Original Article

Clinico-Cytological & USG Correlation of Lymphadenitis with CBNAAT

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Abstract

Background: Cervical lymphadenopathy is a common clinical manifestation of numerous pathological conditions, including infectious, inflammatory, and neoplastic diseases. Among these, tuberculous lymphadenitis (TBL) constitutes a major proportion of extrapulmonary tuberculosis (EPTB), particularly in high-burden regions. The objective is to evaluate the clinico-cytological and ultrasonographic correlation of lymphadenitis with cartridge-based nucleic acid amplification test (CBNAAT) findings, and to determine the diagnostic accuracy and complementary role of each modality in the assessment of cervical lymphadenopathy. **Material and Methods:** A prospective observational study was conducted on 100 patients presenting with cervical lymphadenopathy at Gandhi Medical College and Hamidia Hospital, Bhopal, from September 2019 to September 2021. **Results:** Among 100 cases, tuberculous lymphadenitis accounted for 38%, followed by chronic non-specific lymphadenitis (35%) and chronic granulomatous lymphadenitis (15%). The disease predominantly affected young adults aged 21–30 years (49%) and males (64%), with a strong association with lower socioeconomic status (75%). **Conclusion:** Cervical lymphadenopathy remains a prevalent manifestation of extrapulmonary tuberculosis in developing regions.

Keywords: Cervical lymphadenopathy, Tuberculous lymphadenitis, FNAC, Ultrasonography, CBNAAT, Extrapulmonary tuberculosis.

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Introduction

One common clinical manifestation is lymphadenopathy and it can be a primary or secondary symptom of a number of illnesses. Although the precise cause is uncertain, it is believed to be multifocal. It is typified by anomalies in the size and echo-texture of lymph nodes as a result of either neoplastic or inflammatory cell invasion.

In surgical practice, cervical lymphadenopathy is a frequent complicating issue. The abnormal swelling of lymph nodes in the head and neck region, usually greater than 1 cm, is known as cervical lymphadenopathy. The majority of cases are self-limiting and benign. Nonetheless, both neoplastic and non-neoplastic illnesses are included in the broad differential diagnosis.

Peripheral lymphadenitis, particularly tuberculous lymphadenitis (TBL), represents a significant proportion of extrapulmonary tuberculosis (EPTB), with the cervical region being most commonly involved. Clinical manifestations often overlap with other etiologies of lymphadenopathy—such as reactive hyperplasia, lymphoma, and metastatic disease—rendering accurate diagnosis challenging.[1] Traditional investigations include fine-needle aspiration cytology (FNAC) and ultrasound (USG) imaging; however, the paucibacillary nature of TBL and heterogeneity of imaging features limit diagnostic certainty.

Fine-needle aspiration cytology provides a minimally invasive method for evaluation of lymph node architecture, identifying granulomatous inflammation and caseation necrosis, yet cytology alone lacks microbiological confirmation and may yield false-negative results.[2] Ultrasonography of lymph nodes reveals characteristic features in tuberculous involvement—such as hypoechoic nodes, intranodal necrosis, peripheral vascularity, and nodal matting—but specificity remains variable and often insufficient to differentiate TBL from other etiologies.[3,4]

The advent of the cartridge-based nucleic acid amplification test (CBNAAT) has significantly improved the microbiological confirmation of Mycobacterium tuberculosis (MTB) and rifampicin resistance in non-pulmonary specimens. Studies demonstrate its utility in lymph node aspirates, with specificity often exceeding 90 % though sensitivity varies widely [5,6]. Integrating clinical, cytological, ultrasonographic, and CBNAAT findings may enhance diagnostic accuracy and facilitate earlier initiation of anti-tubercular therapy (ATT).

In this study, we propose to evaluate the clinico-cytological and ultrasonographic correlation of lymphadenitis, with reference to CBNAAT results, to determine the additive value of multimodal

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diagnostics in a high-burden setting. We establish a comprehensive diagnostic algorithm that addresses limitations of individual modalities and promotes prompt, accurate identification of TBL. The present study, was undertaken to evaluate various clinical, sonographical & cytomorphological pattern of cervical lymphadenopathy and correlated with AFB & CBNAAT positivity.

Materials and Methods

This prospective observational study was undertaken in the Department of General Surgery, Gandhi Medical College and Hamidia Hospital (GMC & HH), Bhopal, Madhya Pradesh. The research aimed to evaluate the clinico-cytological and ultrasonographic correlation of lymphadenitis with cartridge-based nucleic acid amplification test (CBNAAT) findings. The study was carried out over a two-year period, from September 2019 to September 2021, after obtaining institutional ethical clearance.

