

BONE MARROW BIOPSIES: A PATTERN ANALYSIS WITH EMPHASIS ON LEUKEMIAS AND ANEMIAS

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ABSTRACT

Objective: To review the bone marrow biopsies to see pattern of leukemia and anemias.

Material and Methods: Retrospective descriptive laboratory-based study conducted in the Pathology Department of Naseer Teaching Hospital, Peshawar from January 2014 to December 2014. Records of all patients were retrieved and data extracted. Inclusion criteria was availability of peripheral smear and complete bone marrow biopsy reports. Excluded were those with history of allergy to any medications or pregnancy.

Results: Age group 10-39 years represented 61.79% of patients were referred for bone marrow biopsies. 1.6 times more males were subjected to bone marrow biopsies than females. Anemia was the most common peripheral cytopenia followed by thrombocytopenia and leukopenia. ALL was found to be the most common pathology found in bone marrow reports followed by Hemolytic Anemia and other malignancies.

Conclusion: It is a simple and reliable procedure to diagnosis different hematological diseases . Also is an effective diagnostic tool when routine investigations fail to make conclusive diagnosis.

Key Words: Bone Marrow Biopsy, Hematological Malignancies, Anemias.

This article may be cited as: Safer M, Rahman SU, Khan MN. Bone marrow biopsies: a pattern analysis with emphasis on leukemias and anemias. *J Med Sci* 2016; 24: (4) 212-215.

INTRODUCTION

Bone marrow biopsy is a useful investigation tool to help diagnose hematological and non-hematological disorders¹ and is performed for many indications such as leukemias, anemias and other hematological pathologies². This procedure is widely use to evaluate the blood cells within the bone marrow, as well as its structure. It is performed along with a complete blood count (CBC) and blood smear to provide information about the health of the bone marrow and capability for blood cell production, including red blood cells (RBCs), white blood cells (WBCs), and platelets.

This is not a routine test but is useful in helping to detect, diagnose, monitor and/or stage a number of diseases and conditions that can affect the bone mar-

row and blood cell production. The procedure of bone marrow biopsy is a cost-effective, technically simple procedure when performed by the experienced and is associated with minimal hazards when precautions are taken³.

MATERIAL AND METHODS

Retrospective descriptive study laboratory-based study conducted in the pathology department of Naseer Teaching Hospital. Records of all patients underwent bone marrow biopsies, during period from January 2014 to December 2014 were retrieved and data extracted.

The information obtained included the demographic data i.e. age and sex of the patient, the most common diagnoses established. A special form was designed for this purpose in which data was displayed. Those reports were included where peripheral smear data was available and where the bone marrow biopsy reports were complete. Those patients who had history of allergy to any medications or were pregnant were not included in study population. After routine hematological investigations i.e. peripheral smear

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Date Received: March 8, 2016

Date Revised: May 10, 2016

Date Accepted: October 5, 2016

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bone marrow biopsy was taken. Smears were made, stained and examined. Patients were referred to hematology department for diagnosis of different clinical and hematological conditions. The presenting signs were anemia, fever or previous history of hematological malignancies.

We looked for the Cellularity in which the volume of cells was compared to the volume of other components of the bone marrow, such as fat. Myeloid/erythroid ratio (M/E) ratio which compared the number of myeloid cells to erythroid cells. Differential count was done where WBC, RBC, platelet-producing cells studied to see orderly and complete maturation, and whether the cells are present in normal proportion to one another.

Leukemia was define as the excessive production of one blood cell, resulting in the presence of large quantities of cells that do not function as normal ones do. Anemia was low number of red blood cells and low hemoglobin. Decreased red blood cells and no increase in reticulocytes was aplastic anemia with suppressed RBC production in the marrow. Data was analyzed in SPSS 17 and results were presented in text and tabular form all patients gave written informed consent for bone marrow sampling. Approval was taken by the Naseer Teaching Hospital Institutional Ethical Review Board before implementation and collection of samples.

