

Indications and outcomes of bone marrow aspiration cytology in a Nigerian tertiary hospital: The Federal Medical Centre, Yola experience

Jasini James¹, Ochaka J Egesie², Obadiah D Damulak², Ezra D Jatau², Ayuba Zakari², Chinedu N Okeke³, Chavala G Nathan¹, Aisha Bornoma¹, Anita J D Sayi⁴

Abstract

Background: Bone marrow aspiration (BMA) cytology is a useful investigative tool in the diagnosis of haematological and non-haematological disorders. The purpose of this work was to identify the main indications and diagnostic outcomes of BMA cytology in our facility.

Methods: A retrospective review of all BMA cytology reports of patients that underwent this procedure in Federal Medical Centre, Yola from January 2018 to December 2019 was carried out.

Results: A total of one hundred and four (104) patients underwent BMAs in the period under review. This comprised of 59 (56.7%) males and 45 (43.3%) females. Their ages ranged between 3 and 82 years with median age of 38 years and interquartile range (IQR): 22-55. The most common clinical indication for BMA was recurrent anaemia which accounted

for 64.4% of all indications, while the most frequent diagnostic outcome was Megaloblastic Anaemia accounting for 34.6%.

Conclusion: It is concluded that the commonest indication for BMA cytology in our facility is recurrent anaemia. The most frequent diagnostic outcome is megaloblastic anaemia. Considering its safety and cost-effectiveness, BMA cytology is a valuable diagnostic procedure among patients presenting with recurrent anaemia in our environment

Key words: Bone marrow aspiration, cytology, indications, outcomes, Yola

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Introduction

Bone marrow aspiration (BMA) is a useful investigation tool in the diagnosis of haematological and non-haematological disorders.^{1,2} However, it was not until 1905, when the Italian physician Pianese reported bone marrow infiltration by the parasite *Leishmania*, that this procedure was applied to clinical evaluation.³ BMA is an invasive procedure that involves the use of aspiration needle that gains access to the marrow cavity during which representative specimen of spongy bone marrow is obtained for diagnostic evaluations especially cytology and stem cell harvest.⁴ More sophisticated and ancillary techniques in which bone marrow aspiration is used include cytochemical stains procedures for cell marker studies, immunophenotyping, microbiologic tests, cytogenetic analysis and molecular studies.⁵

Additionally, for therapeutic reasons, BMA is a major procedure for harvesting stem cells for haemopoietic stem cell transplantation.⁶ Often, a trephine biopsy is carried out as part of the same

procedure.⁷ The procedure of bone marrow aspiration is cost-effective, technically simple for the experienced and is associated with minimal complications when precautions are taken.⁷ Indications include diagnosis, staging, and therapeutic monitoring for lymphoproliferative disorders such as Hodgkin and non-Hodgkin lymphoma, hairy cell leukaemia, chronic lymphocytic leukaemia, myeloproliferative disorders, myelodysplastic syndrome and multiple myeloma.⁸ Furthermore, evaluation of cytopenias, thrombocytosis, leukocytosis, anaemia, and iron status can be performed. Bone marrow examination is also done to rule out infiltrative infectious diseases such as fungal infections, tuberculosis, and other granulomatoses.⁸

The application of bone marrow analysis has grown to incorporate other, non-haematologic, conditions such as investigation for pyrexia of unknown origin (PUO), in those with AIDS and other conditions.⁹

The recommended Turn-Around Time (TAT) is 24 hours irrespective of the indication, site used and the staining technique employed, as timely reporting can be life saving.¹⁰

This work described our experience in Federal Medical Centre, Yola (FMCY), with special emphasis on indications and diagnostic outcomes of bone marrow examination.

Materials and Methods

The study was approved by the Ethical committee of the FMCY. This was a descriptive retrospective study in which records of all patients that underwent BMA

¹Department of Haematology and Blood Transfusion Federal Medical Centre, Yola ²Department of Haematology and Blood Transfusion Jos University Teaching Hospital, Jos ³Department of Haematology and Blood Transfusion Bingham University Teaching Hospital, Jos ⁴Department of Nursing Services, Federal Medical Centre, Yola

All correspondences to:

Jasini James

Email: jasinijames31@gmail.com

cytology in FMCY, from January 2018 to December 2019 were retrieved and data analyzed. The information obtained included the demographic data, indications for the procedure and established diagnoses.

BMA is invasive and require proper patient education and consent. In brief, the procedure consists of inserting a special needle (Salah bone marrow aspiration needle) into specific sites of bone such as posterior iliac crest commonly or anterior iliac crest, under aseptic conditions and anaesthesia, collecting sample of the marrow which will be examined microscopically. All reports of BMA procedure done within the period under review were selected for the study and none was excluded.

