Original Research Article

Diagnostic performance of Ultrasound and Doppler in differentiating Benign and Malignant Cervical Lymph Nodes

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Abstract

Introduction: Ultrasonography is a noninvasive, nonionizing imaging technique which enables to see the anatomical structures with the use of ultrasound waves and provides valuable diagnostic information. ultrasound uses a gray scale to detect the various anatomical structures of the body and study their morphological characteristics and is capable of detecting vessels as small as those found in lymph nodes.**Aims**: To evaluate cervical lymphnodes in patients presented with neck masses in differentiation of Benign and Malignant Cervical Lymph Nodes by Ultrasound and Doppler and to correlate them with histopathological finding. **Materials and methods:** A prospective diagnostic study was performed on 72 patients with neck masses treated with complaint of palpable cervical lymph node. All patients' necks were scanned multidirectionally by gray-scale and Doppler techniques. After sonography, lymph nodes were biopsied and investigated to find out whether they were Benign (reactive, tubercular) or Malignant(metastatic or lymphomatous)**Results:** High-resolution Ultrasonography showed a sensitivity of 90% and specificity of 100% in detecting tubercular lymphadenitis, sensitivity of 95.6% and 95.9% specificity in the detection of reactive lymphadenitis, sensitivity of 89.4% and specificity of 96.2% in detecting metastatic lymphadenopathy, sensitivity of 83% and specificity of 98% in the detection of Lymphomatous Lymph nodes. USG diagnosis made based on the features mentioned above proved to be highly significant. **Conclusion:**Ultrasound is safe, cost-effective, informative, easily available in clinical practice, takes few minutes of examination with experienced sonologist, most neck masses can be assessed and diagnosed with a great deal of accuracy.

Keywords: Ultrasonography,Cervical lymph nodes, Color Doppler, Benign, Malignant,Tubercular Lymphadenitis.

Introduction

Lymph nodes are normal structures distributed throughout the human body. Enlarged cervical lymph node/s is one of the common presenting symptoms or clinical signs in diverse groups of diseases[1].Incidental cervical lymph nodes are seen commonly in asymptomatic patients and in patients with known malignancy[2]. Hence, identifying the relevant lymph nodes is important in treating these patients. Differentiating malignant from non malignant causes of cervical lymphadenopathy is crucial in deciding the next course of action.Imaging techniques play a very important role in diagnosing head and neck pathologies especially those involving deeper soft tissues. Lymphadenopathy is one such condition where critical evaluation becomes mandatory not only to assess the severity of the disease but also to determine disease prognosis and proper treatment planning. Clinical examination of cervical lymph nodes is important in such patients but mostly remains difficult owing to their diverse location and multiple numbers.

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Ultrasonography also plays an essential role in precise tumor staging, helping in effective therapy and follow up. USG and USG guided fine needle aspiration cytology, if necessary, is useful for cervical nodes[3].New ultrasound techniques by their physical background, potentials and applications regarding usefulness during intra-operative procedures. Ultrasono-graphy is a fast and relatively inexpensive modality and could determine small lymph nodes (< 55 mm) better than other techniques . In addition, ultrasonography could assess both internal and external anatomy of cervical lymph nodes . Gray scale sonography is used for evaluation of number, size, shape and borders of lymph nodes . Pattern of intranodal vessels, blood flow velocity and vascular resistance are assessed by power Doppler sonography as well. Although, various criteria have been proposed to differentiate metastatic lymph nodes from benign ones, the most valuable and specific sonographic features are under dispute.

Materials and Methods

It is a Prospective Study in100 patients, by purposive consecutive sampling in patients with neck mass/swelling referred to the Department of Radiodiagnosis will be included in the study. It is done for a period of 2 Years from September 2018 to September 2020.Details of the study protocol was explained to the subjects. Informed consent wasobtained.Ultrasound examination of neck was performed using Philips- Affiniti 30 ultrasound unit with a linear array transducer of 7.5-10 MHz. The Sonographic evaluation of the

lesion was be done to note the size/ shape, site, margins, appearance, echotexture and vascularity and relation with the adjacent structures. The diagnosis was confirmed by histopathological findings.

