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CLINICOPATHOLOGICAL PROFILE OF LYMPHADENOPATHY IN CHILDREN: A CROSS-SECTIONAL STUDY OF 151 CASES FROM A TERTIARY CARE HOSPITAL IN NORTH INDIA

Pathology

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ABSTRACT

Background: Lymphadenopathy is a frequent paediatric complaint with a wide aetiological spectrum ranging from benign reactive hyperplasia to tuberculosis and malignancy. Region-specific data on its clinicopathological pattern remain limited.**Objectives:** To evaluate the clinical and cytomorphological pattern of lymphadenopathy in children attending a tertiary care hospital and to determine its association with age, sex, and anatomical site.**Methods:** This cross-sectional study enrolled 151 children aged 1–18 years with clinically significant lymphadenopathy (cervical nodes >1 cm; axillary/inguinal nodes >1.5 cm) over two years at a tertiary care institute in Uttar Pradesh. Clinical evaluation, haematological work-up, chest radiography, and fine needle aspiration cytology (FNAC) with May–Grünwald–Giemsa, haematoxylin–eosin, and Ziehl–Neelsen staining were performed. Associations with demographic and clinical variables were tested by chi-square test ($p<0.05$ significant).**Results:** The 6–10-year age group was most affected (29.8%), with a male-to-female ratio of 1.22:1. Fever was the commonest symptom (86.8%). FNAC revealed reactive lymphadenitis in 57.0%, tubercular lymphadenitis in 23.8%, granulomatous lymphadenitis in 7.9%, suppurative lymphadenitis in 6.0%, and lymphoma in 3.3% of cases. Lymph node matting and posterior cervical/submandibular location showed strong association with tubercular aetiology, while supraclavicular involvement correlated with malignancy. FNAC diagnosis was significantly associated with age group ($p<0.001$) and lymph node site ($p<0.001$) but not sex ($p=0.41$).**Conclusion:** Most paediatric lymphadenopathy is benign and reactive, but tuberculosis remains a major treatable cause. FNAC is a reliable, minimally invasive first-line diagnostic tool that can guide rational management and reduce unnecessary excisional biopsies in children.

KEYWORDS

Lymphadenopathy; Paediatrics; Fine Needle Aspiration Cytology; Tuberculosis; Lymphadenitis; Cytodiagnosis

INTRODUCTION

Lymphadenopathy, defined as abnormal enlargement of one or more lymph nodes beyond 1 cm in the cervical region or 1.5 cm in the axillary and inguinal regions, is among the most frequent findings encountered in paediatric clinical practice.[1,2] Because lymph nodes in children are physiologically more prominent owing to ongoing antigenic stimulation from recurrent infections, distinguishing benign reactive enlargement from a serious underlying disorder is a recurring diagnostic challenge.[3]

The aetiological spectrum of paediatric lymphadenopathy is broad and is strongly influenced by geography, socioeconomic status, and nutritional background. In resource-limited settings such as India, infective causes—particularly upper respiratory tract infections, suppurative skin infections, and tuberculosis—predominate, whereas viral infections and reactive hyperplasia are more common in higher-income countries.[4,5] Lymphadenopathy may be localized, typically reflecting infection in the corresponding drainage area, or generalized, which raises suspicion of systemic viral illness, autoimmune disease, or malignancy.[6,7] The cervical region is the commonest site involved in children because of the high frequency of head and neck infections.

Clinical assessment of node size, consistency, tenderness, mobility, and matting, together with systemic features such as fever, weight loss, and night sweats, provides important diagnostic clues; firm, fixed, non-tender, and progressively enlarging nodes raise concern for tuberculosis or malignancy, whereas soft, mobile, tender nodes favour a reactive process.[8,9] Tuberculous lymphadenitis remains the leading cause of extrapulmonary tuberculosis in Indian children and continues to pose diagnostic difficulty because its presentation overlaps with other granulomatous and neoplastic conditions.[10,11]

