Evaluation of Cervical Lymphadenopathy using Ultrasonography and comparison with FNAC Findings

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Abstract

Imaging techniques are crucial in diagnosing head and neck pathologies. A thorough evaluation of deeper soft tissues such as muscles, vessels, and lymph nodes is necessary to determine the severity of a disease, its prognosis and to plan treatment. The cervical group of lymph nodes is implicated in various head and neck conditions like tuberculosis, lymphoma, and metastasis from different sites. These diseases often present as cervical lymphadenopathy during their natural progression. Ultrasound proves to be more sensitive (96.8%) than palpation (73.3%) in detecting cervical lymphadenopathies. To evaluate cervical lymphadenopathy using grayscale and color Doppler ultrasonography and compare with FNAC findings. A total of 50 patients were referred for ultrasonography of the neck with suspected cervical lymphadenopathy to the Department of Radiodiagnosis from indoor or outdoor services of Saraswathi Institute of Medical Sciences, Hapur, U.P. Among the 50 lymph nodes, 12 were proven to be malignant and 38 were proven to be benign on FNAC. Features such as S/L ratio >0.5, absence of echogenic hilum, and abnormal vascular pattern demonstrated sensitivities of 91.6%, 91.67%, and 83.3%, specificities of 73.68%, 65.79% and 63.64% and positive predictive values (PPVs) of 77.70%, 72.82%, and 69.62% respectively. Ultrasound findings of S/L ratio, absence of echogenic hilum, and abnormal vascular pattern revealed good sensitivity, specificity, and accuracy in differentiating benign and malignant lymph nodes.

Keywords: Cervical lymphadenopathy, Ultrasound, Color Doppler, Morphological features, Malignant lymph nodes

Introduction

The cervical lymph node is frequently involved in various diseases, including reactive, tubercular, malignant, and metastatic conditions. There will be morphological and vascular-architectural differences among various nodal diseases which aid in differentiating benign from malignant causes Ultrasound with color Doppler is a commonly used and safe method for detecting and characterizing these nodes. Due to their superficial location, cervical lymph nodes provide better spatial resolution on ultrasound compared to CT and MRI [1]. Ultrasound has higher sensitivity than that of palpation (for detection of cervical lymphadenopathies. This study is done to show the efficacy of ultrasound and Doppler in differentiating reactive, tubercular, and malignant cervical lymph nodes.

Ultrasound is preferred over CT and MRI for evaluation of cervical neck nodes because of nonionizing, noninvasive, cost factor, availability, and determination of characteristics of cervical nodes in greater detail than CT and MRI by using high-resolution transducers, i.e., S/L ratio, border, matting, echotexture, echogenic hilum and vascular pattern.

Different nodal diseases present distinct morphological and vascular architectural variations, which can help distinguish benign from malignant causes. The histological alterations within the node correspond to the morphologic changes observed on gray-scale sonography. In metastatic nodes, the normal vascular morphology is disrupted by neoplastic infiltration. In contrast, inflammatory diseases cause dilation of the intranodal vessels. These changes can be visualized using, grayscale and color Doppler [2].
Accurately distinguishing between benign and malignant lymph nodes can reduce the number of patients undergoing unnecessary invasive procedures like FNAC and biopsy.

Methodology

- We intend to evaluate cervical lymphadenopathy using grayscale and color Doppler ultrasonography.
- The main source of data for this study will be patients referred to the Department of Radiodiagnosis from indoor or outdoor services of Saraswathi Institute of Medical Sciences, Hapur.
- The patients selected for the study will be explained the entire procedure and informed consent will be taken from the patient following which detailed clinical history and examination is to be recorded as per proforma.
- Referred patients of suspected cervical lymphadenopathy will be evaluated using grayscale and CD Ultrasonography with Siemens (accuson x 300) or Philips HD 15 machines using a linear transducer (7-10 MHz frequency). Modification of the scanning technique will be done according to the patient profile.
- The morphological assessment involved a gray-scale evaluation of the short-axis to long-axis (S/L) ratio and the presence or absence of an echogenic hilum. Doppler examination was conducted. The vascularity pattern (central, peripheral, mixed, or avascular.
- Findings of gray scale ultrasound and color Doppler will be evaluated and will be compared with histopathological or cytological diagnosis as the gold standard.
- After FNAC, a cytopathology report was obtained from the Department of Pathology. The sensitivity, specificity, PPV, NPV, and accuracy of various morphological features and Doppler indices in distinguishing malignant from benign nodes were determined using contingency tables.

