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Sonographic diagnosis of tuberculous lymphadenitis in the neck

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Abstract
Tuberculous cervical lymphadenitis is the most common manifestation of extra-pulmonary tuberculosis and is a very frequent cause of a peripheral lymphadenitis in the developing world (1).
The article reviews the radiological features, diagnostic role and accuracy of ultrasonography in patient presenting with tuberculous lymphadenitis of neck.
We attempt to evolve a sono-diagnostic model for tuberculous cervical lymphadenitis.
The study included clinically suspected cases of cervical tuberculosis from year may 2016 to October 2018. Ultrasound features of lymph nodes were studied along with ultrasound guided FNAC of lymph nodes. Ultrasound features of cases positive for cervical tuberculosis were retrospectively investigated and a sonographic diagnosis was developed according to the number of sonographic features. Follow up sonography, treatment response, CBNAAT and culture were used for final diagnosis.
37 of 50 patients enrolled in study were diagnosed to be cervical tuberculosis positive. The study result showed that a predominantly hypoechoic node with a heterogeneous echo pattern and intranodal necrosis had a relative high sensitivity and specificity, however overall diagnostic sensitivity and specificity of the '2 or more categories 'was higher than other categories.
Background-
In impoverished countries where tuberculosis (TB) is endemic, TB continues to be a major health concern. India is the country with the highest burden of TB.
Early detection and effective treatment are crucial for tuberculosis control.
Lymphadenitis is the primary manifestation of tuberculosis in 5% ofthe immunocompetent population, with the cervical lymph nodes providing the site of infection in two thirds of cases. Ultrasound is an excellent first-line investigation as it is not only able to assess cervical lymphadenopathy but also enables guided fine needle aspiration cytology. Tubercular lymphadenitis mimics other pathological processes & yields inconsistent physical & laboratory results (2). Variouslaboratorytestslike-routine blood investigation with ESR, Fine needle aspiration cytology (FNAC), Ultrasonography of cervical lymph node, Mantoux test, Excision biopsy, X- ray chest, etc. are done to established the diagnosis of tuberculosis in cervical lymphadenopathy (3).
Sonography is used for detection and characterization of lymph nodes and several studies have been performed for investigating whether sonography can be used to differentiate between tuberculous, metastatic and lymphomatous lymph nodes.
Materials and method-
This is a retrospective observation study.
50 patients referred for cervical lymphadenopathy between May 2016 to October 2018 were included in this study.
Inclusion criteria: *Clinically Suspected Cases*
Exclusioncriteria:
- *Patients < 5 years ofage and > 60 years of age*
- *Unwilling Patients*
- *Clinically Non-TB Lymphnodes*
- *Swellings occurring aftertrauma*

Keywords*-Tuberculosis, lymph nodes, neck, sonography, diagnosis*

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I. Aims and Objectives

1. To study the clinical – radiological aspect of the tuberculous lymphadenitis of neck and help clinician in management ofillness.
2. To study the radiological features, diagnostic role and accuracy of ultrasonography in patient presenting with tuberculous lymphadenitis of neck.
3. To study the quantitative and qualitative characteristics oftuberculous cervical lymphadenitis.

4. To assess the diagnostic accuracy of individual sonographic features in patients with clinical suspicion of tuberculous lymphadenitis in the neck by comparing it with results of treatment response, CBNAAT (gene expert) and LJ culture test done by FNAC of lymphnodes.
5. To evolve a sono-diagnostic model for tuberculous cervical lymphadenitis.

Ultrasound image analysis-

Neck sonography was performed with a high-resolution ultrasound instrument (ESAOTE MY LAB 60 machine, PHILIPS AFFINITI 50G machine and SAMSUNG ACCUVIX XGmachine).

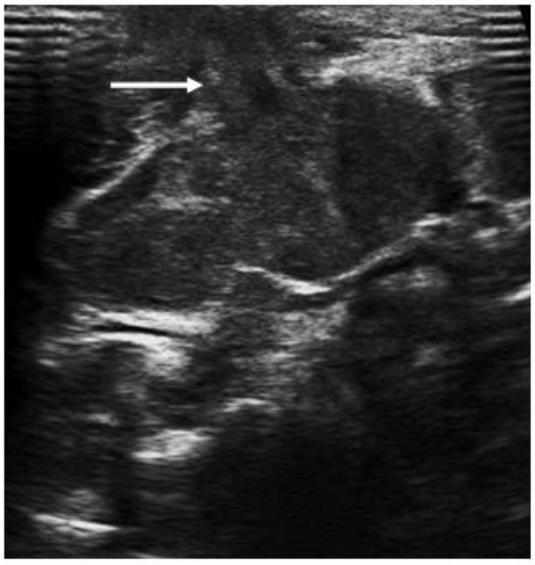
Site, number, size and consistency of lymph nodes are noted.