Study Population and Sample Size: The study included 100 consecutive patients presenting with cervical lymphadenopathy who attended either the outpatient department (OPD) or were admitted to the inpatient department (IPD) of General Surgery during the study period. Written informed consent was obtained from all participants after explaining the nature and purpose of the study in their native language.

Inclusion Criteria

1. Patients aged above 12 years.
2. Both inpatient and outpatient individuals presenting with neck swelling of more than three weeks' duration.
3. Patients irrespective of their antitubercular therapy (ATT) status, including those who were treatment-naïve or already receiving ATT.

Exclusion Criteria

1. Patients presenting with acute lymphadenitis of less than three weeks' duration.
2. Patients with isolated lymphadenopathy confined to axillary or inguinal regions.
3. Individuals with generalized lymphadenopathy secondary to known malignancy or immunodeficiency disorders.

Data Collection and Clinical Assessment: Detailed demographic data, including age, sex, residence, and socioeconomic background, were recorded. A thorough clinical history was elicited, emphasizing the onset, duration, progression, and associated symptoms such as fever, night sweats, weight loss, or pain. Particular attention was paid to previous tuberculosis infection, contact history, and ongoing or prior ATT.

Comprehensive physical examination was conducted with special focus on the cervical region to assess the site, size, consistency, tenderness, mobility, and matting of lymph nodes. Systemic examination was performed to rule out associated pulmonary or extrapulmonary tuberculosis.

Laboratory and Radiological Investigations: All patients underwent baseline hematological and biochemical investigations, including complete blood count (CBC), coagulation profile, and viral markers (HIV, HBsAg, and HCV) to exclude immunocompromised conditions.

Radiological evaluation comprised:

- Chest X-ray (Posteroanterior view): To identify evidence of active or healed pulmonary tuberculosis.
- Ultrasonography (USG) of the Neck: Conducted using a high-frequency linear transducer to evaluate nodal characteristics such as size, shape, echotexture, presence of necrosis, calcification, hilar vascularity, and nodal matting. Findings suggestive of tuberculous etiology—like hypoechogenicity, central necrosis, and peripheral vascularity—were specifically documented.

Cytological and Microbiological Evaluation: Fine-needle aspiration cytology (FNAC) was performed on all patients under aseptic precautions using a 22–23 gauge needle attached to a 10 mL syringe. Smears were prepared on clean glass slides and stained with May-Grünwald-Giemsa and Ziehl–Neelsen stains. The cytological diagnosis was categorized as reactive lymphadenitis, suppurative lymphadenitis, granulomatous lymphadenitis, or tuberculous lymphadenitis based on morphological features.

Samples obtained from FNAC were also subjected to CBNAAT (Xpert MTB/RIF assay) to detect Mycobacterium tuberculosis DNA and assess rifampicin resistance. The procedure followed the manufacturer's protocol using GeneXpert equipment. Results were interpreted as "MTB detected," "MTB not detected," or "invalid/error," with rifampicin resistance reported when applicable.

In cases with respiratory symptoms, sputum samples were collected for Ziehl–Neelsen staining for acid-fast bacilli (AFB) and CBNAAT testing to correlate pulmonary and extrapulmonary findings.

Data Analysis: All data were systematically recorded in a structured proforma. The clinical, cytological, and ultrasonographic findings were compared and correlated with CBNAAT results to determine sensitivity, specificity, and concordance rates. The results were analyzed statistically to assess the diagnostic efficacy of each modality individually and in combination.

Ethical Considerations: The study protocol was reviewed and approved by the Institutional Ethics Committee of Gandhi Medical College, Bhopal. Confidentiality of patient data was strictly maintained throughout the study, and all procedures adhered to the ethical principles outlined in the Declaration of Helsinki.

Results

A total of 100 patients with cervical lymphadenopathy were studied at the Department of General Surgery, Gandhi Medical College, Bhopal, from September 2019 to September 2021. All were evaluated by clinical examination, ultrasonography (USG), fine needle aspiration cytology (FNAC), acid-fast bacilli (AFB) staining, and CBNAAT testing.

Tuberculous lymphadenitis represented the most frequent cause (38%), followed by chronic non-specific lymphadenitis (35%). Overall, non-neoplastic lesions accounted for 91% of cases, emphasizing the dominance of infectious etiologies.

