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Clinico-Pathological and Sonographical Study of Cervical Lymphadenopathy: A Hospital based Cross-sectional Study in Tertiary Care Centre in Western Uttar Pradesh

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ABSTRACT

Background: Cervical lymphadenopathy is a common clinical condition with a wide spectrum of etiologies ranging from benign reactive and infective lesions to malignancy. Accurate differentiation between benign and malignant causes is essential for timely diagnosis and management.

Methods: This hospital-based cross-sectional analytical study was conducted on 96 patients presenting with clinically evident cervical lymphadenopathy. All patients underwent detailed clinical evaluation, ultrasonographic assessment, and fine needle aspiration cytology (FNAC). Ultrasonographic findings were correlated with FNAC diagnosis, and the diagnostic performance of ultrasonography was assessed using FNAC as the reference standard.

Results: The mean age of the study population was 29.01 ± 18.19 years, with a slight male predominance (52.08%). Persistent neck swelling was the most common presenting complaint (93.75%), while pain and weight loss were each observed in 20.83% of cases. Multiple lymph node involvement was seen in 57.29% of patients, and firm consistency was the most common clinical finding (45.83%). On ultrasonography, 60.42% of nodes were oval, 54.17% had preserved hilum, and 35.42% showed necrosis. Central vascularity was observed in 37.50% of cases. FNAC revealed tubercular lymphadenitis as the most common diagnosis (38.54%), followed by reactive lymphadenitis (32.29%). Malignant lesions included metastatic malignancy in 7.29% and lymphoma in 6.25% of cases. Ultrasonography showed a significant association with FNAC diagnosis ($p < 0.001$), with sensitivity of 58.33%, specificity of 79.76%, positive predictive value of 29.17%, and negative predictive value of 93.06%.

Conclusion: Cervical lymphadenopathy in this cohort was predominantly benign, with tubercular lymphadenitis as the leading cause. Ultrasonography is a useful initial screening tool, but FNAC remains essential for definitive diagnosis.

Keywords: *Cervical lymphadenopathy; ultrasonography; fine needle aspiration cytology; tubercular lymphadenitis; reactive lymphadenitis; diagnostic accuracy.*

INTRODUCTION

The lymphatic system forms a crucial part of the circulatory and immune systems. The system consists of lymphatic vessels as well as lymphoid organs such as lymph nodes, thymus, and spleen. Some of the important functions include transportation of interstitial fluid back into the bloodstream, lymph filtration and immune responses against foreign

pathogens [1–5]. Lymph nodes in particular are widely distributed along lymphatic channels and contribute to antigen trapping, immune cell activation and inflammatory responses. Cervical lymph nodes are of particular interest because of their extensive distribution across the neck region and their involvement in a variety of infective, inflammatory and neoplastic disorders. For ease of localization and ease of treatment planning, cervical lymph nodes are anatomically divided into levels I to VII during assessment of head and neck diseases [1,3].

Cervical lymphadenopathy, which refers to abnormal enlargement of cervical lymph nodes, is a very common clinical presentation across all age groups. Infectious, neoplastic and autoimmune conditions can result in lymphadenopathy, though the latter is rare [6–9]. Tuberculosis causes a significant proportion of cervical lymphadenopathy cases in developing countries such as India and contributes to disease burden [6,7]. Malignant causes of lymphadenopathy such as lymphoma and metastatic carcinoma account for increasing proportions of cases as age advances [8,9]. Therefore reactive or tuberculous lymphadenopathy is commoner in younger patients while lymphadenopathy in elderly patients must be carefully evaluated for metastatic disease and lymphoproliferative disorders [6,8,9].

History taking and general examination are vital initial steps in patients presenting with cervical lymphadenopathy. Factors such as duration of the swelling, pain, presence of fever, constitutional symptoms such as weight loss and night sweats as well as other associated symptoms should be carefully assessed. Palpable characteristics of the lymph node such as size, consistency, tenderness, mobility, matting and fixation to overlying skin or deeper structures can be helpful in making a provisional diagnosis [9,10]. Malignant causes should be highly suspected in lymph nodes that are hard in consistency, fixed to overlying structures, non-tender, progressively increasing in size or located in the supraclavicular fossa [10]. However clinical examination alone is usually not sufficient because both benign and malignant causes can present with similar features [9,10].