Fine needle aspiration cytology (FNAC) has become the investigation of choice for the initial evaluation of paediatric lymphadenopathy because it is simple, rapid, minimally invasive, and cost-effective, and it has substantially reduced reliance on excisional biopsy in this age group.[12,13] When combined with Ziehl–Neelsen (ZN) staining for acid-fast bacilli, FNAC enables confirmation of tuberculous aetiology with reasonable sensitivity, while excisional biopsy is reserved for cases with inconclusive cytology or suspected lymphoma.[14,15]

Despite the availability of FNAC, contemporary, region-specific data correlating clinical presentation with cytomorphological diagnosis in Indian children remain limited. This study was therefore undertaken to describe the clinicopathological profile of paediatric lymphadenopathy presenting to a tertiary care hospital and to evaluate the diagnostic utility of FNAC across age, sex, and anatomical subgroups.

MATERIALS AND METHODS

Study design and setting

This hospital-based, cross-sectional, observational study was conducted jointly in the Departments of Pathology and Paediatrics of a tertiary care teaching institute in Barabanki, Uttar Pradesh, India, over a period of 24 months. The reporting of this study conforms to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies.

Study population and sample size

Children aged 1–18 years presenting with clinically significant lymphadenopathy to the outpatient and inpatient services of the Department of Paediatrics, and subsequently referred to the Department of Pathology for cytological evaluation, were eligible. The sample size was calculated using the standard formula for estimating a population proportion, with $Z = 1.96$, an expected prevalence of lymphadenopathy of 0.89, and an absolute precision of 5%, yielding a minimum requirement of 151 patients. Consecutive sampling was used to enrol all eligible patients during the study period until this number was reached.

Inclusion and exclusion criteria

Children aged 1–18 years with cervical lymph nodes exceeding 1 cm, or axillary and inguinal nodes exceeding 1.5 cm, were included. Children with midline neck masses, a pre-existing diagnosis of leukaemia, lymphoma, or other haematological malignancy, and those with bleeding disorders or uncorrectable coagulopathy were excluded.

Clinical evaluation

A structured clinical proforma was used to record demographic details, duration and nature of presenting complaints, constitutional symptoms (fever, weight loss, night sweats, loss of appetite), history of contact with tuberculosis, and immunization status. Lymph nodes were examined for site, size, number, laterality, consistency, tenderness, mobility, and presence of matting or sinus formation. Nutritional status

was graded according to standard criteria for protein-energy malnutrition.

Laboratory and radiological investigations

All patients underwent complete blood count, peripheral blood smear examination, erythrocyte sedimentation rate (ESR), Mantoux testing, and chest radiography as clinically indicated.

FNAC procedure

After obtaining written informed consent from parents or legal guardians, FNAC was performed under aseptic precautions using a 22–23-gauge needle attached to a 10 mL disposable syringe; ultrasound guidance was used for deep-seated nodes when required. Five to six smears were prepared from each aspirate. Two smears were fixed immediately in 95% alcohol for haematoxylin and eosin (H&E) staining, two were air-dried for May–Grünwald–Giemsa (MGG) staining, and additional smears were stained with Papanicolaou (PAP) stain where indicated. ZN staining for acid-fast bacilli was performed on smears showing cytomorphological features suggestive of tuberculous or granulomatous lymphadenitis. Cytological diagnoses were categorized as reactive lymphadenitis, tubercular lymphadenitis, granulomatous lymphadenitis (non-tubercular), suppurative lymphadenitis, lymphoma, or inadequate/unsatisfactory sample.

Ethical considerations

The study was approved by the Institutional Ethics Committee prior to commencement, and written informed consent, including consent for FNAC, was obtained from the parent or legal guardian of every participating child.

Statistical analysis

Data were entered in Microsoft Excel and analysed using standard statistical software. Categorical variables were summarized as frequencies and percentages. The chi-square test was used to assess associations between categorical variables, including FNAC diagnosis with age group, sex, and anatomical site. A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

A total of 151 children with clinically significant lymphadenopathy were evaluated during the study period.

Demographic profile

The 6–10-year age group was most frequently affected (45 cases, 29.8%), followed by 11–15 years (43, 28.5%), 1–5 years (39, 25.8%), and 16–18 years (24, 15.9%) (Table 1). A male preponderance was observed, with 83 boys (55.0%) and 68 girls (45.0%), giving a male-to-female ratio of 1.22:1.

