Romanian Journal of Rhinology, Vol. 4, No. 14, April-June 2014

LITERATURE REVIEW

Ultrasonography of head and neck lymph nodes performed by the ENT specialist

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ABSTRACT

The purpose of this article is to review the current knowledge about ultrasonography of head and neck lymph nodes in order to enable the ENT specialist to differentiate benign versus malignant masses. All classic ultrasonographic criteria (size, shape, hilum, echogenicity, margins, structural changes, edema, Doppler flow, vessel location, vascular pedicles and pattern) are explained with an emphasis on sensitivity and specificity. The second part of this paper illustrates the anatomical structures necessary to be identified in order to localize different lymph nodes to certain cervical levels. Also, we underline differential diagnosis between inflammatory lymphadenopathy, tuberculosis, lymphoma and metastasis of various origins. The main advantages of performing head and neck ultrasonography are: cost-efficiency, fast, non-irradiating. We hope to grow the awareness of our fellow Romanian ENT specialists to the use of ultrasonography as a powerful screening and diagnostic tool. Recent technical advances, such as contrast and sonoelastography, are briefly presented.

KEYWORDS: head and neck, lymph nodes, ultrasonography

INTRODUCTION

Nowadays, the key to a proper treatment is a quick diagnosis followed by a thorough staging of the disease, and head and neck pathology is no exception to this endeavour. Furthermore, ENT specialists face a growing pressure from the need of cost efficiency and a limited access to CT and MRI. Unilateral nodal metastasis in patients with head and neck malignancies lowers the five year survival rate by 50% and bilateral malignant nodes will further reduce survival rate to 25%[1]. In order to differentiate benign from malignant lymph nodes, one should be acquainted with the classic ultrasonographic criteria, but recent data confer these criteria different levels of sensibility and specificity. Afterwards, any mass must be placed at a certain cervical level, facilitating TNM staging of the disease. Therefore, we illustrate the anatomical landmarks identified by ultrasonography needed for delineating cervical levels. Linear array, 10 MHz transducers are required for performing head and neck ultrasonography. The highest available Doppler frequency with low wall filter settings and colour gain adjusted below the level of nonvascular flickering within tissues should be used[1]. All images presented in this paper come from patients admitted to the ENT Department, Coltea Clinical Hospital. All patients signed an Informed Consent in compliance with the Declaration of Helsinki and current Good Clinical Practice.

ULTRASONOGRAPHIC CRITERIA

There are several ultrasonographic criteria used to differentiate benign from malignant lymph nodes:

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size, shape, presence or absence of hilum, echogenicity, margins, structural changes (such as focal cortical nodules, intranodal necrosis, reticulation, calcification, matting and soft tissue edema) and Doppler criteria (presence of flow, central or peripheral distribution, number of vascular pedicles, vascular pattern, and impedance values - RI, PI – resistance index and pulsatility index).

Size. Ahuja et al[2] established, in 2005, different cut-off points depending on the neck level where the node is situated. Thus, for levels 1 and 2, a node is considered benign if it is smaller than 9 mm. A mass situated at neck levels 3-6 is benign if it is smaller than 8 mm. These cut-off values are credited with 89% sensibility and 94% specificity. However, the greatest value of measuring a lymph node during the follow-up is the increase in size on consecutive examinations, performed in cases with suspicious metastatic nodal involvement. Conversely, a size reduction on serial examinations could be a useful indicator for response to oncologic treatment.

Shape. Usually, benign nodes are oval or elongated and malignant nodes present as rounded masses. The ratio L/S> 2 or S/L<0.5, meaning that the long axis (L) of an oval benign node will be two times greater than the axial diameter (S), is credited with 66% sensitivity and 92% specificity[3]. This ratio can be a misleading factor in case of parotid and submandibular nodes where, due to anatomical positioning, normal or reactive nodes are rounded (Figure 1). Also, lymphomatous nodes are rounded. Moreover, non-malignant conditions, such as Kimura disease, Rosai Dorfman disease and tuberculosis, are associated with rounded lymph nodes[4].

