

# Sonographic assessment of normal cervical lymph nodes in a sample of Syrian population

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## ABSTRACT

**Background:** Sonographic examination is an important tool in assessment of normal and abnormal cervical lymph nodes. The aim of the study is to assess the distribution and the characteristic features of normal cervical lymph nodes in a sample of Syrian population.

**Materials and Methods:** Fifty healthy Syrian subjects (25 men and 25 women) with an age of 20-60 years old, who had their cervical lymph nodes examined by ultrasound. Three hundred and two lymph nodes were detected. Lymph nodes were evaluated for their number, size, site, echogenic hilus, shape, as well as for the border sharpness. The subjects were categorized by age into four groups, (20-30, 31-40, 41-50, 51-60 years). Statistical analysis of data was done using SPSS software (version 11.5), and analytical one way analysis of variance (ANOVA), Duncan's Multiple Range Test.

**Results:** The results showed that there was no significant difference in mean number of nodes between different age groups. All lymph nodes were hypoechoic; majority of them possessed an echogenic hilus, with transverse diameter of 8 mm or less. All lymph nodes were oval except for submandibular and parotid nodes which appeared round.

**Conclusions:** This study provides a sonographic appearance of normal cervical lymph nodes in relation to their site, size, shape, numbers, border sharpness, and echogenic hilum, in a sample of Syrian population.

**Key words:** Gray scale sonography, cervical lymph node, Syrian population. (J Bagh Coll Dentistry 2013; 25(2):94-100).

## الخلاصة

**خلفية البحث:** يعتبر الفحص بالأصوات فوق الصوتية من الأدوات المهمة لتقييم العقد اللمفاوية العنقية السليمة وغير السليمة. الهدف من البحث: تقييم توزيع وخصائص العقد اللمفاوية العنقية السليمة لدى عينة من المجتمع السوري.

**مواد وطرائق البحث:** تم فحص العقد اللمفاوية العنقية السليمة لخمسين فرداً سورياً (25 ذكراً و 25 أنثى) بعمر 20-60 سنة، باستخدام جهاز الأمواج فوق الصوتية، تم الكشف عن 302 عقدة لمفاوية، قيمت هذه العقد من ناحية العدد، والحجم، والموقع، ووجود السرة، والشكل، فضلاً عن وضوح الحافات. قُسمت أفراد العينة إلى الفئات العمرية التالية (20-30، 31-40، 41-50، 51-60 سنة). تم انجاز التحليل الإحصائي باستخدام برنامج SPSS (version 11.5)، واختبارات Duncan's Multiple Range (ANOVA).

**النتائج:** أظهرت النتائج عدم وجود اختلافات معنوية بين الفئات العمرية، جميع العقد اللمفاوية منخفضة الصدى، ومعظمها تحتوي على سرة، ويقطر مستعرض  $\geq 8$  ملليمتر. جميع العقد بيضوية الشكل (نسبة القطر المستعرض/القطر الطولي  $> 0.5$ )، باستثناء العقد اللمفاوية تحت الفك الأسفل والتكفية كانت دائرية الشكل (نسبة القطر المستعرض/القطر الطولي  $\leq 0.5$ ). هذه الدراسة أوضحت مظاهر العقد اللمفاوية العنقية السليمة في الفحص بالأصوات فوق الصوتية بما يتعلق بموقع العقد، والحجم، والشكل، والعدد، ووضوح الحافات، ووجود السرة لدى عينة من المجتمع السوري.

**كلمات مفتاحية:** الأمواج فوق الصوتية، العقد اللمفاوية الرقبية، المجتمع السوري.

## INTRODUCTION

Ultrasound (US) is a useful imaging modality in the evaluation of cervical lymphadenopathy <sup>(1,2)</sup>. Gray-scale sonography is widely used in evaluation of the number, size, site, shape, borders, matting, adjacent soft-tissue edema, and internal architectures of cervical lymph nodes <sup>(3,4)</sup>.

