

Original Research Article

A STUDY OF FINE NEEDLE ASPIRATION CYTOLOGY OF LYMPH NODE LESIONS AT TERTIARY CARE CENTER OF WESTERN INDIA

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ABSTRACT

Background: Lymphadenopathy is a common clinical presentation associated with reactive, infectious, granulomatous and neoplastic conditions. Fine needle aspiration cytology (FNAC) provides a rapid, minimally invasive and economical method for evaluating enlarged lymph nodes. **Aim:** To study the frequency and cytomorphological spectrum of lymph node lesions diagnosed by FNAC at a tertiary care centre in Western India.

Materials and Methods: This hospital-based cross-sectional study was conducted in the Cytopathology Laboratory, Department of Pathology, GMERS Medical College and its attached Civil Hospital, Gandhinagar, from July 2023 to February 2025. A total of 300 patients of all age groups and both sexes presenting with palpable lymph node enlargement were included. FNAC was performed using a 22-24-gauge needle. Smears were stained with Giemsa, Papanicolaou and haematoxylin and eosin stains. Ziehl-Neelsen staining and GeneXpert testing were used in suspected tuberculous lesions when indicated. Data were analysed using descriptive statistics and the chi-square test. A p value <0.05 was considered statistically significant.

Results: The highest proportion of patients belonged to the 21-30-year age group (24.3%), followed by 11-20 years (23.7%). Males constituted 54.0% and females 46.0%. Cervical lymph nodes were the most frequently involved nodes (84.3%), and most nodes were firm (89.3%). Haemorrhagic aspirate was obtained in 89.3% of cases. Non-neoplastic lesions constituted 91.0% (95% CI: 87.2-93.7), whereas neoplastic lesions accounted for 9.0% (95% CI: 6.3-12.8; p<0.001). Tuberculous lymphadenitis was the most frequent diagnosis (55.7%), followed by reactive lymphadenitis (17.7%) and tuberculous abscess (15.7%). Metastatic carcinoma constituted 81.5% of neoplastic lesions, with squamous cell carcinoma being the predominant metastatic subtype. Neoplastic lesions increased significantly with advancing age ($\chi^2=84.51$, p<0.001). Cytological diagnosis also differed significantly according to sex ($\chi^2=24.88$, p=0.006).

Conclusion: FNAC was an effective first-line investigation for differentiating non-neoplastic from neoplastic lymph node lesions. Tuberculous lymphadenitis was the predominant diagnosis, reflecting the high burden of tuberculosis in the study region. Metastatic carcinoma was the leading neoplastic lesion and occurred predominantly among older patients. Histopathology and ancillary investigations remained essential for indeterminate lesions and suspected lymphomas.

Keywords: Fine needle aspiration cytology; Lymphadenopathy; Tuberculous lymphadenitis.

INTRODUCTION

Lymphadenopathy is a common clinical finding encountered in patients of all age groups and may result from a broad spectrum of conditions ranging from benign reactive changes and acute infections to granulomatous diseases, lymphomas and metastatic malignancies. Lymph nodes are important components of the immune system and act as biological filters by trapping microorganisms, foreign antigens and malignant cells. Enlargement of lymph nodes may therefore represent either a localized pathological process or a manifestation of systemic disease. Careful evaluation of lymphadenopathy is essential because the clinical appearance of benign and malignant lymph node lesions may overlap considerably. Fine needle aspiration cytology (FNAC) is a simple, rapid and minimally invasive technique used for the initial evaluation of enlarged lymph nodes. It can usually be performed in an outpatient setting without anaesthesia, causes minimal discomfort and provides cytological material at a relatively low cost.^[1,2] FNAC facilitates the early differentiation of reactive, inflammatory, granulomatous and malignant lesions and can guide clinicians in selecting appropriate treatment or additional investigations. In India, tuberculous lymphadenitis remains an important cause of lymph node enlargement, and demonstration of epithelioid cell granulomas, caseous necrosis or acid-fast bacilli in aspirated material can support an early diagnosis. Suppurative lymphadenitis and reactive lymphoid hyperplasia are also frequently encountered benign lesions. Among malignant lesions, FNAC may identify metastatic squamous cell carcinoma, adenocarcinoma and other metastatic tumours and may suggest Hodgkin or non-Hodgkin lymphoma.^[3] The accuracy of FNAC depends on adequate sampling, proper smear preparation, appropriate staining and careful interpretation of cytomorphological findings. Ancillary techniques such as acid-fast staining, GeneXpert testing, immunocytochemistry, flow cytometry and histopathological examination may be required in selected cases. In particular, lymphoma diagnosis and subtyping may be difficult on cytomorphology alone because assessment of nodal architecture is limited. Standardized reporting systems, including the Sydney System for lymph node cytopathology, have been proposed to improve diagnostic consistency, risk stratification and clinical communication.^[4] Despite these limitations, FNAC remains an effective first-line investigation for peripheral lymphadenopathy, especially in high-volume and resource-constrained healthcare settings.^[5]

Aim

To study the frequency and cytomorphological spectrum of lymph node lesions diagnosed by fine needle aspiration cytology at a tertiary care centre in Western India.