Hilum. A central echogenic hilum that interrupts the continuity of cortical tissue and is continued with the perinodal fat tissue is present in normal and reactive nodes. In malignant nodes, due to the proliferation of cells, the hilum is absent. By combining the stringent criteria for malignancy of round shape and absent echogenic hilum, we obtain high specificity, but questionable sensitivity[5].

Echogenicity. Compared to neck muscles, both reactive and malignant nodes are hypoechoic, hyperechogenicity being a more reliable landmark for thyroid cancer metastasis, due to intranodal thyroglobulin deposits[6]. Metastases from squamous cell carcinoma often show mixed echogenicity.

Margins. Benign nodules present sharp margins, whereas malignant nodes are characterized by irregular and blurred margins, marking extracapsular and extranodal spread. These findings are correlated with a severe prognosis[7].

Focal cortical nodules result from eccentric cortical hypertrophy, which indicates a possible tumor infiltration (Figure 2).

Coagulation necrosis is identified as an echogenic focus that casts no shadow and it is associated either with tuberculous nodes or with metastasis.

Cystic or liquefaction necrosis. Frequently observed in squamous carcinoma metastases or papillary thyroid carcinoma, these structural changes appear as eccentric fluid areas within the volume of the lymph node[8]. This type of necrosis is seen also in advanced stages or in patients undergoing radiation therapy (Figure 3).

Reticulation is encountered mostly in lymphomas and associates the occurrence of thin echogenic lines that septate the hypoechoic solid texture of enlarged nodes (Figure 4)[9].

Calcification. This sign, small peripheral microcalcifications, is observed in metastases from thyroid carcinoma[10]. Larger solitary calcifications can also be seen in residual tuberculous adenopathy.

Matting is never seen in reactive nodes, as it is a sign of extracapsular spread of malignancy. However, it is discovered during radiation therapy, regardless of the nature of the neoplasm[11].

Peripheral halo and perinodal edema are structural changes suggestive for tuberculosis and they are not found in case of reactive nodes.

Figure 1 Ultrasonographic examination - numerous small reactive nodules

Figure 2 Ultrasonographic examination - metastasis of spindle cell carcinoma confirmed by histopathology

Figure 3 Metastasis of thyroid carcinoma confirmed by histopathology

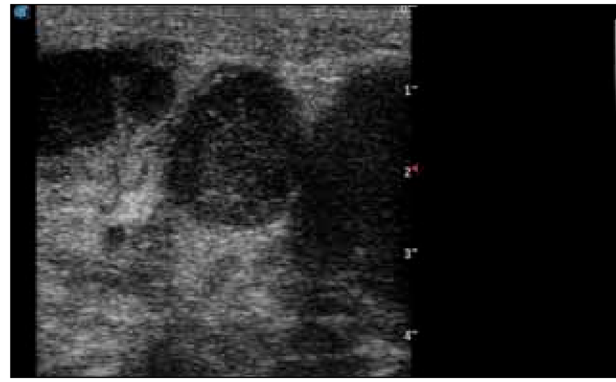

Figure 4 Multiple nodules in lymphoma

Absence or presence of flow. Small benign nodes do not present Doppler flow within their volume. Malignant nodes are vascularised due to their increase metabolic requirements[12].

Vessel location and distribution. Benign nodes present central hilar vessels that are Y-shaped or club-shaped. When taking into consideration the possibility of malignancy, one should look after a mixed hilar and peripheral pattern. This criterion confines 83% sensitivity and 98% specificity to the diagnosis of nodal metastasis[13]. Benign nodes have a single vascular pedicle in the hilum, while multiple chaotic pedicles invading the cortex are a mark for malignancy. Chikui T et al[14] stated that flow criteria improve the examiners' confidence without modifying the diagnosis offered by gray-scale criteria only (Figure 5).

Flow impedance. Inflammation in reactive nodes produces vasodilatation resulting in low impedance. Tumoral compression in rapid growing lymph nodes results in increased impedance. If we use a cut-off value of 0.7 for RI, we obtain a sensitivity of 86% and a specificity of 70%. Moreover, a cut-off value of 1.4 for PI offers a sensitivity of 80% and a specificity of 86%[15].