Ultrasonography allows the evaluation of not only lymph nodes that are 10 mm in diameter or more, which are generally diagnosed as cervical lymph node metastasis-positive by computed tomography (CT) or magnetic resonance imaging (MRI), but also lymph nodes of less than 10 mm diameter, based on sufficient image information <sup>(5)</sup>.

Although CT and MRI are used to evaluate cervical lymph nodes, the nature and internal architecture of small lymph nodes (<5 mm) may not be readily assessed <sup>(6)</sup>.

The inaccuracy of clinical palpation paved the way for further studies in search of other more accurate diagnostic means for detecting neck nodes. Debate persists over the relative merits of imaging in the evaluation of the neck for metastatic disease. Imaging techniques like CT and MRI have been popularized to detect metastatic neck nodes <sup>(7)</sup>. Many previous researches have usually studied pathologic nodes, and few studies have examined normal cervical lymph nodes <sup>(8-10)</sup> and these were predominantly in Caucasians. To our knowledge, the distributions of normal cervical lymph nodes in a sample of Syrian population have not been described previously. A clear understanding of the distribution and sonographic appearances of normal cervical lymph nodes is necessary in differentiating normal from abnormal nodes.

The purpose of this study was to assess the sonographic features of normal cervical lymph nodes in different regions of the neck, in a sample of Syrian population.

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## MATERIALS AND METHODS

Fifty healthy Syrian subjects (25 men and 25 women) with no history of neck surgery, glandular fever, chronic tonsillitis, tuberculosis, head and neck malignancy, or lymphomas, were included in the study. The age for the subjects was 20-60 years, average age: 40 years. All the scans were performed with Convex Scanner/Convex/Linear Ultrasonic Scanner (HS-4000 Honda Electronic CO., LTD-Japan) and 10 MHz linear-array transducer.

The subjects lay supine on the couch with the shoulders supported by a pillow. The neck was hyper extended. Since the shape of the nodes depends on the scan plane, scans were obtained with the transducer placed transversely and longitudinally until the plane showed the maximum cross-sectional area of the lymph node. Eight regions in the neck were delineated as described by Hajek et al. <sup>(11)</sup>: (1) submental, (2) submandibular, (3) parotid, (4) upper cervical, above the hyoid bone and along the common carotid artery (CCA) and internal jugular vein (IJV), (5) middle cervical, between the hyoid bone and the cricoid cartilage and along the CCA and IJV, (6) lower cervical, below the cricoid cartilage and along the CCA and IJV, (7) supraclavicular fossa, and (8) posterior triangle (also known as accessory chain), as shown in figure 1. All lymph nodes were divided into left and right site, except the submental nodes, which are located in the midline.

All detected lymph nodes were assessed for their site, size, numbers, shape (short-to-long-axis [S/L] ratio), and border sharpness, as well as for the presence of an echogenic hilum.

The parameters which were considered in this study and their definition are as follows:

1. Distribution: the cervical lymph nodes were categorized into eight regions or levels on the basis of their location in the neck <sup>(11)</sup>.
2. Mean long axis (L), which is the largest dimension of the lymph node.
3. Mean short axis (S), which is the greatest dimension perpendicular to (L).
4. Shape index (S/L): the ratio of S and L. The nodes were divided into 2 groups as  $S/L < 0.5$  indicates a long or oval node, whereas  $S/L \geq 0.5$  indicates a rounded node.
5. Echotexture and homogeneity: lymph nodes were divided as hypoechoic, isoechoic, or hyperechoic to surrounding muscles <sup>(12)</sup>.
6. Echogenic hilus: the major vascular hilus appears as a hyperechoic linear structure within a lymph node and is continuous with

the surrounding connective tissue <sup>(13)</sup> as shown in figure 2.

7. The nodal border was assessed for its sharpness, which determined by the smoothness of the margin between the lymph node and the surrounding tissue; this border is either well-defined/ sharp border or ill-defined/ unsharp border <sup>(9)</sup>.