Table 1. Age and sex distribution of study participants (N=151)

Variable	Category	Number (n)	Percentage (%)
Age group (years)	1–5	39	25.8
	6–10	45	29.8
	11–15	43	28.5
	16–18	24	15.9
Sex	Male	83	55.0
	Female	68	45.0

Clinical presentation

Fever was the most frequent presenting symptom (131 cases, 86.8%), followed by loss of appetite (45, 29.8%) and weight loss/pallor (41 each, 27.2%). Multiple lymph nodes were noted in 88 children (58.3%), while 63 (41.7%) had a solitary node. Most nodes were soft (66.2%), tender (59.6%), and mobile (80.1%); matting was present in 36 cases (23.8%). Chest radiography was abnormal in 18 children (11.9%), all showing hilar lymphadenopathy (Table 2, Figures 1–3).

Table 2. Clinical presentation and lymph node characteristics (N=151)

Parameter	Category	Number (n)	Percentage (%)
Symptom	Fever	131	86.8
	Loss of appetite	45	29.8
	Weight loss	41	27.2
	Pallor	41	27.2
Node number	Single	63	41.7
	Multiple	88	58.3
Consistency	Soft	100	66.2
	Firm	51	33.8
Tenderness	Present	90	59.6
	Absent	61	40.4
Mobility	Mobile	121	80.1
	Fixed/restricted	30	19.9
Matting	Present	36	23.8
	Absent	115	76.2
Chest X-ray	Hilar	18	11.9
	Normal	133	88.1

Nutritional status

Normal nutrition was recorded in 76 children (50.3%), while the remainder showed mild (34, 22.5%), moderate (25, 16.6%), or severe (16, 10.6%) protein-energy malnutrition. Malnutrition severity increased with age, being most marked in the 11–18-year group.

FNAC diagnosis

FNAC yielded reactive lymphadenitis in 86 cases (57.0%), tubercular lymphadenitis in 36 (23.8%), granulomatous lymphadenitis in 12 (7.9%), suppurative lymphadenitis in 9 (6.0%), lymphoma in 5 (3.3%), and an inadequate sample in 3 (2.0%) (Table 3, Figures 4–10). Overall, 62 cases (41.1%) were FNAC-positive for specific pathology (tubercular, granulomatous, suppurative, or lymphoma), while 89 (58.9%) were reactive or inadequate.

Table 3. Distribution of FNAC diagnoses (N=151)

FNAC diagnosis	Number (n)	Percentage (%)
Reactive lymphadenitis	86	57.0
Tubercular lymphadenitis	36	23.8
Granulomatous lymphadenitis	12	7.9
Suppurative lymphadenitis	9	6.0
Lymphoma	5	3.3
Inadequate sample	3	2.0
Total	151	100.0

Ancillary investigations

ESR was ≤20 mm/hr in 82 children (54.3%), 21–40 mm/hr in 33 (21.9%), and >40 mm/hr in 36 (23.8%). A family history of tuberculosis was elicited in 29 children (19.2%). Among 57 cases in which ZN staining was performed, acid-fast bacilli were demonstrated in 28 of 36 tubercular lymphadenitis cases (77.8%), compared with 3 of 12 granulomatous (25.0%) and 1 of 9 suppurative cases (11.1%), confirming the high diagnostic yield of ZN staining specifically in tuberculous disease.

Associations between FNAC diagnosis and clinical variables

A statistically significant association was found between age group and FNAC diagnosis (chi-square test, p<0.001); reactive lymphadenitis predominated in younger children, while tubercular lymphadenitis and lymphoma were proportionately more frequent in older children and adolescents (Table 4). No significant association was found between sex and FNAC diagnosis (p=0.41), indicating that the male preponderance in overall case numbers did not reflect a sex-based difference in underlying pathology.