Objectives

1. To determine the frequency of different benign and malignant lymph node lesions diagnosed by FNAC.
2. To assess the distribution of lymph node lesions according to age, sex and anatomical site.
3. To describe the characteristic cytomorphological features of different lymph node lesions and categorize them into diagnostic groups.

MATERIALS AND METHODS

The present study carried out in the Cytopathology laboratory of pathology department at GMERS Medical College, Gandhinagar.

Study Type: Cross-Sectional Study.

Time Period: July 2023 to February 2025.

Inclusion Criteria

All age group of patients of both sexes present with lymph node swelling in OPD and indoor wards of GMERS Medical College attached civil hospital Gandhinagar for FNAC of lymph node.

Exclusion Criteria

Patients who will not giving consent for the procedure of FNAC of lymph node.

Method:

- Patients present with palpable lymph node swelling in OPD and indoor wards of GMERS Medical College attached civil hospital, Gandhinagar.
- When patient will be referred from clinicians and come to the cytology laboratory, a brief history will be taken and clinical examination will be done. After that the patient will be assured that the procedure is simple, harmless and relatively painless and consent will be taken for the same.
- All relevant data will be entered into prescribed format.

Materials Needed for Aspiration:

- Disposable needles of 22-24G with length of 2.5-3.8 cm
- Disposable plastic syringes of 5-10 cc
- Glass slides – clean and grease free
- Methanol as fixative
- Reagents for H&E stain, Giemsa stain and AFB stain
- Sterile gloves, gauze piece and spirit swabs

Method of Aspiration:

- The procedure was performed without anaesthesia by trained pathologists. The lesion fixed with one hand, with quick single motion 22G needle with 5ml or 10ml disposable syringe as required was inserted into the mass through the skin, a change in consistency was felt.
- The needle was moved back and forth in the mass in different directions keeping the needle in the mass.
- Aspirated material was taken on labelled glass slides by pushing the plunger and smears were prepared. The methanol-fixed smears were stained with Papanicolaou, Haematoxylin and

Eosin [H&E], or Giemsa stain and in suspected cases of tuberculous lymphadenitis, one smear was prepared for AFB stain. Some aspirated material was collected in a Falcon tube for gene expert study.

Statistical Analysis:

All data were collected and entered in Microsoft Office Excel 2007 Software. Appropriate statistical test was applied for analysis of data by using SPSS version 26.

RESULTS

Table 1: Overall clinical and FNAC profile of patients with lymph node lesions, presented in five sections (N=300)

Study parameter	n (%)	95% CI	Test statistic	p value
A. Age group			$\chi^2=175.74$, df=8	<0.001
≤10 years	52 (17.3)	13.5-22.0		
11-20 years	71 (23.7)	19.2-28.8		
21-30 years	73 (24.3)	19.8-29.5		
31-40 years	40 (13.3)	9.9-17.6		
41-50 years	26 (8.7)	6.0-12.4		
51-60 years	17 (5.7)	3.6-8.9		
61-70 years	13 (4.3)	2.5-7.3		
71-80 years	7 (2.3)	1.1-4.7		
>80 years	1 (0.3)	0.1-1.9		
B. Sex			$\chi^2=1.92$, df=1	0.166
Male	162 (54.0)	48.3-59.6		
Female	138 (46.0)	40.4-51.7		
C. Consistency of lymph node			$\chi^2=426.24$, df=2	<0.001
Firm	268 (89.3)	85.3-92.3		
Soft	28 (9.3)	6.5-13.2		
Hard	4 (1.3)	0.5-3.4		
D. Nature of aspirate			$\chi^2=423.68$, df=2	<0.001
Haemorrhagic	268 (89.3)	85.3-92.3		
Purulent	20 (6.7)	4.4-10.1		
Cheesy	12 (4.0)	2.3-6.9		
E. Broad cytological category			$\chi^2=201.72$, df=1	<0.001
Non-neoplastic lesions	273 (91.0)	87.2-93.7		
Neoplastic lesions	27 (9.0)	6.3-12.8		

Among the 300 patients with lymph node lesions, the largest proportion belonged to the 21-30-year age group (24.3%; 95% CI: 19.8-29.5), followed by 11-20 years (23.7%; 95% CI: 19.2-28.8) and ≤10 years (17.3%; 95% CI: 13.5-22.0). The frequency progressively decreased after 30 years, with only one patient (0.3%) aged above 80 years. The age distribution was statistically significant ($\chi^2=175.74$, df=8, $p<0.001$), indicating that lymph node lesions were more frequently encountered among younger patients. Males constituted 54.0% (95% CI: 48.3-59.6) and females 46.0% (95% CI: 40.4-51.7); however, the difference was not statistically

significant ($\chi^2=1.92$, df=1, $p=0.166$). Most lymph nodes were firm in consistency (89.3%; 95% CI: 85.3-92.3), while 9.3% were soft and 1.3% were hard, showing a significant difference in consistency ($\chi^2=426.24$, df=2, $p<0.001$). Haemorrhagic aspirate was obtained in 89.3% of cases, followed by purulent aspirate in 6.7% and cheesy aspirate in 4.0% ($\chi^2=423.68$, df=2, $p<0.001$). Cytologically, non-neoplastic lesions accounted for 91.0% (95% CI: 87.2-93.7), whereas neoplastic lesions constituted 9.0% (95% CI: 6.3-12.8), demonstrating a statistically significant predominance of non-neoplastic lesions ($\chi^2=201.72$, df=1, $p<0.001$).