The maximum transverse diameter of each node was used to determine mean nodal size. The shape of a lymph node, as visualized on sonography, varies by scan plane, so the short and long axis of the lymph nodes were measured in the plane that showed the maximum cross-sectional area. The subjects were categorized by age into groups, (20-30 years, 31-40 years, 41-50 years, 51-60 years). Statistical analysis of data was done using SPSS software (version 11.5), include descriptive (frequency, percentage, mean, standard deviation), and analytical one way analysis of variance (ANOVA), followed by Duncan's Multiple Range Test. Difference was considered as significant when  $P < 0.05$ .

## RESULTS

In 50 subjects, 302 lymph nodes were detected. All subjects had bilateral lymph nodes. The smallest node detected in this study measured 2.0 mm x 4.5 mm, and the largest node measured 8.3 x 19.9 mm.

There were 162 nodes in the 25 male subjects and 140 nodes in the 25 female subjects. The mean number of lymph nodes in male subjects (6.48 nodes) is higher than that in female subjects (5.60 nodes).

When the subjects were classified into five different age groups (20-30, 31-40, 41-50, 51-60 years), no significant difference was found in mean number of nodes between different age groups, as shown in tables 1,2,3.

The number, shape, border sharpness, short axis, and long axis of the lymph nodes in different regions of the neck are shown in table 4.

Majority of lymph nodes detected in this study (98.8%) had a transverse diameter of 8 mm or less as shown in figure 3.

Evaluation of lymph node size based on short axis were less than 5mm as shown in figure 4, while evaluation of lymph node size based on long axis shows that, the majority of nodes in the cervical chain, and posterior triangle were larger than 8 mm as in figure 5.

The optimum cut-off value of the S/L ratio was determined in different regions of the neck: submental (0.43), submandibular (0.61), parotid (0.58), upper cervical (0.42), middle cervical

(0.36), lower cervical(0.31), supraclavicular(0.41) and posterior triangle (0.42), as shown in figure 6.

## DISCUSSION

This study was done in Department of Oral Medicine, Dentistry College, Damascus University.

Normal superficial lymph nodes are not palpable and, quite often, they are not seen with US. Inflammatory or reactive nodes may become apparent on US, still being impalpable. Palpable and visible nodes may be benign or malignant (14,15).

All subjects in this study had at least five lymph nodes detected, and there is no age and gender difference in the average number of normal cervical nodes, this results agree with Ying et al (10) and Ying et al (15). The normal lymph nodes that were detected in the present study were the submandibular (region 2), 41.3%, parotid (region 3) 25.8%, upper cervical (region 4) 13.2%, submental (region 1) 5.6%, middle cervical (region 5) 4.3%, supraclavical (region 7) 3.9%, posterior triangle (region 8) 3.9%, and lower cervical (region 6) 1.6%. The distribution of the nodes are almost similar to previous studies (9,15). As multiple lymph node involvement is common in lymphoma and metastasis, the solitariness of lymph nodes may be useful in diagnosis (16). All lymph nodes found in submental, middle cervical, lower cervical, supraclavicular, and posterior regions are solitary 100%, while submandibular region shows 82.35% (solitary), 13.73% (paired), 3.92% (multiple), the parotid region 98.68% (solitary), 1.32% (multiple), and the upper cervical region 67.44% (solitary), 2.56% (paired). This result is in agreement with Ying et al (9) and Ying et al (15), except in posterior triangle lymph nodes which appear multiple in their study, they suggested that, since multiple lymph nodes are common in posterior triangle, multiplicity of lymph nodes alone is not useful for diagnosis in this region, and other features need to be elicited.

The echogenicity of normal lymph nodes varies between hypoechoic and isoechoic in comparison to the surrounding fatty tissue. Both reactive and malignant lymph nodes are hypoechoic compared to neighboring strap muscles. Lymphomatous, tuberculous and lymphadenitis nodes are also hypoechoic; therefore hypoechoic is not a useful diagnostic sign (3,4). In the eight regions studied, all lymph nodes (100%) are hypoechoic. The normal parenchyma exhibits homogeneous and low echogenicity because of the predominance of

a homogeneous cell population of lymphocytes without much tissue interface (17).

