ORIGINAL ARTICLE

Journey through Lymphoma: Exploring a Diverse Spectrum of Cases in a Tertiary Care Hospital

Vallalkani[1], Kavitha[1], Sumithra A[1], Sulochana Sonti[1]

[1] Department of Pathology, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Saveetha Nagar, Thandalam, NH 48, Chennai, Tamil Nadu, 602105, India.

ABSTRACT

Introduction: Lymphomas are lymphoproliferative tumours that may arise from B lymphocytes, T lymphocytes, or Natural killer (NK) cells. Understanding the diverse spectrum of lymphoma variants is paramount for accurate diagnosis, effective management, and improved patient outcomes. This study aims to explore the spectrum of lymphoma variants encountered in a tertiary care hospital. **Materials and methods:** This study was conducted at the Histopathology laboratory of Saveetha Medical College and Hospital, Chennai from January 2022 to February 2024. It is a retrospective study, and the test samples were the specimens sent for histopathological analysis. A total of 32 cases of lymphomas were analyzed during the study period. **Results:** During the study period, the total number of lymphoma cases received in our histopathology department was 32 cases, of which 24 (75%) cases were non-Hodgkin lymphoma (NHL) and 8 (25%) cases were Hodgkin lymphoma (HL). They were correlated with parameters like age, sex, histopathologic type, location and immunohistochemical characteristics. **Conclusion:** Exploring diverse lymphoma variants within a tertiary care hospital setting is crucial for enhancing diagnostic accuracy and tailoring effective treatment strategies. This understanding enables healthcare professionals to provide more personalized and targeted care, ultimately leading to improved patient outcomes.

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Corresponding Author:
K.Kavitha, MD DNB
Email: drkavithasmch@gmail.com
Tel : +91 9566531418

INTRODUCTION

Lymphomas represent a diverse group of lymphoproliferative tumors that originate from different types of immune cells, including B lymphocytes, T lymphocytes, and Natural Killer (NK) cells. These malignancies account for approximately 3% of all cancer types worldwide [1]. The incidence and distribution of lymphomas exhibit significant variation across different geographical regions, influenced by factors such as genetics, environmental exposures, and infectious agents. Lymphomas are among the most common hematological neoplasms, with nearly half of all newly diagnosed cases falling into this category. Globally, lymphomas are the sixth most frequent type of cancer in both men and women [2]. Traditionally, lymphomas are categorized into two primary groups: Non-Hodgkin's Lymphoma (NHL) and Hodgkin's Lymphoma (HL). This classification is based on the histological identification of Reed-Sternberg (RS) cells, which are characteristic of Hodgkin's Lymphoma. Non-Hodgkin's Lymphoma, on the other hand, comprises a heterogeneous group of lymphoid cancers with diverse biological behaviors and clinical outcomes. Over time, the classification of lymphomas has become more complex, with the World Health Organization (WHO) periodically updating its classification system. This evolving classification reflects the discovery of new lymphoma subtypes, each defined by unique morphological, molecular, and clinical characteristics [3,4]. The vast majority of lymphomas, approximately 90–95%, arise from the neoplastic transformation of B cells. The remaining cases originate from T lymphocytes or NK cells, which contribute to the diversity of lymphoma subtypes [3,5]. The prevalence of Non-Hodgkin's Lymphoma, particularly Diffuse Large B-Cell Lymphoma (DLBCL), varies significantly across different regions. DLBCL is the most common subtype of NHL, accounting for about one-third of all cases, and it demonstrates considerable

variation in its clinical presentation and response to treatment depending on geographic and demographic factors [3,6,7]. A comprehensive understanding of the various lymphoma subtypes is essential for accurate diagnosis, appropriate therapeutic intervention, and improving patient outcomes. Each subtype exhibits distinct prognostic factors, epidemiological patterns, and responses to therapy, making tailored treatment strategies increasingly important. This study seeks to delve into the diverse spectrum of lymphoma variants, examining their correlations with critical parameters such as age, gender, histopathological type, and immunohistochemical characteristics. By doing so, the research aims to contribute to the existing knowledge on lymphomas, providing insights that could enhance diagnostic accuracy and therapeutic efficacy.

