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Clinicopathological Evaluation of Bone Marrow Involvement in Patients with Hodgkin Lymphoma.

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Abstract

Background: Bone marrow involvement represents an important manifestation of disease dissemination in patients with Hodgkin and non-Hodgkin lymphoma and may contribute to clinical staging, prognostic assessment, and therapeutic decision-making. Histopathological examination of bone marrow specimens provides valuable information regarding the presence and patterns of lymphoma infiltration, particularly in patients presenting with advanced-stage disease. ***Aim:*** The study aimed to determine the incidence and patterns of bone marrow involvement in patients with Hodgkin and non-Hodgkin lymphoma. ***Material and Methods:*** The study included 150 patients diagnosed with Hodgkin and non-Hodgkin lymphoma, comprising 81 patients with Hodgkin lymphoma and 69 patients with non-Hodgkin lymphoma. Demographic characteristics, histological categorization, clinical staging, and bone marrow involvement were evaluated. Bone marrow findings were assessed in relation to the clinical stage and lymphoma classification. Non-Hodgkin lymphoma cases were categorized according to the Rappaport classification. ***Results:*** Among the 81 patients with Hodgkin lymphoma, 41 were males and 40 were females, whereas the non-Hodgkin lymphoma group comprised 35 males and 34 females. The largest age group in both lymphoma categories was 11–30 years. Among non-Hodgkin lymphoma cases, well-differentiated diffuse lymphocytic lymphoma constituted 49 cases (71.01%), while diffuse histiocytic nodular lymphoma accounted for 20 cases (28.99%). Bone marrow involvement in the Hodgkin lymphoma group was observed in 9 patients with Stage III disease. In the non-Hodgkin lymphoma group, marrow involvement was identified in 3 patients with Stage III disease and 12 patients with Stage IV disease, demonstrating a greater representation of marrow involvement among patients with advanced clinical stages. ***Conclusion:*** Bone marrow involvement was predominantly observed among patients with advanced-stage lymphoma. Clinicopathologic assessment, in correlation with clinical staging and histological classification, remains important in the comprehensive evaluation of patients with Hodgkin and non-Hodgkin lymphoma.

Keywords: Bone Marrow, Hodgkin Lymphoma, Lymphocytic Lymphoma.

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INTRODUCTION

Bone marrow involvement represents an important manifestation of disease dissemination in patients with Hodgkin lymphoma and may have implications for disease staging, prognosis, therapeutic planning, and clinical outcomes. Hodgkin lymphoma is a lymphoid malignancy characterized by the presence of Hodgkin and Reed–Sternberg cells within an inflammatory cellular background, and its clinical presentation and histopathological characteristics vary considerably across disease stages. Although the disease frequently involves lymph nodes and extranodal lymphatic structures, bone marrow infiltration may occur in advanced disease and is associated with systemic manifestations, hematological abnormalities, and alterations in the clinical course. The identification of bone marrow involvement is therefore an important component of the comprehensive clinicopathologic assessment of patients diagnosed with Hodgkin lymphoma [1].

Bone marrow examination has traditionally been incorporated into the evaluation of patients with lymphoma to assess the extent of disease involvement and establish accurate staging. Histopathological examination of bone marrow specimens provides information regarding the distribution, extent, and morphological characteristics of lymphoma infiltration. In Hodgkin lymphoma, marrow involvement may demonstrate variable patterns of infiltration, including focal, interstitial, nodular, or diffuse involvement, and may be accompanied by fibrosis, reactive cellular changes, or alterations in the hematopoietic compartment. The recognition of these morphological patterns may assist in differentiating lymphoma-associated marrow changes from other hematological or reactive conditions [2,3].

The frequency of bone marrow involvement in Hodgkin lymphoma varies according to the histological subtype, clinical stage, disease burden, and diagnostic methodology employed. Patients with advanced-stage disease, systemic symptoms, or abnormal hematological parameters may demonstrate a higher likelihood of marrow involvement. Furthermore, the histological evaluation of marrow specimens may provide additional diagnostic information in patients presenting with atypical clinical or radiological findings. Clinicopathologic correlation remains essential for interpreting marrow findings within the context of the patient's overall disease profile and for establishing the extent of lymphoma dissemination [4,5].