Table 2: Frequency of benign and malignant lymph node lesions diagnosed by FNAC (N=300)

Cytological diagnosis	n (%)	95% CI	Test statistic	p value
Non-neoplastic lesions	273 (91.0)	87.2-93.7	$\chi^2=201.72$, df=1	<0.001
Tuberculous lymphadenitis	167 (55.7)	50.0-61.2		
Reactive lymphadenitis	53 (17.7)	13.8-22.4		
Tuberculous abscess	47 (15.7)	12.0-20.2		
Granulomatous lymphadenitis	4 (1.3)	0.5-3.4		
Acute suppurative lymphadenitis	2 (0.7)	0.2-2.4		
Neoplastic lesions	27 (9.0)	6.3-12.8		
Metastatic carcinoma	22 (7.3)	4.9-10.9		
Non-Hodgkin lymphoma	3 (1.0)	0.3-2.9		
Hodgkin lymphoma	2 (0.7)	0.2-2.4		
Total	300 (100.0)			

Distribution within the major diagnostic categories

Subgroup	n (%) within subgroup	95% CI within subgroup	Test statistic	p value
Non-neoplastic lesions (n=273)			$\chi^2=330.06$, df=4	<0.001
Tuberculous lymphadenitis	167 (61.2)	55.3-66.8		

Reactive lymphadenitis	53 (19.4)	15.2-24.5		
Tuberculous abscess	47 (17.2)	13.2-22.2		
Granulomatous lymphadenitis	4 (1.5)	0.6-3.7		
Acute suppurative lymphadenitis	2 (0.7)	0.2-2.6		
Neoplastic lesions (n=27)			$\chi^2=28.22$, df=2	<0.001
Metastatic carcinoma	22 (81.5)	63.3-91.8		
Non-Hodgkin lymphoma	3 (11.1)	3.9-28.1		
Hodgkin lymphoma	2 (7.4)	2.1-23.4		

Of the 300 lymph node lesions examined, 273 (91.0%; 95% CI: 87.2-93.7) were non-neoplastic and 27 (9.0%; 95% CI: 6.3-12.8) were neoplastic. This difference was statistically significant ($\chi^2=201.72$, df=1, $p<0.001$). Tuberculous lymphadenitis was the most frequent diagnosis, accounting for 167 cases (55.7%; 95% CI: 50.0-61.2), followed by reactive lymphadenitis in 53 (17.7%) and tuberculous abscess in 47 (15.7%). Granulomatous and acute suppurative lymphadenitis were uncommon, representing 1.3% and 0.7%, respectively. Within the 273 non-neoplastic lesions, tuberculous lymphadenitis

constituted 61.2%, reactive lymphadenitis 19.4% and tuberculous abscess 17.2%, with a significant difference in their distribution ($\chi^2=330.06$, df=4, $p<0.001$). Among neoplastic lesions, metastatic carcinoma was the predominant diagnosis, occurring in 22 of 27 cases (81.5%; 95% CI: 63.3-91.8). Non-Hodgkin lymphoma and Hodgkin lymphoma accounted for 11.1% and 7.4% of neoplastic lesions, respectively. The distribution of neoplastic diagnoses was also statistically significant ($\chi^2=28.22$, df=2, $p<0.001$).

Table 3: Distribution of lymph node lesions according to age, sex and anatomical site (N=300)

A. Age-wise distribution of non-neoplastic and neoplastic lesions

Age group	Non-neoplastic, n (%)	Neoplastic, n (%)	Total, n (%)	Test statistic	p value
≤10 years	51 (98.1)	1 (1.9)	52 (17.3)		
11-20 years	69 (97.2)	2 (2.8)	71 (23.7)		
21-30 years	72 (98.6)	1 (1.4)	73 (24.3)		
31-40 years	39 (97.5)	1 (2.5)	40 (13.3)		
41-50 years	22 (84.6)	4 (15.4)	26 (8.7)		
51-60 years	8 (47.1)	9 (52.9)	17 (5.7)		
>60 years	12 (57.1)	9 (42.9)	21 (7.0)		
Total	273 (91.0)	27 (9.0)	300 (100.0)	$\chi^2=84.51$, df=6	<0.001

Age showed a significant association with the broad cytological category of lymph node lesions ($\chi^2=84.51$, df=6, $p<0.001$). Non-neoplastic lesions predominated among patients aged ≤50 years, constituting 98.1% of cases in those aged ≤10 years, 97.2% in the 11-20-year group, 98.6% in the 21-30-year group, 97.5% in the 31-40-year group and 84.6% in the 41-50-year group. In contrast, the proportion of

neoplastic lesions increased substantially in older patients. Neoplastic lesions accounted for 52.9% of cases among patients aged 51-60 years and 42.9% among those older than 60 years. These findings indicated that inflammatory and infectious lesions were predominantly observed in younger patients, whereas the likelihood of neoplastic lymphadenopathy increased with advancing age.