MATERIALS AND METHODS

This study was conducted at the Histopathology laboratory of Saveetha Medical College and Hospital, Chennai from January 2022 to February 2024 after getting proper approval from the Institutional Review Board. It is a retrospective study, and the test samples were the specimens sent for histopathological analysis. A total of 32 cases of lymphomas were analyzed during the study period. The inclusion criteria were the excision or biopsy samples of all cases with a confirmed diagnosis of lymphoma based on histopathological examination. The exclusion criteria were the cases of lymphoproliferative disorders other than lymphomas. The parameters like age, sex, relevant history, clinical details, and investigation details regarding any case were taken from the histopathological examination request forms and the MIAS (Medical Information Archiving Software) database of our hospital.

All relevant data were tabulated in Microsoft Office Excel 2016 and correlated. The obtained tissue specimens were fixed in formalin, processed, stained using Hematoxylin and eosin (H&E) stain, and examined under a light microscope to assess the cellular morphology, tissue architecture, and malignant features to identify the lymphomas. In addition, immunohistochemistry (IHC) was done for further characterization, confirmation, and classification of lymphomas. Based on the staining pattern observed, the results were interpreted to arrive at a diagnosis and classification of lymphoma.

Hematoxylin and Eosin (H&E) staining procedure:

1. Deparaffinization:
Place tissue sections on microscopic slides. Immerse the slides in xylene or a xylene substitute for 2-3 minutes to remove paraffin wax. Repeat the process 2-3 times to ensure complete deparaffinization.
2. Rehydration:
Transfer the slides through a series of graded alcohols to rehydrate the tissue. 100% ethanol for 2 minutes (2 changes), 95% ethanol for 2 minutes, and 70% for 2 minutes. Rinse slides in distilled water for 2 minutes to remove alcohol.
3. Hematoxylin Staining:
Immerse the slides in hematoxylin solution for 5-10 minutes, depending on the strength of the hematoxylin and desired staining intensity. Rinse the slides in running tap water for 5 minutes to remove excess stain. Differentiate in 0.3% acid alcohol for a few seconds to remove nonspecific staining (until sections appear light purple). Rinse immediately in running tap water for 5 minutes. “Blue” the sections by immersing the slides in ammonia water or Scott’s tap water substitute for 30 seconds to 1 minute. Rinse in running tap water for 5 minutes.
4. Eosin Staining:
Immerse the slides in eosin solution for 1-3 minutes, depending on the desired staining intensity. Rinse quickly in distilled water to remove excess eosin.
5. Dehydration:
Dehydrate the slides through graded alcohols: 70% ethanol for 30 seconds, 95% ethanol for 1 minute, 100% ethanol for 1 minute (2 changes). Ensure that the sections are fully dehydrated before proceeding.
6. Clearing:
Transfer the slides to xylene or a xylene substitute for 2-3 minutes (2 changes) to clear the tissue sections. Ensure the tissue is transparent, indicating complete clearing.
7. Mounting:
Apply a few drops of mounting medium to the tissue section. Carefully place a coverslip over the section to avoid air bubbles. Allow the slides to dry completely before viewing under a microscope.

IHC staining procedure:

Four-micron sections were cut from each study block and mounted on positively charged slides. The slides were labeled with the laboratory number and type of test. The slides were in an incubator at 37 degrees Celsius overnight for drying. The immunohistochemical processing was carried out the next day

1. The slides were deparaffinized with 3 changes of xylene (6 minutes each).
2. The slides were hydrated using decreasing grades of Isopropyl alcohol – 3 changes (5 minutes each)
3. They were washed under running tap water for 5 minutes.
4. Antigen retrieval was done by pressure cooker method using Tris- EDTA retrieval solution at p H 9.0
5. The pressure cooker was cooled under running tap water. Once the pressure was reduced, the lid was opened and the slides were washed in tap water.
6. Sections were washed twice in Tris Buffered Saline for 5 minutes with gentle rocking
7. The sections were covered with 0.3% hydrogen peroxide solution for 10 minutes to block endogenous peroxide enzyme activity.