RESULTS

A total of 89 bone marrow aspirates were analyzed during 2014. The most common referral symptoms for biopsies were anemia, fever, and/or previous histories of hematological malignancies. Patient demographics are summarized in Table 1.

Table 2 summarizes the frequency of various pathologies found in bone marrow biopsies during 2014. The most important pathology was found to be various leukemias accounting for 48.3% of all bone marrow biopsies. Among these Acute Lymphoblastic Leukemia (ALL) was the single most predominant (30.3%) pathology, 21.3% of bone marrow biopsies were consistent with features of various anemias including aplastic anemias (2.2%), while 23.6% of biopsies were found normal including those which were performed because of anemia in peripheral smears. Later accounted for 5.6% of all bone marrow biopsies.

Table 3 compares the findings of peripheral smears done at the time of marrow biopsies. The three major categories of bone marrow biopsies described above are contrasted. As can be seen, Anemia was universal in all cases except one. Normal TLC Counts were predominant in cases of normal bone marrow biopsies, and those with features of anemias; equal numbers of cases of normal leukocyte count and increased leukocyte counts were noted in leukemic biopsies. Leukemias

also represented the single case of decreased leukocyte count. Another important feature regarding leukemias was the very high mean TLC count in peripheral smears i.e. 54700.

Table 4 summarizes the bone marrow findings in ALL vs Hemolytic Anemias. As is depicted, in hemolytic anemias the only significant findings were increased

Table 1. Segregation of Bone Marrow Biopsy Reports on the basis of Gender and age group

Age group in years	Gender		Count	Percentage
	Male	Female		
0-9	5	1	6	7.7
10-19	17	9	26	33.3
20-29	6	7	13	16.7
30-39	7	9	16	20.5
40-49	2	1	3	3.8
50-59	2	2	4	5.1
60-69	9	1	10	12.8
Undetermined	11			12.4
Total	48	30	89	100

Table 2: Frequency of various pathologies found in bone marrow biopsies

Class	Pathology	Count	Percentage
Anemias	Aplasia	2	2.2
	Features of Hemolytic Anemia	17	19.1
Leukemias	Acute Lymphoblastic Leukemia	27	30.3
	Chronic Lymphocytic Leukemia	1	1.1
	Acute Myeloblastic Leukemia	8	9.0
	Chronic Myelogenous Leukemia	7	7.9
Pre-leukemic Disorders	Myelodysplastic Syndrome	2	2.2
Bone Marrow Infiltration	Lymphoma invading Bone Marrow	1	1.1
Normal Bone Marrow Studies	Normal Bone Marrow Studies with Anemia in Peripheral Smear	5	5.6
	Normal Bone Marrow Study	16	18
Total		89	100

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Table 3: Comparison of Peripheral Smear in Normal Biopsy Reports Vs Anemias and Leukemias

Normal Bone Marrow Biopsies (n=21)				Anemias (n=19)			Leukemias (n=43)		
No. of Cases	De-creased %age	Normal %age	Increased %age	De-creased %age	Normal %age	Increased %age	De-creased %age	Normal %age	Increased %age
Hb Levels	20(95.2%)	1(4.8%)	0	19(100%)	0	0	43(100%)	0	0
TLC	0	16(76.2%)	5(23.8%)	0	13(68.4%)	6(31.6%)	1(2.3%)	21(48.8%)	21(48.8%)
Plt	1(1.8%)	17(81%)	3(14.3%)	8(42.1%)	10(52.6%)	1(5.3%)	24(55.8%)	18(41.9%)	1(2.3%)

Mean Values found in the above categories of bone marrows

Type of Tests	Normal Bone Marrow Biopsies	Anemias	Leukemias
Hb Min/Max	4/13.6	3.1/10	2.4/11.7
Mean Hb Levels	8.8	6.4	7.8
TLC Min/Max	3500/15000	2800/21000	850/290000
Mean TLC Levels	9348	9200	54700

Table 4. Overview of Bone Marrow Findings in Acute Lymphoblastic Leukemias Vs Hemolytic Anemias

