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A CLINICAL, CYTOLOGICAL, HISTOMORPHOLOGICAL EVALUATION OF LYMPHNODES IN CHILDREN

Pathology

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ABSTRACT

Introduction: Lymphadenopathy is a common clinical condition in children, largely resulting from continuous exposure to infectious agents and antigenic stimulation leading to reactive lymphoid hyperplasia. Although most cases are benign and self-limiting, persistent or atypical lymphadenopathy may indicate serious underlying pathology, including malignancy. Fine Needle Aspiration Cytology (FNAC) serves as a rapid, minimally invasive, and cost-effective diagnostic tool, while histopathological examination remains the gold standard. Correlation between clinical, cytological, and histomorphological findings enhances diagnostic accuracy and guides appropriate management.**Aim & Objective:** To comprehensively evaluate lymphadenopathy in children through clinical, cytological, and histomorphological methods and to assess clinical presentation for improving diagnostic accuracy.**Methodology:** This prospective observational study was conducted over two years on 150 children aged 1–12 years presenting with lymphadenopathy. Detailed clinical evaluation was followed by FNAC in all cases. Histopathological examination and immunohistochemistry were performed where indicated. Data were analyzed using statistical methods to determine associations and diagnostic accuracy.**Result:**The majority of cases were seen in the 7–9 years age group with slight male predominance. Cervical lymph nodes were most commonly involved (65.3%) and showed the largest size. Hard lymph nodes were significantly associated with malignancy. Reactive lymphadenitis was the most common histological pattern, and a high cytology–histology concordance was observed. Reactive hyperplasia was the most frequent final diagnosis.**Conclusion:**Pediatric lymphadenopathy is predominantly benign, with reactive hyperplasia as the leading cause. FNAC is a reliable first-line diagnostic tool, and its correlation with histopathology improves diagnostic precision. Early and combined evaluation is essential for accurate diagnosis and effective management.

KEYWORDS

Pediatric Lymphadenopathy, Fine Needle Aspiration Cytology (FNAC), Histopathology, Reactive Lymphadenitis, Cervical Lymph Nodes, Immunohistochemistry (IHC), Cytology–histology Correlation, Malignancy, Reactive Hyperplasia, Diagnostic Accuracy

INTRODUCTON

Lymphadenopathy is a common clinical finding in children, primarily due to continuous exposure to new infectious agents and antigens, leading to reactive hyperplasia of lymphoid tissue. It is most frequently observed in children below 12 years of age, reflecting heightened immune activity. In most cases, lymph node enlargement is benign, self-limiting, and non-malignant, accounting for approximately 85–87% of cases[1,2]. However, persistent, atypical, or symptomatic lymphadenopathy may indicate serious underlying conditions, including malignancy, necessitating further evaluation of nodal structure and cytology.

Fine Needle Aspiration Cytology (FNAC) has emerged as a rapid, minimally invasive, safe, and cost-effective first-line diagnostic tool for evaluating lymphadenopathy. It provides cytological material with minimal discomfort, avoids surgical procedures, and is particularly suitable for pediatric patients[3]. FNAC plays a crucial role in differentiating reactive, infectious, and malignant causes, thereby facilitating early diagnosis and timely management.

Although lymphoid tumors constitute only 3–5% of all malignancies, lymph nodes are common sites for metastatic spread, making early diagnosis essential. FNAC is highly useful in initial assessment; however, definitive diagnosis of conditions such as Non-Hodgkin Lymphoma requires histopathological examination through biopsy, which remains the gold standard. Thus, FNAC and histopathology are complementary techniques.

Correlation of cytological findings with histomorphology enhances diagnostic accuracy and helps assess false-positive and false-negative rates, strengthening the reliability of FNAC[4]. Advances such as immunocytochemistry using monoclonal antibodies have further improved diagnostic precision by identifying tumor cell origin and differentiating morphologically similar conditions.

In this study, immunohistochemistry (IHC) was performed in confirmed and suspicious lymphoma cases to enable accurate diagnosis and subclassification, thereby aiding prognosis and treatment planning[5,6]. The study emphasizes a comprehensive approach combining clinical, cytological, and histomorphological evaluation for better diagnosis of pediatric lymphadenopathy. Such an approach is essential as children exhibit distinct disease patterns, and early, accurate diagnosis can prevent complications and improve outcomes.