8. Slides were washed twice in Tris Buffered Saline for 5 minutes.
9. Slides were incubated with each primary antibody (1:100 dilution) for the duration specified for each antibody according to the manufacturing guidelines.
10. Slides were washed twice in Tris Buffered Saline for 5 minutes.
11. Slides were incubated with a primary antibody amplifier (Master diagnostics) for 30 minutes.
12. Slides were washed twice in Tris Buffered Saline for 5 minutes.
13. Slides were incubated with Master HRP polymer for 15 minutes.
14. Slides were washed twice in Tris Buffered Saline for 5 minutes.
15. Chromogen DAB working solution was added and incubated for 5 mins (DAB working solution: 50µl of DAB chromogen in 1ml of DAB substrate).
16. Sections were washed with Tris Buffered Saline thrice.
17. Counterstaining with Hematoxylin was done for 15 seconds.
18. Slides were rinsed in water for 5 minutes.
19. Dehydration and clearing were performed through increasing grades of alcohol (80%, 90% & 100%) and xylene for 5 minutes each.
20. Sections were mounted with DPX mountant.
21. Appropriate positive controls were run for each marker.

ETHICAL CLEARANCE

This study was approved by the Research Ethics Committee, Institutional Review Board, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University. IRB approval number- 128/03/2024/PG/SRB/SMCH.

RESULTS

During the study period, the total number of lymphoma cases received in our histopathology department was 32 cases, of which 24 (75%) cases were non-Hodgkin lymphoma (NHL) and 8 (25%) cases were Hodgkin lymphoma (HL). 20 (62.5%) cases were males of which 15 cases were NHL and 5 cases were HL, and 12 (37.5%) cases were females in which 9 cases were NHL and 3 cases were HL as shown in Fig. 1. Fig. 2 depicts the age-wise distribution of lymphoma cases in which most of the cases (n=12, 37.5%) belonged to the age group 46 to 60 years, followed by 61 to 75 years and the minimum number of cases (n=3, 9.4%) were found in the age group 76 to 90 years. Table I shows the frequency and distribution of various types of lymphomas based on location, with the lymph node being the most common site (n=19, 59.4%) followed by the tonsil, stomach, soft palate, parotid, ileum, caecum, appendix and most of them were non-Hodgkin lymphoma (Fig. 3).