Ultrasound features used for diagnosis are -

(A) a predominantly heterogeneous hypoechoic node with intranodal necrosis.
(B) matted lymph nodes.
(C) perinodal soft tissue having poorly defined anechoic areas with or without sinus and abscess formation. (white arrow)
(D) colour Doppler sonography showing displaced vascularity.

(A)

(B)



(C)

(D)

Sonographically Guided Fine-Needle Aspiration
Sonographically guided fine-needle aspiration of lymph nodes was performed after sonography using a 10-mL plastic syringe attached to a conventional 21-gauge needle. Samples collected were sent for CBNAAT (Cartridge-based nucleic acid amplification test) and culture.

Diagnosis
Final diagnosis of cervical tuberculosis was established by taking into consideration treatment response to anti-tuberculous drugs, CBNAAT and culture results.

II. Observation and analysis

Outofthe50patientsobservedinthestudy,37werediagnosedwithcervical tuberculous lymphadenitis.
Out of the 37 TB patients observed in the study, majority belonged to age group of 16-30 years.
The number of female patients were 25 which is 67.5% of total 37 TB patients. The number of male patients were 12 which is 32.5% of total 37 TB patients.
Majority of patients were from rural and semi-urban areas.

Themostcommon necklevelinvolvedwaslevelV, thatistheposteriortriangle of the neck, which was involved in 22 of 37, constituting 54.4% TB patients.
Most lymph nodes were <3 cm in size.

The 37 TB patients were evaluated sonographically and four features characteristic to TB were observed. The most common feature recorded was Feature A, seen in 32 of 37 i.e. 86.5% patients, followed by Feature D, seen in 27 i.e. 73% TB patients, followed by Feature B seen in 24 i.e. 65% TB patients and least commonly seen was Feature C, seen in 13 i.e. 40.5% TB patients.

Table-1: USG Findings

USG Findings	Noofpatients(n=37)	% ofpatients
Hypoechogenicity and Necrosis (Feature A)	32	86.5
Matting (Feature B)	24	64.8
Anechoicareainperinodalsoft tissue (Feature C)	13	40.5
Displaced Vascularity (Feature D)	27	72.9

Sensitivity,specificity, positive predictive value, negative predictive value and accuracy of the individual sonographic features were noted for the diagnosis of cervical tuberculosisinthepresentstudy.Thedataforcalculationhasbeenobtained byobservationandfollow-upofthe50patientsenrolledinthepresentstudy.
FeatureAshowshighestsensitivityandspecificitywhichwas
97%and70.6%respectively.ItalsohasthehighestPPVandNPVi.e.86.5% and 92.3% respectively and hence, ultimately, the highest accuracy of88%.
Feature D showed the second best accuracy, with a sensitivity of 96.4%, specificity of 54.5%, PPV of 73%, NPV of 92.3% and accuracy of 78%.
Feature B turned out to have 64% accuracy with a sensitivity of 85.7%, specificity of 36.3%, PPV of 64.8% and NPV of 61.5%.
FeatureCwasfoundtobetheleastaccuratewithasensitivity of 81.2%, specificityof23.5%,PPV of 35.1%andNPV of 61.5%.Itsaccuracycamearoundto 42%.

Table-2: Diagnostic indices for individual sonographic features

Sonographic Feature	Sensitivity,n(%)	Specificity,n(%)	PPV, n (%)	NPV, n (%)	Accuracy, n (%
A (Hypoechogenicityandnecrosis)	32/33 (97.0)	12/17 (70.6)	32/37 (86.5)	12/13 (92.3)	44/50 (88.0)
B (Matting)	24/28 (85.7)	8/22 (36.3)	24/37 (64.8)	08/13 (61.5)	32/50 (64.0)
C (Anechoic area in perinodal soft tissue)	13/16 (81.2)	8/34 (23.5)	13/37 (35.1)	8/13 (61.5)	21/50 (42.0)
D (Displaced vascularity)	27/28 (96.4)	12/22 (54.5)	27/37 (73.0)	12/13 (92.3)	39/50 (78.0)

To summarize the above findings, the sonographic features of tuberculous lymphnodescanbearrangedinthefollowingsequenceindescendingorder of accuracy – Feature A > Feature D > Feature B > FeatureC.