Inclusion Criteria: Patients of all age groups with neck mass referred for the ultrasound examination and who have also undergone FNAC/biopsy.

Exclusion Criteria: Mandibular lesions, Neck masses of vascular origin, Apical chest lesions with extension into the neck and Lesions arising from the larynx and cervical oesophagus

Statistical analysis: Sensitivity, specificity and predictive values were calculated on collected data.

Kappa statistics were used to analyze data and findings were interpreted with other studies.

Table 1: Findings

K < 0.20	Poor agreement
K = 0.21 – 0.4	Fair agreement
K = 0.41 – 0.6	Moderate agreement
K = 0.61 – 0.8	Good agreement
K = 0.81 – 1.0	Very good agreement

P < 0.05 – Significant, P < 0.01 – Highly significant and P > 0.05 – Not significant

Results

The following study was conducted on 72 patients referred to the department of radio diagnosis for the sonographic evaluation of neck masses.

Table 2: Frequency of patients in different age groups

Age (years)	**Frequency**	**Percentage(%)**
<21	6	8
21-40	40	55
41-60	21	30
>61	5	7
Total	72	100
Gender		
Males	34	47
Females	38	53

The age group ranged between 5 months to 72 years. The maximum numbers of patients were seen within the age range 21-40 years.Majority of the patient were females predominantly. (Table 1)

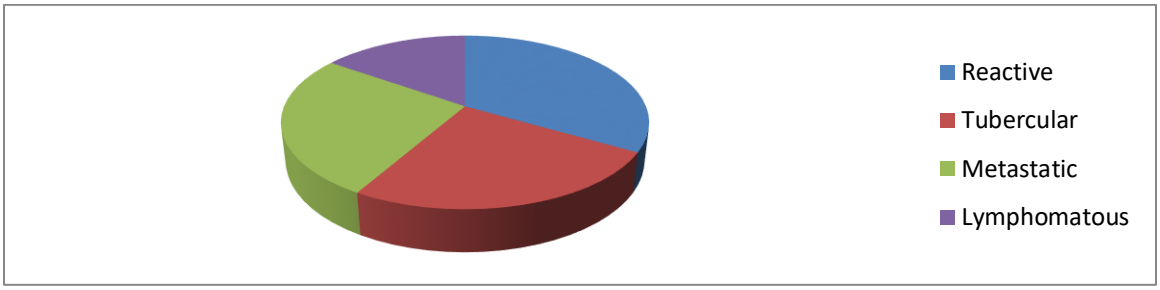

Fig 1:Lymph node lesions

Most of the masses are reactive lesions 24 cases (33%)

Table 2: USG features of Lymphnodal pathology (N = 72)

	Benign		**Malignant**	
	Reactive	**Tubercular**	**Metastatic**	**Lymphomatous**
Echotexture				
Hypoechoic	24	14	12	6
Hyperechoic	0	0	4	5
Isoechoic	0	4	3	0
Shape				
Oval	24	14	3	1
Round	0	4	16	10
Calcification	0	4	6	0
Intranodal necrosis	0	14	12	5
Echogenic hilus	20	13	0	0
Border				
Sharp	0	4	15	7
Unsharp	14	16	4	4
Surrounding soft tissue				
Normal	16	0	16	7