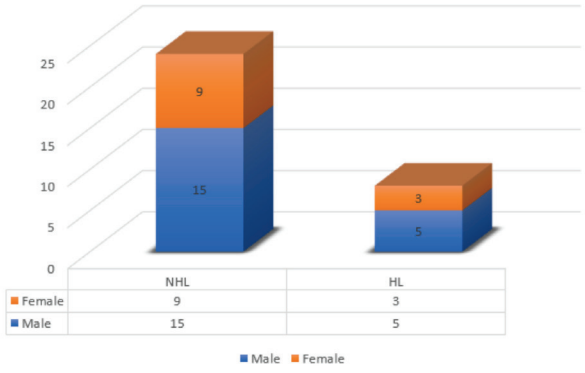

Fig. 1: Gender distribution of NHL and HL

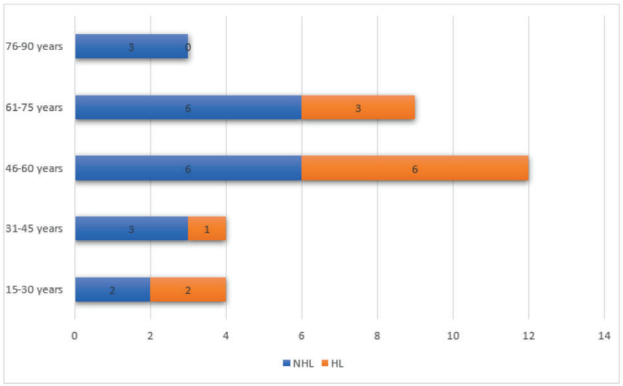

Fig. 2: Age-wise distribution of NHL and HL

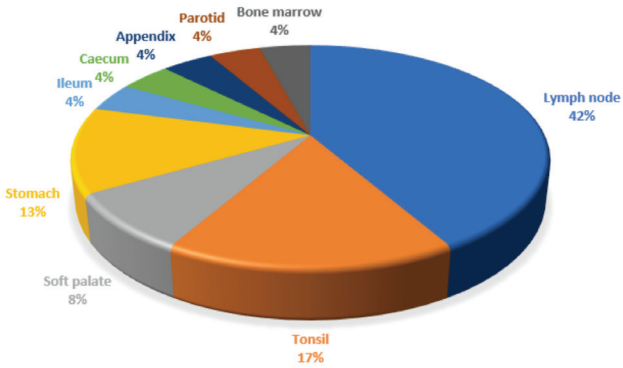

Fig. 3: Distribution of NHL based on site of involvement

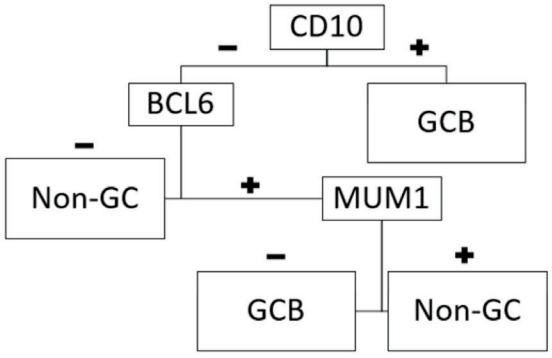

Fig. 4: Hans algorithm
CD10- Cluster of Differentiation 10
BCL6: B-cell lymphoma 6
GCB: Germinal center B-cell
Non-GC: Non- Germinal center B-cell
MUM1: Multiple myeloma oncogene 1

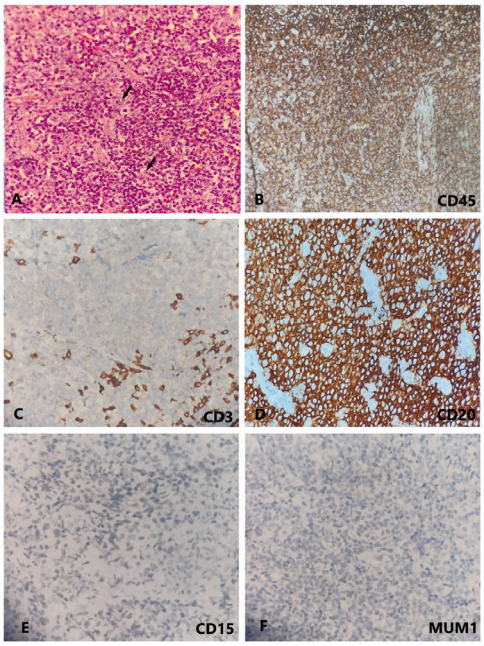

Fig. 5: DLBCL in a 50-year-old female
A: Diffuse lymphoid infiltrates with atypical lymphoid cells (arrows)
B: CD45 showing diffuse positivity in atypical lymphoid cells
C: CD3 showing negativity in the atypical lymphoid cells and focal positivity in the scattered reactive lymphocytes
D: CD20 showing diffuse positivity
E: CD15 negativity
F: MUM1 negativity