Results

We evaluated a total of 50 patients who met the selection criteria and referred for ultrasonography to the department of radio-diagnosis from indoor or outdoor services of Saraswathi Institute of Medical Sciences, Hapur. They were examined using Grey Scale ultrasound, and Doppler Sonography, and the final diagnosis was confirmed by FNAC.

Age Distribution

The age of the patients ranged from 5 to 75 years.

Table1: Descriptive Statistics of age

	Total no.	Minimum	Maximum	Mean	Std. Deviation
Age in years	50	5	75	47.18	17.84

Table 2: Age Distribution

Age	<10Y	10-20Y	20-30Y	30-40Y	40-50Y	50-60Y	60-70Y	>70Y	
No. Of Cases	3	2	5	5	10	11	12	2	50

The age of the patients ranged from 5-75 years. The majority of patients were in the age group of 60-70 years followed by age groups of 50-60 years and 40-50 years.

Sex Distribution

Of the 50 cases, 36 were males (72%) and 14 females (28%).

Table 3: Sex Distribution

	Frequency	Percent
Female	14	28%
Male	36	72%
Total	50	100%

Among the total 50 lymph nodes, 38 were benign (76%), (24 reactive and 14 tubercular), 12 were malignant (24%), (9 metastatic, and 3 lymphomatous). The most common cause of cervical lymphadenopathy was reactive in 24 patients (48%), followed by tuberculosis in 14 patients (28%), metastasis in 9 patients (18%) and lymphoma in 3 patients (6%).

Ultrasonography Morphology

Short Axis to Long Axis Ratio (S/L Ratio)

The shape of the lymph node can be assessed objectively by taking the short-to-long axis ratio (S/L ratio) of the enlarged lymph nodes.

Elliptical lymph nodes typically have an S/L ratio less than 0.5, while round nodes have an S/L ratio greater than 0.5.

Table 4: Distribution of shape

S/L	Reactive	Tuberculosis	Metastasis	Lymphoma	Total
<0.5	19	9	1	0	29
≥0.5	5	5	8	3	21
Total	24	14	9	3	50

The above table shows that lymph nodes with S/L ratio <0.5 are more in reactive nodes, while lymph nodes with S/L ratio > 0.5 are more in malignant and Tubercular nodes.
n malignant disease infiltration of the malignant tissue result in early distortion of internal nodal architecture with mass effect which may not be equal at all points within the node leading to change in shape (round) In malignant disease infiltration of the malignant tissue *requal at all points within the node leading to change in shape (round).*

Table 5: Distribution of Border

	Sharp	Unsharp	Total
Reactive	7 (29%)	17(71%)	24
Tubercular	5 (35.7%)	9(64.2%)	14
Metastasis	6 (66.6%)	3 (33.3%)	9
Lymphoma	3 (100%)	0	3

In our study out of 9 malignant nodes 6 shows sharp border, out of 24 reactive 17 shows unsharp border, out of 14 tubercular 9 shows unsharp border and out of 3 lymphomatous 0 shows unsharp border.
The above table shows that malignancy/metastasis nodes are having more of sharp borders and benign nodes are having more of unsharp borders.

Distribution of Echogenic Hilum
The normal echogenic hilum was absent in 2 (8.3%) of reactive, and 11 (78.5%) of the tubercular nodes. Among malignant nodes echogenic hilum was not seen in 8(88.8%) of the metastatic nodes and 3 (100%) in lymphomatous nodes.

Table 6: Distribution of lymph nodes according to ehogenic hilum

	Echogenic Hilum (+)	Echogenic Hilum (-)	Total
Reactive	22 (91.6%)	2 (8.3%)	24
Tubercular	3(21.4%)	11(78.5%)	14
Metastasis	1(11.1%)	8(88.8%)	9
Lymphoma	0	3(100%)	3
	26	24	50

In our study the normal echogenic hilum was preserved in 91.6% of the reactive, while the echogenic hilum was distorted in 78.5% of the tubercular, 88.8% of metastatic, and 100% in lymphomatous nodes.
The loss of echogenic hilum in tuberculosis was due to necrosis, resulting in heteroechoic nodes with echogenic foci formed by areas of caseation. Suppurative lymph nodes also exhibited a loss of echogenic hilum.

Distribution of Echotexture

Table 7: Distribution of lymph nodes according to echotexture

	Homogeneous	Heterogeneous	Total
Reactive	24 (100%)	0(0%)	24
Tubercular	9 (64%)	5(36%)	14
Metastasis	6 (66.6%)	3(33.3%)	9
Lymphoma	2(66.6%)	1(33.3%)	3
	41 (82%)	9 (18%)	50

The above table shows homogenous echotexture in 24 out of 24 reactive node, 2 out of 3 lymphomatous, heterogenous echotexture noted in 5 out of 14 tubercular and 3 out of 9 metastatic lymph nodes.
In our analysis reactive lymph nodes show more of homogeneous pattern and lymph nodes of metastatic / tubercular etiology present with Heterogeneous echotexture.

