

*Original article*

## Diagnostic Evaluation of Haematological Diseases Based on Bone Marrow Examination

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### *Abstract*

**Background:** Bone marrow examination is a safe invasive procedure and can provide sufficient explanation for unexplained cytopenias, leukaemia and other haematological disorders including metastases to the marrow by detailed morphological description of the marrow elements.

**Objective:** To see the importance of bone marrow examination for the diagnosis of haematological disorders.

**Materials and Methods:** It was a descriptive cross-sectional study comprising 196 patients who underwent bone marrow examination for evaluation of haematological disorders in the Department of Haematology, Enam Medical College and Hospital during the period of July 2012 to December 2019. **Results:** Total number of cases were 196, male to female ratio was 1.56:1 and majority of the patients were >18 years of age (84.69%). Common indications for bone marrow examination were pancytopenia (33.67%) and diagnosis of leukaemia/myeloproliferative neoplasm (23.98%). In our study, haematological conditions were 79.08%. Among these malignant conditions were 55.10% and nonmalignant conditions were 23.98%. Aplastic anaemia (14.29%) and immune thrombocytopenia (7.65%) were the most common non-malignant disorders. Common malignant disorders were acute myelogenous leukaemia (20.41%) and multiple myeloma (9.69%). **Conclusion:** Bone marrow examination is a simple and effective procedure in reaching the final diagnosis of haematological diseases.

**Key words:** Bone marrow examination; Haematological disorders; Pancytopenia; Acute myelogenous leukaemia

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### Introduction

The bone marrow is the major haematopoietic organ and a primary lymphoid tissue, responsible for the production of erythrocytes, granulocytes, monocytes, lymphocytes and platelets.<sup>1</sup> Both primary and secondary diseases affect the marrow and distort the normal marrow cellular architecture. The type of

haematological disorders are different in the developed countries than in developing countries and usually present with features of anaemia, thrombocytopenia, and neutropenia.<sup>2</sup> In most of the cases we reach the diagnosis by detailed history, physical findings and some basic blood tests. However, in many cases bone

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marrow examination is essential for confirmation of diagnosis, staging of the diseases and monitoring of treatment. Bone marrow examination can provide sufficient explanation for unexplained cytopenias, leukaemia and other haematological disorders including metastases to the marrow by detailed morphological description of the marrow elements.<sup>3</sup> It is a most frequent and safe invasive procedure done routinely in the hospitals with very little or no risk of bleeding and can be done safely in case of severe thrombocytopenia.<sup>4</sup> The aim of this study is to see the importance of bone marrow examination for the diagnosis of different haematological disorders.

### Materials and Methods

This descriptive cross-sectional study was done in the Department of Haematology, Enam Medical College & Hospital (EMCH) from July 2012 to December 2019. Sample size was 196 which was purposively selected. Clinical parameters were assessed, peripheral blood smear along with necessary haematological investigations were done. Then bone marrow aspiration was done thereafter. When aspirated material was inadequate or dry tap, trephine biopsy was done. Data were collected and subsequently analyzed. In our study all patients which were indicated for bone marrow examination were selected except previously diagnosed cases.

### Results

Total 196 patients were included in this study, age range between 2 to 85 years. The mean age was 41.96 years. Two (1.02%) patients were under 5 years, 28 (14.29%) between 5 years to 18 years, 166 (84.69%) were above 18 years. Out of 196 patients, 119 (60.71%) were male and 77 (39.29%) were female with male to female ratio 1.56:1. Most common indication of bone marrow examination was pancytopenia in 66 (33.67%) cases and diagnoses of leukaemia/myeloproliferative neoplasm (MPN) was 47 (23.98%). Indications of bone marrow examination are given in Table I.

Among the 196 cases, normal marrows were 31 (15.82%) and pathological marrows were 165 (84.18%). In case of pathological marrow, 155 (79.08%) were haematological diseases and 10 (5.10%) were non-haematological diseases. Malignant haematological conditions were 108 (55.10%) and nonmalignant haematological conditions were 47 (23.98%). Aplastic anaemia (n=28, 14.29%) and immune thrombocytopenia (n=15, 7.65%) were the most common non-malignant haematological disorders. Common malignant haematological disorders were acute myelogenous leukaemia (n=40, 20.41%) and multiple myeloma (n=19, 9.69%). The spectrum of haematological disorders is summarized in Table II.

Table I: Indication of bone marrow examination (n=196)

Clinical conditions	Number	Percentage
Anaemia	38	19.39
Thrombocytopenia	16	8.16
Bicytopenia	14	7.14
Pancytopenia	66	33.67
Leuco-erythroblastic blood picture	2	1.02
Diagnosis of Leukaemia and MPN	47	23.98
Fever of unknown origin	2	1.02
Low back pain, body ache	11	5.61

MPN: Myeloproliferative Neoplasm

Table II: Haematological disorders found in the study (n=155)

Haematological diseases	Number	Percentage
<i>Nonmalignant condition</i>	47	30.32
Megaloblastic anaemia	4	2.58
Aplastic anaemia	28	18.06
Immune thrombocytopenia	15	9.68
<i>Malignant condition</i>	108	69.68
Acute lymphoblastic leukaemia (ALL)	17	10.97
Acute myelogenous leukaemia (AML)	40	25.81
Chronic lymphocytic leukaemia (CLL)	1	0.61
Chronic myelogenous leukaemia (CML)	11	7.10
Multiple myeloma	19	12.26
Myelodysplastic syndrome	10	6.45
Myelofibrosis	1	0.61
Essential thrombocythemia	5	3.23
Polycythaemia rubra vera	4	2.58

