Ultrasonographic anatomy of head and neck – a pictorial for the ENT specialist

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Abstract

An increased pressure on ENT departments has evolved as head and neck pathology is showing a higher incidence and prevalence. Therefore, the ENT specialist should develop good skills in ultrasonographic examination of patients with head and neck masses. The aim of this paper is to enable the ENT specialist to identify anatomical landmarks on ultrasonographic images in order to expedite the diagnosis with a higher degree of certainty. We describe the steps for a proper ultrasound examination of the patient. We illustrate the following anatomical areas: submandibular gland, thyroid gland, parathyroid glands, oropharynx, larynx, parotid glands, etc. Moreover we emphasize the differential diagnosis that should be taken into account when examining pathology in these regions. Ultrasonographic examination of head and neck pathology is cost efficient, non irradiating and permits fast follow up with serial examination of the lesions. Furthermore one can perform an initial TNM staging of the case prior to other expensive imaging studies such as CT and MRI. We hope to raise the awareness of fellow ENT specialists in performing ultrasonography as future developments such as elastography and CEUS will increase the specificity and sensitivity of this diagnostic method.

Keywords: ultrasonography, head, neck, ENT, anatomy

Introduction

There is a growing interest for ENT specialists worldwide in using first hand ultrasonography (US) examination of patients with head and neck masses [1,2]. Questioning our fellow ENT colleagues we discovered a fear of approaching this imaging method and a tendency to rely on examinations performed only in radiology departments. Given the fact that only in our Hospital there are thousands of cases with head and neck tumors, the costs associated with imaging studies could be reduced by using US performed by the ENT specialist as a central diagnostic imaging tool, thus reducing the pressure on the radiology department and expediting the diagnosis [3]. Of course for a good diagnosis

first of all a good knowledge of the US anatomical landmarks is necessary [4].

The aim of this paper is to present the investigation techniques and enable the ENT specialists and allied specialties to master the first key steps in US examination of head and neck. The main anatomical regions depicted in this pictorial review are: submandibular gland, thyroid gland, parathyroid glands, oropharynx, larynx, parotid glands, etc. For every above mentioned anatomical region, we will emphasize the differential diagnosis and common pitfalls.

Investigation technique

Patient position

The patient is placed in a supine position with the head in mild extension. As in any other US examination the patient should feel comfortable and, if not naked, wearing a blouse that should not cover the base of the neck. A small pillow should be available in cases the examination requires a hyperextension of the neck.

Equipment

Although current equipments enable the use of linear probes with higher frequency one should use at least a

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linear transducer with a frequency of 10 MHz, this aspect being correlated with the diagnostic capability: with a higher frequency there is a better resolution but with a lower depth of the examined structures. Therefore a transducer with a variable frequency would be of great help enabling the examination of both deep and superficial structures in the same session. For thin patients a depth of examination of only 45mm is sufficient and this will enable the identification of the vertebral body in the lower part of the image. When examining the tongue and the oropharynx the depth of the examination should be increased to 60-70mm. As a general rule any anatomical region should be examined in 2 perpendicular ultrasonographic windows [5]. A very important step of any US exam is the Doppler examination as every structure visualized should be depicted in Doppler signal also, especially for differentiation between benign/malignant tumors or inflammatory/non-inflammatory lesions.

Structures that need to be examined

Thyroid gland

The thyroid gland is situated below the sternothyroid and sternohyoid muscles and anterior to the trachea, at the level of projection of the C5-T1 vertebrae. Normal value for the thickness of the isthmus gland is 5 mm and for the thyroid lobes the antero-posterior diameter is 10-20 mm and the medio-lateral diameter 10-30 mm [6]. Figure 1 and 2 depict the longitudinal and transversal view of the thyroid with the positioning of the transducer and the anatomical landmarks. The structure of the gland is slightly granulated but homogenous and the echogenicity is higher when compared with the sternocleidomastoid muscle. Differential diagnosis for diffuse changes of the thyroid gland are the acute and subacute thyroiditis, Hashimoto thyroiditis, Graves disease, Riedel thyroiditis, malignant lymphoma, diffuse parenchymatous goiter, diffuse colloid goiter, or regressive fibrotic changes. Circumscribed changes in the thyroid gland are realized by true cysts, pseudocysts, nodular goiter, adenoma, colloid nodule, hyaline connective tissue, abscess, oncocytoma, malignant tumors and calcifications.

