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SONOGRAPHIC ASSESSMENT OF CERVICAL LYMPHADENOPATHY: ROLE OF HIGH RESOLUTION AND COLOR DOPPLER ULTRASOUND

Radiology

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ABSTRACT

Objective: To study the role of High Frequency Ultrasound and color Doppler in diagnostic evaluation of cervical lymphadenopathy.
Methods: The present study was carried out in the Department of Radiodiagnosis, ESIC Medical College & Hospital, Faridabad. The study included sixty-four patients of different age groups presented with cervical lymphadenopathy. The nodal parameters included: site, mean long axis (L), mean short axis (S), shape index (S/L), echotexture and homogenicity, margins, ancillary features like calcification, necrosis, posterior enhancement, matting and surrounding tissue changes, vascular pattern and mean arterial resistive index (RI). The final diagnosis was reached by FNAC and excisional biopsy. The nodes were classified as reactive, lymphomatous and metastasis.
Results: The study results showed that malignant LNs, especially metastatic, are accompanied with rounded shape, homogenous echotexture, peripheral vascularity and significantly high Resistive Index (RI). Among these sonographic findings, nodal shape (S/L ratio) and RI were more accurate for differentiating benign from malignant LNs. Most of the LNs with ill-defined margins were metastatic. Calcification, necrosis, posterior enhancement, matting and hilar flow pattern were characteristically found in tubercular lymphadenitis.
Conclusion: The sonographic findings had relatively high accuracy in differentiating benign from malignant cervical LNs. Ultrasound can be used as first line imaging tool in the diagnostic evaluation of cervical lymphadenopathy, especially in developing countries like India due to its ease, reproducibility and cost effectiveness.

KEYWORDS:

Cervical Lymph Node (LN), Reactive, Metastasis, Lymphoma, Ultrasound, Color Doppler.

INTRODUCTION

Cervical lymph nodes (LNs) are composed of lymphoid tissue and are located along the lymphatic vessels in the neck. Many pathologic processes involve the LNs, so that detection of LNs involvement has great therapeutic and prognostic implications. Ultrasound (US) is a useful imaging modality in evaluation of cervical lymphadenopathy because of its high sensitivity and specificity when combined with fine-needle aspiration cytology [1]. With the use of color doppler sonography, the vasculature of the LNs can also be evaluated which provides additional information in the sonographic examination of cervical LNs. It has become an effective way to obtain more information about the examined LNs with no appreciable increase in the duration and invasiveness of the examination. Recent literature has indicated the possibility of differentiating malignant from benign nodes by observing the vascular patterns on high-resolution color doppler sonography [2]. The proposed study is an endeavour to assess the role of grey scale and color doppler sonography in diagnostic evaluation and characterisation of cervical lymphadenopathy as benign or malignant, with an acceptable degree of certainty, in order to avoid unnecessary invasive diagnostic procedures.

MATERIALS AND METHODS

The present study was carried out over a period of 18 months, in the Department of Radiodiagnosis, ESIC Medical College & Hospital, Faridabad. The study included sixty-four patients of different age groups referred from the ENT OPD of the hospital with a clinical diagnosis of cervical lymphadenopathy. A detailed clinical assessment was done and informed consent for sonographic examination of neck was taken from all the patients.

Comprehensive high-resolution color doppler sonography of the neck was performed by experienced sonologist using Philips Clear Vue 350 ultrasound machine with multi-frequency (7 to 9 MHZ), linear phased-array transducers. The scanning was performed in supine position with the neck of the patient hyper-extended with a pillow under the shoulders to provide optimum exposure of the neck. For color doppler assessment of the cervical nodes scanning was done using slow frame rate, low pulse repetition frequency, narrow gate, low wall filter setting and high doppler gain in order to maximise doppler sensitivity so as to detect even small flow in the enlarged nodes. The parameters which were considered in this study included: site, mean long axis (L), mean short axis (S), shape index (S/L), echotexture and homogenicity, margins, ancillary features like calcification, necrosis, posterior enhancement, matting and surrounding tissue changes, vascular pattern and mean arterial resistive index (RI). These parameters are defined as follows.