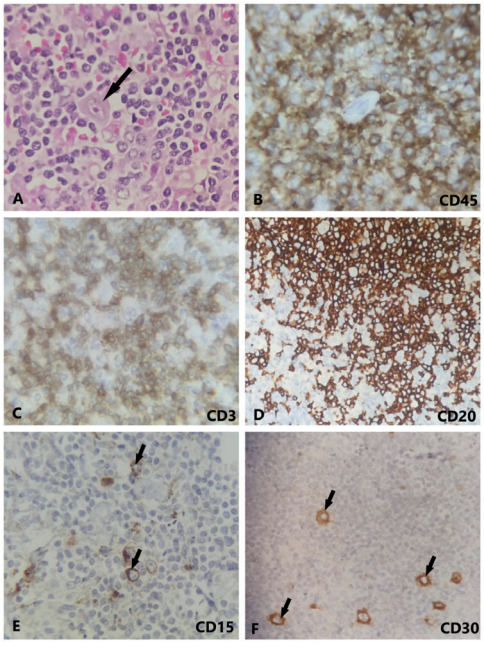

Fig. 6: Lymph nodal HL in a 22-year-old male
A: Hodgkin cell with a single round to oval nucleus and prominent eosinophilic nucleoli (arrow)
B: Diffuse CD45 positivity
C: Diffuse CD3 positivity
D: Diffuse CD20 positivity
E: CD15 showing membranous and golgi positivity in Reed Sternberg cells (arrows)
F: CD30 showing strong, membranous and golgi positivity in Reed Sternberg cells (arrows)

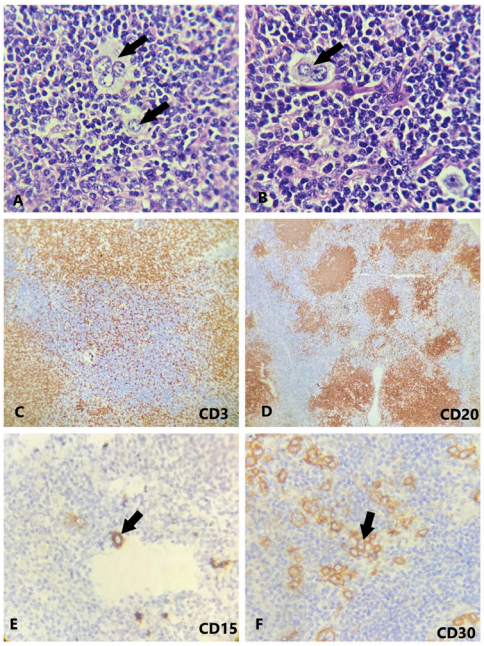

Fig. 7: Lymph nodal HL in a 57-year-old male
A, B: Classic Reed-Sternberg (RS) cells with large size, bilobed to multilobed nucleus, prominent eosinophilic nucleolus and ample amphophilic cytoplasm (arrows)
C: CD3 showing negativity in RS cells and positivity in reactive lymphoid cells
D: CD20 showing negativity in RS cells and positivity in residual lymphoid follicles
E: CD15 showing strong, membranous and golgi positivity in RS cells (arrows)
F: CD30 showing strong, membranous and golgi positivity in RS cells

Following histopathological examination, immunohistochemistry was done with a selective panel of markers routinely employed for lymphoma diagnosis and classification. The immunohistochemistry markers used were Cluster of Differentiation 45 (CD45), CD3, Ki67, CD15, CD30, B-cell lymphoma 6 (BCL6), multiple myeloma oncogene 1 (MUM1). Non-Hodgkin lymphomas of DLBCL type were classified into the Germinal center B-cell and Non-Germinal center subtypes based on the Hans algorithm (Fig. 4) using the markers CD10, BCL6 and MUM1. All cases of HL were classic Hodgkin lymphomas with mixed cellularity type being the most common. Fig. 5 represents NHL of the tonsil in a 50-year-old female which is a DLBCL, Germinal center B-cell subtype showing CD45, CD20 positivity and CD3, CD15 and MUM1 negativity. Fig. 6 and Fig. 7 represent HL encountered in lymph nodes in 22-year-old and 57-year-old males respectively.

