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Analysis of Bone Marrow and Peripheral Blood Film findings in sixty diagnosed cases of Lymphoma

Nidhi Goel[1,*], Mohanvir Kaur[2], Manjit Singh Bal[3]

[1]*Dept. of Pathology, Hind Institute of Medical Sciences, Safedabad, Uttar Pradesh, India*
[2]*Dept. of Pathology, Government Medical College, Patiala, Punjab, India*
[3]*Dept. of Pathology, M.M Medical College, Kumarhatti-Solan, Himachal Pradesh, India*

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ABSTRACT

Introduction: Lymphoma constituting 55.6% of hematological malignancy, its prognosis depends on the correct diagnosis and stage of the disease, which is established after examination of peripheral blood film (PBF), bone marrow aspiration (BMA) and bone marrow biopsy (BMB) along with other parameters.
Objective: The objective is to find out the percentage and pattern of bone marrow involvement, along with peripheral blood changes in lymphoma.
Material and Methods: PBF, BMA and BMB findings studied in 60 lymphoma patients during a period of 3 years. The PBF and aspiration smears stained with Leishmann's stain, while the trephine biopsy processed and stained with Haematoxylin and eosin (H & E) stain and Reticulin stain. The results were scrutinized, compared and evaluated.
Results: The male to female ratio was 1.4:1, including 53(88.3%) cases of NHL and 7(11.7%) cases of HL. Most common age group involved in NHL was 51-60 years and in HL was 31-40 years. 19/60 (31.7%) cases showed leucocytic lymphocytosis on PBF examination. Percentage lymphocytes in marrow differential count was increased in 16(26.7%) cases and were reported with bone marrow involvement on BMA and BMB and 1 case having borderline percentage lymphocyte count on BMA was reported as bone marrow involved case, only after examining the BMB. The diffuse pattern of involvement was most common in 7(41.2%), followed by paratrabecular pattern in 6(35.3%) cases.
Conclusion: Thus to conclude bone marrow examination give valuable information in lymphoma, about disease burden, percentage of involvement, pattern of involvement and baseline involvement prior to therapy.

1. Introduction

Peripheral blood film (PBF), Bone marrow aspiration (BMA) and Bone marrow biopsy (BMB) is routinely performed to diagnose haematological diseases. Lymphoma is a primary malignant neoplasm of the lymphoid tissue, these malignant cells often originate in lymph nodes, presenting as an enlargement of the node (a tumor). It can also affect other organs in which case it is referred to as extranodal lymphoma. Extranodal sites include tonsil, thymus, waldyer's ring, gastrointestinal tract, ovaries, testis, skin, lungs and brain.[1]

Lymphomas constitute 55.6% of all hematological malignancy, of which NHL is more common i.e. 47.4% (87.4% of all lymphoma) and HL constituting 7.0% (12.6% of all lymphoma). In NHL B-cell lymphoma make most approximately 85% and T-cell lymphoma is remaining approximately 15%.[2]

Non-Hodgkin lymphoma is divided into four stages based on how far the disease has spread.

1. Stage I (early disease): the cancer is found only in a single lymph node or in one organ or area outside the lymph node.

* *Corresponding author*.
E-mail address: dr.nidhigoel@gmail.com (N. Goel).

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2. Stage II (locally advanced disease): the cancer is found in two or more lymph node regions on one side of the diaphragm.
3. Stage III (advanced disease): the cancer involves lymph nodes both above and below the diaphragm.
4. Stage IV (widespread disease): the cancer is found in several parts of one or more organs or tissues (in addition to the lymph nodes). Or, it is in the liver, blood or bone marrow. [3]

The prognosis therefore depends on the correct diagnosis and stage of the disease, which is established after examination of PBF and BMA, BMB along with other parameters. [1] Bone marrow examination refers to the pathologic analysis of samples of bone marrow obtained by BMB (often called a trephine biopsy) and BMA. Bone marrow examination is useful in the diagnosis of haematological illness and staging of hematologic disease. [4]

In the present study PBF, BMA and BMB were done in those cases where diagnosis of Hodgkin lymphoma and non Hodgkin lymphoma has been made by cytomorphology following working formulation classification. The role of BMA and BMB along with peripheral blood film is to assess the stage of Lymphoma. [5]

The role of the blood smear in the case of lymphoma is to suggest a likely diagnosis or range of diagnosis, to indicate which additional tests should be performed and to provide a morphologic context without which immunophenotyping and other sophisticated investigations cannot be interpreted. In the present study, the concentration was be on the increased lymphocytosis and cytomorphology. [5]

The morphological assessment of aspirated or biopsy specimens of bone marrow is based on two principles. First, it has the organised structure such that in normal health, bone marrow cells display distinct numerical and spatial relationships to each other. Second, that the individual bone marrow cells have distinctive cytological appearances that reflect the lineage and stage of maturation. Each or all of these features may specifically be disordered in disease. [6]

1.1. Bone marrow sampling in lymphoma is done in a number of clinical settings: [7]

1. Staging of patients with diagnosis of lymphoma already established from other tissue site.
2. To establish an initial diagnosis of lymphoma in a patient with lymphadenopathy in deep sites, not readily accessible for biopsy.
3. Restaging of lymphoma patients to evaluate the effectiveness of treatment or for disease recurrence.
4. Evaluation of a patient with cytopenia (s), fever, and/or organomegaly in whom lymphoma is not specifically suspected.