Table 1: Etiology of Cervical Lymphadenopathy

Etiology	No. of Cases	Percentage (%)
Tuberculous lymphadenitis	38	38
Chronic non-specific lymphadenitis	35	35
Chronic granulomatous lymphadenitis	15	15
Malignant metastasis	9	9
Acute suppurative lymphadenitis	3	3
Total	100	100

Table 2: Demographic Distribution

Variable	Category	No. of Cases	Percentage (%)
Sex	Male	64	64
Sex	Female	36	36
Age Group (years)	21–30	49	49
Age Group (years)	31–40	31	31
Age Group (years)	41–50	11	11
Age Group (years)	>50	9	9
Socioeconomic Status	Lower	75	75
Socioeconomic Status	Middle	25	25
Socioeconomic Status	Higher	0	0

A male predominance (2.4:1) was noted, with the highest number of patients in the 21–30-year group (49%). Most belonged to the lower socioeconomic class (75%), indicating an inverse relationship between socioeconomic status and disease occurrence.

Table 3: Site of Lymph Node Involvement

Lymph Node Level	Tuberculosis	CNSL	CGL	Malignant	Suppurative
Level I	0	3	0	3	3
Level II	35	17	15	5	2
Level III	36	10	15	4	0
Level IV	14	4	4	2	0
Level V	1	3	0	1	0

The upper (level II) and middle (level III) jugular groups were the most frequently involved, particularly in tuberculous and granulomatous lymphadenitis.

Table 4. Diagnostic Accuracy of FNAC and CBNAAT

Diagnostic Test	Sensitivity (%)	Specificity (%)
FNAC	94.73	95.16
CBNAAT	97.22	95.31
AFB Staining	50.00	87.09

FNAC and CBNAAT demonstrated high diagnostic accuracy, while AFB staining showed limited sensitivity.

Table 5. Comparison of USG and FNAC Diagnosis

USG Diagnosis	Tubercular	CNSL	Malignant	Total
Tubercular	30	4	1	35
Malignant	5	1	8	14
CNSL	3	30	0	33
Total	38	35	9	82

Ultrasonography correlated well with FNAC findings, especially for tuberculous and malignant nodes, reaffirming the complementary role of both techniques.

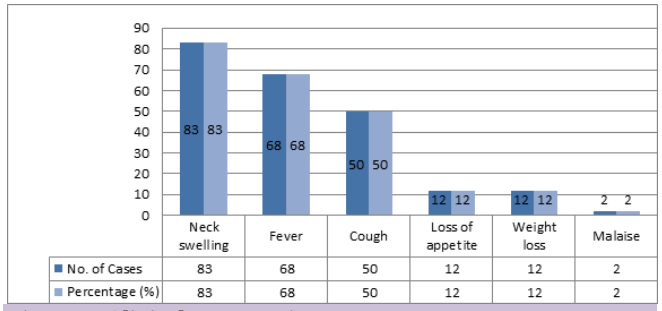

Figure 1. Clinical Presentation

Neck swelling was the most common symptom (83%), followed by fever (68%) and cough (50%). Constitutional symptoms were less frequent.

Discussion

This discussion is based on the evaluation of 100 patients diagnosed with cervical lymphadenopathy at the Department of General Surgery, Gandhi Medical College and Hamidia Hospital, Bhopal, between September 2019 and September 2021. The analysis included demographic characteristics, clinical presentation, ultrasonographic features, and cytological and

microbiological findings obtained through FNAC, acid-fast bacilli (AFB) staining, and cartridge-based nucleic acid amplification test (CBNAAT).

Etiological Spectrum Among the 100 cases, 91% were non-neoplastic, while 9% were neoplastic, a distribution consistent with the findings of Shafiullah and Syed Humayun Shah et al,[7] (94% and 6%, respectively) and Natraj et al,[8] (90.6% and 9.4%). The predominance of non-neoplastic lesions underscores the continued burden of infectious causes, particularly tuberculosis, in regions with high endemicity.

In this study, tuberculous lymphadenitis constituted the most frequent diagnosis (38%), followed by chronic non-specific lymphadenitis (35%), chronic granulomatous lymphadenitis (15%), malignant metastasis (9%), and acute suppurative lymphadenitis (3%). Comparable findings were reported by Aruna Das et al,[9] who observed tuberculosis in 63.8% of cases, and by Jindal et al,[10] who recorded 48.4%. The lower incidence of tubercular lymphadenitis in Kim et al,[11] (13.9%) reflects regional differences, as their study population originated from areas with low tuberculosis prevalence. Overall, these observations affirm that tuberculosis remains the principal cause of cervical lymphadenopathy in developing nations.