Itisfoundthatofallthecategories,categoryof≥1hadthehighestsensitivity andlowestspecificity.However,thiscategoryshowsahighaccuracyof84%, whichisthehighestamongalltheothercategories.Thiscouldbeattributedto the lower number of patients enrolled in the study and the selection of highly suspicious cases of TB in the study population, as well as the high incidence of TB among the source population.

Category≥ 2showedboth–ahighsensitivityaswellasahighspecificity.It also has a high accuracy of 82% for the givenpopulation.

Categories of ≥ 3 and 4 showed high specificity but low sensitivity. All patients with all four features positive were later confirmed to have cervical tuberculous lymphadenitis.

Table-3: Diagnostic indices for sonographic features

Sonographic Feature	Sensitivity, n (%)	Specificity,n(%)	PPV, n (%)	NPV, n (%)	Accuracy, n (%)
≥ 1	37/37 (100)	05/13 (38.4)	37/45 (82.2)	05/05 (100)	42/50 (84)
≥ 2	31/37 (83.8)	10/13 (76.9)	31/34 (91.1)	10/26 (38.4)	41/50 (82)
≥ 3	19/37 (51.3)	12/13 (92.3)	19/20 (95.0)	12/30 (40.0)	31/50 (62)
4	07/37 (18.9)	13/13 (100)	07/07 (100)	13/43 (30.2)	20/50 (40)

III. Discussion

High-resolutionultrasoundisafirst-lineimagingtoolforassessmentoflymph nodes in the neck. Its main role is to characterize the lymph nodes as wellastoguideinterventionalprocedures.

In contrast to the usual oval shape of normal or reactive lymph nodes, however, TCL commonlyappears as round lesions (6). Tuberculous nodes are predominantly hypoechoic largely because of the highincidenceofintranodalcysticnecrosis(7). Posterior acousticenhancementisalsofrequentlyreported. (4,5)The borders of cervical tuberculous nodes are usually unsharp(6). When left unattendedtheinflammationmayprogressbeyondlymphnodesandspread into subcutaneous tissues. The so-called "collar stud" abscess or a fistula tract may be seen on US in this stage(5). An intranodal cystic necrosis pushing the hilus away from its central position would cause displaced vascularity, acommon US feature (81%) of tuberculous nodes(6).

Among the 4 individual sonographic features, a predominantly hypoechoic node with a heterogeneous echo pattern and intranodal necrosis showed high sensitivity, specificity, a high PPV, NPV and overall accuracy. Poorly defined anechoic areas in the perinodal soft tissue with or without sinusand abscess formation showed low specificity, low PPV and a relatively higher sensitivity. A vascular distribution with apparently avascular areas and displaced vascularity on color Doppler sonography showed high sensitivity and NPV but low specificity and PPV. Therefore, only one sonographic feature i.e., a predominantly hypoechoic node with a heterogeneous echo pattern and intranodal necrosis showed both high sensitivity andspecificity.

For sonographic diagnosis, the"1 or more" category was more accurate for diagnosis of tuberculous lymphadenitis than the "2 or more,", "3 or more," and "4" categories. Of all 50 patients, 45 (90%) were classified as "1 ormore,"34 (68%) as "2 or more," 20 (40%) as "3 or more"and 7 (14%) as "4." Ofthe37patientswithtuberculouslymphadenitis,37(100%)wereclassified as "1 or more," 31 (83.8%) as "2 or more," 19 (51.3%) as "3 or more"and 7 (18.9%) as "4." In comparison with the "2 or more" category, the "1 or more" categoryhadhighsensitivitybutlowspecificity,andthe"3ormore"category had high specificity and a high PPV but low sensitivity. However, we did not investigate a diagnostic index for sonographic diagnosis of tuberculous lymphadenitis according to different combinations of the 4 sonographic features.

Thisstudyhasseverallimitations.First, it was areretrospectivestudyinwhich limitedsonogramswereused.Second,studypopulationwaslimitedandwas obtainedfromageographicalareawithhighincidenceaswellasprevalence oftuberculosis.Third,4patientsincludedinthestudywereconfirmedtohave reactivated tuberculosis, which were notdiscriminated.

IV. Conclusion

In conclusion, the study results showed that a predominantly hypoechoic node with a heterogeneous echo pattern and intranodal necrosis had both high sensitivity and specificity for identification of tuberculouslymphadenitis,buttheoveralldiagnosticsensitivityaswell as specificity of the "2 or more" category was

higher, than those of other categories. Therefore, our sonographic diagnostic method may be useful for detection of tuberculous lymphadenitis in clinically suspectedpatients.

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