Sampling of the marrow consists of either aspiration of the cellular component and/or acquirement of tissue fragments. Aspiration of the marrow, has been utilized for cytologic assessment, with analysis directed toward morphology and obtainment of a differential cell count. [8]

The pattern of infiltration can only be fully assessed using sections from trephine biopsy specimens. The major patterns can be seen, either alone or in combination. Such patterns are important in the differential diagnosis of lymphoproliferative disorders and can also be of prognostic significance. They are designated: (i) interstitial (ii) focal (iii) diffuse (iv) paratrabecular (v) mixed. [9]

Contraindications to BMA/ BMB a) Hemorrhagic disorders such as congenital coagulation factor deficiencies (eg, hemophilia), disseminated intravascular coagulation and concomitant use of anticoagulants. If a BMA or a BMB is absolutely indicated in these patients, then factor replacement or cessation of anticoagulation should be considered before the procedure, and the patient should be closely monitored for 24h post-procedure. b) Skin infection or recent radiation therapy at the sampling site. C)Bone disorders such as osteomyelitis or osteogenesis imperfecta. [10]

2. Objective

The objective was to find out the percentage and pattern of bone marrow involvement, along with peripheral blood changes in lymphoma.

3. Materials and Methods

The present study was conducted in the Pathology Department enrolling 60 patients including both indoor and outdoor , with microscopic diagnosis of Lymphoma after taking an informed consent. The sex and age of the patient was no criterion for the selection of cases. Detail history including name, age, sex, site of involvement, hepatosplenomegaly, allery to any drug, ongoing treatment or history of medication or treatment taken was recorded. Current and previous laboratory data was reviewed, and a peripheral blood smear examined, to validate the request for a bone marrow study. Request for BMA and BMB is made in already diagnosed cases of lymphoma whether patient has already received any treatment for lymphoma or its done for the first time. The investigations CBC, Reticulocyte Count, PBF, BMA and BMB were performed and recorded in all cases and the data was statistically analysed. The preferred site for bone marrow examination was posterior superior iliac spine. The required procedure were done under Aseptic condition after taking permission from institutional ethical committee and all the procedure were done according to the decleration of Helsinki. Optimal, adequate local anaesthesia, and proper technique with sterilized equipments was used to avoid the incidence of complications related to procedure. After the procedure was complete, the patient was asked to lie flat for 5–10

minutes to provide pressure over the procedure site. Simple analgesics were used to ease soreness, if present. Patients are also advised to avoid washing the procedure site for at least 24 hours after the procedure is completed.

3.1. Statistical analysis

Microsoft Office Excel and Open Epi Software is used for data analysis.

3.2. Observations

The present study comprising of 60 cases of lymphoma is based on critical evaluation of BMA and trephine biopsy along with PBF findings. The patients of all ages and both the sexes were considered in the study. For the convenience, patients were divided age wise into 7 groups i.e. group 1 (0 -10years), group 2 (11-20 years), group 3 (21-30 years), group 4 (31-40 years), group 5 (41-50 years), group 6 (51-60 years) and group (above 60years).

In this study it was observed that the maximum number of patients 20 (33.33%) were of age group 51-60 years followed by 15(25%) patients of age group above 60 years . The males were more commonly affected i.e. 35 (58.3%) were male patients and rest 25 (41.7%) patients were females. The maximum number of 13 (37.1%) male patients were of age group above 60 years followed by 8 (22.9%) of age group 51-60 years, whereas the maximum number of 12 (48%) female patients were of age group 51-60 years, followed by 6 (24%) of age group 31-40 years. (Table 1)

53/60 cases were of NHL and 7 cases were of HL. In NHL 43/53 (81.1%) cases presented with nodal enlargement and 10/53 (18.9%) cases had extranodal presentation. In cases of HL, none had extranodal presentation and all the cases i.e. 7/7 (100%) cases presented with nodal enlargement. (Table 2)

19/60 (31.66%) cases of lymphoma showed increase in ALC in PBF examination. On analyzing we found that these 19/60 (31.66%) cases showing increase were of NHL type. So, 19 /53 (35.8%) cases showed increased ALC in NHL while none (0%) case showed increased level of ALC in HL on PBF examination. (Table 3 , Figure 1)

On BMA, we found that 16/60(26.7%) cases showed increase and 1 /60 (1.66%) case showed borderline and rest 43/60 cases showed normal percentage lymphocyte count in Marrow differential count. On further evaluating we found that the cases with increased and borderline percentage lymphocyte count were of NHL type and none was of HL type. (Table 4 , Figures 2, 3 and 4)