Abnormal	0	4	3	2
Matted	0	14	0	2

The shape of the lymph nodes as analysed by ultrasound included 38 (52.7%) lymph nodes with oval shape and 34 (41.6%) with round shape. In 90% of benign lymph nodes, the shape was oval and in 86.6% of malignant lymph nodes the shape was round.Out of 72 lymph nodes, 56 were hypoechoic, 9 were hyperechoic, 7 were isoechoic.38 hypoechoic nodes were found to be benign, 18 hypoechoic nodes were found to be malignant on histopathology. All the 9 hyperechoic nodes were found to be malignant.Out of 7 isoechoic nodes 4 were benign and 3 were malignant.10 nodes had calcification within it and out of which 4 were tubercular, 6 were metastatic on histopathology. 31 nodes had internal necrosis, out of which 14 were tubercular, 12 were metastatic, 5 were lymphomatous nodes. Echogenic hilum was seen in 33 nodes and all were proved to be malignant.(Table 2)

Table 3: High-resolution ultrasonography in Tubercular Lymphadenitis

		HPE/ FNAC		**Total**
		True disease +	**True disease -**	
USG	Positive	18	0	18
	Negative	2	52	54
Total		20	52	72

Sensitivity- 90%	PPV- 100%
Specificity- 100%	**NPV- 100%**
K- 1.0- Very good agreement	**P- 0.000- Highly significant**

High-resolution Ultrasonography showed a sensitivity of 90% and specificity of 100% in detecting tubercular lymphadenitis.(Table 3)

Table 4: High-resolution ultrasonography in Reactive Lymphadenitis

		HPE/ FNAC		**Total**
		True disease +	**True disease -**	
USG	Positive	22	2	24
	Negative	1	47	48
Total		23	49	72

Sensitivity- 95.6%	PPV- 91.6%
Specificity- 95.9%	**NPV- 97.9%**
K- 0.83- Very good agreement	**P- 0.000- Highly significant**

High-resolution Ultrasonography showed a sensitivity of 95.6% and 95.9% specificity in the detection of reactive lymphadenitis. two cases of the lymphomatous node were misdiagnosed as reactive lymphadenitis, while one patient with reactive lymphadenopathy was diagnosed with lymphomatous node on USG. (Table 4)

Table 5: High-resolution ultrasonography in Metastatic Lymphadenopathy

		HPE/ FNAC		**Total**
		True disease +	**True disease -**	
USG	Positive	17	2	19
	Negative	2	51	53
Total		19	53	72

Sensitivity- 89.4%	PPV- 89.4%
Specificity- 96.2%	**NPV- 96.2%**
K- 0.85- Very good agreement	**P- 0.000- Highly significant**

High-resolution Ultrasonography showed a sensitivity of 89.4% and specificity of 96.2% in detecting metastatic lymphadenopathy. two cases of tubercular lymphadenitis were diagnosed as metastatic lymphadenopathy on USG. (Table 5)

Table 6: High-resolution ultrasonography in Lymphomatous Lymph nodes

		HPE/ FNAC		**Total**
		True disease +	**True disease -**	
USG	Positive	10	1	11
	Negative	2	59	61
Total		12	60	72

Sensitivity- 83%	PPV- 90.9%
Specificity- 98%	**NPV- 96.7%**
K- 0.71- Good agreement	**P- 0.000- Highly significant**

High-resolution Ultrasonography showed a sensitivity of 83% and specificity of 98% in the detection of Lymphomatous Lymph nodes. One patient with reactive lymphadenitis was diagnosed as a lymphomatous node on USG. (Table 6)