AIM AND ONJECTIVE

- A comprehensive analysis of lymph nodes in children through clinical, cytological, and histomorphological evaluations to understand the underlying causes of lymphadenopathy and improve diagnostic accuracy.
- To assess the clinical presentation of lymphadenopathy in children, including the location, size, consistency, and associated systemic symptoms, to provide a preliminary clinical diagnosis.

MATERIAL AND METHODS

This prospective observational study was conducted to evaluate lymph nodes in children using clinical, cytological, and histomorphological methods, with the objective of identifying the causes of lymphadenopathy and improving diagnostic accuracy. The study was carried out in the Department of Pathology in collaboration with the Department of Pediatrics at a tertiary care hospital serving as a regional referral center. The duration of the study was two years, from January 2025 to December 2026, allowing sufficient time for participant recruitment and detailed evaluation. A total of approximately 150 children were included, with the sample size calculated based on prior hospital data using a 95% confidence level ($Z = 1.96$), estimated prevalence (p), and a margin of error of 5% ($E = 0.05$).

Children aged 1 to 12 years presenting with palpable lymphadenopathy and whose parents or guardians provided written informed consent were included in the study. Children who had received prior treatment for lymphadenopathy, had known immunodeficiency disorders or malignancies, or had contraindications to biopsy procedures such as bleeding disorders were excluded. All enrolled participants underwent a detailed clinical evaluation, which included assessment of lymph node characteristics such as location, size, and consistency, along with associated systemic symptoms.

Fine needle aspiration cytology (FNAC) was performed on all palpable lymph nodes under aseptic conditions using a 22-gauge needle attached to a 10 ml syringe. Samples were collected by experienced cytologists, and slides were prepared using May-Grunwald Giemsa and Papanicolaou stains for cytological evaluation. In cases where FNAC findings were inconclusive or suggestive of malignancy, histological examination was carried out through excisional or core needle biopsy under local anesthesia. Tissue samples were processed and stained with hematoxylin and eosin for routine examination, while special stains such as Ziehl-Neelsen and immunohistochemical markers were applied as required.

Data obtained from clinical examination, FNAC, and histopathological findings were recorded in a structured proforma and analyzed using SPSS software. Descriptive statistics were used to summarize demographic and clinical characteristics, while inferential statistics, including Chi-square tests, t-tests, and ANOVA, were applied to assess associations between variables. Logistic regression analysis was used to identify predictors of malignancy and adjust for confounding factors. A p-value of less than 0.05 was considered statistically significant. This integrated methodological approach combining clinical, cytological, and histopathological evaluation provided a comprehensive framework for accurate diagnosis and effective management of pediatric lymphadenopathy.

RESULT

Table 1. Demographic Profile of Pediatric Patients with Lymphadenopathy

Age Group (years)	Number (%)	Male (%)	Female (%)	p-value
1–3	34 (22.7)	19 (55.9)	15 (44.1)	0.726
4–6	38 (25.3)	20 (52.6)	18 (47.4)	
7–9	41 (27.3)	25 (61.0)	16 (39.0)	
10–12	37 (24.7)	20 (54.1)	17 (45.9)	
Interpretation: Balanced distribution across ages with slight male predominance (p=0.726).				

The above table represents the demographic profile of pediatric patients with lymphadenopathy distributed across four age groups. The highest proportion of patients belonged to the 7–9 years age group (27.3%), followed by 4–6 years (25.3%), 10–12 years (24.7%), and 1–3 years (22.7%). Across all age categories, a slight male predominance was observed, with males constituting between 52.6% and 61.0% of cases, while females accounted for 39.0% to 47.4%. However, the difference in gender distribution across age groups was not statistically significant, as indicated by a p-value of 0.726, suggesting a balanced distribution of lymphadenopathy cases among different ages with no significant gender bias.