In this study out of 60 cases of lymphoma, 17/60 (28.3%) cases confirmed bone marrow involvement by lymphoma on BMB and 43/60 (71.7%) cases do not showed bone marrow involvement. On analyzing we found that these 17 cases were of NHL type. These cases were the same those revealed increased and borderline lymphocyte percentage count on marrow differential on BMA. (Table 5)

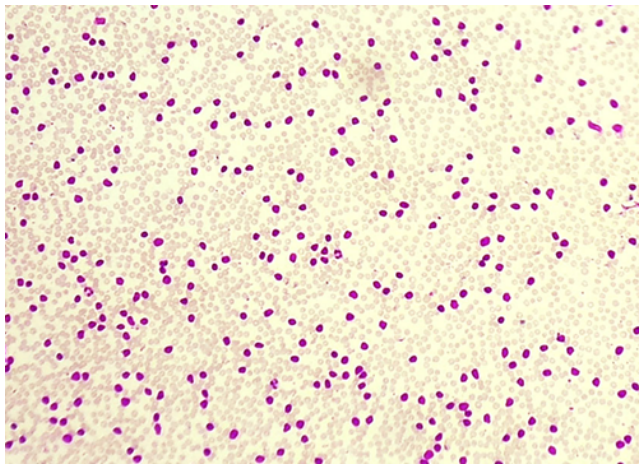

Fig. 1: Photomicrograph showing increased TLC with lymphocytosis in PBF of lymphoma patient (Leishman's stain 40X)

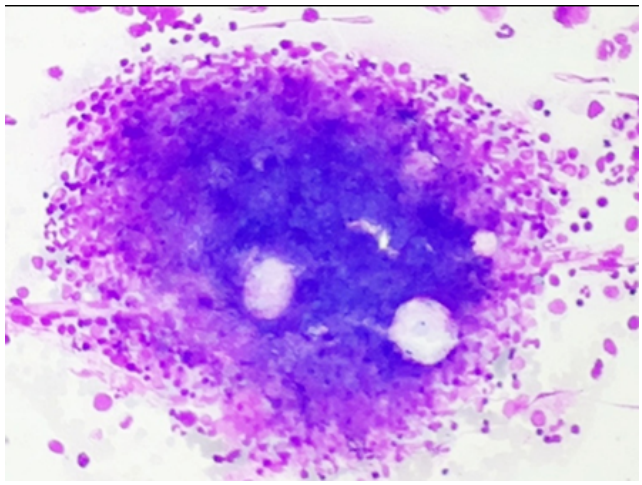

Fig. 2: ShowingBM particle with predominance of Mononuclear cells in BMA smear of lymphoma patients (Leishman's stain 100X)

Out of 17 cases with bone marrow involvement, maximum number 741.2%) cases showed diffuse pattern of bone marrow involvement, followed by 6 (35.3%) cases showed paratrabecular pattern of involvement, 3(17.6%) cases showed mixed pattern of involvement, 1(5.9%) case showed interstitial pattern of involvement and none showed nodular pattern of involvement. (Table 6 , Figures 5 and 6)

In the present study, out of 19 cases with increased absolute lymphocyte count, 17(89.5%) cases showed bone marrow involvement by lymphoma and 2(10.5%) cases do not showed bone marrow involvement. These 2 cases might be due some other reason of lymphocytosis. All these 17 patients with bone marrow involvement showed ALC level increased.

Table 1: Distribution of males and females patients in different age groups

Age Groups (in years)	Male		Female	
	Number of Patients	Percentage	Number of Patients	Percentage
0-10	1	2.9%	0	0%
11-20	1	2.9%	2	8%
21-30	2	5.7%	1	4%
31-40	6	17.1%	6	24%
41-50	4	11.4%	2	8%
51-60	8	22.9%	12	48%
> 60	13	37.1%	2	8%
Total	35	100%	25	100%

Table 2: Distribution of cases with nodal and extranodal involvement in NHL and HL patients

Presentation	Non-Hodgkin Lymphoma		Hodgkin Lymphoma	
	Number of Patients	Percentage	Number of Patients	Percentage
Nodal	43	81.1%	7	100%
Extranodal	10	18.9%	0	0%
Total	53	100%	7	100%

Table 3: Correlation of absolute lymphocyte count (ALC) on PBF

ALC levels	Non-Hodgkin Lymphoma		Hodgkin Lymphoma	
	Number of Patients	Percentage	Number of Patients	Percentage
Increased N=19 (31.66%)	19	35.8%	0	0%
Normal N=41 (68.33%)	34	64.2%	7	100%
Total N=60 (100%)	53	100%	7	100%

Table 4: Distribution of cases on the basis of percentage lymphocyte count in marrow (BMA) IN NHL and HL cases

Percentage lymphocyte count in marrow	Non-Hodgkin Lymphoma		Hodgkin Lymphoma	
	Number of Patients	Percentage	Number of Patients	Percentage
Increased N=16 (26.7%)	16	30.2%	0	0%
Borderline N=1(1.66%)	01	1.88%	0	
Normal N=43 (71.67%)	36	67.92%	7	100%
Total N=60(100%)	53	100%	7	100%