## Discussion

Bone marrow examination is one of the most important diagnostic procedures in haematological practice. It is useful not only for the diagnosis of different blood disorders but also for various systemic illnesses. In this study, the age ranged 2 years to 85 years. Mahfuz et al<sup>5</sup> reported similar findings. Mean age of our patients were 41.96 years. Mean age found by Pudasaini et al<sup>4</sup>, Mahfuz et al<sup>5</sup>, Gandapur et al<sup>6</sup>, Atla et al<sup>7</sup>, Kibria et al<sup>8</sup> were 37.9, 28.2, 40, 32.4 and 27.05 years in their respective studies. In present study, majority (84.69%) of the patients were above 18 years which is similar to that reported by Ekwere et al<sup>9</sup> in their study (79%). Male to female ratios were 1:0.59, 2:1, 1: 0.70, 1.2:1 in the studies of Mahfuz et al<sup>5</sup>, Gandapur et al<sup>6</sup>, Kibria et al<sup>8</sup>, Ekwere et al<sup>9</sup>. In our study, it was 1.56:1. Pancytopenia (33.67%, n=66) was the most common indication of bone marrow examination in our study. The study results are near similar with Atla et al<sup>7</sup> (37%) and Ahmad et al<sup>10</sup> (29.8%). However, pancytopenia was the third common indication in the study done by Gandapur et al<sup>6</sup> (22.80%), Bashawri et al<sup>11</sup> (11.9%), Dapus et

al<sup>12</sup> and Tripathy et al<sup>13</sup>. They reported anaemia as the commonest indication for this procedure, but in this study, it was the third common indication. In our study, pathological marrows were 84.18%. Mahfuz et al<sup>5</sup>, Ekwere et al<sup>9</sup> showed pathological marrows 97.80% and 93.50% respectively in their studies. Malignant/non-malignant haematological disorders were 86.60% in Mahfuz et al<sup>5</sup> which is near similar to our study findings (79.08%). Malignant and non-malignant haematological conditions were 55.10% and 23.98% separately in this study. In their study Mahfuz et al<sup>5</sup> found these lesions 64.20% and 22.4% respectively. Among the non-malignant disorders, aplastic anaemia was 14.29%. Diagnosis was based on bone marrow examination and trephine biopsy. Mahfuz et al<sup>5</sup>, Kabria et al<sup>8</sup>, Rahim et al<sup>14</sup> and Sreedevi et al<sup>15</sup> found aplastic anaemia 8%, 10.73%, 14.15% and 9.3% in their studies. In suspected cases of ITP, we examine bone marrow to exclude other haematological diseases. ITP was seen in 7.65% cases in our study. Some other studies showed it 4.8%, 8.9%, 6.21%, and 6.5%.<sup>5,6,8,9</sup> In case of megaloblastic anaemia, our finding was lower (2.04%) than other studies done by Pudasaini et al<sup>4</sup> (12.3%), Mahfuz

et al<sup>5</sup> (8%), Ahmed et al<sup>10</sup> (11%). In our center, we avoided bone marrow examination in suspected cases of megaloblastic anaemia because it is not essential for diagnosis. In case of haematological malignancy, acute leukaemia was 29.08%. Among these acute myelogenous leukaemia (AML) were 20.41% and acute lymphoblastic leukaemia (ALL) were 8.67%. In our country, Hossain et al<sup>16</sup> found AML 28.3% and ALL 14.1%. These findings are higher than our findings because it was a multicenter national level study. In our study, AML is more common than ALL. Similar studies were conducted by Kibria et al<sup>8</sup> and Shastry et al<sup>17</sup>, where maximum cases were of AML.

In the present study, multiple myeloma was 9.69%, which is similar to the studies of Kibria et al<sup>8</sup> (9.04%), Ekwere et al<sup>9</sup> (8.1%), and Hossain et al<sup>16</sup> (10.5%). In this study myelodysplastic syndrome was 5.10%. Mahfuz et al<sup>5</sup>, Gandapur et al<sup>6</sup>, Hossain et al<sup>16</sup> showed it 3%, 3.3%, 4.5% respectively in their studies.

The incidence of myeloproliferative neoplasm (MPN) in this study was 10.71%. Among the MPN, chronic myelogenous leukaemia (CML) was 5.61%, essential thrombocythaemia (ET) 2.55%, polycythaemia vera 2.04%, and myelofibrosis 0.51%. MPN 8.57% and CML 5.71% were seen by Kumar et al<sup>18</sup>, 10.5% MPN was seen by Atla et al<sup>7</sup> and 7.4% CML was seen by Mahfuz et al<sup>5</sup> which were near similar to the findings in our study.

Bone marrow examination is a safe invasive procedure done routinely in the hospital. It is a simple and valuable diagnostic tool in the diagnosis and management of haematological as well as non-haematological diseases. When routine investigations fail to reach a final diagnosis, this can help in early diagnosis of the disease and subsequently its management. In this study, we used bone marrow examination for the diagnosis of various haematological diseases.

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