Age and Sex Distribution The majority of patients in the present study belonged to the 21–30-year age group (49%), followed by 31–40 years (31%). These findings closely parallel those of Shafiullah et al,[1] who found 72% of cases between 11–30 years, and Jha et al,[13] who reported maximal involvement among patients aged 11–20 years. Similarly, Kim et al,[11] observed the highest incidence between 20–50 years. The consistent clustering of cases in young adulthood suggests a higher vulnerability due to occupational exposure, immune reactivity, and social determinants such as crowding and nutritional status.

Regarding sex distribution, a male predominance (2.4:1) was observed, which aligns with Purohit et al,[14] (1.4:1) but contrasts with studies by Bedi et al,[15] which reported female preponderance. The male predominance in the present series may be attributed to increased exposure to environmental pathogens, outdoor occupational risk, and greater likelihood of hospital presentation among males in this population.

Clinical Presentation and Site Distribution Clinically, neck swelling was the most common presenting symptom, often accompanied by fever and cough, consistent with the classical manifestations of tubercular lymphadenitis described in prior Indian studies. Among the 38 patients with tuberculous lymphadenitis, 84% exhibited constitutional symptoms such as fever and weight loss, similar to observations by Patel and Mehta.[14]

Anatomically, the level III cervical lymph nodes were the most frequently involved (94.7%), with multiple-level involvement noted in 73.6% of patients. These findings corroborate the work of Dandapat et al,[16] who identified the upper deep jugular nodes as the predominant site of disease. Similarly, some studies,[17,18] reported frequent involvement of the posterior triangle lymph nodes, confirming the predilection of tubercular infection for the jugular chain.

Chest X-ray findings suggestive of pulmonary tuberculosis were identified in 18% of tuberculous cases, closely matching the 16% positivity reported by Jha et al.[13] This demonstrates that radiological evidence of pulmonary involvement is often absent in extrapulmonary tuberculosis, reinforcing the diagnostic value of cytological and molecular methods.

Diagnostic Correlation: FNAC, USG, and CBNAAT The FNAC findings in the present study demonstrated 94.73% sensitivity and 95.16% specificity in diagnosing tuberculous lymphadenitis, which is consistent with reports by Jha et al,[13] (92.8%), Chao,[19] and Loh (88% and 96%), and Dandapat et al (83%).[16] Comparable results were also found in the works of Dasgupta et al,[20] they whom established FNAC as a reliable diagnostic tool for lymphadenopathy of infectious or malignant origin.

This superior accuracy highlights the diagnostic advantage of molecular assays in confirming tuberculosis and detecting drug resistance, even in paucibacillary specimens. Synthesis and Clinical Implications The collective findings of this study confirm that tuberculosis continues to be the predominant cause of cervical lymphadenopathy in the Indian subcontinent, primarily affecting young adults of low socioeconomic status. The combination of FNAC, USG, and CBNAAT provides a highly effective, minimally invasive diagnostic triad, reducing the need for open biopsies while ensuring prompt diagnosis and treatment initiation.

The consistency of these results with previous regional and international studies further validates the reliability of this diagnostic approach. FNAC remains indispensable for morphological evaluation, USG enhances anatomical localization, and CBNAAT adds rapid molecular confirmation. Together, these modalities represent an evidence-based, cost-effective diagnostic strategy for cervical lymphadenopathy, particularly in tuberculosis-endemic areas.

Conclusion

Cervical lymphadenopathy occurs frequently across all age groups. Comprehensive clinical assessment supported by ultrasonography and fine-needle aspiration cytology (FNAC) can effectively minimize the need for invasive biopsies. Prompt and precise diagnosis, coupled with drug susceptibility testing, is crucial for initiating appropriate therapy without delay in cases of extrapulmonary tuberculosis (EPTB). Among diagnostic modalities, the cartridge-based nucleic acid amplification test (CBNAAT) plays a significant role in detecting EPTB, particularly in acid-fast bacilli (AFB)-negative cases, as it demonstrates higher sensitivity and specificity than Ziehl–Neelsen staining. Its application facilitates early diagnosis and management of cervical lymphadenopathy, thereby improving patient outcomes.

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Conflicts of interest

There are no conflicts of interest.

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