B. Sex-wise distribution of individual cytological diagnoses

Cytological diagnosis	Male (n=162), n (%)	Female (n=138), n (%)	Total, n (%)	95% CI of total proportion
Acute suppurative lymphadenitis	1 (0.6)	1 (0.7)	2 (0.7)	0.2-2.4
Granulomatous lymphadenitis	3 (1.9)	1 (0.7)	4 (1.3)	0.5-3.4
Hodgkin lymphoma	2 (1.2)	0 (0.0)	2 (0.7)	0.2-2.4
Metastatic carcinoma, unclassified	2 (1.2)	0 (0.0)	2 (0.7)	0.2-2.4
Metastatic invasive ductal carcinoma	0 (0.0)	2 (1.4)	2 (0.7)	0.2-2.4
Metastatic squamous cell carcinoma	16 (9.9)	1 (0.7)	17 (5.7)	3.6-8.9
Metastatic adenocarcinoma	1 (0.6)	0 (0.0)	1 (0.3)	0.1-1.9
Non-Hodgkin lymphoma	2 (1.2)	1 (0.7)	3 (1.0)	0.3-2.9
Reactive lymphadenitis	33 (20.4)	20 (14.5)	53 (17.7)	13.8-22.4
Tuberculous abscess	26 (16.0)	21 (15.2)	47 (15.7)	12.0-20.2
Tuberculous lymphadenitis	76 (46.9)	91 (65.9)	167 (55.7)	50.0-61.2
Total	162 (100.0)	138 (100.0)	300 (100.0)	
Test of significance			$\chi^2=24.88$, df=10	p=0.006

The cytological distribution of lymph node lesions differed significantly according to sex ($\chi^2=24.88$, df=10, $p=0.006$). Tuberculous lymphadenitis was the most frequent diagnosis in both sexes but was

proportionately more common among females than males, affecting 91 females (65.9%) and 76 males (46.9%). Reactive lymphadenitis was observed in 33 males (20.4%) and 20 females (14.5%), while

tuberculous abscess occurred in 26 males (16.0%) and 21 females (15.2%). Metastatic squamous cell carcinoma demonstrated a marked male predominance, being diagnosed in 16 males (9.9%) compared with one female (0.7%). Both cases of metastatic invasive ductal carcinoma of the breast occurred among females. Hodgkin lymphoma was

identified in two males, whereas non-Hodgkin lymphoma was diagnosed in two males and one female. Thus, although the overall number of male and female patients was relatively comparable, the pattern of specific cytological diagnoses differed significantly between the sexes.

C. Anatomical distribution of lymph node lesions

Anatomical site	n (%)	95% CI	Test statistic	p value
Cervical	253 (84.3)	79.8-88.0	$\chi^2=1420.00$, df=7	<0.001
Submandibular	18 (6.0)	3.8-9.3		
Axillary	9 (3.0)	1.6-5.6		
Supraclavicular	6 (2.0)	0.9-4.3		
Inguinal	4 (1.3)	0.5-3.4		
Submental	4 (1.3)	0.5-3.4		
Postauricular	3 (1.0)	0.3-2.9		
Preauricular	3 (1.0)	0.3-2.9		
Total	300 (100.0)			

Cervical lymph nodes were the most frequently involved anatomical group, accounting for 253 cases (84.3%; 95% CI: 79.8-88.0). Submandibular lymph nodes were the second most common site but represented only 18 cases (6.0%; 95% CI: 3.8-9.3). Axillary and supraclavicular lymph nodes accounted for 3.0% and 2.0% of cases, respectively. Inguinal

and submental nodes each represented 1.3%, while postauricular and preauricular nodes each accounted for 1.0%. The anatomical distribution was statistically significant ($\chi^2=1420.00$, df=7, p<0.001), demonstrating a pronounced predominance of cervical lymphadenopathy in the study population.