Majority of lymph nodes detected in this study (98.8%) had a transverse diameter of 8 mm or less as shown in figure 3,4, this result is in agreement with Ying et al (15), who investigated that most nodes in white and Chinese subjects had a maximum transverse diameter of 8 mm or less (96% and 98%, respectively), and in agreement with other studies (8,9), which shows that (95%) of the nodes had a maximum transverse diameter of 8 mm or less.

Evaluation of size based on long axis of the nodes shows that, the majority of nodes in the cervical chain, and posterior triangle were larger than 8 mm as in figure 5. This is also similar to the finding of Bruneton et al (8), who stated that cervical nodes except submental and submaxillary groups usually demonstrate a larger longitudinal diameter and a shorter transverse diameter.

Shape has been stated to be a useful criterion in differentiating normal or reactive nodes from malignant nodes. An oval node (S/L ratio < 0.5) indicates normal or reactive node, whereas malignant nodes tend to be round (S/L ratio ≥ 0.5) (3,18). Lymph nodes that were detected in this study were oval in shape (S/L ratio < 0.5), with the exception of submandibular and parotid nodes which appeared round (S/L ratio ≥ 0.5), similar to the results of Ying et al (9), Ying et al (15) and Ying and Ahuja (19). Although pathologic nodes are usually round, normal submandibular and parotid nodes can also be round in shape (95% and 59% respectively) (9). This may be due to inflammation in the oral cavity which predisposes to the development of reactive hyperplasia in these lymph nodes, leading to proliferation of lymphocytes within the lymphoid follicles, and cortical widening occurs in every region of the lymph node, and their shape becomes ovoid to round (20). Therefore, shape of lymph nodes cannot be the sole criterion in the diagnosis.

Normal and reactive nodes present a central echogenic hilum that interrupts the continuity of the cortical and is continued with the perinodal fat tissue. This appearance is due to the abutment of multiple medullar sinuses acting as interfaces (3, 4, 21). It has been shown that about 90% of benign cervical nodes with a diameter above 5mm display an echogenic hilum (4). This study shows that 89.53% of detected nodes possessed an echogenic hilus, while 10.47% of nodes do not show echogenic hilus. Nodes without echogenic hilus have a transverse axis less than 3mm (small lymph nodes). This result is in agreement with

Ying et al<sup>(22)</sup>, who stated that echogenic hilus is a normal sonographic feature of most of the normal cervical lymph nodes (86%), and small lymph nodes may not show echogenic hilus.

This study showed that normal lymph nodes in the upper neck (submental, submandibular, parotid, and upper cervical regions) usually have illdefined borders (88.24%, 81.6%, 94.9%, 72.5% respectively), whereas lymph nodes in middle cervical (92.3%), lower cervical (80%), supraclavicular (91.6%), and posterior region (83.3%) predominantly have well defined borders, which is in agreement with Ying et al<sup>(22)</sup>. The high frequency of unsharp borders of submental, submandibular, and parotid nodes may be due to poor transducer contact, as these nodes are under the ramus of the mandible, and may also be related to the deposition of fat within the nodes. Thus, nodes with sharp borders are seen predominantly in lower neck and posterior triangle, whereas unsharp nodes are common in the upper neck<sup>(23)</sup>.

As the longitudinal diameter of the nodes is an unreliable criterion in the differential diagnosis of cervical nodes<sup>(24)</sup>, only the maximum transverse diameter of each node was used to determine mean nodal size.

When combining size and shape and using 5 mm, 8 mm, and 1 cm as cut-off point in short axis, this study shows that, with 5 mm as cut-off point 57.2% fulfilled both criteria for normality, with 8 mm as cut-off point 49.1% fulfilled both criteria, and with 1 cm as cut-off point 48.3% fulfilled both criteria for normality. Therefore, we suggested that, nodal size (short axis) greater than 10 mm combined with an S/L ratio greater than 0.5 may be useful to identify pathologic nodes. Similar findings also have been reported by Sugama and Kitamura<sup>(25)</sup>, who showed that lymph nodes with a transverse diameter of 10 mm and an S/L ratio greater than 0.5 were likely to be metastatic.