Histological assessment of bone marrow biopsy specimens is particularly valuable in identifying focal infiltration that may not be adequately represented in aspirate samples. The architectural characteristics of the marrow, cellular composition, stromal alterations, and distribution of abnormal lymphoid cells contribute to the diagnostic evaluation. Immunohistochemical investigations may further assist in identifying characteristic cellular populations and differentiating Hodgkin lymphoma involvement from other lymphoproliferative disorders, reactive conditions, and non-neoplastic marrow abnormalities. The integration of morphological and ancillary findings improves diagnostic precision and facilitates a more comprehensive assessment of disease involvement [6,7].

Despite advances in imaging modalities and staging procedures, histopathological evaluation continues to provide valuable information regarding bone marrow involvement in lymphoma. The clinicopathologic examination of marrow specimens may contribute to understanding the relationship between marrow infiltration and clinical characteristics, histological subtype, disease stage, and hematological findings. The systematic assessment of bone marrow involvement in Hodgkin lymphoma is therefore relevant for establishing the patterns of infiltration and evaluating its association with the clinical and pathological profile of affected patients [8–10].

The present study was undertaken to determine the incidence and patterns of bone marrow involvement in patients with Hodgkin and non-Hodgkin lymphoma, with emphasis on the clinicopathologic evaluation of bone marrow findings and their relationship with relevant clinical and histopathological characteristics.

MATERIALS AND METHODS

The study was conducted on 150 patients diagnosed with Hodgkin and non-Hodgkin lymphoma who underwent bone marrow examination as part of their diagnostic evaluation or disease staging. Clinical details, including age, sex, presenting symptoms, relevant hematological parameters, clinical diagnosis, and histopathological classification of lymphoma, were recorded from the available medical records. Bone marrow aspirate and biopsy specimens were examined for the presence or absence of lymphoma involvement. The biopsy specimens were evaluated for marrow cellularity, architecture, distribution of lymphoid infiltrates, and morphological features suggestive of lymphoma involvement. The patterns of marrow infiltration, including focal, nodular, interstitial, and diffuse involvement, were assessed wherever applicable. Additional histopathological or immunohistochemical findings were considered when available to support the diagnosis. The incidence of bone marrow involvement was calculated among the studied patients, and the observed clinicopathologic findings were evaluated in relation to lymphoma type and relevant clinical and pathological characteristics.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2019) and then exported to data editor page of SPSS version 19 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

RESULTS

Table 1 demonstrated the age-wise and sex-wise distribution of patients with Hodgkin and non-Hodgkin lymphoma. Among the 81 patients with Hodgkin lymphoma, 41 were males and 40 were females. The largest proportion of patients belonged to the 11–30 years age group, comprising 20 males and 17 females, followed by the 31–50 years age group, which included 9 males and 6 females. In the 51–70 years age group, 6 males and 12 females were observed, while the above 70 years age group included 6 males and 5 females. Among the 69 patients with non-Hodgkin lymphoma, 35 were males and 34 were females. The 11–30 years age group constituted the largest category, comprising 17 males and 29 females. The 31–50 years age group included 6 males and 6 females, whereas the 51–70 years age group comprised 6 males and 5 females. No patients above 70 years of age were represented in the non-Hodgkin lymphoma group.

Table 2 demonstrated the histological categorization of non-Hodgkin lymphoma cases according to the Rappaport classification. Among the 69 cases, well-differentiated diffuse lymphocytic lymphoma was the predominant histological type, accounting for 49 cases (71.01%). Diffuse histiocytic nodular lymphoma was observed in 20 cases, representing 28.99% of the study group. Thus, well-differentiated diffuse lymphocytic lymphoma constituted the major histological category among the non-Hodgkin lymphoma cases evaluated.