Imaging helps guide clinicians in their assessment of cervical lymphadenopathy. Ultrasonography (USG) is often used as the first line imaging modality because it is non-invasive, inexpensive, involves no ionizing radiation and allows comprehensive evaluation of superficial nodes across the cervical region [11,12]. It can help determine the size, shape, border of the node as well as characteristics of echogenic hilum, internal architecture, necrosis and calcification. USG also allows concurrent assessment of surrounding soft tissues for any associated pathology. Doppler examination can further increase the diagnostic yield by allowing assessment of blood flow characteristics within the nodes [11,12]. Cross sectional imaging modalities like CT and MRI can be employed for assessment of deeper nodes and more widespread disease [13].
Fine Needle Aspiration Cytology or FNAC has gained widespread acceptance as an inexpensive, minimally invasive investigation with good diagnostic accuracy for cervical lymphadenopathy. Because of its simplicity and rapidity, FNAC is often employed as the first line investigation in evaluating patients with cervical lymphadenopathy. FNAC can accurately differentiate inflammatory/reactive lesions from granulomatous and malignant lesions [14,15]. Ultrasound guided FNAC sampling is even more accurate especially in sampling small or deep seated nodes. Therefore, an integrated approach combining clinical evaluation, imaging, and cytology is essential for accurate diagnosis and appropriate management of cervical lymphadenopathy.

METHODOLOGY

Study design and setting:

This cross-sectional analytical study was carried out in the Department of Otorhinolaryngology, in a tertiary care centre serving rural India, especially patients belonging to the state of Western Uttar Pradesh. The duration of the study was 15 months, from March 2024 till June 2025.

Study population:

All consecutive patients attending ENT OPD with palpable cervical lymph nodes were assessed for eligibility. Patients meeting the inclusion criteria and consenting for participation were recruited after providing written informed consent.

Eligibility criteria:

Patients of either sex and all ages with cervical lymphadenopathy were included. Patients willing to take part in the study and giving consent were enrolled. Patients with no prior definitive treatment for the presenting lymph node pathology were included. Those patients unwilling to give consent, known head and neck malignancies already receiving treatment, patients with bleeding disorder/coagulation abnormality (contra indication to FNAC), and patients in whom cytological/histopathological confirmation was not available were excluded from the study.

Sample size calculation:

Sample size was done using the standard formula for estimation of single population proportion: $n = (Z^2 \times P \times (1-P)) / d^2$; by taking $Z = 1.96$ at 95% confidence interval, $P = 0.5$ as there was no existing data on such practice in our region (and thereby expected maximum variability), $d = 0.10$ as the study outcome wanted absolute precision level of 10%. This gave us a sample size of 96. This was rounded off after considering possible attrition due to incomplete follow-up and non-diagnostic/conclusive pathology reports, and a minimum of 100 patients were targeted for the study.

Data collection procedure:
After enrolment, detailed demographic and clinical information was recorded for each patient. This included age, sex, duration of swelling, site of lymph node involvement, associated symptoms such as fever, weight loss, night sweats, and pain, as well as relevant medical history.

Clinical examination:
Head and neck examination was completed in all patients. Clinically, we recorded number of involved nodes, size (largest diameter by palpation in two perpendicular axes), consistency, tenderness, fixation to underlying tissues, and evidence of matting. Nodes were described based on normal cervical nodal levels.

Sonographic evaluation:
All patients had high-resolution ultrasound of the neck using a linear high-frequency transducer probe (7–12 MHz). The study was done with the patient lying supine with slight extension of the neck. All patients had their nodal size parameters (long axis diameter and short axis diameter) measured and their nodal shape index calculated as the ratio between short axis and long axis diameter (ratio < 0.5: oval; ratio ≥ 0.5: round). Morphologic descriptors recorded included echogenicity, homogeneity of nodes, echogenic hilum noted or not, nodal margins, intranodal necrosis, calcification, presence or absence of posterior acoustic enhancement, nodal matting and perinodal soft tissue edema. Color Doppler study was performed in all patients and the vascular pattern was noted as hilar, peripheral or mixed or no flow and resistive index was noted wherever possible. Suspected diagnosis of nodes was based on grayscale morphology and Doppler appearance as reactive, tubercular, lymphomatous or metastatic lymph nodes based on previously described sonographic criteria.