Statistical analysis

The data were analyzed using Statistical Package for Social Science (SPSS) version 23.0 software. Continuous variables uniformly distributed were described using mean and standard deviation (SD), while the non uniformly distributed continuous variables were reported as median with interquartile (IQR) range and compared using the Kruskal Wallis test. The main outcome variables analyzed were age, sex, indication of BMA and the diagnoses.

Results

A total of one hundred and four (104) patients underwent BMA procedure in the period under review. This comprised 59 (56.7%) males and 45 (43.3%) females with a ratio of 1.3:1. Their ages ranged between 3 and 82 years with median age of 38 years and IQR: 22-55. Majority 79 (75.0%) of the patients were aged between 18 and 64 years (Table 1).

The most common clinical indication for BMA was recurrent anaemia in 67 (64.4%) of the patients, followed by massive splenomegaly 16 (15.4%) and pancytopenia 6 (5.8%) (Table 2). The most common diagnosis was Megaloblastic Anaemia in 36 (34.6%) affecting patients mostly within the age range of 18 and 64 years that constituted 29.8% of all cases, followed by Acute Myeloid Leukaemia in 15 (14.4%) cases and Chronic Myeloid Leukaemia in 10 (9.6%) cases. Reactive Bone Marrow Plasmacytosis and Waldenstrom Macroglobulinaemia diagnosis was made respectively in one case only (Table 3).

The diagnoses stated above were reached based on bone marrow findings mainly, and other ancillary investigations such as serum protein electrophoresis (SPEP), Philadelphia chromosome detection and BCR-ABL1 mRNA transcripts quantitation etc.

Table 1: Age and sex distribution of patients

| Age group (years) | Male n(%) | Female n(%) | Total (%) |
|--------------------|-----------|-------------|-------------|
| <5 (under 5) | 1 (1.0) | 0 (0.0) | 1 (1.0) |
| 5-17 (children) | 7 (6.7) | 4 (3.8) | 11 (10.6) |
| 18-44 (adults) | 28 (26.9) | 22 (21.2) | 50 (48.1) |
| 45-64 (middle age) | 17 (16.3) | 12 (11.5) | 29 (27.9) |
| ≥65 (elderly) | 6 (5.8) | 7 (6.7) | 13 (12.5) |
| Total | 59 (56.7) | 45 (43.3) | 104 (100.0) |

Table 2: Indications for BMA

| Indication | Frequency (%) |
|---|---------------|
| Recurrent anaemia | 67 (64.4) |
| Massive splenomegaly | 16 (15.4) |
| Pancytopenia | 6 (5.8) |
| Post chemotherapy (To confirm remission) | 4 (4.0) |
| Thrombocytopenia | 3 (2.9) |
| Generalized lymphadenopathy & bone pain | 1 (1.0) |
| Hepatosplenomegaly & peripheral plasmacytoid lymphocytes | 1 (1.0) |
| Hypersplenism | 1 (1.0) |
| Lymphocytosis & generalized lymphadenopathy | 1 (1.0) |
| Non Hodgkin's lymphoma | 1 (1.0) |
| Chronic back pain & Pathological fracture | 1 (1.0) |
| Recurrent fever & proptosis | 1 (1.0) |
| Plasmacytoma | 1 (1.0) |
| Total | 104 (100) |

Discussion

In this study we described in summary the basic procedure, our findings of the indications and diagnostic outcomes of bone marrow aspiration for the period under review. The BMA can be done for all age groups and gender, however, in our study the patients were aged between 3 and 82 years with male preponderance. Nearly comparable age ranges with male preponderance were reported by various studies conducted locally and internationally. Awwalu *et al*¹¹ and Egesie *et al*¹² working independently in Zaria and Jos reported an age range of 1-78years and 3-77years respectively with male preponderance. In India, Khan *et al*¹³ and Gohli *et al*¹⁴ reported age ranges between 1-80 and 1-78 years respectively with male preponderance. However in Ghana, Beddu-Addo *et al*¹⁵ reported female preponderance which is at variance with our findings. This could mean that in Ghana based on study by Beddu-Addo *et al*¹⁵ more females accessed medical care than their male counterpart.