1. Site: LNs were classified according to cervical nodal chain into different groups.
2. Mean long axis (L): the largest dimension of the lymph node.
3. Mean short axis (S): the greatest dimension perpendicular to mean long axis (L).
4. Shape index (S/L): the ratio of mean short axis and mean long axis. The nodes were divided into two groups as S/L <0.5 and S/L >0.5.
5. Echotexture and homogenicity: LNs were divided as hypoechoic or isoechoic to surrounding muscles and with homogenous or heterogeneous echopattern.
6. Margins: based on the margins LNs were divided into two groups, those with well defined margins and those with ill defined margins.
7. Ancillary features: presence or absence of calcification, intranodal necrosis, posterior enhancement and matting. Status of the surrounding tissue as normal or abnormal.
8. Vascular pattern: assessed by color flow mapping and was classified as hilar, central or peripheral.
9. Mean arterial resistive index (RI): recorded as mean RI of visible arterial vessels within the Lns.

The final diagnosis was reached by FNAC and excisional biopsy. The nodes were classified as reactive, lymphomatous and metastasis. The results were subjected to statistical analysis. P value of <0.05 was considered significant.

RESULTS

Sixty-four patients presenting with cervical lymphadenopathy were studied, with a total of 225 LNs. Majority of the patients were seen in 11-30 years age group. However no correlation was seen with age and sex in these patients.

Reactive nodal enlargement was found to be the most common pathology (40 patients with 146 nodes) followed by metastasis in 14 patients (45 LNs) and lymphoma in remaining 10 patients (34 nodes).

From reactive group 69 (47.26%) LNs were found to be tubercular in 17 patients. From 45 metastatic LNs, 31(68.88%) were due to laryngeal malignancies, four (8.8%) secondary to nasopharyngeal malignancy, three (66.6%) from thyroid malignancy, two (4.4%) due to parotid malignancy, two (4.4%) from tongue carcinoma, and three (66.6%) from unknown primary. Of 34 lymphomatous nodes 22 (64.7%) were from Hodgkin's disease and remaining 12 (35.3%) were non-Hodgkin's lymphomas.

Posterior triangle was found to be the commonest site for reactively enlarged nodes (n=91), internal jugular chain for metastatic LNs (n=16) and submandibular and upper cervical for lymphomatous nodes (n=15).

Results of ultrasonographic assessment of LNs are shown in table 1. S/L ratio <0.5 was seen in 122 LNs (54.22%) and S/L ratio >0.5 in 103 LNs (45.77%). In 51 (34.9%) reactive LNs, 16 lymphomatous LNs (47.05%) and 36 metastatic LNs (80%) the S/L ratio was >0.5. Statistically significant difference between S/L ratios of malignant and benign LNs was observed. S/L ratio >0.5 had statistically significant association with malignancy (P value <0.05).

From 225 LNs, 157 (69.77%) had homogenous echotexture and 68 (30.22) inhomogeneous echotexture. Eighty five (58.21%) of reactive LNs, 34 (100%) of lymphomatous LNs and 38 (84.44%) of metastatic LNs had homogenous echotexture. Sixty one (41.78%) of reactive LNs, and seven (15.55%) of metastatic LNs had heterogeneous echotexture. All of the lymphomatous LNs and most of the reactive LNs (97.26%) had well-defined margins. Eighteen (8%) LNs had ill-defined margins including four (2.73%) reactive and 14(31.11%), metastatic LNs. Ill defined margin had statistically significant association with metastatic LNs (P value < 0. 001).

Calcification was not seen in any case of lymphoma or metastasis. It was seen in only seven (4.8%) reactive LNs, which were seen in patients with tubercular aetiology. Posterior enhancement was seen in 35(23.97%) reactive LNs and in none of the metastatic or lymphomatous LNs. Surrounding tissue was found to abnormal in 18(12.32%) of reactive LNs and in three (6.66%) of the metastases. Matting was seen in 26(17.8%) of reactive (tubercular) LNs but was absent in lymphoma and metastases.