Fine needle aspiration cytology:
Ultrasound-guided fine needle aspiration cytology (FNAC) was performed with the use of a 22–23 gauge needle on the most representative/n largest lymph node obtained under aseptic precautions. Real-time guidance allowed avoidance of vascular injury and aspiration of primarily solid areas when lymph nodes exhibited necrosis. The obtained smears were stained with May-Grünwald-Giemsa and Hematoxylin and Eosin (H&E) stains. Cytological diagnosis rendered was reactive lymphadenitis, tuberculous lymphadenitis, lymphoma, metastatic malignancy, or nondiagnostic.

Histopathological examination:Excisional biopsy was done if fine needle aspiration cytology was inadequate, lymphoma was suspected, or when there was continued clinical suspicion despite benign cytology. Histopathology was used as a reference standard for final diagnosis.

Statistical analysis:
Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as age were expressed as mean ± standard deviation, whereas categorical variables were summarized as frequencies and percentages. The association between categorical variables, particularly ultrasonographic impression and FNAC diagnosis, was assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant. Agreement between ultrasonography findings and FNAC diagnosis was evaluated using Cohen's kappa coefficient. Diagnostic performance of ultrasonography in detecting malignant cervical lymphadenopathy was calculated using FNAC as the reference standard. Sensitivity, specificity, positive predictive value, and negative predictive value were determined using standard 2 × 2 contingency table analysis. All statistical tests were two-tailed, and results were interpreted at a 95% confidence interval.

RESULT
A total of 96 cases of clinically apparent cervical lymphadenopathy were enrolled in the study. Each patient underwent clinical examination, ultrasonography and cytopathology. Of the 96 patients enrolled, all 96 patients fulfilled the inclusion criteria and were entered into the study. The patients' demographic, clinical and radiological parameters were tabulated followed by ultrasound-guided fine needle aspiration cytology. Histopathology was performed for cases with indeterminate cytology or strong clinical suspicion. Results are reported under the following headings: Demographics, Clinical presentation, US Features, Cytopathological Diagnosis, Correlation of US findings with FNAC.

Table 1 shows that cervical lymphadenopathy in our study population mainly involved young individuals. Mean age ± standard deviation was 29.01 ± 18.19 years showing maximum involvement of children, adolescents, and young adults. Males were slightly more common than females (52.08% versus 47.92%). There was no significant smoking (89.58%) or alcohol history (81.25%) in our study population indicating that these were not baseline characteristics of our patients. Duration of swelling was the most common clinical feature (93.75%) emphasizing that lymph node swelling was the main presenting complaint. Constitutional-inflammatory symptoms were minimal with pain and weight loss seen in only 20.83% of patients each, fever in 12.50% and night sweats in 7.29% of patients. Sinus or abscess formation occurred in only 5.21% of cases suggesting that advanced suppurative disease was not common.

Table 1. Baseline demographic and clinical profile of study participants (N = 96)

Variable	Category	N (96)	%
Age group (years)	Mean age	29.01 ± 18.19 years.	
Sex	Male	50	52.08
	Female	46	47.92
Smoking history	Yes	10	10.42
	No	86	89.58
Alcohol history	Yes	18	18.75
	No	78	81.25
Clinical symptoms/signs	Duration of swelling present	90	93.75
	Pain present	20	20.83
	Fever present	12	12.50
	Weight loss present	20	20.83
	Night sweats present	7	7.29
	Sinus/abscess present	5	5.21

Table 2. Clinical examination and ultrasonographic characteristics of cervical lymph nodes (N = 96)

Variable	Category	n	%
Number of nodes	Single	41	42.71
	Multiple	55	57.29
Consistency	Soft	28	29.17
	Firm	44	45.83
	Hard	24	25.00
Mobility	Mobile	63	65.63
	Fixed	33	34.37
Matted nodes	Present	29	30.21
	Absent	67	69.79
Shape	Oval	58	60.42
	Round	38	39.58
Hilum	Preserved	52	54.17
	Lost	44	45.83
Border	Regular	56	58.33
	Irregular	40	41.67
Necrosis	Present	34	35.42
	Absent	62	64.58
Color Doppler vascularity	Central	36	37.50
	Peripheral/Mixed/Avascular	60	62.50

Table 3. FNAC-based cytopathological diagnosis of cervical lymphadenopathy (N = 96)

Diagnosis	n	%
Reactive lymphadenitis	31	32.29
Tubercular lymphadenitis	37	38.54
Suppurative lymphadenitis	10	10.42
Other benign lesions	5	5.21
Metastatic malignancy	7	7.29
Lymphoma	6	6.25
Total	**96**	**100.00**