Table 5: Distribution of cases of NHL and HL with bone marrow involvement (BMI) by lymphoma: on the basis of bone marrow examination on BMB

BM Involvement	Non-Hodgkin Lymphoma		Hodgkin Lymphoma	
	Number of Patients	Percentage	Number of Patients	Percentage
Present N=17 (28.33%)	17	32.1%	0	0%
Absent N=43 (72.66%)	36	67.9%	7	100%
Total N=60 (100%)	53	100%	7	100%

Table 6: Distribution of bone marrow involved cases on the basis of pattern of involvement in BMB

Pattern	Number of Patients	Percentage
Diffuse	7	41.2%
Paratrabecular	6	35.3%
Interstitial	1	5.9%
Nodular	0	0%
Mixed	3	17.6%
Total	17	100%

Table 7: Correlation of absolute lymphocyte count and bone marrow involvement in 60 cases of lymphoma

Bone marrow involvement	ALC increased Number of Patients	Percentage	ALC normal Number of Patients	Percentage
Present	17	89.5%	0	0%
Absent	2	10.5%	41	100%
Total cases	19	100%	41	100%

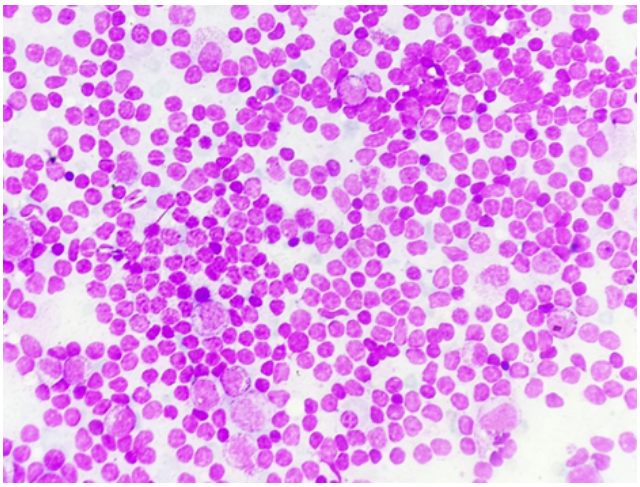

Fig. 3: Photomicrograph showing hypercellular BM with increased lymphocytes in BMA smear of lymphoma patients (Leishman's stain 400X)

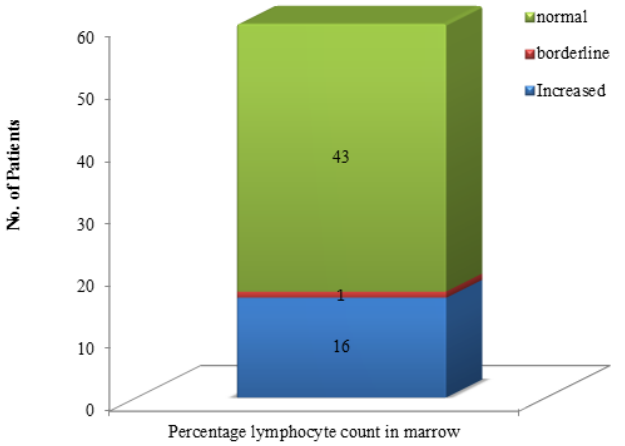

Fig. 4: Percentage lymphocyte count on bone marrow aspiration in 60 CASES of lymphoma

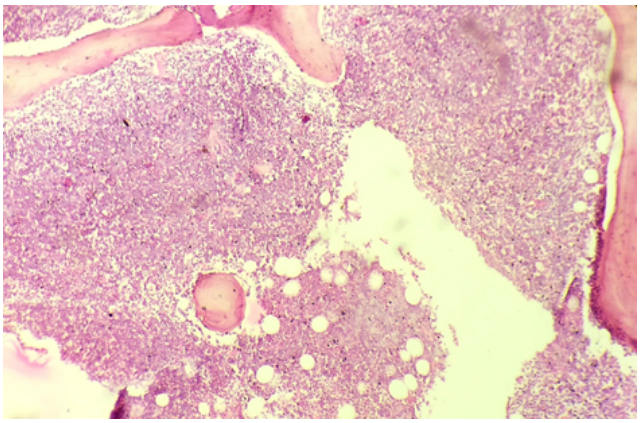

Fig. 5: Photomicrograph showing hypercellularity in thin section of BMB of patient of lymphoma with BM involvement by lymphoma showing diffuse pattern of involvement (H & E stain 100X)