On color doppler sonography 194 (86.22%) LNs showed the evidence of colour flow, comprising 129 (88.35%) reactive LNs, 31(68.88%) metastatic LNs and 34 (100%) lymphomatous LNs. Perfusion was found to be hilar in 121(93.79%) and both central and peripheral in eight (6.2%) of reactively enlarged LNs (Figure 1). Thirty (88.23%) of lymphomatous LNs had flow signals located both in periphery and centre of node (Figure 2). One lymph node had peripheral flow signals only and three (8.8%) showed a perfused hilum. Nodal metastases showed peripheral perfusion in 28 (90.32%) LNs (Figure 3). Only three (9.67%) nodal metastases showed isolated centrally located perfusion (Table 2). Peripheral vascular pattern had statistically significant association with malignant LNs (P value < 0.05).

Mean arterial RI in reactive LNs was 53.56; range was 48 to 72. Mean arterial RI in lymphomatous LNs was 66.14; range was 58 to 84. Mean arterial RI in metastatic LNs was 81.12; range was 66 to 92. Statistically significant difference between mean arterial RI of malignant and benign LNs was observed (P value <0.05). Maximum mean arterial RI was observed in metastatic LNs.

Table1. Sonographic features of Cervical Lymph Nodes

Sonographic Feature	Reactive (n=146)	Metastasis (n=45)	Lymphoma (n=34)
Mean Short Axis	10.2 mm	10.3 mm	10.0 mm
Mean Long Axis	20 mm	15.2 mm	15.2 mm
Shape S/L<0.5 S/L>0.5	 95 51	 09 36	 18 16
Echogenicity Hypoechoic Isoechoic	 138 08	 45 -	 54 -
Homogenicity Homogeneous Heterogeneous	 85 61	 38 07	 34 -
Calcification	07	-	-
Nodal Margins Well defined/ Sharp Ill defined/ Unsharp	 142 04	 31 14	 34 -
Posterior Enhancement	35	-	-
Surrounding Tissue Normal Abnormal	 128 18	 45 03	 34 -
Matting	26	-	-

Table2. Perfusion patterns of Cervical Lymph Nodes

Diagnosis	Perfused Nodes	Site of Perfusion		
		Hilar	Peripheral	Central
Reactive (n=146)	129	121	08	08
Metastasis (n=45)	31	-	28	03
Lymphoma (n=34)	34	03	31	30

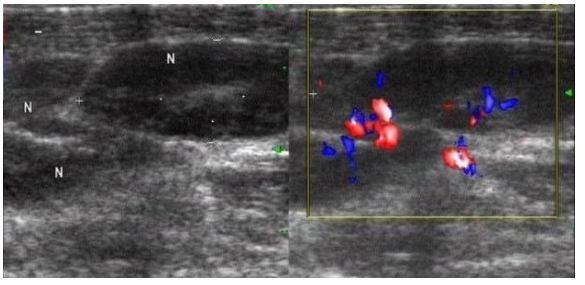

Figure 1- Reactive Lymphadenopathy: Ultrasound image showing well defined, oval homogenously hypoechoic lymph nodes with hilar pattern of vascularity

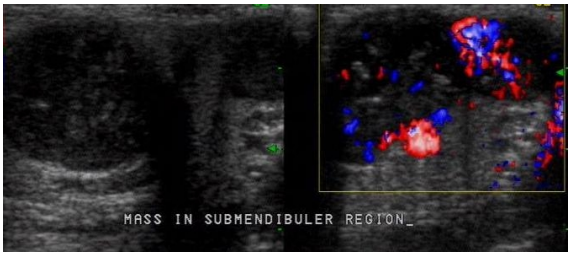

Figure 2- Lymphoma: Ultrasound image showing rounded homogenously hypoechoic lymph nodes with diffuse (central and peripheral) vascularity.

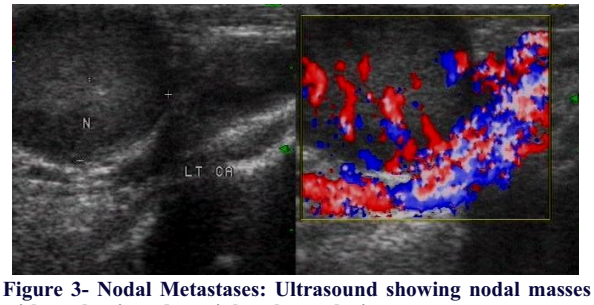

Figure 3- Nodal Metastases: Ultrasound showing nodal masses with predominantly peripheral vascularity.