Table 4. Association of ultrasonographic impression with FNAC diagnosis and diagnostic performance of ultrasonography (N = 96)

Table 4A. Correlation between ultrasonographic impression and FNAC diagnosis

USG impression	FNAC benign n (%)	FNAC malignant n (%)	Total	p-value
Benign	67 (79.76)	5 (41.67)	72	**<0.001**
Malignant	17 (20.24)	7 (58.33)	24	
Total	**84 (100.00)**	**12 (100.00)**	**96**	

Cohen's kappa: 0.25

Table 4B. Diagnostic accuracy of ultrasonography using FNAC as reference standard

Parameter	Value (%)
Sensitivity	58.33
Specificity	79.76
Positive predictive value	29.17
Negative predictive value	93.06

Bilaterality was observed more commonly than unilateral presentation with involvement of cervical lymph nodes (57.29%). The predominance of lymph node size, consistency, and mobility were firm (45.83%), mobile (65.63%) and had fixation present in 34.37% of cases respectively. Microbially-induced granulomatous inflammation such as tuberculosis could not be ruled out as attributes of fixed nodes were seen in 30.21% of our study population. Oval shaped (60.42%) and nodes with hilar preservation (54.17%) were the most common ultrasound features seen. Features with known potential for malignancy such as round shaped (39.58%), loss of hilar architecture (45.83%), irregular margins (41.67%) and intranodal necrosis (35.42%) were also seen. Color flow Doppler ultrasonography revealed central vascularity (37.50%) to be less frequent as compared to peripheral type (62.50%) that includes mixed and absent vascularity (Table 2).

The distribution of etiologies is summarized in Table 3. Benign causes were seen in majority of patients with cervical lymphadenopathy. Tubercular lymphadenitis was the most frequent cytopathological diagnosis seen (38.54%), followed by reactive lymphadenitis (32.29%). Infective/ reactive were the most common causes of cervical lymphadenopathy. Suppurative lymphadenitis accounted for another 10.42% while remaining benign lesions were seen in 5.21% of patients. Malignant lesions were seen in lesser numbers comprising metastatic malignancy (7.29%) and lymphoma (6.25%).

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DISCUSSION

In our study, The mean age of the patients in the present study was 29.01 ± 18.19 years, which demonstrates that the disease most commonly affected relatively young patients. Infectious and inflammatory diseases usually present in younger age groups; therefore, our results suggest that these etiologies are a major cause of cervical lymphadenopathy in our patients. There were more male patients (52.08%) compared to female patients (47.92%) which represents mild male predominance. Sujatha et al. [16] also found that majority of the patients were in the age group of 21–30 years and that there was mild male predominance in their study. Maximum number of patients in the age group of 21–30 years was also noted by Chauhan and Mehta [18], with a male-to-female ratio of 1.3:1, which is similar to our study. Sun et al. [17] reported older age groups in non-HIV-positive patients, while Shah et al. [19] found that malignant causes of cervical lymphadenopathy were more common in the fifth and sixth decades. Therefore, older age was associated with neoplastic causes more than other causes. In our study younger age group is mostly affected which may be due to involvement of benign lesions and infective causes like tuberculosis and reactive lymphadenitis.

Patients who had smoking/alcohol habits formed only 10.42%/18.75% of the study population, while patients with no history of smoking/alcohol usage formed 69.79% of the study population. This shows that the classical risk factors for malignancy of head and neck region were absent in majority of the patients. However, clinical profile was strongly dominated by the lesions of infectious/inflammatory origin. Anand et al. [20] reported non-specific reactive hyperplasia (29.3%) and granulomatous inflammation (28.9%) as the most common causes of cervical lymphadenopathy comprising a total of 58.2% of cases, while only 13.8% of patients had malignancies on histopathology. Rahman et al. [21] and Sujatha et al. [16] also showed preponderance of benign and tuberculous lesions over malignant causes in their studies. This shows that cervical lymphadenopathy in similar cohorts is predominantly due to infections rather than smoking and alcohol induced malignancy.