DISCUSSION

This study analyzed 32 cases of lymphoma, encompassing both Hodgkin Lymphoma (HL) and Non-Hodgkin Lymphoma (NHL), and found a notable predominance of NHL over HL. This finding is consistent with global trends, where NHL is recognized as the more common form of lymphoma. The higher incidence rates of NHL

compared to HL across various populations have been well-documented in the literature. Our observations align with previous studies conducted by Jagadale et al., Polepole et al., Aslam et al., Sharma et al., and Mukherjee et al., who also reported a similar trend [1,2,8,9,10]. This consistency across studies underscores the significance of NHL as a major subtype of lymphoma, reinforcing the need for continued research into its etiology, progression, and treatment.

The demographic analysis of our study population revealed a male predominance in lymphoma cases, a pattern that is consistent with findings from studies by Jagadale et al., Polepole et al., and Aslam et al. [1,2,8]. This gender disparity in lymphoma incidence has been observed across different regions and populations, suggesting that biological, environmental, or lifestyle factors may contribute to a higher susceptibility in males. Understanding the underlying causes of this gender difference remains an area of active research, with potential implications for both prevention and treatment. Further studies could explore the role of hormonal influences, occupational exposures, and genetic predispositions in contributing to this disparity.
Age distribution analysis in our study highlighted a peak incidence of lymphoma in the middle-aged population, particularly among individuals aged 46 to 60 years. This observation corroborates established age patterns reported in studies by Jagadale et al., Sarma et al., and Aslam et al. [1,3,8]. The occurrence of lymphoma in this age group is significant, as it suggests that the disease often strikes individuals at a time when they are likely to be in the midst of their professional and personal lives. The impact of a lymphoma diagnosis at this stage of life can be profound, affecting not only the patients but also their families and communities. Moreover, the presence of lymphoma in older age groups emphasizes the importance of considering age-related factors in diagnosis and treatment. Older patients may have comorbidities and reduced tolerance to aggressive therapies, necessitating personalized treatment approaches that balance efficacy with quality-of-life considerations.

Anatomical distribution analysis revealed that lymph nodes were the most frequently involved site in our cases, consistent with the established understanding that lymph nodes are the primary sites of lymphoid tissue and the hallmark location for lymphoma manifestation. This finding is in line with numerous studies, including that by Polepole et al. [2]. The predominance of nodal involvement in lymphoma cases reinforces the importance of thorough lymph node evaluation in the diagnostic workup of suspected lymphoma patients. However, our study also identified cases of extranodal involvement, underscoring the diverse tissue tropism exhibited by lymphomas. Lymphomas can arise in or spread to virtually any tissue in the body, making it imperative for clinicians to maintain a high index of suspicion for extranodal disease, particularly in patients presenting with unusual or unexplained symptoms. The identification of extranodal involvement has important implications for staging, prognosis, and treatment planning, as extranodal lymphomas may behave differently and require specialized therapeutic approaches.

The predominance of NHL among extranodal lymphomas in our study highlights the heterogeneous nature of NHL subtypes and their variable tissue predilections. Different NHL subtypes can exhibit distinct biological behaviors, patterns of spread, and responses to treatment. For instance, while some subtypes may preferentially involve lymph nodes, others may be more likely to present in extranodal sites such as the gastrointestinal tract, skin, or central nervous system. This variability necessitates tailored diagnostic and therapeutic strategies based on the specific subtype and anatomical site involved. Our study identified Diffuse Large B-Cell Lymphoma (DLBCL) as the most common NHL subtype, a finding that is consistent with reports from Aslam et al., Pervez et al., Susanibar-Adaniya et al., and Wang et al. [8,11,12,13]. DLBCL is a particularly aggressive form of NHL, but it is also one of the most responsive to treatment when diagnosed early. The identification of DLBCL as the predominant subtype in our study underscores the need for timely and accurate diagnosis, as well as the importance of subtype-specific treatment protocols that can improve patient outcomes.
In the context of Hodgkin Lymphoma (HL), our study found that mixed cellularity was the most prevalent subtype, with a notable predominance of cases occurring in males. This finding agrees with studies conducted by Siddiqui et al., Bhurani et al., Yadav B et al., and Ganesan P et al. who reported similar patterns in large cohorts of HL patients [1,14,15, 16, 17]. Mixed cellularity HL is characterized by a heterogeneous cellular composition, including the presence of Reed-Sternberg cells in a background of mixed inflammatory cells. The male predominance observed in our study and others may reflect underlying biological differences in immune system function or genetic susceptibility between genders. Further research into the molecular and immunological underpinnings of HL could provide valuable insights into why certain subtypes, such as mixed cellularity, are more common in males and how these differences might influence treatment response and prognosis.