Table 4: Cytomorphological spectrum and diagnostic categorization of lymph node lesions (N=300)

Diagnostic category	Characteristic cytomorphological findings	n (%)	95% CI	Test statistic	p value
Tuberculous lymphadenitis	Epithelioid cell granulomas, Langhans-type giant cells, caseous necrosis and lymphocytes; AFB may be demonstrated	167 (55.7)	50.0-61.2	$\chi^2=918.73$, df=10	<0.001
Reactive lymphadenitis	Polymorphous lymphoid population containing small lymphocytes, centroblasts, centrocytes, immunoblasts and tingible-body macrophages	53 (17.7)	13.8-22.4		
Tuberculous abscess	Abundant caseous or suppurative necrosis, degenerated inflammatory cells and occasional epithelioid cells; AFB may be present	47 (15.7)	12.0-20.2		
Metastatic squamous cell carcinoma	Cohesive clusters and dispersed malignant squamous cells with nuclear pleomorphism, dense cytoplasm and keratinisation	17 (5.7)	3.6-8.9		
Granulomatous lymphadenitis	Epithelioid cell granulomas with giant cells and lymphocytes without definite caseous necrosis	4 (1.3)	0.5-3.4		
Non-Hodgkin lymphoma	Monomorphic dispersed atypical lymphoid cells with high nuclear-to-cytoplasmic ratio and irregular nuclear contours	3 (1.0)	0.3-2.9		
Acute suppurative lymphadenitis	Numerous neutrophils, necrotic material, cellular debris and occasional macrophages	2 (0.7)	0.2-2.4		
Hodgkin lymphoma	Mixed inflammatory background containing atypical mononuclear or binucleate Reed-Sternberg-like cells	2 (0.7)	0.2-2.4		
Metastatic invasive ductal carcinoma of breast	Cohesive clusters of pleomorphic epithelial cells with prominent nucleoli and occasional acinar formations	2 (0.7)	0.2-2.4		
Metastatic carcinoma, unclassified	Malignant epithelial cells arranged in cohesive clusters without definite cytological evidence of the primary subtype	2 (0.7)	0.2-2.4		
Metastatic adenocarcinoma	Malignant gland-forming cells arranged in acini or three-dimensional clusters, with cytoplasmic vacuolation and prominent nucleoli	1 (0.3)	0.1-1.9		
Total		300 (100.0)			

The cytomorphological spectrum differed significantly across diagnostic categories ($\chi^2=918.73$, df=10, p<0.001). Tuberculous lymphadenitis was the predominant diagnosis, accounting for 167 cases (55.7%; 95% CI: 50.0-61.2), and was characterized by epithelioid cell granulomas, Langhans-type giant

cells, caseous necrosis and a lymphocytic background, with acid-fast bacilli demonstrable in some cases. Reactive lymphadenitis constituted 17.7% of cases and showed a polymorphous lymphoid population comprising small lymphocytes, centroblasts, centrocytes, immunoblasts and tingible-

body macrophages. Tuberculous abscess was identified in 15.7% and displayed abundant caseous or suppurative necrosis with degenerated inflammatory cells and occasional epithelioid cells. Metastatic squamous cell carcinoma accounted for 5.7% and showed cohesive clusters or dispersed malignant squamous cells with nuclear pleomorphism, dense cytoplasm and keratinisation. Granulomatous lymphadenitis constituted 1.3%, while non-Hodgkin lymphoma accounted for 1.0% and showed a monomorphic population of atypical lymphoid cells. Acute suppurative lymphadenitis, Hodgkin lymphoma, metastatic invasive ductal carcinoma and unclassified metastatic carcinoma each constituted 0.7%. Metastatic adenocarcinoma was the least frequent diagnosis, accounting for one case (0.3%; 95% CI: 0.1-1.9).

DISCUSSION

Fine needle aspiration cytology is widely used as an initial investigation for lymphadenopathy because it is rapid, minimally invasive, inexpensive and capable of differentiating most inflammatory, infectious and metastatic lesions. In the present study, FNAC demonstrated a broad cytomorphological spectrum, with a marked predominance of non-neoplastic and tuberculous lesions. These findings reflected the pattern commonly reported from tertiary-care centres in India and other regions where tuberculosis remains endemic.

Age and sex distribution

The highest proportion of patients belonged to the 21-30-year age group (24.3%), followed by 11-20 years (23.7%) and ≤ 10 years (17.3%). The age distribution was statistically significant ($\chi^2=175.74$, $p<0.001$). Comparable findings were reported by Swaroopa et al. (2019),^[1] who observed the highest frequency in the 21-30-year group, and by Shah et al. (2016),^[2] who reported that approximately 26.4% of patients were aged 21-30 years. Nakum et al. (2023),^[3] similarly found that 29.1% of patients were in this age group. Malhotra et al. (2017),^[4] also documented a higher frequency of lymphadenopathy among young adults. The predominance of younger patients in these studies may be attributed to the high frequency of infectious and reactive lymph node lesions, particularly tuberculous lymphadenitis, in this age group.

Males constituted 54.0% of the present study population and females constituted 46.0%; however, the overall sex difference was not statistically significant ($p=0.166$). A slight male predominance was also reported by Shah et al. (2016),^[2] and Gayathri et al. (2015).^[5] In contrast, some studies have reported female predominance, especially where tuberculous lymphadenitis represented most FNAC diagnoses. These variations may result from differences in healthcare-seeking behaviour, referral patterns, occupational exposure and the regional prevalence of tuberculosis.