Neck swelling was the chief presenting complaint seen in 93.75% of patients. Pain, weight loss, fever, night sweats, sinus or abscess formation were noted in 20.83% each, 12.50% and 7.29% and 5.21% of cases, respectively. This shows that most patients presented with nodal enlargement only while systemic or suppurative features were not common. Rahman et al. [21] also reported neck swelling to be the most common presenting feature followed by pain and fever in patients who predominantly had tuberculosis and benign lesions. Anand et al. [20] stated that presence of systemic symptoms was significantly higher in patients with malignant pathology.

We found that multiple lymph node involvement was more common than solitary involvement on clinical examination of the neck. Also firm nodes were maximum on palpation followed by soft and hard nodes respectively. Mobile nodes were also found to be more than fixed nodes. Matted nodes were seen in 30.21% of our patients. This shows that chronic

inflammatory conditions such as tuberculous lymphadenitis was a common finding in our patients. Anand et al. [20] reported cervical lymph nodes to be firm on palpation most commonly and reactive/ granulomatous lesions were found to be most common on histopathological examination. Rahman et al. [21] and Sujatha et al. [16] also showed high prevalence of tuberculosis in their studies. Tuberculous lymphadenitis also commonly presents with multiple, firm and matted lymph nodes. So, on clinical examination, our findings were suggestive of infection predominant pathology.
Oval nodes with preserved hilum were maximum on ultrasonography of the neck followed by round nodes with loss of fatty hilum. Nodes with irregular borders, centrally placed necrosis, absence of fatty hilum, and nodes with peripheral vascularity were also seen significantly, suggesting suspicious lymph nodes. So our study had mixed category of reactive, tuberculous and malignant nodes. Jaiswal and Sharma [22] opined that shape of node, hilar echogenicity, nodal margins and vascular pattern help differentiate benign from malignant nodes on ultrasonography. Gupta A. et al. [23] concluded that malignant nodes were significantly round in shape and showed peripheral vascularity whereas necrosis, calcification, matting and presence of soft tissue changes were significantly higher in tuberculous nodes. Yu et al. [24] too found frequent loss of hilum, necrosis and peripheral vascularity in tuberculous lymphadenitis on ultrasonography. Thus, our study followed the same pattern of ultrasonographic findings as has been previously described.

Tubercular lymphadenitis was the most common cause of cervical lymphadenopathy in our study followed by reactive lymphadenitis and suppurative lymphadenitis. Metastatic malignancy and lymphoma were also seen but were less common. Rahman et al. [21], Gupta D et al. [25], Anand et al. [20] and Sujatha et al. [16] all observed similar results in their studies with dominance of reactive and tuberculous lesions compared to malignant lesions. Thus tuberculosis can be said to be a common cause of cervical lymphadenopathy in our region.On statistical analysis, ultrasonography showed a statistically significant association with FNAC diagnosis ($p < 0.001$). However, Cohen's kappa value showed only fair agreement between ultrasonography and FNAC. Sensitivity was only moderate and positive predictive value was low. Specificity and negative predictive value were relatively higher. So we can conclude that ultrasonography can be used as screening modality and to rule out malignancy but cannot be used as a replacement of FNAC.

In conclusion, cervical lymphadenopathy was seen maximum in younger age group. Males were affected slightly more than females. Smoking and alcohol were not found to be common risk factors in our patients. Firm mobile lymph nodes were maximum on clinical examination which were predominantly oval with preserved hilum on USG. Tubercular lymphadenitis was the most common cause of cervical lymphadenopathy in our study. Hence a diagnostic algorithm involving clinical features followed by ultrasonography and FNAC can be used for effective evaluation of cervical lymphadenopathy.

CONCLUSION

Our study shows that cervical lymphadenopathy affects relatively younger patients in our environment, and the causes are usually benign conditions. Tubercular lymphadenitis was the most frequent cause followed by reactive lymphadenitis. Persistence of neck swelling was the most common clinical presentation. Systemic symptoms and suppurative signs were uncommon. Clinically and USG features revealed a heterogeneous grouping of patients, with many patients displaying attributes of both chronic inflammatory and neoplastic conditions. There was significant correlation between USG features and FNAC diagnosis. USG can be helpful as a non invasive first line screening tool having good specificity and high negative predictive value. Poor agreement of USG with FNAC and a low positive predictive value imply that ultrasound cannot be used as a standalone diagnostic modality for cervical lymphadenopathy. Hence FNAC had to be done for confirmation of the diagnosis. Clinical, ultrasonographic and cytopathologic correlation offers the best approach to ensure accurate diagnosis and treatment of cervical lymphadenopathy.

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