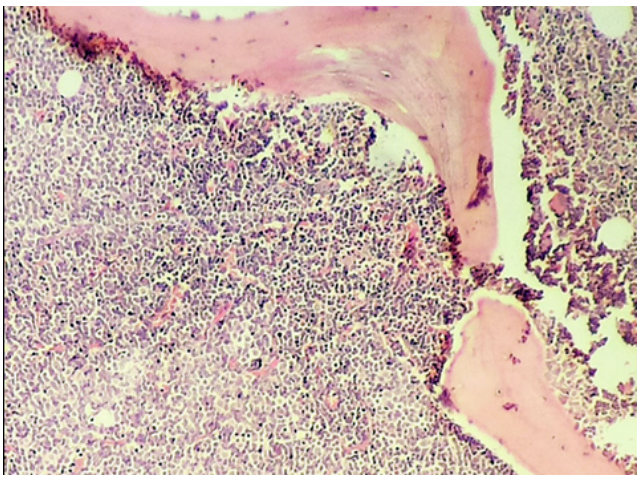

Fig. 6: Photomicrograph showing thin section of BMB of patient of lymphoma with BM involvement by lymphoma showing diffuse pattern of involvement (H & E stain 400X)

Out of 41 cases with normal absolute lymphocyte count, none showed bone marrow involvement by lymphoma. (Table 7)

In this study out of 17 cases with bone marrow involvement by lymphoma, 16(94.1%) cases showed increased percentage lymphocyte count in marrow on bone marrow aspiration but 1(5.9%) case showed borderline percentage lymphocyte count in marrow differential which was confirmed for involvement on BMB. 43 cases of lymphoma without bone marrow involvement by lymphoma showed normal percentage lymphocyte count in marrow differential. (Table 8)

Table 8: Correlation between percentage lymphocyte count in marrow with bone marrow involvement

Percentage lymphocyte count in marrow	BMI Present		BMI Absent	
	Number of Patients	Percentage	Number of Patients	Percentage
Increased	16	94.1%	0	0%
Normal	1	5.9%	43	100%
Total	17	100%	43	100%

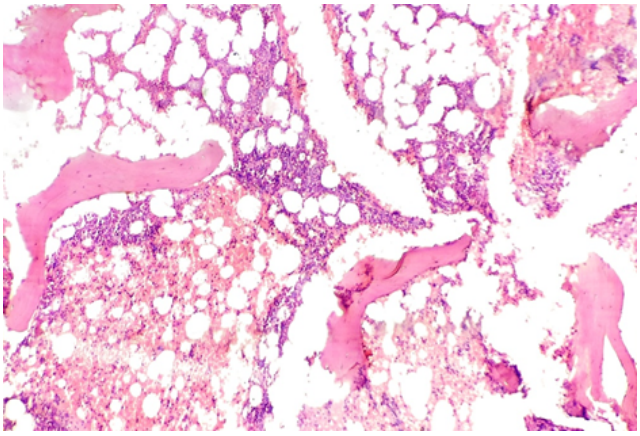

Fig. 7: Photomicrograph showing mildly hypercellularity in thin section of BMB of patient of lymphoma with BM involvement by lymphoma showing paratrabecular pattern of involvement (H & E stain 100X)

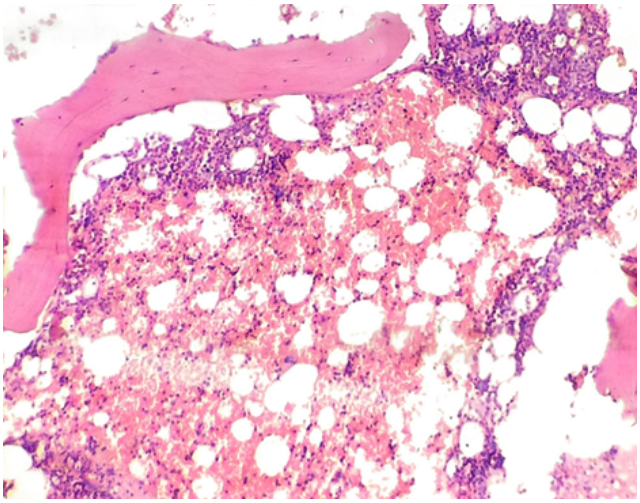

Fig. 8: Photomicrograph showing thin section of BMB of patient of lymphoma with BM involvement by lymphoma showing paratrabecular pattern of involvement (H & E stain 400X)

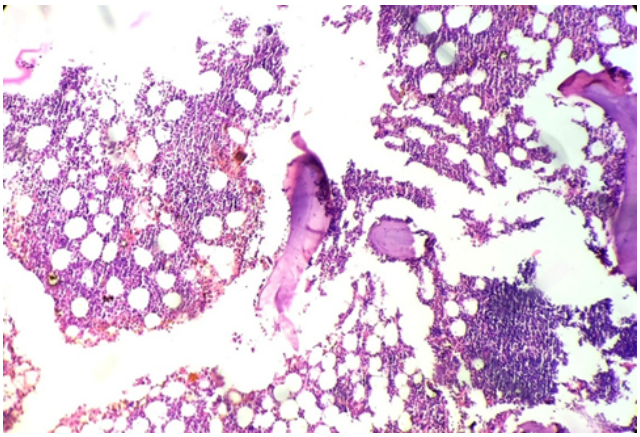

Fig. 9: Photomicrograph showing hypercellularity in thin section of BMB of patient of lymphoma with BM involvement by lymphoma showing mixed pattern of involvement (H & E stain 100X)

