [7] Ahmed SQ, Khan OU, Zafar N. Utilization of bone marrow examination in a secondary care hospital. JRMJ 2011; 15: 40-41.
- [8] Damulak OD, Damen JG. Diagnostic outcome of bone marrow aspiration in a new centre in Nigeria. Glo Adv Res J Med Sci. 2012; vol. 1(7): 166-171.
- [9] Tripathy S, Dudani S. Comparative Evaluation of Simultaneous bone marrow aspiration and trephine biopsy. Experience from routine Haematology practice. Indian Journal of Clinical Practice 2013; vol 24: nos 5.
- [10] Jubelirer SJ, Harpold R. The role of bone marrow examination in the diagnosis of Idiopathic Thrombocytopenic Purpura: Case series and literature review. Clin Appl Thromb Hemost 2012; 8(1): 73-76.
- [11] Westerman DA, Grigg AP. The diagnosis of Idiopathic Thrombocytopenic Purpura in adults: Does bone marrow biopsy have a place? Med J Aust. 1999; 170(5): 216-217.
- [12] Mahabir VK, Ross C, Poporic S, Sur ML, Bourgeois J, Lim , *et al.* A blind study of bone marrow examination in patients with Primary Immune Thrombocytopenia. Eur J. Haematol 2013; 90(2): 121-126.
- [13] Neunert C, Lim W, Crowther M, Cohen A, Solberg L , Crowther MA. American Society of Haematology 2011 evidence based practice guideline for immune thrombocytopenia. Blood 2011; 117: 4190-4207.
- [14] Calpin C, Dick P, Poon A, Feldman W. Is bone marrow aspiration needed in acute childhood Idiopathic Thrombocytopenic Purpura to rule-out Leukaemia? Arch. Pediatr Adolesc Med 1998; 152: 345-347.
- [15] Jha A, Sayam G, Adhikari RC, Panta AD, Jha R. Bone marrow examination in cases of Pancytopenia. J Nepal Med Assoc 2008; 47: 12-17.
- [16] Kibria SG, Islam MDU, Chowdhury ASMJ, *et al.* Prevalence of Haematological disorder: A bone marrow study of 177 cases in a private hospital at Faridpur. Faridpur Med Coll J 2010; 5: 11-13.
- [17] Laishram S, Shimray R, Sharma AB, Pukhrabam G, Singh AM, Sharma LOC. Neoplastic lesions in bone marrow. A 10 year study in a teaching hospital. JLMCM 2008; 9: 175-178
- [18] Carvalho NF, Kemy RD, Carrington PH, Hall DE. Severe nutritional deficiencies in toddlers resulting from breast milk alternative. Paediatrics 2001; 131: E46.
- [19] Kumar R, Sangwan L, Peter R, Bansal S, Malik T. Prevalence and aetiology of nutritional anaemia in children

aged 6 month to 60 month in Fatehabad district of Haryana. Journal of Basic and Applied Sciences 2014; vol 4(1): 317-321.

[20] Stoltzfus R. Iron deficiency: Global prevalence and consequences. Food. Nutr Bull 2003; 24(4): S99-103.

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