	ALL			Hemolytic Anemia		
	Decreased %age	Normal %age	Increased %age	Decreased %age	Normal %age	Increased %age
Cellularity	6 (22.2%)	10 (37%)	11(40.7%)	1(5.9%)	4(23.5%)	12(70.6%)
Erythropoiesis	12 (44.4%)	6 (22.2%)	9(33.3%)	0	1(5.9%)	16(94.1%)
Granulopoiesis	24 (88.9%)	3 (11.1%)	0	5(29.4%)	12(90.6%)	0
Lymphopoiesis	1 (3.7%)	9 (33.3%)				

cellularity due to increased erythropoiesis in most of the biopsies. On the other hand, almost all lines of maturation were suppressed in ALL except lymphopoiesis where increase was noted in 63% of ALL cases. M/E ratio was universally decreased in ALL as was the uniformity of peroxidase negativity. In 86.7% of cases, there was incomplete remission in ALL at the end of induction therapy.

DISCUSSION

Fifty-five (61.79%) were in age group of 10 to 39 years of age of which males were 1.6 time more biopsied as compare to females reason being men seek treatment more frequently at formal health services also this is the economically productive age for them, whereas women are more likely to self-treat or use alternative therapies. Also due to the multiple roles of females it makes it difficult for them to access the health services⁴ on time.

Leukemia particularly Acute Lymphoblastic Leukemia (ALL) was found as the single most important cause of peripheral cytopenia which is consistent with some studies⁵. But is contrary to studies done in Pakistan, Yemen, Nepal where AML was found

to be the dominant Leukemia^{6,7,8}. The reason being that our study was a hospital based study and only those were included who presented to us, also sample size was too small and also it caters mainly for the Afghan refugees who have different cultural and socioeconomic background then the general population.

Anemia was found as universal presentation in patients referred for bone marrow biopsy even in cases with normal studies. The cause of this anemia could be multifactorial⁹ but in leukemia there is maturation block or suppression of erythroid with increased production of blast cells resulting in decreased or defective production of normal erythrocytes which results in anemia¹⁰. ALL was found to be associated with peripheral cytopenia in majority of cases, thrombocytopenia was found in 55.8% of cases while leucopenia was reported in only one case. Leucopenia in untreated cases is unlikely but thrombocytopenia can be associated in cases of CML in accelerated phase or blast crisis¹¹. Underlying mechanisms of cytopenias are related to infiltration of marrow by neoplastic cells¹², phagocytosis of hematopoietic cells by neoplastic cells¹³, autoimmune destruction of cells¹³ or hypersplenism¹². However

this was reflected in our study where 33.3% of cases showed increased Erythropoiesis because immature erythroid precursors are sensitive to apoptotic triggering mediated by activation of the intrinsic and extrinsic apoptotic pathways¹⁴. Also in post induction period regeneration of erythroid series precedes the regeneration of myeloid series and megakaryocytes, which is the first sign of bone marrow regeneration where as appearance of unilinear islands of erythroid precursors is followed by myeloid cells and megakaryocytes¹⁵.

The limitation of the study was it was a retrospective, hospital record based study. There was selection bias as only those were studied who presented to hospital as it did not take into account the number of similar cases within the community, therefore, the results could not be generalized. Also the data was taken from records which were not filled by the researcher themselves hence lacked relevant information.

CONCLUSION

Although bone marrow biopsy is an invasive procedure but it is a simple and valuable diagnostic tool in the diagnosis and management leukaemia and types of anaemias, where routine investigations fail to reach a conclusive diagnosis, it can help in early diagnosis of the disease and can improve the outcome of the disease morbidity and mortality.

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CONFLICT OF INTEREST: Authors declare no conflict of interest
GRANT SUPPORT AND FINANCIAL DISCLOSURE NIL

AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

- Safeer M:** Main idea.
Rahman SU: Concept and data collection.
Khan MN: Bibliography and statistics.
Gul R: Data collection.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.