The optimum cut-off value of the S/L ratio was determined in different regions of the neck: submental (0.43), submandibular (0.61), parotid (0.58), upper cervical (0.42), middle cervical (0.36), lower cervical (0.31), supraclavicular (0.41) and posterior triangle (0.42), this result is almost similar to Ying et al<sup>(26)</sup>, they concluded that the optimum cut-off value in different regions of the neck was: submental (0.5), submandibular (0.7), parotid (0.5), upper cervical (0.4), middle cervical (0.3) and posterior triangle (0.4).

This study evaluates the distribution and the characteristic features of normal cervical lymph

nodes in a sample of Syrian population. Normal cervical nodes are found in eight regions of all subjects, particularly in the submandibular, parotid, and upper cervical regions. All nodes are hypoechoic. The majority of nodes demonstrate an echogenic hilus, and with a maximum transverse diameter  $\leq 8$  mm.

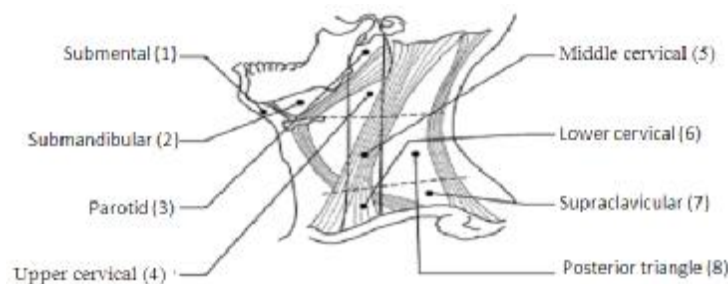
The shapes of nodes are oval except the submandibular and parotid regions are round. Normal lymph nodes in the upper neck have ill-defined borders, while lymph nodes in middle cervical, lower cervical, supraclavicular and posterior regions have well defined borders.

The S/L ratio in all regions  $\leq 0.5$  except the submandibular and parotid regions, as these nodes normally have an S/L ratio greater than 0.5.

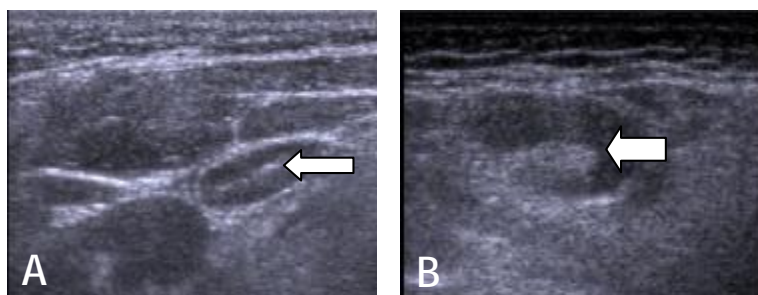
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**Figure 1: Radiological classification of cervical lymph nodes** <sup>(11)</sup>



**Figure 2: Gray-scale sonograph of A. upper cervical lymph node. B. Submandibular lymph node. In a healthy 56-years old man, which appear hypoechoic and oval, with echogenic hilus (arrows).**

**Table 1: Descriptive statistics of lymph nodes number and age groups**

Age Group	No.	Mean	+ SD
20-30	14	5.50	2.175
31-40	9	6.89	3.296
41-50	10	4.90	2.514
51-60	17	6.71	4.283

SD: Standard deviation

**Table 2: ANOVA test shows mean number of lymph nodes between different age groups**

	SS	Df	MS	F-value	p-value
Between groups	31.102	3	10.367	0.956	0.422
Within groups	498.818	46	10.844		
Total	529.920	49			

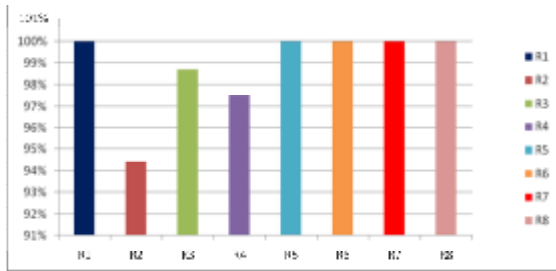
*P*-value > 0.05: not significant**Table 3: Duncan's Multiple Range Test shows mean number of lymph nodes between different age groups**