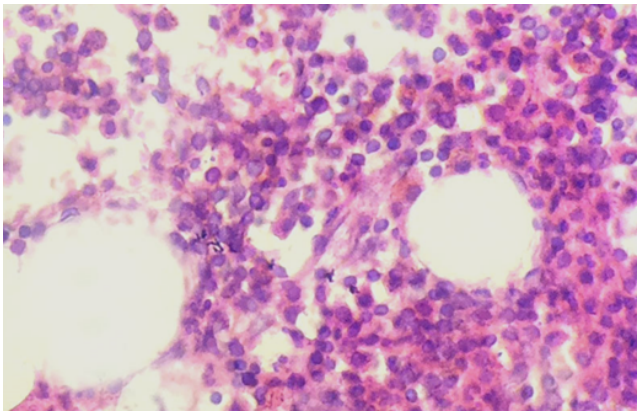

Fig. 10: Photomicrograph showing thin section of BMB of patient of lymphoma with BM involvement by lymphoma showing interstitial pattern of involvement (H & E stain 400X)

4. Discussion

The present study was conducted in the department of Pathology, constituted examination of PBF, BMA and BMB in 60 cases of lymphoma. The results were scrutinized, compared and evaluated.

4.1. Types of lymphoma

Out of 60 cases of lymphoma, 53 cases (88.3%) were of NHL and 7 cases (11.7%) were of HL. The results of this study were compared with other studies which were as follows:

In the present study 88.3% cases of lymphoma were of NHL and 11.7% cases were of HL. Hence, a preponderance of NHL was observed. These results were comparable with results of previous such studies. The study by Durosinmi et al[11] showed NHL in 80% and HL in 20%, Sukpanichnant[12] reported NHL in 92.1% and HL in 7.9%, Jeong et al[13] observed NHL was in and HL in 6.7%, Sovani et al[14] showed NHL in 94.3% and HL in 5.7%, Goyal et al[15] found NHL in 73.9% and HL in 26.1%, Mondal et al[16] reported NHL in 76.3% and HL in 23.7% of cases. The results of the present study most closely matched the results of study done by Sukpanichnant.[12]

4.2. Presentation of NHL

In the present study out of 53 cases of NHL, the cases with nodal manifestation were 43(81.1%) and the cases with extranodal manifestation were 10 (18.9%). The results of this study were compared with other studies which were as follows:

In the present study 81.1% cases of NHL were nodal and 18.9% cases were extranodal. Hence, preponderance of nodal manifestation was observed. The results were comparable with the results of studies done by Hassan et al[17] in which nodal presentation was in 85% and extranodal was in 15% of cases, Krol et al[18] in which nodal presentation was in 80% and extranodal in 20% of cases, Padhi et al.[19] in which nodal presentation was in 78% and extranodal in 22% of cases, and Mondal et al[16*in*]which nodal presentation was in 72.3% and extranodal was in 27.7% of cases. The results of the present study most closely matched the results of the study done by Krol et al.[18] (Table 10)

4.3. Presentation of HL

In the present study out of 7 cases of HL, all the cases (100%) were with nodal presentation and no case (0%) had extranodal presentation. The results of this study were compared with other studies which were as follows:

In the present study all the cases of HL was with nodal presentation, hence, preponderance of nodal presentation was observed. The results were comparable with the results of studies done by Avila et al[20] in which nodal presentation was in 96% and extranodal in 4% of cases, and Mondal et al[16] in which nodal presentation was in 100% of cases and extranodal in 0% of cases. The results best matched the results of the study done by Mondal et al.[16] (Table 11)

4.4. Gender distribution in NHL

Out of 53 patients of Non-Hodgkin lymphoma, 30 cases (56.6%) were males and 23 cases (43.4%) were females. The results of this study were compared with other studies which were as follows:

In the present study 56.6% cases of NHL were males and 43.4% cases were females. Thus, male preponderance was seen in the present study. The results were comaparable with the results of Hassan et al[17] in which males were 65% and females were 35%, Durosinmi et al[11] in which males were 66.6% and females were 33.3%, and Kumar et al[21] in which males were 66.6% and 33.3% were females. The results of this study most closely matched with the results of study done by Hassan et al.[17] (Table 12)

4.5. Gender distribution in HL

Out of 7 patients of Non-Hodgkin lymphoma, 5 cases (71.4%) were males and 2 cases (28.6%) were females. Male predominance was seen in the present study. The results of this study were compared with other studies which were as follows:

In the present study 71.4% cases of HL were males and 28.6% were females. Hence, male preponderance seen in the present study. The results were comparable with the results of Durosinmi et al[11] in which both males and females were 50%, Anunobi et al[22] in which males were 64% and females were 36%, and Mondal et al[16] in which males were 81.5% and females were 18.5%. The results of the present study most closely matched the results of the study done by Anunobi et al.[22] (Table 13)

4.6. Peripheral blood involvement in lymphoma

In the present study of 60 cases of lymphoma, 19(31.7%) cases showed peripheral blood involvement (lymphocytosis and increased absolute lymphocyte count) and 41 cases (68.3%) did not show any peripheral blood changes. The results of this study were compared with other studies where were as follows:

In the present study 31.7% of cases of lymphoma had peripheral blood involvement. These results were comparable with results of previous such studies. Study done by Arber and George[23*sho*]wed peripheral blood involvement in 29% of cases and Sovani et al[14] reported peripheral blood involvement in 37.1% of cases. The results of the present study most closely matched the results of the study done by Arber and George.[23] (Table 14)

4.7. Bone marrow involvement in NHL

In the present study of 60 cases of lymphoma, 53 cases were of NHL. Out of 53 cases of NHL, 17(32.1%) cases showed bone marrow involvement and 36 cases(67.9%) did not show bone marrow involvement. The results of this study

Table 9: Comparison of cases of lymphoma with other studies

Author and year of study	Non-Hodgkin Lymphoma	Hodgkin Lymphoma
Durosinmi et al [11]	80%	20%
Sukpanichnant [12]	92.1%	7.9%
Jeong et al [13]	93.3%	6.7%
Sovani et al [14]	94.3%	5.7%
Goyal et al [15]	73.9%	26.1%
Mondal et al [16]	76.3%	23.7%
Present study	88.3%	11.7%

Table 10: Comparison of nodal and extranodal manifestation of non- hodgkin lymphoma cases with other studies

Author and year of study	Non- Hodgkin Lymphoma	
	Nodal	Extranodal
Hassan et al [17]	85%	15%
Krol et al [18]	80%	20%
Padhi et al [19]	78%	22%
Mondal et al [16]	72.3%	27.7%
Present study	81.1%	18.9%

Table 11: Comparison of nodal and extranodal presentation of hodgkin lymphoma cases with other studies

Author and year of study	Hodgkin Lymphoma	
	Nodal	Extranodal
Avila et al [20]	96%	4%
Mondal et al [16]	100%	0%
Present study	100%	0%

Table 12: Comparison of the cases by gender wise distribution with other studies

Author and year of study	Non-Hodgkin Lymphoma	
	Males	Females
Hassan et al [17]	65%	35%
Durosinmi et al [11]	66.6%	33.3%
Kumar et al [21]	66.6%	33.3%
Present study	56.6%	43.4%

Table 13: Comparison of the cases by gender wise distribution with other studies

Author and year of study	Hodgkin Lymphoma	
	Males	Females
Durosinmi et al [11]	50%	50%
Anunobi et al [22]	64%	36%
Mondal et al [16]	81.5%	18.5%
Present study	71.4%	28.6%

Table 14: Comparison of the peripheral blood involvement in cases lymphoma cases with other studies

Author and year of study	Peripheral blood film changes	
	Present	Absent
Arber and George [23]	29%	71%
Sovani et al [14]	37.1%	62.9%
Present study	31.7%	68.3%

Table 15: Comparison of the bone marrow involvement in cases of non-hodgkin lymphoma cases with other studies

Author and year of study	Bone marrow involvement in NHL	
	Present	Absent
Baroni et al[24]	21.8%	78.2%
Haddy et al[25]	18.9%	81.1%
Lai et al[26]	30%	70%
Conlan et al[27]	32%	68%
Juneja et al[28]	38%	62%
Campbell et al[29]	27%	73%
Mondal et al[16]	30.3%	69.7%
Present study	32%	68%

were compared with other studies which were as follows:

In the present study 32% cases of NHL showed BMI which was comparable with results of Baroni et al[24] in which BMI was in 21.8% cases, Haddy et al[25] in which BMI was in 18.9% cases, Lai et al[26] in which BMI was in 30% cases, Conlan et al[27] in which BMI was in 32% cases, Juneja et al[28] in which BMI was in 38% cases, Campbell et al[29] in which BMI was in 27% cases, Mondal et al[16] (2014) in which BMI was in 30.3% cases. The results of the present study best matched the results of the study done by Conlan et al.[27] (Table 15)

4.8. Bone marrow involvement in HL

In the present study of 60 cases of lymphoma, 7 case were of HL. Out of 7 cases of HL, no case showed bone marrow involvement. The results of this study were compared with other studies which were as follows:

In the present study none of the case of HL showed bone marrow. The results were compared with the results of study done by Bartl et al[30] in which BMI was reported in 10% of cases, Ellis et al[31] in which BMI was observed in 7.1% of cases, Marisavljevic et al[32] in which BMI was in 10.2% of cases, Howell et al[33] in which BMI was in 5.2% of cases, Kini et al[34] in which BMI was in 10% cases and Mondal et al[16] in which BMI was in 9.3% of cases. The present study was done on the limited number of 60 cases of lymphoma and out of these 60 cases only 7 cases were of HL.(Table 16)

4.9. Pattern of bone marrow involvement on BMB in lymphoma

In the present study of 60 cases of lymphoma, 17 cases showed bone marrow involvement. Out of these 17 cases, diffuse pattern of involvement was observed in 7 cases (41.2%), followed by 6 cases (35.3%) of paratrabecular pattern, 3 cases (17.6%) of mixed pattern, 1 case (5.9%) of interstitial pattern and none had nodular pattern of infiltration. The results of this study were compared with other studies which were as follows:

In the present study the maximum number of (41.2%) cases showed diffuse pattern of involvement, followed by paratrabecular pattern (35.3%). Interstitial pattern was in 5.9% cases, mixed pattern was in 7.6% of cases and none case (0%) was of nodular pattern of involvement. The results were comparable to the results of Li et al[35] in which 44.9% cases had diffuse pattern, 29.3% cases had paratrabecular pattern, 11.6% cases had interstitial pattern, 6.1% cases had nodular pattern, 8.1% cases had mixed pattern and Jeong et al[16] in which 40% cases had diffuse pattern, 34.5% cases had paratrabecular pattern, 20% cases had interstitial pattern, 5.5% cases had nodular pattern, 0% cases had mixed pattern. In all the studies there was seen preponderance of the diffuse pattern of involvement followed by patratrabecular pattern.(Table 17)

5. Summary

In the present study 60 cases of lymphoma were evaluated by PBF involvement, BMA and BMB examination. There were 35(58.33%) males and 25(41.67%) females with male to female ratio 1.4:1.

Out of 60 cases of lymphoma, 53 (88.3%) cases were of NHL and 7 (11.7%) cases were of HL. In 53 cases of NHL 43(81.1%) cases were with nodal presentation and 10(18.9%) cases were with extranodal presentation. In the study all the 7 cases of HL had nodal presentation. In both NHL and HL male preponderance was observed with male to female ratio of 1.3:1 and 2.5:1 respectively. Most common age group involved in NHL was 51-60 years and In HL was 31-40 years.

Out of 60 cases of lymphoma 19(31.7%) cases showed peripheral blood involvement with leucocytic lymphocytosis.

On BMA 41 (68.3%) cases showed hypercellular marrow and 19 (31.7%) cases showed normocellular. Percentage lymphocytes in marrow differential count was increased in 16 (26.7%) of cases and 44 (73.3%) cases had percentage lymphocyte count within normal limits. Out of these 44 cases, 1 case was having borderline percentage lymphocyte count. 16 cases were reported with bone marrow involvement by lymphoma on BMA and 1 case with borderline percentage lymphocyte count was reported as bone marrow involved case, after examining the BMB.

Table 16: Comparison of the bone marrow involvement in cases of hodgkin lymphoma cases with other studies

Author and year of study	Bone marrow involvement in HL	
	Present	Absent
Bartl et al[30]	10%	90%
Ellis et al[31]	7.1%	92.9%
Marisavljevic et al[32]	10.2%	89.8%
Howell et al[33]	5.2%	94.8%
Kini et al[34]	10%	90%
Mondal et al[16]	9.3%	90.7%
Present study	0%	100%

Table 17: Comparison of frequency of pattern of involvement in cases of lymphoma with other studies

Author and year of study	Pattern of bone marrow infiltration by lymphoma				
	Diffuse	Paratrabecular	Interstitial	Nodular	Mixed
Li et al[35]	44.9%	29.3%	11.6%	6.1%	8.1%
Jeong et al[13]	40%	34.5%	20%	5.5%	0%
Present study	41.2%	35.3%	5.9%	0%	7.6%

On BMB 40(66.7%) cases were hypercellular and 20 (33.3%) cases were normocellular . Bone marrow involvement was present in 17(28.3%) cases, out of 60 cases of lymphoma. The diffuse pattern of involvement was in 7(41.2%) cases, followed by paratrabecular pattern in 6 (35.3%) cases, 3(17.6%) cases with mixed pattern and 1(5.9%) case with interstitial pattern of bone marrow involvement. Preponderance of diffuse pattern of involvement was present, followed by paratrabecular pattern of BM involvement in this study.

6. Conclusion

Examination of the peripheral blood film and bone marrow is one of the diagnostic pillars in haematological disorders. Bone marrow examination give valuable information in lymphoma, about disease burden, percentage of involvement, pattern of involvement and baseline involvement prior to therapy, which will be useful to establish the stage and therapy of the patient. Bone marrow aspiration gives more clear cytomorphological details whereas Bone marrow biopsy give more accurate picture of extent of involvement and architectural pattern Bone marrow aspiration often not very helpful as it may be falsely negative but provides wonderful cytomorphological details. Thus to conclude bone marrow aspiration and biopsy are complimentary to each other.

6.1. Abbreviations

NHL: Non-hodgkin Lymphoma, HL: Hodgkin lymphoma, BMA: Bone marrow aspiration, BMB: Bone marrow Biopsy, BMI: Bone marrow involvement, PBF: Peripheral blood film, ALC : absolute Lymphocyte count, CBC: complete blood count, H & E: Haematoxylin and eosin.

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8. Conflict of interest

None.

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Author biography

Nidhi Goel Assistant Professor

Mohanvir Kaur Associate Professor

Manjit Singh Bal Professor and HOD

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