Table 3: Outcomes of bone marrow aspiration cytology by age group

| Diagnosis | <5years | 5-17years | 18-44years | 45-64years | ≥65years | Total (%) |
|---------------|----------|------------|------------|------------|------------|------------|
| MA | 0 | 2 (1.9%) | 16 (15.4%) | 15 (14.4%) | 3 (2.9%) | 36 (34.6) |
| AML | 1 (1.0%) | 6 (5.8%) | 5 (4.8%) | 2 (1.9%) | 1 (1.0%) | 15 (14.4) |
| CML | 0 | 0 | 9 (8.6%) | 1 (1.0%) | 0 | 10 (9.6) |
| AA | 0 | 1 (1.0%) | 4 (3.8%) | 1 (1.0%) | 3 (2.9%) | 9 (8.7) |
| ALL | 0 | 0 | 6 (5.8%) | 0 | 0 | 6 (5.8) |
| CLL | 0 | 0 | 0 | 2 (1.9%) | 4 (3.8%) | 6 (5.8) |
| Combined | 0 | 0 | 3 (2.9%) | 2 (1.9%) | 1 (1.0%) | 6 (5.8) |
| IDA & MA | | | | | | |
| HR | 0 | 1 (1.0%) | 3 (2.9%) | 0 | 0 | 4 (3.9) |
| ITP | 0 | 0 | 2 (1.9%) | 1 (1.0%) | 0 | 3 (2.9) |
| NBM | 0 | 0 | 1 (1.0%) | 2 (1.9%) | 0 | 3 (2.9) |
| MM | 0 | 0 | 1 (1.0%) | 1 (1.0%) | 0 | 2 (1.9) |
| BMM | 0 | 0 | 0 | 1 (1.0%) | 1 (1.0%) | 2 (1.9) |
| RBM | 0 | 1 (1.0%) | 0 | 0 | 0 | 1 (1.0) |
| Plasmacytosis | | | | | | |
| WM | 0 | 0 | 0 | 1 (1.0%) | 0 | 1 (1.0) |
| Total | 1 (1.0%) | 11 (10.6%) | 50 (48.1%) | 29 (27.9%) | 13 (12.5%) | 104(100.0) |

Key:

ALL: Acute Lymphoblastic Leukaemia

AML: Acute Myeloid Leukaemia

BMM: Bone Marrow Metastasis

CLL: Chronic Lymphocytic Leukaemia

CML: Chronic Myeloid Leukaemia

IDA & MA: Iron Deficiency Anaemia & Megaloblastic Anaemia

HR: Haematological Remission

ITP: Immune Thrombocytopenic Purpura

MA: Megaloblastic Anaemia

MM: Multiple Myeloma

NBM: Normal Bone Marrow

RBM: Reactive Bone Marrow

WM: Waldenstrom Macroglobulinaemia

AA: Aplastic Anaemia

We observed from this study that the commonest indication for BMA was recurrent anaemia which accounted for 64.4% of all indications. Similar findings were reported in Bauchi (North-eastern Nigeria), Enugu (South-eastern Nigeria), Kenya and Pakistan.¹⁶⁻¹⁹ In contrast to our findings, pancytopenia was the most common indication for BMA as reported by Elmadhoun *et al*²⁰ in Sudan. In their study, Elmadhoun and colleagues reported that the most common age group that underwent the procedure were adults above 45 years. This finding points to the age of bone marrow derangements such as aplastic anaemia presenting as pancytopenia.²⁰

Megaloblastic anaemia was the most common

diagnosis encountered constituting 34.6% of all the cases studied followed by AML. The findings of megaloblastic anaemia as the commonest diagnosis may be connected with the poor socioeconomic status of the people of Adamawa and environs as they constitute majority of the studied population. This is further buttressed by the National Bureau of Statistics report of May 2020, on Poverty and Inequality in Nigeria 2019.²¹

Poor cooking methods that destroy most of the folate in vegetables may also be a contributing factor. Other systemic diseases with associated hyper-metabolism may contribute to this finding too.²² This agrees with the findings of Khan *et al*¹³, Gohli *et al*¹⁴ and Rufai *et al*¹⁶, but in contrast to what has been documented as the commonest cause of anaemia worldwide, that is iron deficiency anaemia.²² Mixed nutritional deficiency and acute leukaemia were the commonest BMA diagnoses reported by Awwalu *et al*¹¹ and Egesie *et al*¹² respectively, this also was at variance with our findings.

Normal bone marrow finding was seen in 2.9% of cases in this study similar to what was reported by Rufai *et al*¹⁶ in Bauchi. However, higher frequencies were reported in Zaria,¹¹ Ghana¹⁵ and India.^{13,14} This can be attributed to the nature of requests and referrals to the Haematology unit by the clinicians. There is the need for referring clinicians to consider involving specialist input before requesting BMA for their patients.

We also observed from this study that majority (97.1%) of the patients sent for BMA cytology had a diagnosis. This makes BMA a valuable tool in investigating the causes of anaemia in a resource poor

country, provided experienced haematologists are available for interpretation.

The limitations of our study include the following; further investigations such as cytochemistry, immunophenotyping (flow cytometry) and cytogenetic studies to confirm diagnosis especially for acute leukaemias (AML & ALL) were not possible due to lack of facility to perform these investigations in our centre. The patients could not access these services at other referral centres due to financial constraints.

Conclusion

This study identified the most common indication and diagnostic outcome of BMA in our setting to be recurrent anaemia and megaloblastic anaemia respectively, hence providing an insight into the commonest cause of recurrent anaemia necessitating BMA in our environment. It is concluded that BMA procedure is important and crucial in reaching a diagnosis in our environment and should always be included in the investigative work up of patients presenting with anaemia especially in settings where qualified haematologists are found.

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Conflict of Interests

The authors hereby declare that they have no conflict of interest.

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