The distribution of individual cytological diagnoses nevertheless differed significantly between males and females ($\chi^2=24.88$, $p=0.006$). Tuberculous lymphadenitis was more frequent among females (65.9%) than males (46.9%). Dharaiya et al. (2018),^[6] and Nakum et al. (2023),^[3] similarly observed a substantial burden of tuberculous lymphadenitis among young women. Conversely, metastatic squamous cell carcinoma was markedly more common among males in the present study. This probably reflected the greater burden of tobacco- and alcohol-associated head and neck cancers among men.

Clinical and aspiration characteristics

Most lymph nodes were firm in consistency (89.3%), while 9.3% were soft and only 1.3% were hard. The differences in consistency were statistically significant ($p<0.001$). Firm nodes were predominantly associated with reactive and tuberculous lymphadenitis. Soft nodes were more likely to yield purulent or necrotic material, whereas hard nodes raised clinical suspicion of metastatic malignancy. Prakash et al. (2020),^[7] emphasized that consistency, mobility, tenderness and fixation provided useful clinical information, although cytological examination remained essential because considerable overlap existed between benign and malignant lesions.

Haemorrhagic aspirate was obtained in 89.3% of cases, while 6.7% produced purulent material and 4.0% produced cheesy material ($p<0.001$). A haemorrhagic aspirate is common because lymph nodes are vascular structures and may occur in reactive, lymphoid and neoplastic lesions. Purulent aspirates generally correspond to acute suppurative inflammation or abscess formation, whereas cheesy material strongly suggests caseous necrosis. Cataño et al. (2016),^[8] described caseous necrosis, epithelioid granulomas and acid-fast bacilli as important findings supporting the diagnosis of tuberculous lymphadenitis.

Anatomical distribution

Cervical lymph nodes were the most frequently involved nodes, accounting for 84.3% of cases, followed by submandibular (6.0%), axillary (3.0%) and supraclavicular nodes (2.0%). The anatomical distribution was highly significant ($\chi^2=1420.00$, $p<0.001$). This result was comparable with Shah et al. (2016),^[2] who reported cervical involvement in 88.5% of cases. Gayathri et al. (2015),^[5] found cervical lymphadenopathy in 74.6%, while Nakum et al. (2023)^[3] reported it in 64.2% of patients. Devkota et al. (2017),^[9] also demonstrated the diagnostic usefulness of FNAC for cervical and other neck swellings.

The predominance of cervical lymphadenopathy may be explained by the frequent involvement of these nodes in tuberculosis, upper respiratory tract infections, oral and dental infections and head and neck malignancies. Cervical nodes are also superficial, easily noticed by patients and readily

accessible for FNAC, which may increase their representation in cytology-based studies.

Non-neoplastic and neoplastic lesions

Non-neoplastic lesions constituted 91.0% of all cases, whereas neoplastic lesions accounted for 9.0%. The predominance of non-neoplastic lesions was statistically significant ($\chi^2=201.72$, $p<0.001$). Chaithra et al. (2020),^[10] and Prakash et al. (2020)^[7] similarly reported that inflammatory and reactive lymph node lesions considerably outnumbered neoplastic lesions. Ha et al. (2023),^[11] confirmed that FNAC was particularly valuable for distinguishing reactive and inflammatory lymphadenopathy from metastatic malignancy, although its diagnostic performance was lower for some primary lymphoid neoplasms. The predominance of non-neoplastic lesions in the present study was consistent with its relatively young study population.

Among non-neoplastic lesions, tuberculous lymphadenitis was the most common diagnosis, accounting for 55.7% of all cases and 61.2% of non-neoplastic lesions. Dharaiya et al. (2018),^[6] reported a comparable frequency of 54.5%, while Gayathri et al. (2015),^[5] and Nakum et al. (2023),^[3] reported frequencies of approximately 49.6%. The high proportion in the present study therefore supports the continuing importance of tuberculosis as a major cause of peripheral lymphadenopathy in Western India. Ganchua et al. (2020),^[12] highlighted that lymph nodes are important sites of persistence and host-pathogen interaction in tuberculosis, helping to explain their frequent involvement.

Reactive lymphadenitis was the second most frequent diagnosis, accounting for 17.7% of all cases and 19.4% of non-neoplastic lesions. Nakum et al. (2023),^[3] reported a comparable frequency of 21.1%, while Swaroopa et al. (2019)^[1] and Gayathri et al. (2015),^[5] also identified reactive lymphadenitis as one of the leading benign diagnoses. Its cytological recognition is important because reactive hyperplasia may occasionally mimic lymphoma, particularly in highly cellular smears.

Tuberculous abscess constituted 15.7% of all lesions. Such cases may show extensive caseous or suppurative necrosis with few or no well-formed granulomas. Consequently, Ziehl-Neelsen staining and molecular testing may be especially useful. The relatively small proportions of granulomatous lymphadenitis (1.3%) and acute suppurative lymphadenitis (0.7%) suggested that most granulomatous and necrotizing lesions could be assigned a tuberculous diagnosis using the combined cytomorphological, clinical and ancillary findings.