Lymph node lesions in study

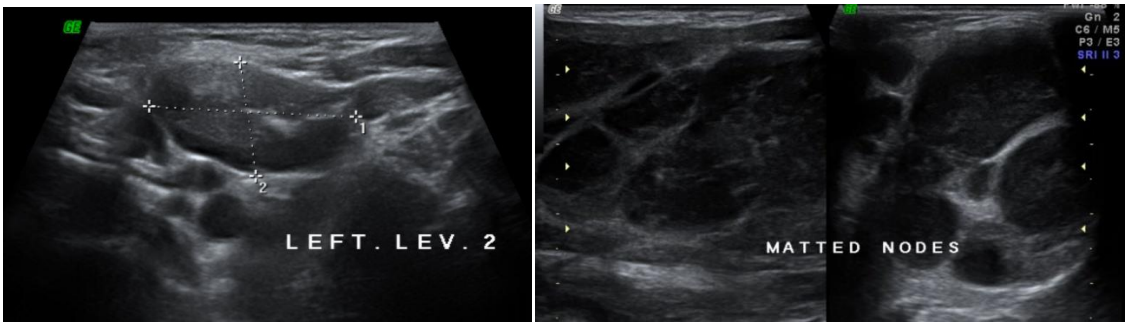

Fig 2: A. Reactive/ Inflammatory lymph nodes with fatty hilum. B. Tubercular lymph nodes- showing necrosis and matted borders

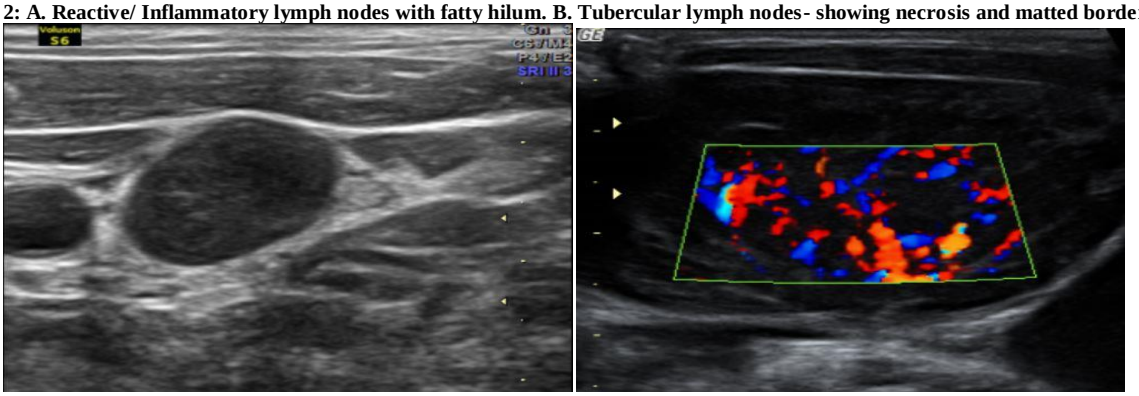

Fig 3: Metastatic lymph nodes with rounded shape, sharp borders, loss of echogenic hilum and increased vascularity

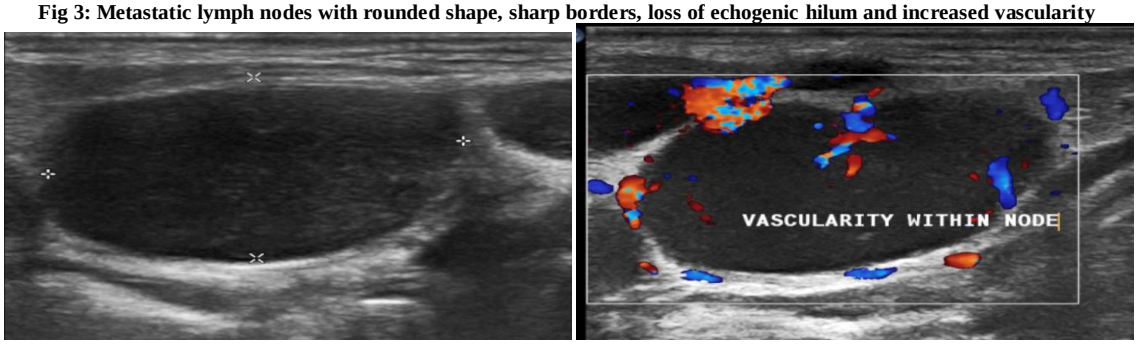

Fig 4: Lymphomatous lymph nodes: Enlarged hypoechoic lymph nodes with predominantly hilar (activated) vascularity