DISCUSSION

In the present study reactive nodal enlargement was found to be the most common pathology with 64.88% of total LNs. This predominance can be explained by high prevalence of tuberculosis and other infectious diseases in India. Similar predominance was also observed by Ahuja et al [3] in South East Asia.

Posterior triangle was found to be the commonest site for reactively enlarged nodes, internal jugular chain for metastatic LNs and submandibular and upper cervical for lymphomatous nodes. Findings similar to our observations have been reported by Ahuja et al [1] and Ying et al [4].

In our study the majority of LNs with a ratio of S/L <0.5 were benign and the majority of the malignant nodes had S/L >0.5. Sensitivity and specificity of S/L <0.5 for the diagnosis of benignity were 65.06% and

80%, respectively. Sensitivity and Specificity of S/L >0.5 for the diagnosis of malignancy were 80% and 65.06%, respectively. Sensitivity and specificity of S/L >0.5 for malignancy have been reported to be 85% and 61 %, respectively in study by Na DG et al [5] .The mean S/L ratio of malignant LNs is significantly higher than that of benign LNs, and metastatic LNs seem to be more spherical. Similar shape indices with accuracy of 95% have been reported by Skeinkemp et al [6]. In our study the majority (84.4%) of metastatic LNs had homogenous echotexture. These findings are comparable with those of Ying et al [4] who found homogenous echotexture in 85% of metastatic nodes. The margins of the majority of LNs were well defined and sharp but 31.11% of the metastatic LNs had ill-defined and unsharp margins. Sensitivity and specificity of ill-defined margin for the diagnosis of metastatic disease were 31.11% and 97.2%, respectively. This finding were consistent with those of Mazaher et al [7] who reported sensitivity and specificity of ill-defined margins of LNs for metastasis as 38.7% and 100%, respectively.

Calcification was not seen in any case of lymphoma or metastasis. It was seen in only 4.79% reactive LNs. Surrounding tissue was found to abnormal in 12.32% of reactive LNs and in none of the metastases and lymphoma. Matting was seen in 17.8% of reactive LNs but was absent in lymphoma and metastases. All the above features were characteristically seen in tubercular LNs. Similar sonographic characteristics have been reported by many authors [4, 8].

In our study color mapping assessed the vascular pattern of the LNs. Perfusion pattern was of peripheral type in the majority of malignant LNs and of hilar type in most of the reactive LNs. Perfusion was found to be hilar in 93.79% of reactively enlarged LNs. Nodal metastases showed peripheral perfusion in 90.32% LNs while 88.23% of lymphomatous nodes had flow signals located both in periphery and centre of node. Sensitivity and specificity of the peripheral vascular pattern for diagnosis of malignancy were 62% and 94.16%, respectively. Vascularity of malignant LNs has been reported higher than benign LNs [9], and malignant LNs have exuberant blood flow in color mapping assessment [10], therefore color doppler has been found to be useful for differentiation of malignant from benign LNs [11]. In our series the mean arterial resistive index (RI) was significantly higher in malignant LNs than in benign LNs. Mean arterial RI in reactive LNs was 53.56 (range 48 - 72). Mean arterial RI in lymphomatous LNs was 66.14 (range 58 – 84). Mean arterial RI in metastatic LNs was 81.12 (range 66-92). In some studies arterial RI of 90 has been reported to be seen only in metastatic LNs [12]. However some authors have reported that pulsed doppler is not useful to differentiate malignant from benign LNs [10].

CONCLUSION

In conclusion different nodal aetiologies can be accurately differentiated by sonography based on various morphological and perfusion characteristics. S/L ratio >0.5, homogenous echotexture peripheral vascular pattern and high mean arterial RI are in favour of malignancy. For differentiation of the metastatic LNs from the others, the S/L ratio and mean arterial RI had higher diagnostic accuracy. However, these parameters, because of some overlapping, may not have a definite value. But still we recommend Ultrasound as the first line-imaging tool in the diagnostic evaluation of cervical lymphadenopathy, especially in developing countries like India due to its ease, repeatability, reproducibility and cost effectiveness.

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