Table 4. Association between age group and FNAC diagnosis (N=151)

Age group (years)	Reactive	Tubercular	Granulomatous	Suppurative	Lymphoma	Inadequate	Total
1–5	30	6	2	1	0	0	39
6–10	28	12	3	2	0	0	45
11–15	20	13	4	4	1	1	43
16–18	8	5	3	2	4	2	24
Total	86	36	12	9	5	3	151

Chi-square test: p<0.001.

Anatomical site of the lymph node was significantly associated with FNAC diagnosis (p<0.001) (Table 5). Tubercular lymphadenitis predominantly involved the posterior cervical (22/62, 35.5%) and submandibular (10/48, 20.8%) regions, while supraclavicular node involvement, although uncommon (3 cases), showed a disproportionately high association with lymphoma (2 of 3 cases).

Matting was strongly linked to tubercular aetiology: of 36 matted nodes, 28 (77.8%) were tubercular, compared with only 8 of 115 (7.0%) non-matted nodes. Hilar lymphadenopathy on chest radiography was observed exclusively among tubercular lymphadenitis cases (18 of 36, 50.0%), with no hilar involvement in any other diagnostic category.

Table 5. Association between anatomical site of lymph node and FNAC diagnosis (N=151)

Site	Reactive	Tubercular	Granulomatous	Suppurative	Lymphoma	Total
Anterior cervical	24	3	2	2	0	31
Posterior cervical	30	22	6	2	2	62
Submandibular	28	10	4	5	1	48
Axillary	3	1	0	0	3	7
Supraclavicular	1	0	0	0	2	3
Total	86	36	12	9	8	151

Chi-square test: $p<0.001$.

Figure 01: Swelling over the cervical region

Figure 02: Mantoux Test (Positive)

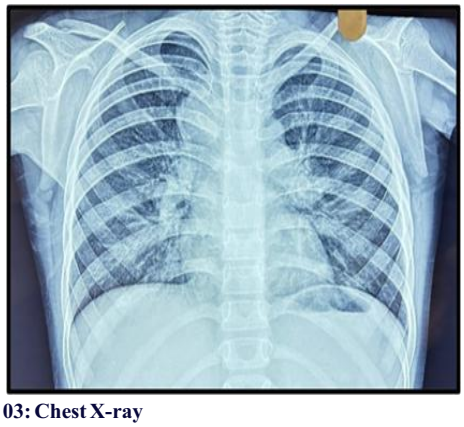


Figure 03: Chest X-ray

Figure 04: Reactive Lymphadenitis, MGG Stain, 10X

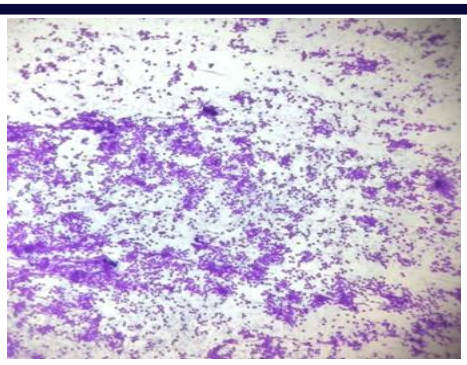


Figure 05: Reactive Lymphadenitis MGG Stain, 40X

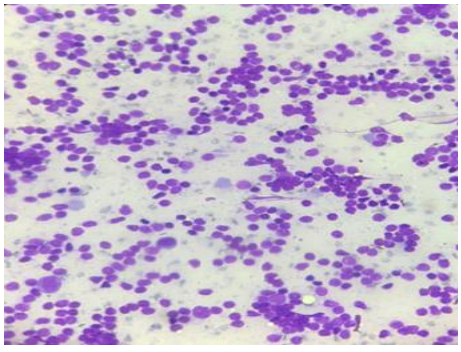


Figure 06: Tubercular Lymphadenitis MGG Stain, 10X

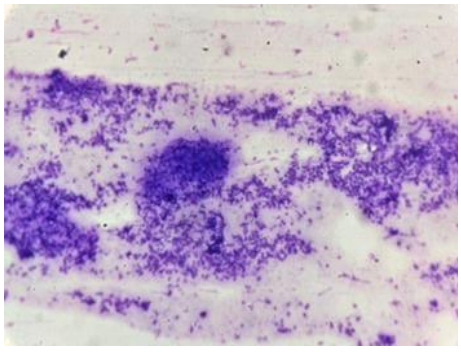


Figure 07: Tubercular Lymphadenitis (Well formed epithelioid granuloma) MGG Stain, 40X