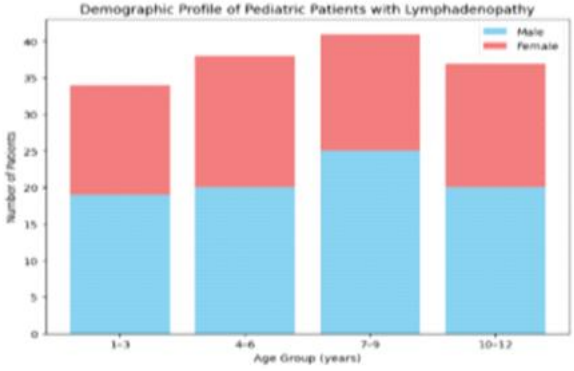


Table 2. Distribution of Lymph Node Location

Location	Number (%)	Mean Size (cm) ± SD	p-value
Cervical	98 (65.3)	2.3 ± 0.8	<0.001
Axillary	24 (16.0)	1.9 ± 0.6	
Inguinal	18 (12.0)	2.0 ± 0.7	
Submandibular	10 (6.7)	1.8 ± 0.5	
Interpretation: Cervical lymphadenopathy predominated, with larger mean size (p<0.001).			

The above table represents the distribution of lymph node locations among the study population, along with their corresponding frequency and mean size. Cervical lymph nodes constituted the majority of cases, accounting for 98 (65.3%) of the total, and also demonstrated the largest mean size of 2.3 ± 0.8 cm, which was statistically significant (p<0.001). Axillary lymph nodes were the second most common, observed in 24 (16.0%) cases with a mean size of 1.9 ± 0.6 cm, followed by inguinal lymph nodes in 18 (12.0%) cases with a mean size of 2.0 ± 0.7 cm. Submandibular lymph nodes were the least frequently involved, seen in 10 (6.7%) cases with a mean size of 1.8 ± 0.5 cm. Overall, cervical lymphadenopathy predominated in both frequency and size, indicating a significant predilection for cervical involvement in the study population.

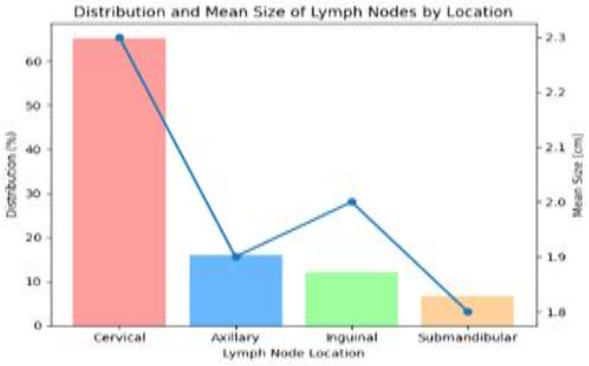


Table 3. Lymph Node Consistency on Palpation

Consistency	Number (%)	Malignancy (%)	p-value
Firm	88 (58.7)	9 (10.2)	0.013
Soft	35 (23.3)	1 (2.9)	
Hard	17 (11.3)	8 (47.1)	
Fluctuant	10 (6.7)	0 (0.0)	
Interpretation: Hard nodes showed higher malignancy rates (p=0.013).			

The above table represents the distribution of lymph nodes based on their location, showing that cervical lymph nodes were the most commonly involved, accounting for 65.3% of cases, followed by axillary (16.0%), inguinal (12.0%), and submandibular (6.7%) nodes; the mean size was largest for cervical lymph nodes (2.3 ± 0.8 cm) compared to axillary (1.9 ± 0.6 cm), inguinal (2.0 ± 0.7 cm), and submandibular (1.8 ± 0.5 cm), with this difference being statistically significant ($p < 0.001$), indicating a predominance of cervical lymphadenopathy with comparatively larger nodal size in the study population

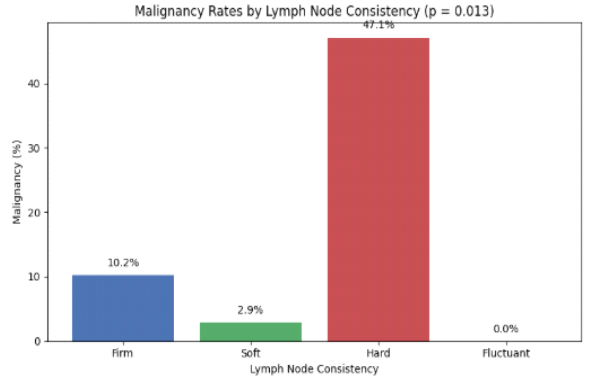


Table 4. Histological Patterns Identified

Histology Pattern	Number (%)	Cytology Concordance (%)	p-value
Reactive	68 (45.3)	63/68 (92.6)	<0.001
Tuberculous	16 (10.7)	14/16 (87.5)	
Suppurative	20 (13.3)	17/20 (85.0)	
Lymphoma	18 (12.0)	15/18 (83.3)	
Metastatic	4 (2.7)	3/4 (75.0)	
Interpretation: High cytology-histology concordance (p<0.001).			