Table 3 demonstrated the relationship between clinical stage and bone marrow involvement among patients with Hodgkin and non-Hodgkin lymphoma. In the Hodgkin lymphoma group, Stage III represented the largest category, comprising 29 cases (35.80%), followed by Stage II with 23 cases (28.40%), Stage I with 20 cases (24.69%), and Stage IV with 9 cases (11.11%). Bone marrow involvement was identified in 9 patients with Stage III disease. In the non-Hodgkin lymphoma group, Stage IV constituted the largest category, comprising 26 cases (37.68%), followed by Stage III with 23 cases (33.33%), Stage I with 17 cases (24.64%), and Stage II with 3 cases (4.35%). Bone marrow involvement was observed in 3 patients with Stage III disease and 12 patients with Stage IV disease.

Table 1: Demographic Distribution of Study Participants

Age group (years)	Hodgkin Male	Hodgkin Female	Non-Hodgkin Male	Non-Hodgkin Female
11–30	20	17	17	29
31–50	9	6	6	6
51–70	6	12	6	5
Above 70	6	5	–	–
Total	**41**	**40**	**35**	**34**
Total cases	**81**		**69**	

Table 2: Categorization of Non-Hodgkin Lymphoma Cases According to Rappaport Classification

Histological type	Frequency	Percentage
Well-differentiated diffuse lymphocytic	49	71.01%
Diffuse histiocytic nodular	20	28.99%
Total	**69**	**100.00%**

Table 3: Relationship Between Bone Marrow Involvement and Clinical Stage of the Patients

Clinical stage	Hodgkin lymphoma Total cases (n=81)	Hodgkin lymphoma Bone marrow affected	Non-Hodgkin lymphoma Total cases (n=69)	Non-Hodgkin lymphoma Bone marrow affected
Stage I	20 (24.69%)	–	17 (24.64%)	–
Stage II	23 (28.40%)	–	3 (4.35%)	–
Stage III	29 (35.80%)	9	23 (33.33%)	3
Stage IV	9 (11.11%)	–	26 (37.68%)	12
Total	**81 (100%)**	**9**	**69 (100%)**	**15**

DISCUSSION

The present clinicopathologic study evaluated the demographic distribution, histological categorization, clinical staging, and bone marrow involvement among patients with Hodgkin and non-Hodgkin lymphoma. The findings demonstrated differences in the distribution of patients across age groups, histological categories, and clinical stages, with bone marrow involvement predominantly observed among patients presenting with advanced-stage disease. The assessment of bone marrow involvement remains an important component of the clinicopathologic evaluation of lymphomas, particularly in the context of disease dissemination, hematological abnormalities, and prognostic assessment. However, the role of bone marrow biopsy in Hodgkin lymphoma staging has evolved considerably with the increasing use of positron emission tomography–computed tomography (PET-CT) [11].

In the present study, the Hodgkin lymphoma group comprised 81 patients, including 41 males and 40 females, demonstrating a nearly equal sex distribution. The largest proportion of patients in this group belonged to the 11–30 years age category, followed by the 31–50 years age group. This distribution is consistent with the recognized epidemiological pattern of Hodgkin lymphoma, which frequently affects adolescents and young adults, although additional cases may occur in older populations. The predominance of younger individuals in the present study may reflect the characteristic age distribution of Hodgkin lymphoma and its variable occurrence across different age groups. Hodgkin lymphoma exhibits a bimodal or age-dependent epidemiological distribution in several populations, although the relative prominence of age peaks varies according to geographical, socioeconomic, and demographic factors [12].

The non-Hodgkin lymphoma group consisted of 69 patients, with 35 males and 34 females, also demonstrating a relatively balanced sex distribution. The largest proportion of patients belonged to the 11–30 years age group, followed by those aged 51–70 years and 31–50 years. Non-Hodgkin lymphoma represents a heterogeneous group of lymphoid malignancies with considerable variation in biological behaviour, histological characteristics, age distribution, and clinical presentation. The observed demographic distribution may therefore reflect the diversity of lymphoma subtypes included within the study

population. Differences in the age distribution of Hodgkin and non-Hodgkin lymphoma are influenced by histological subtype, underlying disease biology, and population-specific epidemiological characteristics [13].