Discussion

Ultrasound showed hypoechoic echotexture in all cases of inflammatory nodes, 14(77%) cases of tubercular nodes, and 12(63%) cases of metastatic lymphadenopathy. 4 cases of metastatic lymphadenopathy showed hyperechogenicity. All inflammatory nodes displayed an oval shape, while metastatic and lymphomatous nodes showed rounded shape on the US, suggesting malignancy. Matting and unsharp borders were seen in 13(72%) tubercular nodes. The above findings were consistent with those described by Chan et al.[4] and Hajek et al[3]According to Bruneton et al[6] ultrasound is of primary value in providing information of an anatomical nature, including the distribution of subclinical nodes, volumetric evaluation, and determination of vascular connection.In our study Ultrasonography showed a sensitivity of 90% and specificity of 100% in detecting tubercular lymphadenitis. USG showed high sensitivity and specificity in detecting tubercular nodes based on unsharp borders, matting, displaced vascularity, and clinical features of pulmonary/ extrapulmonary tuberculosis. In James Geake et al[7] study Ultrasound showed Sensitivity is 89% and Specificity was 100% 89% which is very much similar with our study. In our study Ultrasonography showed a sensitivity of 95.6% and 95.9% specificity in the detection of reactive lymphadenitis. Some studies showed high specificity of ultrasound as in the studies performed by Alam et al.[8] and Hefeda et al.[9] of about 100% and 95.6%, respectively. Which agrees with our study.Our study Metastatic Lymphadenopathyshowed sensitivity and specificity of 89.4% and 96.2%, respectively. These findings have also been described by Asai et al[10] and Chan et al[4]. Sumi et al[11] found that ultrasound has great potential in detecting metastatic nodes from squamous cell carcinoma in the head and neck region because of its ability to delineate changes in the internal architecture. Our study revealed similar results. According to Anand et al[12], the sensitivity and specificity in detecting metastatic nodes was 82% and 92.5%. According to Giovagnorio et al[13] , type II vascularity (activated Hilar) was more frequently associated with lymphoma. Peripheral subcapsular vessels, typical of metastasis, are rare in lymphoma (exception-high grade lymphomas). The differential diagnosis between lymphoma and lymphadenitis is frequently impossible with sonographic and Doppler patterns alone. Ying and Ahuja[14].

Considering the internal echogenicity the present study confirmed that 60% of the metastatic cervical lymph nodes showed hyperechoic pattern of echogenicity whereas normal and reactive nodes revealed 100% hypoechoic pattern of echogenicity with highly significant value .Danninger et al.[15] ultrasonography sensitivity and specificity for detecting malignant nodes was 96% and 69%, respectively.High-resolution Ultrasonography showed a sensitivity of 83% and specificity of 98% in the detection of Lymphomatous Lymph nodes.Vinayaka U S et al[16] had 96% sensitivity and 90.6% specificity for differentiatingneoplasms which is coincidence with our study.Thus, the USG proves to be the first-line imaging modality in the characterization of neck masses and to determine their vascularity; subsequently, CT and MRI may be carried out to determine the extent and further characterization of the lesion. Finally, all USG diagnosis must be correlated with tissue diagnosis (FNAC/Histopathology) and/or surgical follow-up.

Conclusion

Ultrasound can differentiate the aetiology of lymph node enlargement to a significant extent. Although no single sonographic criterion should be used alone in deciding whether a lymph node is normal or malignant, the combination of characteristics such as increased size, round shape, absence of an echogenic hilus, intranodal necrosis, and peripheral or displaced vascularity make malignancy more likely. Ultrasound enables real-time imaging, which allows the guidance of needles accurately into the lesion of interest to obtain a diagnostic aspirate/ biopsy. It is safe, cost-effective, informative, easily available in most hospitals, takes few minutes of examination, and in the hands of an experienced sonologist, most neck masses can be assessed and diagnosed with a great deal of accuracy.Ultrasound should ideally be the investigation of choice, after which CT and MRI can be used to determine the further extent of a mass and better define its tissue characteristics.

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