The above table represents the distribution of various histological patterns identified in the study along with their corresponding cytology–histology concordance rates and statistical significance. Reactive lesions constituted the most common pattern, accounting for 68 cases (45.3%), with a high concordance of 92.6% (63/68). Tuberculous lesions were observed in 16 cases (10.7%) and showed a concordance rate of 87.5% (14/16), while suppurative lesions

comprised 20 cases (13.3%) with an 85.0% concordance (17/20). Lymphoma accounted for 18 cases (12.0%) and demonstrated a concordance of 83.3% (15/18), whereas metastatic lesions were least frequent with 4 cases (2.7%) and a concordance rate of 75.0% (3/4). Overall, a high level of cytology–histology concordance was observed across all patterns, and the association was found to be statistically significant ($p < 0.001$).

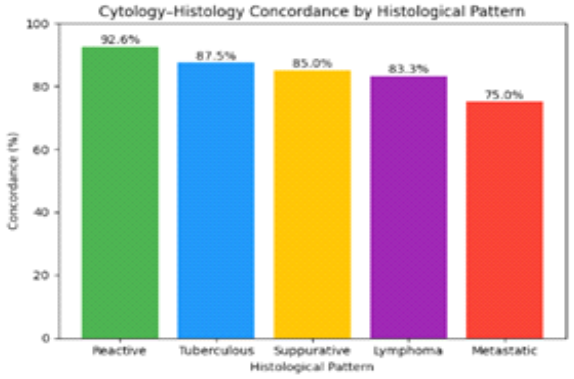
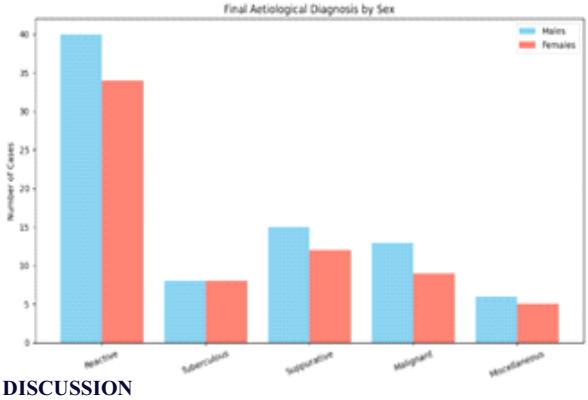


Table 5. Final Aetiological Diagnosis

Diagnosis	Number (%)	Males (%)	Females (%)	p-value
Reactive	74 (49.3)	40 (54.1)	34 (45.9)	0.418
Tuberculous	16 (10.7)	8 (50.0)	8 (50.0)	
Suppurative	27 (18.0)	15 (55.6)	12 (44.4)	
Malignant	22 (14.7)	13 (59.1)	9 (40.9)	
Miscellaneous	11 (7.3)	6 (54.5)	5 (45.5)	
Interpretation: Reactive hyperplasia most common; no sex difference (p=0.418).				

The above table represents the final aetiological diagnosis among the study population along with the distribution according to sex and the associated p-value. Reactive hyperplasia was the most common diagnosis, accounting for 74 cases (49.3%), with a slightly higher proportion in males (54.1%) than females (45.9%). Tuberculous lymphadenitis constituted 16 cases (10.7%) and showed equal distribution between males and females (50.0% each). Suppurative lesions were observed in 27 cases (18.0%), with a male predominance (55.6%) compared to females (44.4%). Malignant diagnoses were seen in 22 cases (14.7%), again more frequent in males (59.1%) than females (40.9%). Miscellaneous causes accounted for 11 cases (7.3%), with males comprising 54.5% and females 45.5%. Overall, reactive hyperplasia emerged as the most common aetiology, and no statistically significant difference was observed between sexes ($p = 0.418$).