Neoplastic lesions and their age distribution

Neoplastic lesions represented 9.0% of cases and became substantially more common with advancing age. They constituted only 1.4-2.8% of lesions in patients aged ≤ 40 years but increased to 15.4% among those aged 41-50 years, 52.9% among those aged 51-60 years and 42.9% among those older than 60 years. The association between age and broad cytological category was significant ($\chi^2=84.51$,

$p<0.001$). This finding was consistent with the established increase in metastatic malignancies and lymphoid neoplasms among older adults. Shah et al. (2016),^[2] Swaroopa et al. (2019)^[1] and Dharaiya et al. (2018),^[6] also observed that malignant lymph node lesions were concentrated in older age groups.

Metastatic carcinoma constituted 7.3% of all cases and 81.5% of neoplastic lesions, making it the predominant neoplastic diagnosis. Dharaiya et al. (2018),^[6] reported metastatic carcinoma in 10.4% of all cases, while Nakum et al. (2023),^[3] reported it in 15.8%. Differences between studies may reflect variation in patient age, oncology referral patterns and the prevalence of head and neck malignancies. In the present study, metastatic squamous cell carcinoma was the predominant metastatic subtype. This was consistent with cervical node involvement from primary malignancies of the oral cavity, pharynx and larynx.

Metastatic invasive ductal carcinoma was identified only among females, consistent with the usual pattern of axillary or cervical lymph node metastasis from breast carcinoma. Adenocarcinoma was uncommon. FNAC can rapidly identify metastatic epithelial malignancy and may suggest its primary site based on cytomorphology and clinical information. However, immunocytochemistry may be needed when the primary tumour is unknown or morphology is poorly differentiated. Chong et al. (2023),^[13] recommended a systematic cytomorphological approach supplemented by ancillary studies for diagnostically difficult lymph node aspirates.

Lymphomas and cytomorphological findings

Non-Hodgkin lymphoma and Hodgkin lymphoma accounted for only 1.0% and 0.7% of cases, respectively. Similar low frequencies were reported by Dharaiya et al. (2018),^[6] and Nakum et al. (2023).^[3] The small proportion of lymphomas may partly reflect the referral of clinically suspected lymphoma cases directly for excision biopsy or the categorization of equivocal aspirates as suspicious rather than definitive.

Non-Hodkin lymphoma was characterized by a relatively monomorphic population of atypical lymphoid cells, while Hodgkin lymphoma showed atypical mononuclear or Reed-Sternberg-like cells in a mixed inflammatory background. Garg et al. (2021),^[14] demonstrated that cytomorphology can provide a useful diagnosis of lymphoma but that diagnostic accuracy varies according to lymphoma subtype and specimen adequacy. Nga (2024),^[15] emphasized that sampling error, reactive immunoblasts, partial nodal involvement and loss of tissue architecture can cause false-negative, false-positive or misclassified lymphoma diagnoses. Therefore, suspected lymphoma should be confirmed by histopathology, immunocytochemistry, flow cytometry or molecular testing when appropriate.

Diagnostic implications

The significant variation in the cytomorphological spectrum ($\chi^2=918.73$, $p<0.001$) reflected the overwhelming predominance of tuberculous and

reactive lesions. The observed features epithelioid granulomas, Langhans-type giant cells and caseous necrosis in tuberculosis; polymorphous lymphoid cells in reactive lymphadenitis; and cohesive pleomorphic epithelial clusters in metastatic carcinoma were consistent with established diagnostic criteria. Caputo et al. (2022),^[16] demonstrated that standardized reporting using the Sydney System could improve categorization, risk stratification and communication between cytopathologists and clinicians. Kanhe et al. (2023),^[17] also found the Sydney System useful for classifying lymph node aspirates in a tertiary-care setting. Qader et al. (2024),^[18] reported that FNAC provided high diagnostic utility for cervical lymphadenopathy, particularly for metastatic disease, although histopathological confirmation remained necessary in indeterminate and lymphoma-suspected cases.

CONCLUSION

Fine needle aspiration cytology was a simple, rapid, minimally invasive and cost-effective first-line investigation for evaluating lymph node lesions. Of the 300 cases examined, non-neoplastic lesions constituted 91.0%, while neoplastic lesions accounted for 9.0%. Tuberculous lymphadenitis was the most frequent diagnosis, followed by reactive lymphadenitis and tuberculous abscess, highlighting the continuing burden of tuberculosis in Western India. Cervical lymph nodes were most commonly involved, and lymphadenopathy occurred predominantly among younger patients. Neoplastic lesions increased significantly with advancing age, and metastatic carcinoma, particularly squamous cell carcinoma, was the predominant neoplastic lesion. FNAC enabled early differentiation between inflammatory, infectious and malignant lesions, thereby facilitating appropriate clinical management. Nevertheless, histopathology and ancillary investigations remained necessary for inadequate, indeterminate and lymphoma-suspected cases.