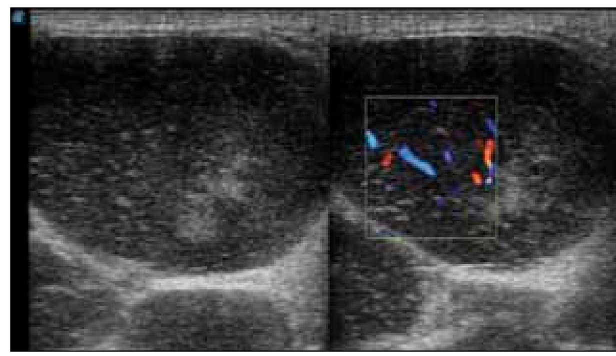

Figure 5 Example of gray scale ultrasonography and color Doppler in a case of B cell lymphoma

ULTRASONOGRAPHIC IDENTIFICATION OF CERVICAL LYMPH NODES SPACES

The ultrasonographic identification of cervical anatomical landmarks allows the topographic localization of the lymph nodes with major implications in the staging of various conditions and in adequate treatment decisions[6]. The lymph nodes are grouped in six levels illustrated in Figure 6. For a thorough examination of all these six levels, we propose the following movements of the transducer on the neck of the patient (Figure 7)[17].

Level IA (submental) is situated between the anterior belly of the digastrics muscles and the hyoid bone (Figure 8).

Level IB (submandibular) contains the submandibular gland and associated structures (Figure 9).

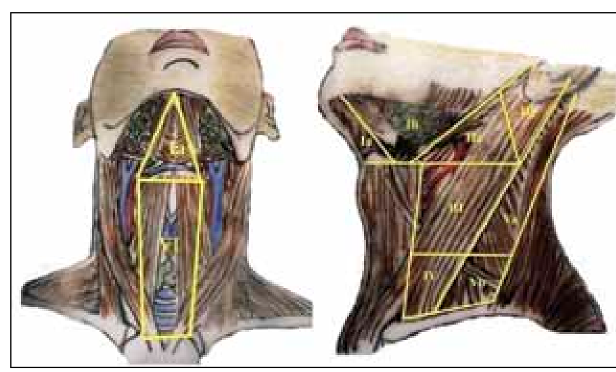

Figure 6 Illustration of the cervical lymph nodes levels

Figure 7 Examination technique at cervical level (the arrows show the movement of the transducer)