Parathyroid glands

The possible location of the parathyroid glands at the level of the upper and lower poles of the thyroid lobes is depicted in figure 3. Normally parathyroid glands are small structures (around 3/4/5 mm) and can be identified only using the high frequency transducers. So, any hypoechoic lesion at these levels is suspected to be a parathyroid adenoma [7].

Submandibular gland

The submandibular gland is a seromucous salivary gland with a complex shape given in its division into a

superficial and profound portion by the posterior belly of the milohioid muscle [8]. Figure 4 shows the positioning of the transducer and the anatomical structures of the region. Possible pathologies encountered at the level of the submandibular glands are sialadenitis, sialolithiasis, mixed benign tumors, carcinoma, enlarged lymph nodes, brachial arch cysts and sarcoidosis.

Oropharynx

The external transcuteaneous approach of the oropharynx is hindered by the mandible and hyoid bone which appear as hyperechoic structures with posterior acoustic shadow. The muscles appear as hypoechoic structures and the surface of the tongue presents a curved shape against the air from the oral cavity. The posterior wall of the pharynx can be visualized only with special endocavitary transducers [9]. The transverse and longitudinal

Fig 1. Longitudinal view at the level of the thyroid gland. STM and SHM stand for the sternothyroid and sternohyoid muscles, T – thyroid gland; C – cartilages of the trachea and one should observe the posterior shadow.

Fig 2. Transverse view at the level of the thyroid gland. SCM – sternocleidomastoid muscle; STM and SHM stand for the sternothyroid and sternohyoid muscles; RL – right lobe; I – isthmus; LL – left lobe; TR – trachea; E – esophagus; CCA – common carotid artery.

Fig 3. The arrows mark the possible location of the parathyroid glands.

scan of the oropharynx, together with transducer position and anatomical structures are depicted in figure 5 and 6.

Parotid gland

A normal parotid gland has a uniformly hyperechoic texture (comparing to adjacent muscles) with a clear delineation from the superficial tissue. The Stensen duct is normally undetected unless it is obstructed. The facial nerve is difficult to be examined due to the anatomical

Fig 4. Left submandibular region. SMG – submandibular gland; MM – milohioid muscle; B – base of the tongue; TR – tonsillar region.

Fig 5. Transverse view of the floor of the mouth. DM – digastrics muscle; MM – milohioid muscle; GHM – geniohyoid muscle; GGM – genioglossus muscle; SLG – sublingual gland; B – base of the tongue.

Fig 6. Longitudinal view of the floor of the mouth. MAND – mandible with the posterior acoustic shadow; GHM – geniohyoid muscle; GGM – genioglossus muscle; B – base of the tongue.

Fig 7. Parotid gland in transverse view. MAS – masseter muscle; MAND – mandible; PG – parotid gland; RMV – retromandibular vein; DM – digastrics muscle; SP – styloid process.

situation (between the deep and superficial lobes) and the intra-parotid division. The intraglandular lymph nodes, normally under 5 mm, are clearly visible when there is an associated pathology [10]. Figure 7 illustrates the positioning of the transducer and the transverse view of the parotid gland. Possible pathological findings at the level of the parotid gland are cysts, abscess, sialadenitis, sarcoidosis, parotid tumors, sialolithiasis, etc.

Larynx

Although ENT specialists can rely on specific fibroscopic procedures in order to evaluate the laryngeal function these procedures could be complimentary to an US exam. This exotic use of US could be useful in emergency departments that do not have immediate access to an ENT service and thus the emergency specialist could extend the FAST-like protocol by discovering edema of the epiglottis or laryngeal fractures. Unfortunately there have been only pilot studies regarding laryngeal US and there is no evidence based standard for performing this procedure. Figure 8 focuses on the longitudinal plane of the larynx at the level of epiglottis. In Figure 9 a transverse view of the larynx at the level of the superior border of the thyroid cartilage is shown. In order to correctly visualize the vocal cords the transducer must be placed in the transverse position at the middle of the thyroid cartilage and in a slightly upward oblique movement as shown in Figure 10. The entire length of the vocal cord and the piriform sinus can be ascertained in an oblique left transverse laryngeal view (fig 11). Another important landmark is the cricoids cartilage with its ring like shape illustrated in transverse view in Figure 12. The entire anterior compartment can be examined through a longitudinal median view at the level of the larynx (fig 13).