Age Group	No.	Mean	+ SD	Duncan's Grouping
20-30	14	5.50	2.175	A
31-40	9	6.89	3.296	A
41-50	10	4.90	2.514	A
51-60	17	6.71	4.283	A

SD: Standard deviation

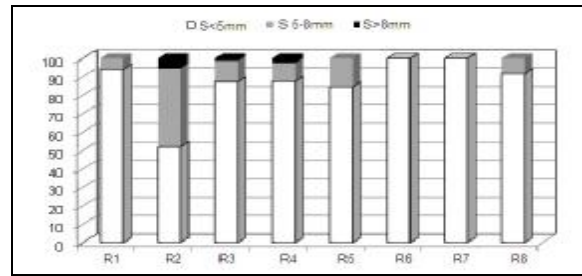
**Table 4: Features of the lymph nodes in different regions of the neck**

Features of Nodes	Regions of the Neck							
	1	2	3	4	5	6	7	8
<b>Number</b>								
1 Node	100%	82.35%	98.68%	97.44%	100%	100%	100%	100%
2 Nodes	0%	13.73%	0%	2.56%	0%	0%	0%	0%
≥ 3 Nodes	0%	3.92%	1.32%	0%	0%	0%	0%	0%
<b>Shape</b>								
S/L < 0.5	88.2%	28.8%	25.6%	90%	100%	100%	83.3%	91.7%
S/L ≥ 0.5	11.8%	71.2%	74.4%	10%	0%	0%	16.7%	8.3%
<b>Nodal Border</b>								
Well-Defined	11.76%	18.4%	5.1%	27.5%	92.3%	80%	91.6%	83.3%
Ill-Defined	88.24%	81.6%	94.9%	72.5%	7.7%	20%	8.4%	16.7%
<b>Short Axis</b>								
< 5 mm	94.1%	52.0%	87.2%	87.5%	84.6%	100%	100%	91.7%
5-8 mm	5.9%	42.4%	11.5%	10.0%	15.4%	0%	0%	8.3%
> 8 mm	0%	5.6%	1.3%	2.5%	0%	0%	0%	0%
<b>Long Axis</b>								
< 5 mm	0%	8.0%	21.8%	7.5%	15.4%	0%	0%	8.3%
5-8 mm	70.6%	37.6%	56.4%	40.0%	7.7%	60%	91.7%	16.7%
> 8 mm	29.4%	54.4%	21.8%	52.5%	76.9%	40%	8.3%	75.0%
<b>Echogenic hilus</b>								
Present	82.7%	98.9%	72.4%	100%	100%	98.1%	80.3%	83.8%
Absent	17.3%	1.1%	27.6%	0%	0%	1.9%	19.7%	16.2%



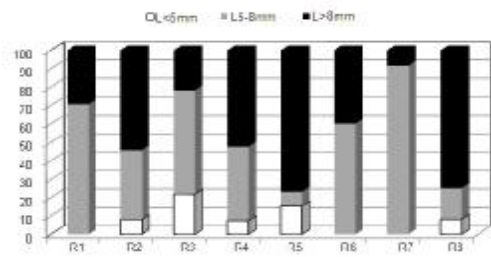
R:Region

Figure 3: Percentage of lymph nodes with short axis of  $\le 8$ .



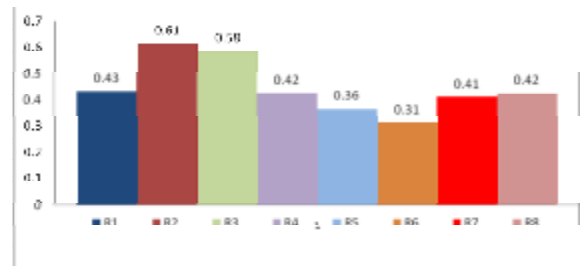
R:Region. S:Short axis.

Figure 4 : Percentage of lymph nodes size in relation to short axis



R:Region. L:Long axis.

Figure 5 : Percentage of lymph nodes size in relation to long axis



R:Region

Figure 6: The optimum cut-off value of the S/L ratio in different regions of the neck.