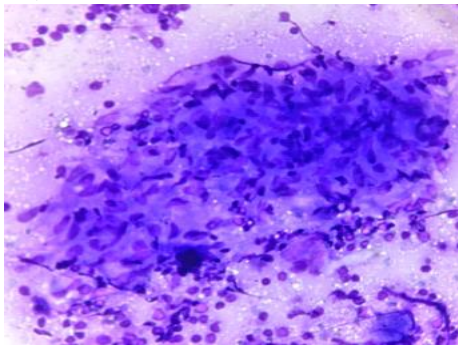


Figure 08: Necrotic Abscess, MGG Stain, 40X

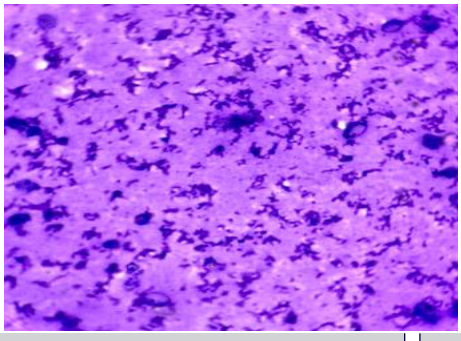


Figure 09: Hodgkin's Lymphoma (Mixed inflammatory background along with RS cells), H&E Stain, 40X

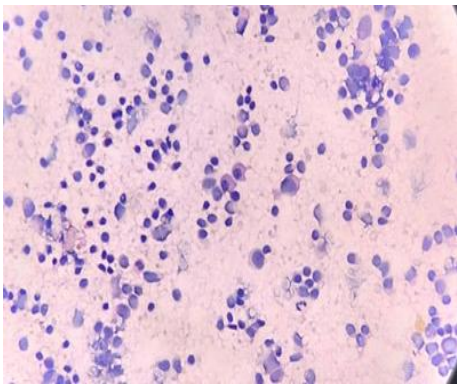
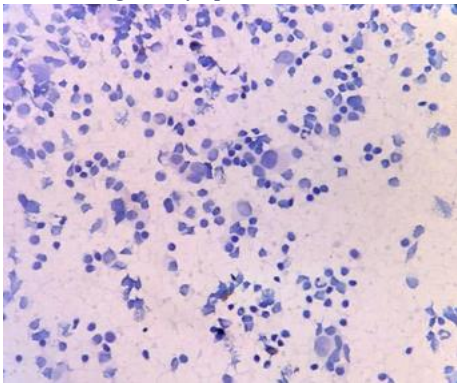


Figure 10: Non-Hodgkin's Lymphoma, H&E Stain, 10X



DISCUSSION

This cross-sectional study of 151 children with clinically significant lymphadenopathy provides a contemporary clinicopathological profile from a tertiary care centre in North India and reaffirms the central diagnostic role of FNAC in this age group.

The predominance of lymphadenopathy in the 6–10-year age group (29.8%) in our cohort is consistent with the observation of Mohan et al, who reported peak occurrence in the 4–8-year group, reflecting heightened antigenic exposure and immune activity during early and middle childhood.[16] Rajender et al similarly reported a peak in the 11–15-year group, while Ahmed et al also noted predominance among school-aged children, together supporting greater environmental pathogen exposure at this stage of life as a plausible explanation.[17,18]

The male-to-female ratio of 1.22:1 observed here parallels findings from Sarsu et al (59% male) and Kara et al (approximately 65% male), and is generally attributed to greater outdoor exposure and possible differences in healthcare-seeking behaviour for male children in this setting.[19,20] Importantly, sex was not significantly associated with FNAC diagnosis (p=0.41) in our study, indicating that while boys present more often, the underlying spectrum of disease does not differ by sex.