Distribution of Matting

Table 8: Distribution of lymph nodes with matting

	Matting (+)	Matting (-)	Total
Reactive	0 (0%)	24(100%)	24
Tubercular	10(71.4%)	4(28.6%)	14
Metastasis	8(88.8%)	1(11.1%)	9
Lymphoma	0 (0%)	3(100%)	3
	18(36%)	32(64%)	50

In our study matting is absent in 24 out of 24 reactive nodes, 3 out of 3 lymphomatous nodes, however matting is present in 10 out of 14 tubercular and 8 out of 9 metastatic nodes.

The above table shows lymph nodes with Matting is the important criteria to diagnose tubercular and metastatic lymph nodes. The soft tissue edema surrounding the lymph nodes causes matting of the lymph nodes.

Vascularity Pattern
Vascularity pattern 34 among the 38 (89%) benign lymph nodes and all 12 malignant lymph nodes showed some vascularity. Among the benign lymph nodes 4 (10.52%) nodes were avascular (1 reactive and 3 tubercular lymph nodes, 26 (68.4%) had central vascularity (22 reactive and 4 tubercular nodes), 3 (8.82%) had mixed pattern of vascularity (1 reactive and 2 tubercular) while 5 (14.70%) lymph nodes had peripheral vascularity.
All the 12 malignant lymph nodes showed some vascularity. Among them, 6 (50%) demonstrated either mixed (6 nodes) or peripheral vascularity 4 nodes (33%) whereas the remaining 2 (17%) nodes demonstrated central vascularity (1 lymphomatous and 1 metastatic node).

Table 9: Distribution of lymph nodes according to the pattern of vascularity

	Reactive	Tuberculosis	Metastasis	Lymphoma	Total
Absent	1	3	0	0	4
Central	22	4	1	1	28
Peripheral	0	5	4	0	9
Mixed	1	2	4	2	9
					50

Discussion
The aim of the present study is to show the efficacy and usefulness of high-resolution ultrasonography and also to evaluate the usefulness of color Sonography in differentiating malignant, tubercular, reactive, and benign cervical lymphadenopathy.
The diagnosis of the presence of metastatic lymph nodes is crucial for therapeutic planning in patients with suspected malignancy. The presence or absence of such metastasis has a great impact on the treatment, risk of recurrence, and survival.

S/L Ratio
- Dong Na DG and team found that an S/L ratio greater than 0.5 had a sensitivity of 85% and specificity of 61% for diagnosing malignancy in their study of 117 nodes (from 105 patients) with cervical lymphadenopathy.
- Our findings indicate that the presence of a round shape had a sensitivity of 91.67% and specificity of 60.53% for the diagnosis of malignancy. It had a PPV of 69.90.%, NPV of 87.90%, and accuracy of 76.10%.
- The S/L ratio $\geq$ 0.5 had a sensitivity of 91.67% and a specificity of 73.68% for the diagnosis of malignancy with a PPV of 77.70%, an NPV of 89.84%, and an accuracy of 82.68%.

It's common for metastatic, lymphomatous (either Hodgkin's or Non-Hodgkin's), and tubercular nodes to appear round, while normal or reactive nodes are usually oval or flat. The shape of the node can be altered by metastatic disease as it infiltrates nodal tissue and expands the nodal capsule. Therefore, round nodes are often indicative of malignancy.[3]
In malignant disease infiltration of the malignant tissue result in early distortion of internal nodal architecture with mass effect which may not be equal at all points within the node

leading to change in shape (round). But in benign diseases there is diffuse enlargement of node without altering the shape that is oval shape.[4]

Border

In one study done by Kaji *et al.* [5], 16 of 19 nodes showed sharp borders in proven malignant cases – 84.2%, and 3 of 19 benign nodes showed unsharp borders – 15.8%.

In our study, 66.6% of malignant nodes showed sharp borders. 71% of reactive nodes showed unsharp borders. 64% of tubercular showed unsharp borders 100% of lymphomatous nodes showed sharp borders.

Sharp borders in malignancy is due to the infiltrating tumor cells replacing normal lymphoid tissues causing an increasing acoustic impedance difference between lymph nodes and surrounding tissues whereas unsharp borders in malignant nodes indicate invasion into adjacent structures. But in benign because of edema or active inflammation of the surrounding tissues, they will have unsharp borders.