Histological categorization of non-Hodgkin lymphoma cases according to the Rappaport classification revealed that well-differentiated diffuse lymphocytic lymphoma constituted the predominant category, accounting for 49 cases (71.01%), whereas diffuse histiocytic nodular lymphoma was observed in 20 cases (28.99%). The predominance of the lymphocytic category indicated a greater representation of this histological pattern within the study population. Histological classification has traditionally been fundamental in the evaluation of non-Hodgkin lymphoma because morphological characteristics provide information regarding the cellular composition, architectural arrangement, and biological behaviour of lymphoid neoplasms. Although historical classifications such as Rappaport's system have been superseded by more advanced classifications incorporating immunophenotypic, molecular, and genetic characteristics, morphological assessment remains an integral component of lymphoma diagnosis and pathological characterization [14].

The relationship between clinical stage and bone marrow involvement demonstrated that marrow involvement was identified in patients with advanced-stage disease in both lymphoma groups. Among patients with Hodgkin lymphoma, bone marrow involvement was identified in 9 patients with Stage III disease, whereas no affected cases were recorded in Stage I or Stage II. This distribution suggests that bone marrow involvement was concentrated among patients with more extensive disease. Bone marrow infiltration in Hodgkin lymphoma is generally associated with advanced clinical disease and may occur alongside systemic symptoms and hematological abnormalities. Histopathological examination may demonstrate variable patterns of infiltration, including focal, diffuse, interstitial, and fibrotic patterns, and recognition of these features may contribute to diagnostic assessment. Published clinicopathologic investigations have similarly reported that bone marrow involvement in Hodgkin lymphoma is more frequently associated with advanced-stage disease and selected clinical or hematological risk factors [15].

In the non-Hodgkin lymphoma group, bone marrow involvement was observed in 3 patients with Stage III disease and 12 patients with Stage IV disease. The greater representation of marrow involvement among Stage IV cases was consistent with the association between advanced-stage lymphoma and extranodal dissemination. Bone marrow infiltration may have important implications for disease classification and staging in non-Hodgkin lymphoma, although the frequency and pattern of involvement vary substantially according to histological subtype. Certain lymphoma subtypes demonstrate a greater propensity for marrow involvement, whereas others may exhibit predominantly nodal or extranodal disease. The assessment of bone marrow therefore requires correlation with the histological diagnosis, clinical presentation, imaging findings, and relevant laboratory parameters. Histopathological evaluation remains particularly important when the identification of marrow infiltration may influence staging, prognostic assessment, or treatment planning.

The findings of the present study highlight the importance of clinicopathologic evaluation in identifying the distribution and patterns of bone marrow involvement in lymphoma. Nevertheless, contemporary staging approaches have increasingly incorporated PET-CT, particularly in Hodgkin lymphoma, owing to its high sensitivity for detecting metabolically active skeletal and marrow lesions. Bone marrow biopsy may therefore be selectively indicated in circumstances where imaging findings are inconclusive, where discordant clinical or hematological findings are present, or where histopathological confirmation may influence clinical management. In non-Hodgkin lymphoma, the utility of bone marrow examination continues to depend on the lymphoma subtype and the clinical context. The interpretation of marrow findings should consequently be integrated with the overall diagnostic and staging evaluation rather than considered in isolation.

CONCLUSION

The study demonstrated that bone marrow involvement was predominantly identified among patients with advanced-stage Hodgkin and non-Hodgkin lymphoma. In the Hodgkin lymphoma group, marrow involvement was observed in Stage III cases, whereas in the non-Hodgkin lymphoma group, involvement was identified in Stage III and Stage IV disease, with the greatest representation among Stage IV patients. Well-differentiated diffuse lymphocytic lymphoma constituted the predominant histological category among non-Hodgkin lymphoma cases. Clinicopathologic evaluation of bone marrow specimens, in correlation with clinical stage and histological classification, remains valuable in the comprehensive assessment of lymphoma patients.

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