DISCUSSION

The present study provides a comprehensive clinicopathological evaluation of pediatric lymphadenopathy and the findings are largely consistent with previously published studies, while also highlighting certain distinctive observations. In terms of demographic distribution, the current study demonstrated a relatively uniform age distribution with a slight male predominance, which was not statistically significant. This is in partial agreement with studies by Patel et al.[7] and Pandey et al.[11], where a higher prevalence was noted in older children (5–14 years) along with male predominance. Similarly, Jain et al.[9] also reported male predominance (55%), suggesting that although gender differences exist, they may not always reach statistical significance, as observed in the present study.

With respect to lymph node location, cervical lymphadenopathy was the most common finding (65.3%) in the present study, which aligns closely with observations reported by Patel et al.[7] (79%), Mahajan et al.[8] (71%), Jain et al.[9] (70%), and Pandey et al.[11] (70%). This consistent predominance of cervical lymph nodes across studies can be attributed to frequent upper respiratory tract infections and regional antigenic exposure in children. Additionally, the present study noted significantly larger mean nodal size in cervical nodes ($p<0.001$), further supporting their clinical relevance in pediatric lymphadenopathy.

On clinical examination, lymph node consistency showed a significant association with malignancy ($p=0.013$), with hard nodes demonstrating a markedly higher rate of malignancy (47.1%). This observation is in concordance with general clinical principles and is indirectly supported by findings from Ghosh et al.[10], who reported a high risk of malignancy in higher cytological categories using the Sydney system. Although other studies did not explicitly correlate consistency with malignancy, the present study reinforces the importance of physical examination in predicting underlying pathology.

Histopathological evaluation in the present study revealed reactive lymphadenitis as the most common pattern (45.3%), followed by suppurative, tuberculous, and malignant lesions. These findings are comparable with those of Mahajan et al.[8] and Jain et al.[9], where reactive lymphadenitis accounted for 68% and 66.7% of cases, respectively. Similarly, Patel et al.[7] and Pandey et al.[11] also reported reactive lymphadenitis as the predominant diagnosis, followed by granulomatous or tuberculous lesions. The proportion of tuberculous lymphadenitis (10.7%) in the present study is slightly lower compared to Jain et al.[9] and Pandey et al.[11] (16–16.7%), which may reflect regional variation in disease prevalence.

An important finding of the present study is the high cytology–histology concordance across all lesion types, with an overall statistically significant association ($p<0.001$). This is comparable to the diagnostic accuracy reported by Mahajan et al.[8] (95.45%) and Ghosh et al.[10] (90.1%), thereby reaffirming the reliability of FNAC as a primary diagnostic modality. The slightly lower concordance observed in malignant lesions (75–83.3%) highlights the need for histopathological confirmation in suspicious or atypical cases, as also emphasized in previous studies.

Regarding final etiological diagnosis, reactive hyperplasia was the most common cause (49.3%), followed by suppurative (18.0%), tuberculous (10.7%), and malignant lesions (14.7%). This pattern is consistent with findings from Patel et al.[7], Jain et al.[9], and Pandey et al.[11], all of whom identified reactive lymphadenitis as the leading cause of pediatric lymphadenopathy. However, the proportion of malignant cases in the present study (14.7%) is relatively higher compared to Patel et al.[7] (6%) and Mahajan et al.[8] (3%), which may be due to referral bias or inclusion of more clinically suspicious cases at a tertiary care center.

the present study corroborates existing literature in demonstrating that reactive lymphadenitis is the predominant cause of lymphadenopathy in children, with cervical nodes being the most commonly involved site. It also emphasizes the high diagnostic utility of FNAC, supported by strong cytology–histology concordance, while highlighting the continued importance of histopathological examination in selected cases.

CONCLUSION

The present study demonstrates that pediatric lymphadenopathy shows a relatively uniform age distribution with a slight, statistically insignificant male predominance. Cervical lymph nodes were the most commonly affected and exhibited significantly larger sizes, highlighting their clinical importance. On palpation, hard lymph nodes were strongly associated with higher malignancy rates, emphasizing the need for careful clinical assessment. Histologically, reactive

hyperplasia emerged as the most frequent finding, followed by infective and malignant causes, with a high cytology–histology concordance confirming diagnostic reliability. Overall, most cases were benign in nature, and no significant sex-based differences were observed in etiological distribution.

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