In our study presence of sharp border had sensitivity of 75% and specificity of 68.42% for the diagnosis of malignancy. It had PPV of 70.37.%, NPV of 73.24% and accuracy of 71.7%.

Echogenic Hilum

The limited branching and separation of the lymphatic sinuses and blood vessels in smaller nodes could be why there are insufficient interfaces for the reflection of ultrasound waves, making the hilum echogenic.

In malignant nodes, the absence of the echogenic hilum is due to replacement by tumor cells. Two metastatic lymph nodes in our study displayed an echogenic hilum. It's possible to observe an echogenic hilum in early nodal malignancy when the medullary lymphatic sinuses have not been sufficiently invaded.

The echogenic hilum, a long-established indicator of benignity, was present in over 90% of benign cervical nodes with a diameter exceeding 5mm in a study conducted by Ahuja and colleagues.

In one study done by Vasallo *et al.* [6], 26 of benign nodes 58% showed a wide central hilus, 35% showed a narrow hilus and 8% no hilus. Of 68 Malignant nodes only 6% of nodal metastasis exhibited a wide central hilus, 48% exhibited no hilus and 46% of malignancies/metastasis showed narrow hilus.

In our study normal echogenic hilum was absent in 13 (34%) of benign and 11 (91%) of the malignant lymph nodes. Among benign nodes echogenic hilum was not seen in 11(84%) of the tubercular nodes but only 2 (15%) of the reactive lymph nodes. Among malignant nodes echogenic hilum was absent in 11(91%) of the malignant nodes and all 3 nodes of lymphoma. Absence of echogenic hilum had sensitivity of 91.67% and specificity of 65.79% for the diagnosis of malignancy. It had PPV of 72.82%, NPV of 88.76% and accuracy of 72%.

Echotexture

In one study done by Toriyabe *et al.* [7] 17 of 19 nodes showed heterogeneous echotexture and were proved as malignant by FNAC study.

In our study presence of homogenous echotexture had sensitivity of 33.33% and specificity of 86.84% for the diagnosis of malignancy. It had PPV of 71.70.%, NPV of 56.57% and accuracy of 60.09%.

Matting

Ying *et al.* [8] stated that Matting is the important criteria to diagnose tubercular lymph nodes. Because of the soft tissue edema surrounding the affected lymph nodes results in matting of the lymph nodes.

Ahuja *et al.* [9] stated that matting and adjacent soft tissue oedema are common in tuberculous nodes, however they can be seen rarely in malignancy.

In our study presence of matting had sensitivity of 66.67% and specificity of 73.68% for the diagnosis of malignancy. It had PPV of 71.70. %, NPV of 68.85% and accuracy of 70.18%**.**

Vascularity

In a study conducted by Van den Brekel MW and colleagues in patients with head and neck squamous cell carcinoma, the vascular pattern was valuable in differentiating metastatic from reactive nodes with a sensitivity and specificity of 85% and 93%, respectively. Another study by Ariji Y and colleagues showed that Doppler sonography study of vascular pattern had high levels of sensitivity (83%) and specificity (98%) in depicting metastatic nodes.

Based on the color flow pattern, Dangore SB [10] and colleagues showed a sensitivity and specificity of 87.60% and 91.66%, respectively, to differentiate between benign and malignant lymphadenopathy.

In our research all the 12 malignant lymph nodes showed some vascularity. Among them 6 (50%) demonstrated either mixed (6 nodes) or peripheral 4 nodes (33%) vascularity whereas remaining 2 (17%) nodes demonstrated central vascularity (1 lymphomatous and 1 metastatic node).

Abnormal vascularity (peripheral or mixed) recorded a sensitivity of 83.33% and a specificity of 63.64% with a PPV of 69.62%, a NPV of 79.25% and an accuracy of 70.59%.

Conclusion

1. High resolution Sonographic examination proved as a valuable primary investigation to Identify lymph nodes and differentiate benign, reactive, tubercular and malignant lymphadenopathy.
2. Ultrasonographic examination proved as a cost effective, radiation free, noninvasive and safe method to evaluated cervical lymphadenopathy.
3. Colour Doppler Sonography provides additional information on vasculature of the lymph nodes and plays an important role in differentiating between the benign, reactive, tubercular and malignant cervical lymphadenopathy.
4. Combination of gray scale Sonographic features and vascular pattern of the lymph nodes have a high accuracy and sensitivity / specificity in differentiating between malignant and benign cervical lymphadenopathy.
5. Finally all USG diagnosis must be correlated with FNAC/histopathology study not only to determine whether the nodes are neoplastic, reactive, tubercular, benign nodes and also to determine the histology of the neoplasm.

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