Finally, our study reported one case of peripheral T-cell lymphoma (PTCL) with bone marrow involvement, presenting as myelofibrosis. PTCL is a rare and aggressive form of lymphoma, and its association with bone marrow involvement is indicative of advanced disease. The presence of myelofibrosis, a condition characterized by the replacement of bone marrow with fibrous tissue, further complicates the clinical management of these patients. Our findings are consistent with previous

studies by Jagadale et al., Chakrabarti et al., Mussolin et al., and Mondal et al., who also noted frequent bone marrow involvement in PTCL cases [1,18,19, 20]. The frequent involvement of the bone marrow in PTCL cases underscores the aggressive nature of this disease and the importance of comprehensive diagnostic evaluation, including bone marrow biopsy, in patients with suspected PTCL. Early detection of bone marrow involvement is crucial for accurate staging and can influence treatment decisions, including the need for more intensive therapies or consideration of hematopoietic stem cell transplantation.

CONCLUSION

Overall, our study contributes valuable insights into the epidemiology and clinicopathological characteristics of lymphomas within our patient population. Exploring diverse lymphoma variants within a tertiary care hospital setting is crucial for enhancing diagnostic accuracy and tailoring effective treatment strategies. By delving into the clinical, histopathological, and molecular characteristics of various subtypes, this study contributes to a deeper understanding of lymphoma's complexity. This understanding enables healthcare professionals to provide more personalized and targeted care, ultimately leading to improved patient outcomes. Continuing interdisciplinary collaboration and ongoing research efforts will further refine our knowledge and approach to managing this heterogeneous group of malignancies.