Limitations of Study

- The study was conducted at a single tertiary care centre; therefore, the findings may not represent the entire population of Western India.
- As a hospital-based study, it was susceptible to referral and selection bias.
- Only patients with palpable and accessible lymph nodes were included; deep-seated lymph node lesions were not evaluated.
- Histopathological correlation was not available for every case, preventing calculation of the overall sensitivity, specificity and diagnostic accuracy of FNAC.
- Immunocytochemistry, flow cytometry and molecular tests were not performed routinely, limiting definitive diagnosis and subtyping of lymphomas.

- Cytological interpretation depended on the adequacy and representativeness of the aspirated material, and focal lesions could have been missed because of sampling error.
- The small number of neoplastic lesions limited detailed subgroup comparisons.
- Long-term clinical follow-up and treatment outcomes were not assessed.

The cross-sectional design established the frequency and cytomorphological spectrum but could not determine incidence or causal relationships.

REFERENCES

1. Swaroopa MJ, Vani B. Study of cytomorphological patterns of lymph nodes by fine needle aspiration cytology and correlation with histopathology. *Saudi J Pathol Microbiol.* 2019;4(8):607-13.
2. Shah PC, Patel CB, Bhagat V, Modi H. Evaluation of peripheral lymphadenopathy by fine needle aspiration cytology: a one-year study at tertiary centre. *Int J Res Med Sci.* 2016;4(1):120-5.
3. Nakum C, Thakkar B, Parikh M. A study of fine needle aspiration cytology of lymphadenopathy in tertiary care centre of Gandhinagar, Gujarat. *Int J Dent Med Sci Res.* 2023;5(1):207-11.
4. Malhotra AS, Lahori M, Nigam A, Khajuria A. Profile of lymphadenopathy: an institutional-based cytomorphological study. *Int J Appl Basic Med Res.* 2017;7(2):100-3.
5. Gayathri MN, Chaurasia S, Bharathi M, Shashidhar HB. Pattern of lymphadenopathy in fine needle aspiration cytology: a retrospective study. *Int J Res Med Sci.* 2015;3(6):1416-9.
6. Dharaiya CM, Sharma RI. Study of fine needle aspiration cytology of lymphadenopathy in tertiary care centre of Ahmedabad, Gujarat. *Trop J Pathol Microbiol.* 2018;4(3):258-63.
7. Prakash AE, Narayanan N, Mohamed SP, Unnikrishnan R. The utility of fine needle aspiration cytology in the diagnosis of lymphadenopathy. *Trop J Pathol Microbiol.* 2020;6(8):472-80.
8. Cataño JC, Robledo J. Tuberculous lymphadenitis and parotitis. *Microbiol Spectr.* 2016;4(6):TNM17-0008-2016.
9. Devkota H, Sibakoti YC, Menyangbo S, Basnet S, Jha MK, Banstola L. Correlation of fine needle aspiration cytology and histopathology of neck swellings presenting at National Academy of Medical Sciences, Kathmandu, Nepal. *Birat J Health Sci.* 2017;2(2):206-10.
10. Chaithra S, Solanki D, Mural PH. Cytomorphological study of lymph node lesions: a study of 130 cases. *Indian J Pathol Res Pract.* 2020;9(2 Pt 1):27-32.
11. Ha HJ, Lee J, Kim DY, Kim JS, Shin MS, Noh I, et al. Utility and limitations of fine-needle aspiration cytology in the diagnosis of lymphadenopathy. *Diagnostics (Basel).* 2023;13(4):728.
12. Ganchua SKC, White AG, Klein EC, Flynn JL. Lymph nodes the neglected battlefield in tuberculosis. *PLoS Pathog.* 2020;16(8):e1008632.
13. Chong Y, Park G, Cha HJ, Kim HJ, Kang CS, Abdul-Ghafar J, et al. A stepwise approach to fine needle aspiration cytology of lymph nodes. *J Pathol Transl Med.* 2023;57(4):196-207.
14. Garg S, Rohilla M, Srinivasan R, Bal A, Das A, Dey P, et al. Fine-needle aspiration diagnosis of lymphoma based on cytomorphology alone: how accurate is it? A cyto-histopathology correlative study. *J Cytol.* 2021;38(3):164-70.
15. Nga ME. Pitfalls in lymph node fine needle aspiration cytology. *Acta Cytol.* 2024;68(3):260-80.
16. Caputo A, Ciliberti V, D'Antonio A, D'Ardia A, Fumo R, Giudice V, et al. Real-world experience with the Sydney System on 1458 cases of lymph node fine needle aspiration cytology. *Cytopathology.* 2022;33(2):166-75.

17. Kanhe R, Tummidi S, Kothari K, Agnihotri M. Utility of the proposed Sydney System for classification of fine-needle aspiration cytopathology of lymph node: a retrospective study at a tertiary care center. *Acta Cytol.* 2023;67(5):455-67.
18. Qader K, Qader M, Mubarak A, Alaradi K. Diagnostic accuracy of fine-needle aspiration cytology in cervical lymphadenopathies at a tertiary care center in the Kingdom of Bahrain. *Cureus.* 2024;16(6):e62184.