Fig 8. Epiglottis in longitudinal view: B – base of the tongue; H – hyoid bone with posterior acoustic shadow; T – thyroid cartilage; E – epiglottis and preepiglottic space.

Fig 9. Upper transverse view of the thyroid cartilage: T – thyroid cartilage; VF – vestibular folds; PEF – preepiglottic fat.

Fig 10. Transverse view of the larynx: T – thyroid cartilage; VC – vocal cords; ARI – arytenoids cartilage.

Fig 11. Vocal cord: T – thyroid cartilage; VC – vocal cords; ARI – arytenoids cartilage; PS – piriform sinus, CCA – common carotid artery.

Fig 12. Transverse view at the inferior border of thyroid cartilage: C – cricoids cartilage.

Fig 13. Longitudinal view at the level of the larynx: H – hyoid bone; T – thyroid cartilage; C – cricoids cartilage; TR – tracheal rings; TG – thyroid gland.

Conclusions

US of head and neck is credited with high sensitivity and specificity similar if not in some cases superior to other imaging studies [11]. Moreover, US guided procedures like FNAB expedite the diagnosis with minimal costs and risks for the patient. Numerous evidence based articles bring new arguments for the use of novel techniques such as elastography [12] and contrast enhanced US [13]. Nevertheless for the oncologic patient, US permits serial examinations during radiation and chemotherapy in order to ascertain the response to treatment and to lower the overall radiation dose by minimizing CT exposure. Given these prospects a first step is to master basic identification of anatomic structures and to combine these data with the experience of ENT specialists in a better preoperative planning of every surgery.

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Conflict of interest: none

References

1. Dumitru M, Anghel I, Costache A, Anghel AG, Sarafoleanu C. Ultrasonography of head and neck lymph nodes performed by the ENT specialist. *Romanian Journal of Rhinology* April-June 2014;4(14).
2. Costache A, Dumitru M, Anghel I, Cergan R. Atlas de anatomie ecografica in otorinolaringologie. SITECH. Craiova 2013.
3. Anghel I, Ciobanu A, Stancu O, Anghel AG, Dumitru M, Lupu AR. Adenopathy – a problem of interdisciplinary diagnosis and management. *Modern Medicine* 2013; 20(3).
4. Lenghel LM, Baciut G, Botar-Jid C, Vasilescu D, Bojan A, Dudea SM. Ultrasonographic identification of the anatomical landmarks that define cervical lymph nodes spaces. *Med Ultrason* 2013; 15: 29-34.
5. Dudea SM, Badea RI, Zdrenghia D, Mircea PA. *Tratat de ultrasonografie clinică. Volumul II: Capul și gâtul, toracele și mediastinul, ecocardiografie, vasele membrelor*. Editura Medicală, București 2006.
6. Baskin HG, Duick DS, Levine RA. *Thyroid Ultrasound and Ultrasound- Guided FNA*. Springer, New York 2008.
7. Sofferman RA, Ahuja AT. *Ultrasound of the Thyroid and Parathyroid Glands*. Springer, New York 2012.
8. Ahuja TA, Evans RM. *Practical Head and Neck Ultrasound*. GMM, London 2000.
9. Iro H, Bozzato A, Zenk J. *Atlas of head and neck ultrasound*. Thieme, Stuttgart 2013.
10. Allan PL, Baxter GM, Weston MJ. *Clinical Ultrasound*. 3rd ed. Elsevier, United Kingdom 2011.
11. Dudea SM, Lenghel M, Botar-Jid C, Vasilescu D, Duma M. Ultrasonography of superficial lymph nodes: benign vs. malignant. *Med Ultrason* 2012; 14: 294-306.
12. Alam F, Naito K, Horiuchi J, Fukuda H, Tachikake T, Ito K. Accuracy of sonographic elastography in the differential diagnosis of enlarged cervical lymph nodes: comparison with conventional B-mode sonography. *AJR Am J Roentgenol* 2008; 191: 604-610.
13. Poanta L, Serban O, Pascu I, Pop S, Cosgarea M, Fodor D. The place of CEUS in distinguishing benign from malignant cervical lymph nodes: a prospective study. *Med Ultrason* 2014; 16: 7-14.