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CONFLICTS OF INTEREST

Nil

REFERENCES

1. Jagadale, K. A., Kesarkhane, M., Singh, S., & Patil, A. M. (2023). Histomorphologic spectrum of Hodgkin and non-Hodgkin lymphomas according to WHO classification 2016 in a tertiary care hospital in Maharashtra. Int J Med Rev Case Rep. 6(22), 36-36. doi: 10.5455/IJMRCR.172-1661421815
2. Polepole P, Mudenda VC, Munsaka SM, Zhang L. Spectrum of common Hodgkin lymphoma and non-Hodgkin lymphomas subtypes in Zambia: a 3-year records review. Journal of Health, Population and Nutrition. 2021 Dec;40:1-9. doi: 10.1186/s41043-021-00261-y
3. Sarma S, Mehta J. Spectrum of lymphomas in India. Int J Mol Immuno Oncol. 2024;9:16-24. doi: 10.25259/IJMIO_18_2023
4. Phillips AA, Smith DA. Health disparities and the global landscape of lymphoma care today. American Society of Clinical Oncology Educational Book. 2017 Jan 1;37:526-34. doi: 10.1200/EDBK_17544
5. Esmeray E, Кьзьк CA. Genetic alterations in B cell lymphoma subtypes as potential biomarkers for noninvasive diagnosis, prognosis, therapy, and disease monitoring. Turk J Biol. 2020;44(1):1-4. doi: 10.3906/biy-1908-23
6. Naresh KN, Srinivas V, Soman CS. Distribution of various subtypes of non-Hodgkin's lymphoma in India: A study of 2773 lymphomas using REAL and WHO Classifications. Ann Oncol. 2000 Jan 1;11:S63-7. doi: 10.1093/annonc/11.suppl_1.S63
7. Babu SM, Garg S, Kanakasetty GB, Kuntegowdanahalli LC, Dasappa L, Rao SA. Diffuse large B-cell lymphoma: A retrospective study from a regional care center in South India. Ind J Cancer. 2018 Jan 1;55(1):66-9. doi: 10.4103/ijc.IJC_450_16
8. Aslam W, Habib M, Aziz S. Clinicopathological Spectrum of Hodgkin's and Non-Hodgkin's Lymphoma: A Tertiary Care Cancer Hospital Study in Pakistan. Cureus. 2022 Jun 3;14(6). doi: 10.7759/cureus.25620
9. Sharma M, Mannan R, Madhukar M, Navani S, Manjari M, Bhasin TS, Gill KS. Immunohistochemical (IHC) analysis of Non-Hodgkin's lymphoma (NHL) spectrum according to WHO/REAL classification: A single centre experience from Punjab, India. J Clin Diagn Res: JCDR. 2014 Jan;8(1):46. doi: 10.7860/JCDR/2014/8173.3988
10. Mukherjee M, Kumar A, Prasad A, Mukherjee S, Era N. Distribution of lymphoid neoplasm in eastern India: An experience from a tertiary care cancer research institute. IP J Diagn Pathol Oncol. 2018 Jul;3(3):172-6. doi: 10.18231/2581-3706.2018.0036
11. Pervez S. Non-hodgkin lymphoma (NHL) in Pakistan. Int J Mol Cell Med. 2012;1(1):62.
12. Susanibar-Adaniya S, Barta SK. 2021 update on diffuse large B cell lymphoma: a review of current data and potential applications on risk stratification and management. Am J Hematol. 2021 May;96(5):617-29. doi: 10.1002/ajh.26151
13. Wang L, Li LR, Young KH. New agents and regimens for diffuse large B cell lymphoma. J Hematol Oncol. 2020 Dec;13:1-23. doi: 10.1186/s13045-020-01011-z
14. Siddiqui N, Ayub B, Badar F, Zaidi A. Hodgkin's lymphoma in Pakistan: a clinico-epidemiological study of 658 cases at a cancer center in Lahore. Asian Pac J Cancer Prev. 2006 Dec;7(4):651-5.
15. Bhurani D, Nair R, Rajappa S, Rao SA, Sridharan N, Boya RR, Raman GS, Menon H, Seshachalam A, Nimmagadda R. Real-world outcomes of hodgkin lymphoma: a multi-centric registry from India. Front Oncol. 2022 Feb 11;11:799948. doi: 10.3389/fonc.2021.799948

16. Yadav B, Sharma S, Malhotra P, Prakash G. Combined modality treatment: outcome in patients with Hodgkin's lymphoma. Journal of Cancer Research and Therapeutics. 2020;16(1):1-6. doi: 10.4103/jcrt.JCRT_465_17
17. Ganesan P, Kumar L, Raina V, Sharma A, Bakhshi S, Sreenivas V, Vijayaraghavan M, Thulkar S. Hodgkin's lymphoma—long-term outcome: an experience from a tertiary care cancer center in North India. Annals of hematology. 2011 Oct;90:1153-60. doi: 10.1007/s00277-011-1262-8
18. Chakrabarti S, Sarkar S, Goswami BK, Mondal S, Roy A, Das S. Hodgkin's and Non-Hodgkin's lymphomas in an Indian rural medical institution: comparative clinicopathologic analysis. Asian Pac J Cancer Prev. 2010 Jan 1;11(6):1605-8.
19. Mussolin LA, Pillon M, d'Amore ES, Santoro N, Lombardi A, Fagioli F, Zanesco L, Rosolen AN. Prevalence and clinical implications of bone marrow involvement in pediatric anaplastic large cell lymphoma. Leukemia. 2005 Sep;19(9):1643-7. doi: 10.1038/sj.leu.2403888
20. Mondal SK, Mandal PK, Roy SD, Chattopadhyay S, Roy S, Biswas PK. Malignant lymphoma in Eastern India: a retrospective analysis of 455 cases according to World Health Organisation classification. J Cancer Res Ther. 2014 Apr 1;10(2):354-8. doi: 10.4103/0973-1482.136639