Fever was the dominant presenting symptom (86.8%), a figure higher than the 75.6% reported by Garkoti et al, but consistent with the broader observation that infective causes dominate the aetiological spectrum of childhood lymphadenopathy in this region.[21] The clinical profile of the nodes themselves—predominantly soft, mobile, and tender—mirrored the benign predominance described by Garkoti et al, who reported mobility and tenderness in 98.4% and 90.9% of cases respectively, reinforcing that most paediatric lymphadenopathy, irrespective of setting, is reactive rather than pathological in nature.[21]
FNAC identified reactive lymphadenitis as the leading diagnosis (57.0%), broadly comparable to the 58.1% reported by Annam et al and somewhat lower than the 74.3% described by Ahmed et al, though higher than the 47.5% noted by Kumar et al, differences likely reflecting variation in referral patterns and regional disease burden.[18,22,23] Tubercular lymphadenitis accounted for 23.8% of cases in our series, closely matching the 24% reported by Rajender et al and exceeding the 14.6% found by Mohan et al, underscoring the continued and substantial burden of tuberculosis among Indian children presenting with lymph node enlargement.[16,17]

The strong association we observed between lymph node matting and tubercular aetiology (77.8% of matted nodes were tubercular) is consistent with the classical clinical teaching that matted, non-tender nodes should heighten suspicion for tuberculosis, and aligns with the anatomical predominance of posterior cervical and submandibular involvement in tubercular cases reported by Khan et al.[24] The exclusive occurrence of hilar lymphadenopathy on chest radiography among tubercular cases in our cohort, together with high acid-fast bacilli positivity on ZN staining specifically within this group, supports the continued value of combining clinical, radiological, and cytological data when tuberculosis is suspected, consistent with prior recommendations for a stepwise diagnostic algorithm.[14,25]

The significant association between older age and both tubercular lymphadenitis and lymphoma corroborates the pattern described by Biswas et al, in which malignant pathology became proportionately more frequent with increasing age, while reactive change predominated in younger children.[26] Likewise, the disproportionate association of supraclavicular lymphadenopathy with malignancy in our series, despite the small absolute numbers, is consistent with long-standing clinical teaching that supraclavicular node enlargement carries a substantially higher likelihood of malignant disease and warrants prompt, thorough evaluation.[27]

The high proportion of children with protein-energy malnutrition, increasing with age, may both predispose to and result from chronic infections such as tuberculosis, highlighting the interplay between nutritional status and infectious morbidity in this population, although the cross-sectional design cannot establish causal direction.

Overall, these findings support FNAC as a sensitive, minimally invasive, and cost-effective first-line investigation for paediatric lymphadenopathy, consistent with the 94% sensitivity and 100% specificity (relative to excisional biopsy) reported by Reddy et al, and the favourable diagnostic performance described by Mahajan et al and Prathima et al.[28,29,30] Judicious use of FNAC, combined with clinical assessment, ESR, and chest radiography, can reliably triage children toward appropriate management while limiting unnecessary surgical intervention.

Limitations

This was a single-centre study, and histopathological confirmation was not uniformly available for all cytologically diagnosed cases, particularly the small number of lymphomas, which may have introduced some diagnostic imprecision. Larger multicentric studies with systematic histopathological correlation are warranted to validate these findings.

CONCLUSION

In this cohort of 151 children with clinically significant lymphadenopathy, reactive lymphadenitis was the commonest cytological diagnosis, affirming that most paediatric lymph node enlargement is benign. Tuberculosis nevertheless remained a major and treatable cause, particularly among older children and those with matted posterior cervical or submandibular nodes and hilar lymphadenopathy on chest radiography. FNAC diagnosis varied significantly with age and anatomical site but not with sex. These findings support a stepwise diagnostic approach—combining careful clinical examination, basic haematological and radiological work-up, and FNAC—as an effective, minimally invasive strategy for evaluating paediatric lymphadenopathy, enabling timely treatment of tuberculous and malignant causes while avoiding unnecessary excisional biopsy in clearly reactive cases.

DECLARATIONS

Ethics approval and consent to participate

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from parents/legal guardians of all participating children.

Conflict of interest

None declared.

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None.

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