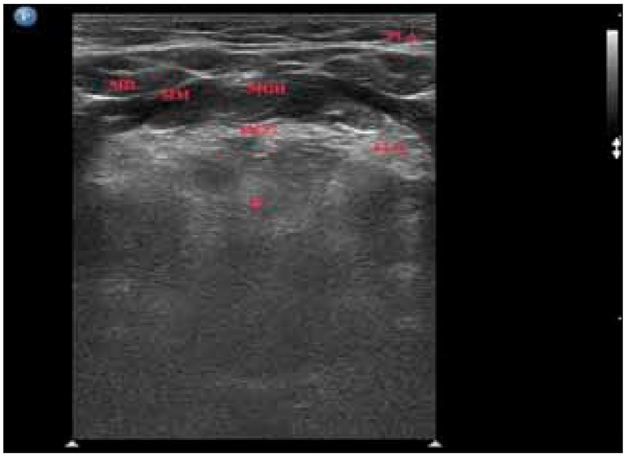

Figure 8 Level IA on ultrasonographic examination

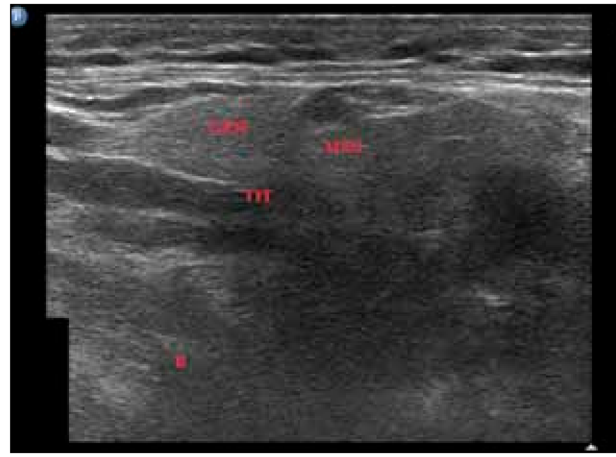

Figure 9 Level IB on ultrasonographic examination

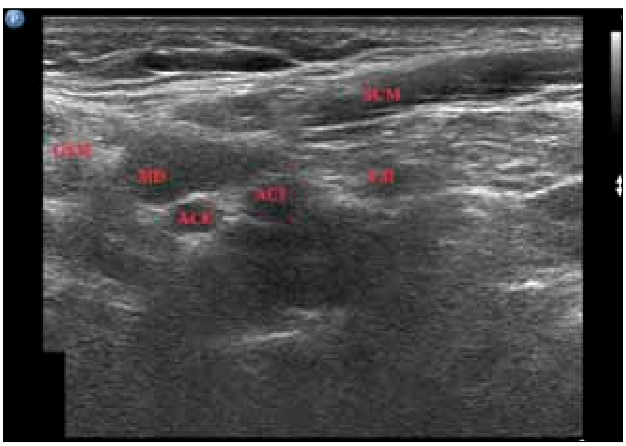

Figure 10 Level II on transverse ultrasonographic view

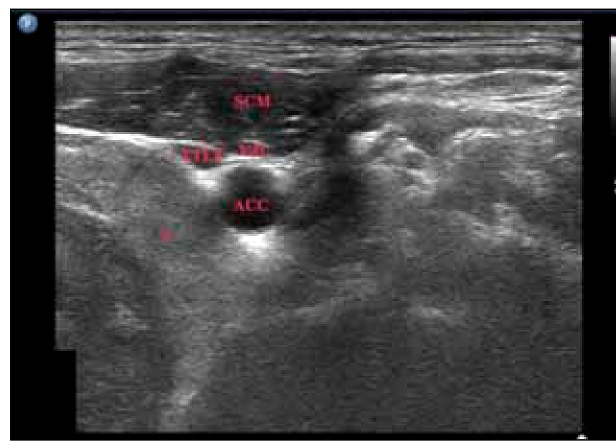

Figure 11 Level III contains the structures surrounding the thyroid gland

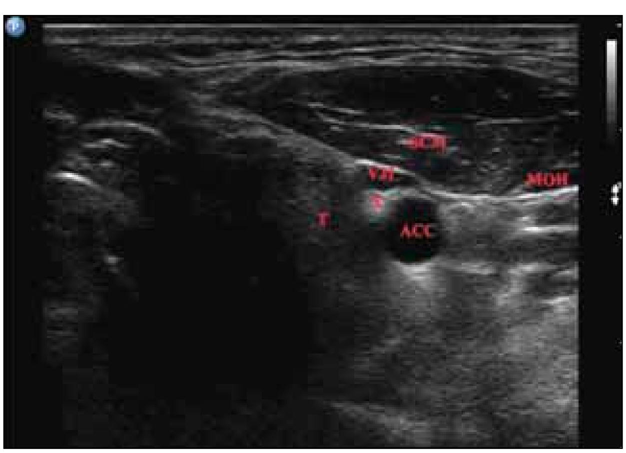

Figure 12 Level IV is centred by the common carotid artery.

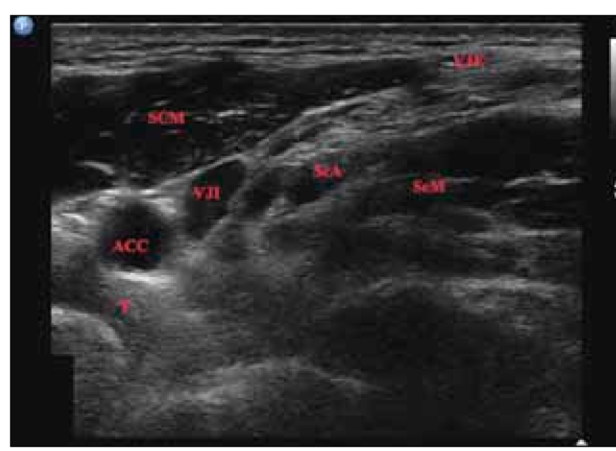

Figure 13 Level V contains accessory spinal nodes, transverse cervical nodes and supraclavicular nodes

Level II contains the lymphatic groups associated to the superior part of the internal jugular vein (Figure 10).

Level III contains the structures below the hyoid bone, above the inferior margin of the cricoid cartilage, posterior from the sternohyoid muscle and anterior to the posterior margin of the sternocleidomastoid muscle (Figure 11).

Level IV can be visualized by swiping the transducer from the inferior margin of the cricoid cartilage downwards to the clavicle (Figure 12).

Level V can be visualized by swiping the transducer along the posterior margin of the sternocleidomastoid muscle from the mastoid region downwards to the clavicle (Figure 13).

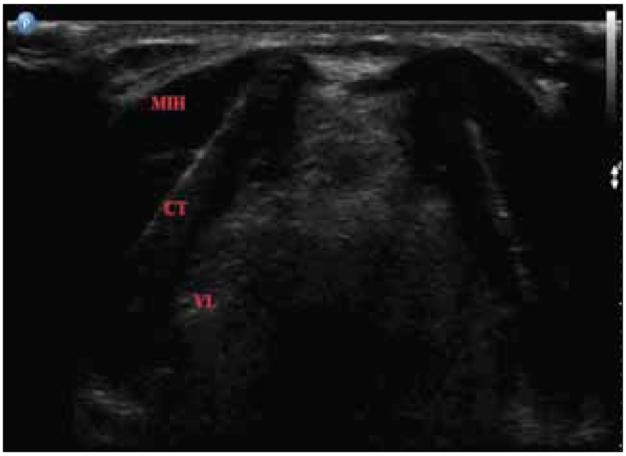

Figure 14 Level VI is centred by the larynx and trachea

Level VI is visualized with a downward movement of the transducer between the hyoid bone (superiorly) and the sterna notch (inferiorly) (Figure 14).

NOVEL TECHNIQUES

Sonoelastography (SE) depicts the relative stiffness of tissues and translates it into orange hues (meaning soft tissue) and blue hues (meaning hard tissue)[18]. Reactive lymph nodes have the same SE appearance as the soft tissues of the neck[19]. Malignant nodes are highly visible in blue when the rigid hard tissue occupies more than 45% of the lymph node area[20]. The combination of elastography data with B-mode sonography results in 92% sensitivity, 94% specificity and 93% accuracy for correct interpretation of the cervical lymph nodes[21].

Contrast enhanced ultrasonography (CEUS) is a modern imaging method evaluating tissue perfusion in real time. Benign nodes show homogenous enhancement patterns, while malignant nodes present mostly inhomogeneous patterns. However, CEUS should not be performed as a routine examination, but only in those cases where the results are uncertain after using both gray scale and Doppler US[22].

CONCLUSIONS

Head and neck ultrasonography is a powerful screening and diagnostic tool in the hand of the ENT specialist. The main advantages are cost efficiency, lack of irradiation and fast serial examinations. Moreover, ultrasonography can assess the treatment efficiency in cases benefiting from chemo and radiation therapy. Correct identification of anatomical landmarks allows a proper TNM staging of the cases, thus gaining time and choosing the optimum treatment option. Associating novel technical advances like sonoelastography and CEUS, the diagnostic power is of 92% sensitivity, 94% specificity and even the most difficult cases can be solved prior to surgery. However, there are few studies showing the perspective of the ENT specialist performing ultrasonography of the head and neck, the majority of data reviewed here are gathered in radiology departments.

Conflict of Interest: None

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